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. . . an insight into DENTISTRY

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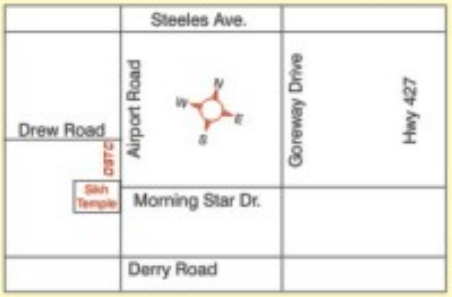


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**To Err is Human**

We have tried our best in designing and printing to provide you correct information.
But any omission error is highly regretted.
-Printer

I am hereby pleased to word for 'Indian Journal of Dental Sciences' which is the official publication of Himachal Pradesh University. As we all know that the field of dentistry is constantly changing and as new research and experiences are added in scientific literature, our knowledge, practices, treatment and drug therapy are altered accordingly. Dentistry is facing lot of advancements recently. One of the advances is the use of lasers of in dentistry.

Laser is 'Light Amplification by Stimulated emission of Radiation'.[1] Lasers can be used in treating wide variety of dental problems. Lasers sterilizes and coagulates blood vessels and therefore can be useful in surgical procedures where bleeding can be minimized leading to cleaner surgeries.

During the last three decades much has been written about lasers in scientific literature and popular media. Both the soft and hard tissue lasers and their uses in dentistry are discussed in detail.

Lasers have many uses in dentistry. Advantages such as bloodless operative and postoperative period, absence of sutures, minimal postoperative pain, and high patient acceptance helps to make lasers a highly advantageous alternative to conventional treatments modalities.

Dr. D. Majumdar MDS
President
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As more and more clinicians discover the advantages of lasers, its presence in dental offices will soon become increasingly common.

In my opinion, some clinicians are still sceptical of entering this existing field because of the size and cost of equipment. This can be due the fact that lasers initially were not only large but also costly. Lasers in future will continue to get smaller in size and less expensive.

In my experience, lasers when used ethically and efficiently have reported with greater patient compliance. These benefits come from greater patient acceptance of certain treatments. But lasers have their own limitations and disadvantages.

The future of dental lasers is bright. Some of the newest, still ongoing research, deals with the use of dental lasers for guided tissue regeneration, connective tissue attachments and tissue welding. It is not inconceivable that dental lasers of the future will be used to make incisions, reflects flaps, perform osseous surgery and than weld the flaps into position. This may come from multiple wavelengths (some of them not known yet) incorporated into one unit. However, the future of dental lasers is bright with some of the newest ongoing researches.

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Original Article

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# The Effect Of Hypnotism On Behavior Control Of Children During Local Anesthetic Injection

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**Abstract**

**Background** : Controlling the behavior of children during pediatric dental treatment is the most important issue. On the other hand, fearing from anesthetic injection in a large number of children causes anxiety, worry about dental treatment and consequently inappropriate behavioral reactions.

**Aim** : The purpose of this project was to evaluate the capability of behavior management procedures based on hypnotherapy for pediatric dental patients.

**Design** : In this project thirty 8 to 12 year old children of both sexes, half male, half female, were selected and placed in two groups Following passing through practical phases starting with anesthetic injection or hypnotherapy prior to injection, in crossover mode, on the 30 subjects and recording their psychological behavioral reactions , data were analyzed.

**Results** : Findings showed no significant difference between both crying and feet movement reactions in two statuses.

**Conclusion** : Analysis of data revealed that, hypnosis can effectively reduce the symptoms of child's anxiety and has few side effects when performed competently. Hypnosis could be a useful method to decrease unfavorable reactions of dental patients.

**Key Words**
Hypnotism, Anesthetic, pediatric, Hypnosis

## Introduction

Success in pediatric dentistry is based on the ability to control the child. The kind of communication during treatment is one of the major differences between adults and pediatric dentistry.

In general, a special relationship might be existed between dentists, and both children and parents during dental treatment[1]. Behavior management is widely agreed to be a key factor in providing dental care for children. In fact, if a child's behavior could not be managed during dental treatment, it would be difficult, if not impossible, to carry out any dental care [2].

Psychological and behavioral findings indicate that local anesthetic injection, placing rubber dam, and starting tooth preparation using high speed hand piece are the three most frightening dental works that make the child anxious.

On the other hand, fearing from anesthetic injection results in anxiety and fearing from dental treatment in a large number of children provokes inappropriate behavioral reactions.

Furthermore, it was studied whether age, previous dental experience, level of dental anxiety and injection site affect the self-reported pain of children during the first and second treatment sessions. After receiving a local anesthetic injection and prior to dental treatment, patients were asked how much pain did they experience.[3]

General anesthesia (DGA) is the only available option to facilitate performing dental treatment in anxious children, This technique must be carried out in a professional environment by an expert and well trained team who are able to comply with the recommendations for alternative sedation techniques[4].

Natural fearing from intensive light, loud sound and sudden strange movement results in stress easily. The most anxiety induced behavioral reaction is shown by children in their first three years of life.

In general, two groups of behavior controlling methods are available. The use of pharmacological agents such as sedatives, nitrous oxide, general anesthesia etc.[1],[5],[6] and behavioral psycho therapy techniques, relaxation and hypnotherapy which are recently assumed to have an increasing prominence as the effective treatment regimes.

Many dentists currently provide pediatric dental treatments under intravenous conscious sedation[7]. Yasny et al suggested, consequently, pre-operative pharmacological intervention may be necessary, Enteral sedation may be the optimal adjunct for such a challenging patient[8].

Dentists have used a number of methods of hypnosis to manage dental phobia disorders [9],[10]

Hypnosis is a state of altered consciousness in which the patient's awareness of surrounding world including somatic sensations turns to awareness of a more comfortable world within his/her mind. The hypnosis technique described here, is very useful to break the phobic cycle of anxiety and fear.

Estimations have shown that significant number of people experience fear and anxiety during dental treatment[11]. The patient's fear from dental treatment is cultural . Hypnosis may be the method of choice in patients who reject or cannot receive pharmacological modalities, or behavioral interventions. Hypnosis is a state of mind in which suggestions are not only more readily accepted than in the waking state, but also are being put into

action upon a much more powerful fashion than would be possible in normal conditions[12].
Reports indicate that while 40% of the population of the world experience fear of dentistry but only 5% is related to true phobia[13].

Pathological dental phobia is characterized by the avoidance of dental treatment in addition to a high level of anxiety[14],[15]. Dental phobia can be classified as a
specific phobia according to DSM IV because it demonstrates the following characteristics[16]:

- The person is inconstantly frightened from described stimuli.
- Confronting the specific stimulus provokes an almost immediate and unpreventable fear reaction.
- The triggering stimulus is usually avoided,
- The person's daily routine is greatly affected by anxiety or avoidance pattern.
- The person realizes that his/her fear is unreasonably exaggerated.

Attempts to assess dental fear have been mainly considered in the purpose of researches. Numerous published studies, collected data of self reported dental anxiety as the primary outcome variable. To assess various anxieties for example, indicators of pre and post treatment level of anxiety have been considered in data collection[17].

Most of the studies about the techniques of management are published by the specialized dental anxiety clinics in America[18], Sweden[19] and Netherlands [20], but rarely by UK dental practitioners [21].
Kvale et al in a meta- analysis concluded that about 80% of participants in the experiment might receive conventional dental care, but they were wondering if the results could be generalized to all patients[13].

**Materials and Methods**
The present study was conducted in the department of oral medicine and diagnosis, school of dentistry, Isfahan University of medical sciences, Isfahan, Iran, 2007. Specific requirements, other than dental equipments and instruments, were a relatively quiet environment for hypnosis and patients' cooperation. In the process of patient selection, thirty children with age range of 8 to 12 years and equal sizes of both sexes were selected. Short explanation was given to the patients and their parents about voluntarily participation in this study. Then, the parents were asked to announce their consent to dental treatment and hypnotherapy.
The patients who did not accept the procedures including anesthetic injection and hypnotherapy and those who had a history of nervous system or mental disorders were excluded from the study. In this crossover study half of the patients received hypnotherapy prior to anesthetic injection in their first session of treatment and only injection in the second session. The order of process for other half was inversely. Then a comparison between two groups was made.
In this study, the physician and the medical care team were the same in both groups and also other conditions, such as visiting duration which were tried to be kept identical.
It was needed to communicate briefly to patients before hypnosis and this had to be done very carefully, of course.
In this way, physician had the opportunity to assess the patients' imagination about this process and also psychological factors affecting hypnotherapy including patients' calmness versus anxiety, patients' confidence, paying attention to different stimuli including verbal and visual ones , attention span and response.
When the patient was sitting quietly in semi-fowler's position and was relatively calm, hypnosis was started.
The hypnosis technique in this study was selected based on the literature . In this technique, a combination of fixed looking method, counting, and imagery which is a helpful combination for children was used. During local anesthetic injections, observations were recorded intermittently.
At the end of injection, the observations during anesthesia including patient's pulse and respiratory rates; behavioral reactions such as crying, hands or feet movement, physical strength, response to speech and oral- physical resistance were recorded by two persons.
Following appropriate inculcation, injecting local anesthetic agent, and returning oral and maxillofacial position to normal, it was time to wake the patient up gradually and talk briefly to assure him / her about having no pain because of successful local anesthetic injection.
Observations were recorded for all patients for both hypnotic and non-hypnotic states.

**Conclusion**
After passing through practical phases on the 30 subjects and recording their behavioral reactions, data were analyzed **(Table 1)**. The statistical method in this study was MC.Nemar`s analysis and the method of data collection was sequel sampling. Fifteen patients received hypnotherapy in their first visit and the other 15 in their seconds.
Findings showed that during local anesthetic injection heart and respiratory rates were less than normal in hypnotic group and there was a significant difference between two groups. These findings indicated that hypnosis reduced adverse and unfavorable reactions therefore was successful **(Table2)**.
Behavioral reactions of two groups were compared and the results are reported in **(Table 3)**. Seventeen out of 30 subjects did not show crying reaction, 8 subjects cried in non hypnotic anesthetic injection

Table No 1

| | | Relative. F | F* |
|---|---|---|---|
| Age | 8year | 23% | 7 |
| | 9 yr | 26% | 8 |
| | 10 yr | 14% | 4 |
| | 11 yr | 23% | 7 |
| | 12 yr | 14% | 4 |
| Gender | Male | 57% | 17 |
| | Female | 43% | 13 |
| Status | Hypnotism | 50% | 15 |
| | Non Hypnotism | 50% | 15 |

[*Frequency]

Table No 2

| Non-hypnotism | Hypnotism | |
|---|---|---|
| 104.1 | 91.1 | Patients average heart rate in a minute |
| 24.4 | 20.8 | Patients average number of respiratory actions in a minute |

Table No 3

| Hypnotism | | Non-hypnotism | | Total |
|---|---|---|---|---|
| Crying | 2 | Crying Reactions | 8 | 10 |
| Non Crying | 17 | Non Crying | 3 | 20 |
| Leg Movement | 1 | Leg Movement | 4 | 5 |
| Non Leg Movement | 23 | Non Leg Movement | 2 | 26 |
| Hand Movement | 1 | Hand Movement | 1 | 2 |
| Non Hand Movement | 19 | Non Hand Movement | 9 | 28 |
| Physical Reactions(P.R) | 2 | Physical Reactions | 2 | 4 |
| Without P.R | 15 | Without P.R | 11 | 26 |
| Verbal Reaction | 0 | Verbal Reaction | 13 | 13 |
| Non Verbal Reaction | 3 | Non Verbal Reaction | 14 | 17 |

state, but they did not do so in hypnotic state; 3 subjects cried in both methods and 2 subjects cried in hypnotic state and did not do so in normal state (p=0.109).
Twenty three subjects had no feet movement reaction during anesthetic injection, 4 subjects had normal response while they showed negative reaction in hypnotic state, 2 subjects had positive reaction in both methods and only one subject had positive reaction in hypnotic state and did not have any reaction in normal state (p=0.375).
Ninteen subjects had no hand movement reaction, one subject showed hand reaction in both methods, 9 subjects had hand movement in normal state while they had no response in hypnotic state and only one subject had hand movement in hypnotic state (p=0.021).
Fifteen subjects did not show any physical resistance to anesthesia, 11 subjects showed a normal response while they did not do so in hypnotic state. Two subjects showed resistance in hypnotic state and only 2 subjects showed resistance in both methods (p<0.022).
Adverse oral reactions (p = 0), and physical-oral response (p =0.021), were showed in two cases of injection alone. The majority of patients in hypnotic state showed favorable reactions.

**Discussion**

Findings showed that the difference between both crying and feet movement reactions in two groups was not statistically significant, but, there were significant difference between other indices.
Regarding our general and specific goals, it can be concluded that the total incidence of adverse reactions during local anesthetic injection was significantly lower in hypnotic state in compare to injection alone.
Hypnotherapy, according to the observed physiological & behavioral statuses of patients, could be used as a treatment method during local anesthetic injection for 8 to 12 year old children.
However, other specific and experimented techniques for behavioral control might be used with hypnosis.
According to the findings of the present and previous studies, hypnosis might be selected by dentists and physicians as an acceptable solution.
Allen & Stanley expressed that traditional behavioral management techniques such as tell- show- do restraint, hand over mouth exercise and sedation were better than the new ones including modeling and contingency management[20].
Among subjects, there were some who did not respond to usual method of behavioral controlling, this might have a root in previous fears, anxieties & dental operations.

Intercultural studies showed that women's level of anxiety is more likely to have a constant value, while men showed a wide range of responses for a level of anxiety due to their culture[23],[24]. A direct relationship between low socioeconomic status and low oral hygiene and consequently more likely to have missed, damaged or decayed teeth has been shown[25],[26]. Therefore these people might have more reasons to fear from dental treatment, but regarding their educational status, no statically significant differences were found.
One special need that many patients have is treating in a way with no or decreased dental fear. While pharmacological-sedation methods are absolutely vital for compassionate and effective treatment of these patients, there are other important & helpful modalities. The first and the most practical method is good communication to calm down all dental patients[11].

Dailey et al[21] showed that dental practitioners involved in dental anxiety issues were unlikely to use any formal method of assessing dental anxiety. During dental treatment, pain is increased by anticipation and fear, and the majority of hypnosis efficacy is attributed to probably reducing non-specific anxiety.

Orne stated" hypnosis has been shown not to be an effective means of causing an individual modify the behavior that he is not ready or willing to modify"[27].
The effectiveness of hypnosis depends not only on the skill of therapist but also the ability of patient to receive the induction[28].

On the other hand, physical, mental and emotional status and hypnotic nature produce tranquility and favorable state. Memories of the treatment free form mental stress or anxiety which may accompany the treatment. Substantial clinical studies demonstrate that hypnosis effectively reduces anxiety, enhances coping, and has been used successfully to treat behavior disorders, school phobias, and sleep disorders. Hypnosis can effectively reduce a child's anxiety and symptoms and has few side effects when used competently[29].

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# The Prevalence Of Malocclusion Among The Local Chandigarh Population – A Hospital Based Study

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**Abstract**

**Objective:** The objective of this study was to assess the prevalence of malocclusion specifically Class II div 1, Class II div 2 and Class III in a sample of patients in Chandigarh. Data for the patients of study were retrieved from the patient's orthodontic records who sought orthodontic treatment at during the period of April 2008 through December 2011.

**Materials & Method:** A total of 768 patients were screened. All the subjects had full complement of permanent teeth up to second molars. The patients with the history of previous orthodontic treatment, extractions of permanent teeth other than 3rd molars, mixed dentition, congenital malformations like Cleft lip or/and palate and systemic diseases were excluded from the study. Assigning the subjects to various occlusal traits was based purely on clinical examination, study models, facial photographs, lateral cephalograms and orthopantomograms for assessment.

**Results:** Class II malocclusion was more prevalent than Class III malocclusion. Out of Class II malocclusion, Divison 1 is more common among various types followed by Class II div 2. Females reported more for orthodontic treatment than males.

**Conclusion:** Class II malocclusion is the most common malocclusion seen in the Chandigarh Population with females reporting more for orthodontic treatment than males because of esthetic reasons.

**Key Words**
Chandigarh Population, Class II malocclusion, Class III Malocclusion.

## Introduction

The term "malocclusion" encompasses all deviations of the teeth and jaws from normal alignment, including a number of distinct conditions, like discrepancies between tooth and jaw size (crowding and spacing), malrelationships of the dental arches (sagittal, transverse, and vertical) and malpositioning of individual teeth.[1] Angle's classification of malocclusions is universally accepted because of its simplicity as a method of description and communication between dental professionals.

Based on the relationship of the mandibular first molars to the maxillary first molars, this system characterizes the Class II malocclusions as having a distal relationship of the mandibular teeth relative to the maxillary teeth of more than one-half the width of the cusp. Two distinct types of Class II malocclusion exist, differing in the inclination of the maxillary central incisors. Class II Division 1 malocclusions exhibit labially inclined maxillary incisors, an increased overjet with a vertical incisor overlap varying from a deep overbite to an openbite and the Class II Division 2 malocclusion showing excessive lingual inclination of the maxillary central incisors accompanied by a deep overbite and minimal overjet. An Angles Class III malocclusion means that the mandibular first molar is anteriorly placed in relation to the maxillary first molar. It is a symptomatic or phenotypic description that uses the first molars and canines as criteria, and it has nothing to do with the maxillary and mandibular skeletal bases.

Class II molar relationship may occur unilaterally, depicted or classified as a class II "subdivision" of the affected side[2] or a bilaterally Class II on both the sides which is a frequently occurring type of malocclusion out of these two.[3]

## Methodology

The current study was carried out in the Orthodontic department of Dr. Harvansh Singh Judge Institute of Dental Sciences, Panjab University, Chandigarh. Data for the study were collected from the patient's records who reported at the department for orthodontic treatment during the period from April 2008 to December 2011. A total of 768 patients were evaluated for the study. All the patients were examined for screening to include subjects with full complement of permanent teeth up to second molars. The patients with the history of previous orthodontic treatment, extractions of permanent teeth other than 3rd molars, mixed dentition, congenital malformations like Cleft lip or/and palate, systemic diseases and patients with Class I and pseudo Class III were excluded from the study.

In addition to the clinical examination, study casts, photographs, lateral cephalograms and orthopantomograms were also evaluated to verify the diagnosis. Patients were labelled for any of four categories of malocclusion on the basis of following features:

**Class II, division 1 group:** Convex soft tissue profile; excessive overjet (more than three mm); protrusive maxillary incisors; Angle Class II molar relationship in centric occlusion.

**Class II, division 2 group:** Decreased anterior facial height; excessive overbite

(more than three mm); retroclination of two or more maxillary incisors; Angle Class II molar relationship in centric occlusion.

**Class II subdivision group:**
Unilateral molar class II relationship with class I molar relation on opposite side in centric occlusion.

**Class III group:** concave soft tissur profile; Angle's Class III molars and canines, retroclined mandibular incisors, and the presence of an edge-to-edge or an anterior crossbite occlusion. Angle Class III molar relationship in centric occlusion.

**Results**
Screening of the total sample of 768 patients consisted of 315 males and 453 females. Age group of patient was from the range of 11.5 years to 32 years. Among 768 patients, class II malocclusion patients were 492 and 276 patients were of Class III malocclusion. **(Figure 1), (Figure 2)**. Out of 492 patients of Class II malocclusion; 360 patients (males165 and females 195) were of Class II division 1; 113 patients (males 40 and females 73) of Class II subdivision; and 19(males 7 and females 12) patients were of Class II division 2 malocclusion. Out of 113 patients of Class II subdivision left subgroup were 50(males 21 and females 29) and right subgroup were 63(males 19 and females 44) Of 276 patients of Class III malocclusion, sex distribution determined was of 131 males and 145 females. **(Figure 3), (Figure 4)**

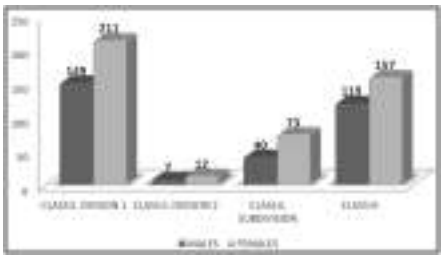

Figure 1: Gender Distribution Of Malocclusion (N = 768)

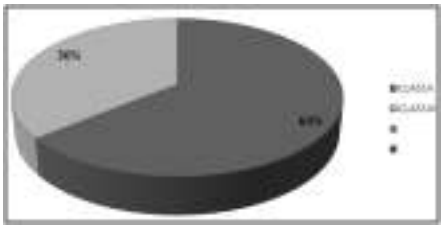

Figure 2: Frequency Of Class Ii & Class Iii Malocclusion

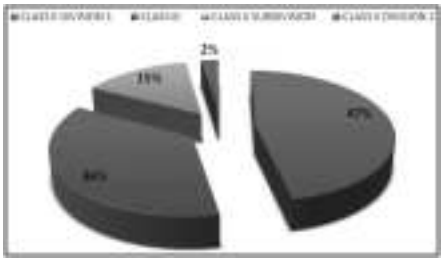

Figure 3: Prevalance Of Malocclusion In Chandigarh Sample (N = 768)

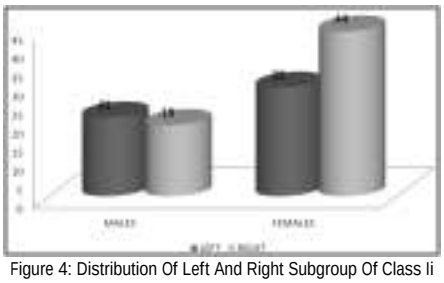

Figure 4: Distribution Of Left And Right Subgroup Of Class Ii Subdivision (N = 113)

**Discussion**
Several studies have evaluated the prevalence of malocclusion in different populations. The results of studies may show great variability due to the differences in classification of occlusal relationships, the developmental period of the study sample, examiner differences, and differences in sample sizes. Instead of differentiating normal and abnormal in a population, determining frequencies of different types of malocclusions in an orthodontically referred population may also give valuable information[4]. This study was conducted in patients referred to the Department of Orthodontics, Dr Harvansh Singh Judge Institute of Dental Sciences, Panjab University, Chandigarh, for orthodontic treatment. This study was carried out as no local study with this magnitude of patients sample size had been carried out in the past. Analysis of a large sample of more mature permanent dentition is mandatory in order to obtain a clear and valid picture of the distribution of occlusal patterns in any given population.

In general, girls report and seek orthodontic treatment more frequently than boys.[5],[6],[7] This factor was reflected in our sample as well.

The methods of recording occlusal traits can be broadly divided into qualitative and quantitative measurements. These methods are useful in describing the occlusal traits for categorizing various types of dental malocclusions for quick and easy documentation as well as providing a common channel of communication among dental professionals. Literature shows that these methods have been used extensively in malocclusion prevalent studies[8]. Although the Angle classification was developed more than a century ago, it still remains the most commonly used classification of malocclusion and its universal acceptance by the dental professionals is evidence of its practicality.[9]

Angle's classification is reliable and valuable in assessing the anteroposterior dental arch relationship. The conflicting evidence seen in results is likely to be related to the type of samples being studied, which may be either clinical samples or random samples drawn from a population[10]. In most of the surveyed populations Class II malocclusion has been found to be more prevalent than the Class III.[11] This finding goes with our results as well. Roughly one-third of the North American population and half of all orthodontic patients present with some sort of Class II malocclusion.[12]

Several genetic and environmental interacting factors are related to the etiology of these malocclusions. Soft diet, mouth breathing, tongue thrusting, sleeping posture, sucking, and other habits as well as specific factors (skeletal growth disturbances, muscle dysfunction, disturbances in embryologic and dental development) interact with heredity in the development of major types of malocclusion. These factors are difficult to separate, in terms of gene-environment interactions. Intraoral environmental change may be a decisive factor, but this change may also reveal previously masked genetic effects. In United States prevalence of Class II malocclusions in population have been quoted from 55.1 per cent (age 8–11) to 67.7 per cent (age 12–17). In comparison to US population being dependent on industrially processed foods, the inhabitants of isolated traditional communities utilize more traditional and home-produced foods providing consistent loading during mastication.[1]

An ultra-orthodox Jewish community in Jerusalem has shown prevalence of 32% for class II/1, 2.3% for class II/2 and 8.5% for class II subdivisions in its children. However, low prevalence of normocclusion (7.4%) can be attributed to genetic background, environmental

influences and the definition used for normal occlusion[13]. Sample of Caucasian's orthodontic patients has shown even larger proportion of class II malocclusion around 70%, far above that of the population sample.[14]

A large Indian sample of children from rural areas have exhibited a prevalence of 13.5% for class II malocclusions[15]. The Class II/2 malocclusion is relatively rare, with a frequency between 1.5 and 5% of all malocclusions. It is more common in females. Findings were quite consistent with our results. Class II/2 malocclusion has not only a specific pathognomonic dental appearance, but it also has several skeletal, sagittal, and especially vertical attributes that differentiate it from both Class I and Class II/1 malocclusions.[16] Unilateral Class II cases were classified as subdivision cases by Angle. He reported that a Class II molar relationship developed because of the distal eruption of the mandibular first molars in relation to normally positioned maxillary first molars.[17] This category of class II malocclusion has consistently shown a prevalence of more than class II/2, but less than that of class II/1[14, 18]. The same trend also expressed itself in current study.

The prevalence of Class III malocclusion varies among different ethnic groups. The prevalence of this type of malocclusion in the Caucasion population is approximately 3-5%.[19]

**Conclusion**

The prevalence of class II malocclusion was more than class III in sample from orthodontic patients visiting orthodontic department of institute in Chandigarh is quite high, representing approximately one third of our orthodontic population. Class II/div1 is prominently more prevalent than the other categories of class II malocclusion. In class II subdivisions, right side is affected most of the times than the left side.Also the orthodontic awareness was also also found to be more among females than males as the proportion of females visiting orthodontic department is more than males. The obvious reason for this is esthetics, which are of more concern for females.

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# Age Estimation Using Mandibular Third Molars

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**Abstract**

**Background & Aims:** Examination of the developmental stages of third molars by modified Demirjian technique and to correlate it with the chronological age and sex among Indian population.

**Material & Methods:** 515 orthopantomographs were collected from children and young adults between the age group of 8-23years and categorized according to the developmental stages proposed by modified Demirjian technique. Descriptive statistics were obtained and the statistical analysis was performed using the Mann-Whitney test between the age and sex.

**Results:** The difference in mean age between males and females was found to be statistically significant regarding the calcification of Stage C ($P<0.05$) and Stage D ($P<0.01$).

**Conclusion:** Statistical analysis showed a strong correlation between the age and third molar development. The examination of third molars would provide reasonable accuracy for the likelihood that a person being in particular age range instead of the estimation of exact chronological age.

**Key Words**
Age estimation, Modified Demirjian Technique, Third molar

Quick Response Code

## Introduction

Teeth represents as an useful material for age estimation. The development of an individual can be affected by genetic, nutritional, hormonal and environmental factors.[1] But, it has been reported that dental mineralization is less affected by external factors when compared to skeletal mineralization.[1]

Teeth, being the hardest calcified tissue of the body tend to remain intact even when the other components of the skeletal system get disintegrated. The high resistance of the teeth to severe insults such as heat, cold and chemical agents makes them the most preferable tissue for forensic studies.[6]

The dental age can be assessed in young children with greater accuracy because many teeth will be undergoing development and calcification at the same time.[3],[4],[5] After the early teens most of the teeth get calcified and erupt except for the third molars. This makes the third molars the most important teeth of choice for age estimation in the late teens and early twenties.[2],[4]

Although the third molars might show some amount of variation in their anatomy and position, several authors state that are the most reliable biologic indicator for estimation of age during the middle teens and early twenties especially when there is a need to determine the juvenile or adult status of an individual when no valid document is available.[5],[6]

Numerous methods have been proposed to estimate the age using third molars. Modified Demirjian technique is an excellent method for age estimation from the radiological appearance of the third molar. The aim of this study was to categorize the orthopantamographs collected from the 515 children and young adults, according to the developmental stages proposed by modified Demirjian technique and to correlate it with the chronological age and sex of the subjects.

## Material and Methods

This study includes 515 orthopantomo graphs of the subjects within the age group of 8 to 23 years (273 males and 242 females), from the Department of Orthodontics, Vyas Dental College and Hospital, in the period from 2000- 2011. Selection criteria included the following: Indian, well nourished, normal growth and development, and free of any known serious illness. The radiographs were examined separately by two observers. Examination and classification covered the development phase of right third molar and when not present, the contralateral molar was considered. Tooth calcification was rated according to the Modified Demirjian method in which one of the eight stages of calcification A to H, was assigned to the third molar tooth **(Figure 1)**.

- Stage A: Calcification of single occlusal points without fusion of different calcifications.
- Stage B: Fusion of mineralization points; the contour of the occlusal surface is recognizable.

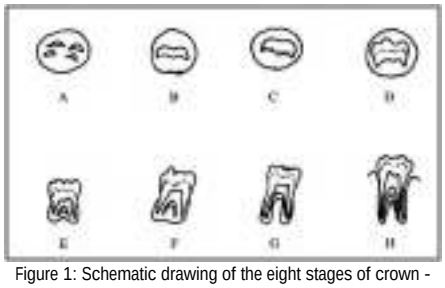

Figure 1: Schematic drawing of the eight stages of crown - root formation of the molars according to modified Demirjian technique.[3]

- Stage C: Enamel formation has been completed at the occlusal surface, and dentine formation has commenced. The pulp chamber is curved, and no pulp horns are visible.
- Stage D: Crown formation has been completed to the level of the cemento-enamel junction. Root formation has commenced. The pulp horns are beginning to differentiate, but the walls of the pulp chamber remain curved.
- Stage E: The root length remains shorter than the crown height. The walls of the pulp chamber are straight, and the pulp horns have become more differentiated than in the previous stage. Radicular bifurcation has commenced to calcify.
- Stage F: The walls of the pulp chamber now form an isosceles triangle, and the root length is equal to or greater than the crown height. The bifurcation has developed sufficiently to give the roots a distinct form.
- Stage G: The walls of the root canal are now parallel, but the apical end is partially open.
- Stage H: The root apex is completely closed (distal root in molars). The periodontal membrane surrounding the root and apex is uniform in width throughout.

The first four stages (A–D) show crown formation from the beginning of cusp calcification to completed crown, and the second four (E– H) root formations from initial radicular bifurcation to apical closing. Descriptive statistics were obtained by calculating the means, standard deviations, and range of the chronologic ages for the eight stages of dental development. Statistical analysis was performed using the Mann-Whitney test between the age and sex.

## Results

Totally 515 subjects were included in the study among which 273 (53%) were males and 242 (47%) were females. The interobserver agreement for the males: 95%, for females: 92% and the overall: 94%. The Mean, Standard Deviation, standard error for Mean, other descriptive statistics and Median for modified Demirjian stages of males **(Table 1)**. The Mean, Standard Deviation, standard error for Mean, other descriptive statistics and Median for modified Demirjian stages of females **(Table 2)**.

Table 1: Descriptive Statistics For The Modified Demirjian Stages Of Males

| Stage | N | Mean | SD | SE of Mean | Median | Min | Max |
|---|---|---|---|---|---|---|---|
| Stage A | 26 | 9.96 | 2.51 | 0.49 | 9.0 | 8 | 16 |
| Stage B | 30 | 11.03 | 2.54 | 0.46 | 11.0 | 8 | 17 |
| Stage C | 40 | 11.18 | 2.36 | 0.37 | 11.0 | 8 | 17 |
| Stage D | 47 | 11.60 | 1.74 | 0.25 | 11.0 | 10 | 17 |
| Stage E | 34 | 14.32 | 2.32 | 0.40 | 14.0 | 10 | 19 |
| Stage F | 15 | 16.07 | 3.20 | 0.83 | 17.0 | 11 | 21 |
| Stage G | 45 | 19.16 | 2.41 | 0.36 | 19.0 | 14 | 23 |
| Stage H | 36 | 21.72 | 1.39 | 0.23 | 22.0 | 18 | 23 |

N Indicated The Number Of Samples; Sd Indicates Standard Deviation And Se Indicates Standard Error

Table 2: Descriptive Statistics For The Modified Demirjian Stages Of Males

| Stage | N | Mean | SD | SE of Mean | Median | Min | Max |
|---|---|---|---|---|---|---|---|
| Stage A | 23 | 9.96 | 2.58 | 0.54 | 9.0 | 8 | 16 |
| Stage B | 30 | 10.87 | 2.57 | 0.47 | 10.5 | 8 | 17 |
| Stage C | 47 | 12.17 | 2.05 | 0.30 | 12.0 | 9 | 17 |
| Stage D | 43 | 12.65 | 1.90 | 0.29 | 12.0 | 10 | 17 |
| Stage E | 31 | 14.94 | 1.90 | 0.34 | 15.0 | 11 | 19 |
| Stage F | 14 | 16.93 | 1.90 | 0.51 | 17.0 | 14 | 20 |
| Stage G | 28 | 19.11 | 2.45 | 0.46 | 19.5 | 15 | 23 |
| Stage H | 26 | 21.19 | 2.12 | 0.42 | 22.0 | 17 | 23 |

N Indicated The Number Of Samples; Sd Indicates Standard Deviation And Se Indicates Standard Error

Table 3: Descriptive Values And Statistical Comparisons Of Modified Demirjian Stages In Both Sexes

| Stage | Gender | N | Mean | SD | SE of Mean | Mean difference | Z | P-Value |
|---|---|---|---|---|---|---|---|---|
| Stage A | Male | 26 | 9.96 | 2.51 | 0.49 | 0.005 | -0.053 | 0.958 |
| | Female | 23 | 9.96 | 2.58 | 0.54 | | | |
| Stage B | Male | 30 | 11.03 | 2.54 | 0.46 | 0.167 | -0.306 | 0.759 |
| | Female | 30 | 10.87 | 2.57 | 0.47 | | | |
| Stage C | Male | 40 | 11.18 | 2.36 | 0.37 | -0.995 | -2.091 | 0.037* |
| | Female | 47 | 12.17 | 2.05 | 0.30 | | | |
| Stage D | Male | 47 | 11.60 | 1.74 | 0.25 | -1.055 | -2.916 | 0.004* |
| | Female | 43 | 12.65 | 1.90 | 0.29 | | | |
| Stage E | Male | 34 | 14.32 | 2.32 | 0.40 | -0.612 | -1.084 | 0.278 |
| | Female | 31 | 14.94 | 1.90 | 0.34 | | | |
| Stage F | Male | 15 | 16.07 | 3.20 | 0.83 | -0.862 | -0.660 | 0.509 |
| | Female | 14 | 16.93 | 1.90 | 0.51 | | | |
| Stage G | Male | 45 | 19.16 | 2.41 | 0.36 | 0.048 | -0.034 | 0.973 |
| | Female | 28 | 19.11 | 2.45 | 0.46 | | | |
| Stage H | Male | 36 | 21.72 | 1.39 | 0.23 | 0.530 | -0.461 | 0.645 |
| | Female | 26 | 21.19 | 2.12 | 0.42 | | | |

N Indicated The Number Of Samples; Sd Indicates Standard Deviation; Se Indicates Standard Error, Z Indicates Value From Standard Distribution And * P < 0.05.

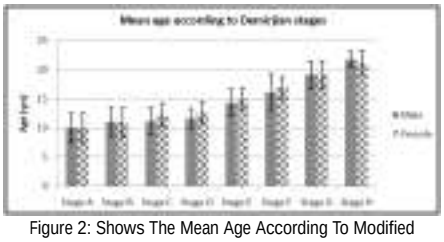

Figure 2: Shows The Mean Age According To Modified Demirjian Stages In Both The Sexes

The difference in mean age between males and females was found to be statistically significant regarding the calcification of Stage C ($P<0.05$) and Stage D ($P<0.01$). In addition no significant difference in mean age was found between males and females in Stage A, Stage B, Stage E, Stage F, Stage G and Stage H ($P>0.05$) **(Table 3)**. The comparison between both the genders according to modified Demirjian stages: mean age and distribution of age is depicted in **(Figure 2)**.

## Discussion

Age estimation is an important exercise for medico-legal (age at death, criminal law cases, legal matters, adult status establishment, etc) and clinical purposes.[3],[6],[7] The need for age estimation has certain important reasons at certain specific age groups: a) 12 years: children below this age are not liable for certain offences; b) 14 years: a child cannot be employed below 14 years; c) 18 years: determines the status of majority and the legally permissible age of marriage in females; d) 21years: legally permissible age of marriage in males.[8] Numerous methods have been proposed for determination of the age. Studies have shown that dental development relates more closely to chronological age than skeletal, somatic or sexual maturity indicators. Tooth formation has been more widely used than tooth eruption for assessing dental maturation, because it is a continuous and progressive process. The methods of age estimation in which tooth is used as an evaluation tool include both – methods requiring the extraction of teeth and Histopathological examination and in-vivo methods which merely require radiographs.[8],[9]

One of the most widely used method is that of Demirjian, Goldstein and Tanner, which was first described in 1973 based on a large number of French– Canadian children.[10] The method evaluates the development of seven mandibular teeth from a panoramic radiograph and calculates dental age. Each tooth is rated according to developmental criteria (amount of dentine deposition, shape changes of pulp chambers, etc.) rather than the changes in size. Eight stages A to H, were defined from the 1st appearance of calcifications to the closure of apex and each one is allocated a score. The

sum of those scores for an individual provided an estimate of dental maturity on a scale (overall maturity scores). These scores are subsequently converted into a dental age using conversion tables.[9]

Third molar development was not included in their investigations. It was only Moores et al and Schour & Masslef and the detailed work by Mincer et al that provided a favorable study of the age related stages of development of third molars.[2]

Numerous authors have conducted studies using modified Demirjian's classification and indicated that reproducibility is higher for mandibular third molars than maxillary third molars.[9]

In the present study we assessed the developmental stages of third molar and compared it with the chronological age and sex of the subjects. 515 subjects were included in the study, the orthopantomographs of the subjects were collected and they were evaluated by modified Demirjian method and the appropriate stage was assigned.

In the present study the Mean age of 9.96years (Median: 9years) was observed for both the genders with respect to stage A, for the Stage B: Mean age of 11.03years for males and 10.87years for females (Median: males – 11years; females- 10.5years), for Stage C: Mean age of 11.18years for males and 12.17years for females(Median: males- 11years; females- 12years), For Stage D: Mean age of 11.60years for males and 12.65 years for females (Median: males- 11years; females- 12years), for Stage E: Mean age of 14.32years for males and 14.94years for females (Median: males- 14years; females- 15years), for Stage F: Mean age of 16.07 years for males and 16.93 years for females (Median: males- 17years, females- 17years), for Stage G: Mean age of 19.16 years for males and 19.11years for females (Median: males- 19 years; females- 19years) and for Stage H: Mean age of 21.72 years for males and 21.19 years for females(Median: males- 22years; females- 22years).

Based on our results it can be assumed the mandibular third molars development starts at the similar age in both the sexes based with respect to the results of Stage A, but with respect to the further stages such as B, C, D, E and F the development is comparatively about 6 months to 1 year earlier in males than in females. But in the stages G and H the development of thirds molars are faster in females than in males by about 5-6 months.

As concluded by Mincer et al. in the A.B.F.O study, the examination of third molars may provide reasonable accuracy for the likelihood that a person is at least, e.g., 18 years old, instead of the estimation of exact chronological age.[3] Therefore, in our study, we investigated the probability of a adolescent being older than the useful age cut points, 14, 18, and 20 years. According to our results, the recognition of earlier stages in teeth development up to and including crown completion ("A," "B," "C," "D" stages) indicates that the person in question is younger than 18 years and would therefore fall under juvenile legislation. Besides, when the root formation is sufficiently advanced to reach the length of the crown length ("F" stage), the likelihood is that the person is at least 14 years old and, in this case, could be subject to criminal liability. When third molar development has already been completed ("H" stage), the probability that the juvenile is at least 18 years old, which is crucial because those over the age of 18 are subject to criminal punishment.

**Conclusion**

Examination of the developmental stage of third molars using Modified Demirjian method can be a useful tool for chronological age determination in the field of legal and forensic odontology. The described data may provide references for third molar examination for the purpose of forensic investigation. However, only some conclusions can be drawn from limited number of subjects. Hence a further continuation of this research with a large sample is required to support our results.

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# Transalveolar Screws

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Quick Response Code

**Abstract**

**AIM:** To evaluate the efficacy, advantages and disadvantages of maxillomandibular fixation done using Transalveolar screws.

**Materials & Methods:** 2W29;0 mm diameter, 12 mm long transalveolar self-tapping titanium screws manufactured and marketed by M/s Orthomax, India were used. These screws were placed in maxilla and mandible, two to three screws per arch, strategically so as to avoid root apices or neurovascular bundle.

**Results:** The main advantage is of minimal glove perforation. The high cost and its limitation in cases with displaced and comminuted fractures is a major drawback.

**Key Words**

Maxillomandibular Fixation(MMF), Transalveolar screws, Mandibular Fractures, Needlestick injuries.

## Introduction

With the evolution of mankind, the incidence, extent and nature of trauma has undergone radical change. Wars and assault are older than recorded history and maxillofacial trauma has indeed been a major consequence. About 42% of all the injuries affect the craniofacial complex, of which 74% victims are male and 26% are female; 57% of these involve the mandible while 26% involve the midface, 13% affected both the midface as well as the mandible[3],[4].

Around the year 460 BC Hippocrates had described the treatment of fracture of the mandible as, "If the teeth at the wound be distorted and loosened when the bone is adjusted, they should be connected together, not only two but more of them, with a gold thread if possible, but otherwise with a linen thread, until the bone be consolidated"[1].From the year 25 BC to the 11th century AD noted surgeons and writers such as Sushruta, Celsus and Avicenna described the conservative means of treating jaw fractures[1]. In 1492 AD Salicetti advised wiring of one jaw to the other to treat fractures as "….this done, tie the teeth of the uninjured jaw to the teeth of the injured jaw in this way[1].

Angle in 1890 published his technique for control of jaw fractures using modified orthodontic bands, threaded arch bars and screw expansion devices for precise restoration of the teeth and fragments[1],[2]. Oliver (1910) used wire ligatures with a loop to immobilize the jaws, this technique was improved upon by Eby (1920) and Ivy (1922)[1]. Since then numerous methods for instituting MMF have evolved over the ages with newer materials and newer techniques ranging from gold wires tied around teeth to nylon threads, stainless steel wire, various type of splints, eyelets, different forms of arch bars, vaccum formed splints, pearl steel wires, button wiring, bonded brackets, self tapping screws to self drilling transalveolar screws and so on[3]. In the year 1989, transalveolar screws were introduced as a new hardware for maxillomandibular fixation. This method was developed with the main aim to lower the risk of the operator while treating Human Immunodeficiency Virus [HIV] positive patients[5]. Since then these have been put to use for various indications of MMF.

## Materials & Methods

In the patients, 2.0 mm diameter, 12 mm long transalveolar self-tapping titanium screws manufactured and marketed by M/s Orthomax, India were used **(Figure 1)**. These screws were placed in maxilla and mandible, two to three screws per arch, strategically so as to avoid root apices or neurovascular bundle, the ideal sites being supero-medial to the maxillary canine and infero-medial to the mandibular canine. After injecting 2% lignocaine with 1:200000 adrenaline by local infiltration in the maxilla and a bilateral inferior alveolar nerve block in the mandible, 1.5 mm diameter drill holes were made transmucosally- not requiring a gingival incision. Each screw was inserted till its head snugly fitted against the buccal mucosa. Once the screws were secured MMF was accomplished by passing 24 Standard Wire Gauge (S.W.G.), soft, stainless steel, pre stretched wires through the slots/ holes on the heads of the screws vertically.

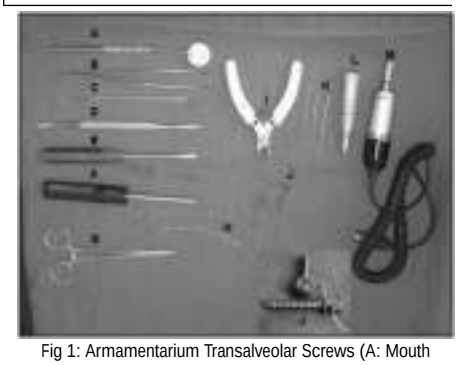

Fig 1: Armamentarium Transalveolar Screws (A: Mouth Mirror, B: Tweezer, C: Double Ended Probe, D: Molt's Periosteal Elevator, E: Universal Screw Driver 2.0 Mm, F: Self Holding Screw Driver 2.5 Mm, G: Needle Holder 6 Inches, H: 24 Gauge Wire, I : Wire Cutter, J : Transalveolar Screws 2.0 Mm (Titanium), K: 1.5 Mm Drill Bits, L : Straight Surgical Handpiece, M: Micro Motor)

## Results

The mean time for application was23.5 min (standard deviation = 17.8 min) ranging from of 20 to 30 min. The ease of

application for the MMF apparatus was graded as "Easy / Moderate / Difficult", by the operator. It was graded as "Easy" for 8 out of 10 patients and "Moderate" for the other 2 patients. The time taken for removal was 15.5 min (standard deviation = 3.7 min) with a range of 10 to 20 min. The ease of removal for the MMF apparatus was graded as "Easy" for 8 out of 10 patients and "Moderate" for the other 2 patients. The mean duration of MMF was 28 days (standard deviation = 4.7 days) with a range of 20 to 38 days. Stability on removal of the MMF apparatus was marked as "Stable / Unstable" by the operator. 5 out of 10 patients had stable MMF apparatus on release whereas the other 5 were unstable. The stability of fixation on release was marked as "Stable / Unstable". It was found to be stable in 8 out of the 10 patients whereas 2 had an unstable fixation. The breach of glove barrier was examined at the time of application of the MMF apparatus and was marked as "Positive / Negative". No perforations were detected after application of the MMF apparatus but at the time of removal of apparatus7 of the 10 removals resulted in no perforations, while in the other 3 procedures, perforations were present. The level of patient comfort was graded by the patient as "Good / Moderate / Difficult" based on his experience. 3 of the 10 patients graded their treatment as "Good", while 7 graded it as "Moderate". The mean cost was INR 864.80 (Standard Deviation = INR 135.70) with a range of INR 803 to 1206. Loosening of the MMF apparatus was evaluated throughout the period of MMF and was marked as "Positive" if loose and as "Negative" if stable. 5 of the 10 patients had a loosening of apparatus, while it was as firm as on application in the other 5 patients.

**Discussion**

The transalveolar screws were developed for decreasing the risk of exposure of the maxillofacial surgeon to needlestick injuries while treating HIV positive trauma patients. Various authors have undertaken studies on a varying number of patients to evaluate the efficacy of these transalveolar screws. The patients in our study were selected serially from the out patient department (O.P.D.) of Oral and Maxillofacial Surgery (OMFS), MM College of Dental Sciences and Research, Mullana, District - Ambala, Haryana, and other departments of MM College of Medical Sciences, Mullana, District - Ambala, Haryana, including the emergency. Comminuted, grossly displaced and dentoalveolar fractures were not included in the study. In our study 2.0 mm diameter, 12 mm long transalveolar self-tapping titanium screws were used. These screws were placed in maxilla and mandible **(Figure 2)**. In 9 out of the 10 patients two screws per arch were placed while in one patient three screws per arch were placed,


Fig 2: Profile View


Fig 2: Intra Operative Occlusion


Fig 2: Pre Operative Occlusion


Fig 2: Intra Operative Right Side


Fig 2: Pre Operative Right Side


Fig 2: Intra Operative Left Side


Fig 2: Pre Operative Left Side


Fig 2: Intra Operative Orthopantomogram.

Fig 2: Pre Operative Orthopantomogram Showing A Fracture Of The Right Subcondyle And Left Angle Of The Mandible.


Fig 2: Post Operative Occlusion

Fig 2: Post Operative Right Side

Fig 2: Post Operative Left Side

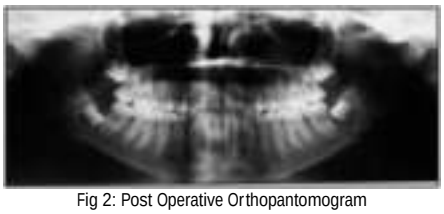

Fig 2: Post Operative Orthopantomogram

strategically so as to avoid root apices or neurovascular bundle. Arthur and Berardo[5] in 1989 first suggested the use of 2 mm self tapping screws to secure MMF, but Busch[6],[7],[8],[10],[16] advocated the use of 2.7 mm self tapping screws as the 2 mm screws were thought to be brittle. Gordon et al[9] also supported the use of 2.7 mm self tapping screws, but Jones[8],[12], Glickman[11], Thotha[13], Ueki[14], Schneider[15], Gibbons[17],[19] and Vartanian[18] all favored the use of 2 mm self tapping screws. Follow up visits were planned at 7 days, 15 days, 1 month, 2 months, 3 months and 5 months from the day of removal of the MMF apparatus. Breach of glove barrier was deemed as one of the main parameters since transalveolar screws were developed with the main aim to lower the risk of the operator when working on a HIV positive patient or a HBV positive patient.

1 screw fracture was seen during the entire study which was in the 32, 33 region. The screw was left in place and an alternative site was prepared for screw fixation inferior to the site of screw fracture. The fractured screw was checked radiographically in the follow up visits. In the studies by Coburn[20] 3 screw

Fig 3: Complications Of Transalveolar Screws

fractures were seen in 122 patients and the screws were left in place uneventfully, Salama et al[22] report 4% screw fractures, Molina et al[23] report 4 cases of screw fracture in 60 patients while Coletti et al[24] report 2 (4%) cases of screw fracture in 49 patients. The time required for application of apparatus as well as for the removal of apparatus is very less and the whole process is also more comfortable for the patient. This method also has a good patient compliance with no swelling or bleeding noted from the site of MMF application. The main advantage also noted in our study is of minimal glove perforation. The high cost and its limitation in cases with displaced and comminuted fractures is a major drawback. All the disadvantages of transalveolar screws along with the tendency of the screws to become loose and unstable after a few days of application caused severe pain and discomfort to the patient. Also it was noted that of the 42 screws applied 1 fractured on application while 9 screws were covered by mucosa **(Figure 3)**. In the reviewed literature by Jones[8],[12], Glickman[11], Thotha[13], Ueki[14], Schneider[15], Gibbons[17],[19], Vartanian[18], Roccia et al[21], Salama[22], Molina et al[23] and Coletti et al[24] it was noted that these screws have a great tendency to cause iatrogenic tooth injury which however was not seen in our study.

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# Comparison Of Efficacy Of Citric Acid And Ethylene Diamine Tetra Acetic Acid (Edta) As Root Conditioning Agents During Periodontal Flap Surgery-in Vivo Study.

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**Abstract**

The aim of study was done to compare the efficacy of citric acid (pH-1) and ethylene diamine tetra acetic acid (EDTA) (pH 7-neutral) as root conditioning agents during flap surgery. A total of fifteen patients having two almost identical bony defects with pocket depth ranging from 4-8 mm, one on either side of same arch were selected. Surface of the selected tooth having maximum pocket depth was considered for the study and were randomly divided into two sites. In site I, citric acid and in site II, EDTA was used as root conditioning agent during periodontal flap surgery. Clinical parameters were recorded at day 0 and after 6 weeks; they included plaque index (PI), probing depth (PD), and clinical attachment level (CAL). The results showed significant improvement by both agents in all parameters. On comparison between site I and site II, reduction in PI and PD and CAL gain was more in site II but difference was statistically non-significant. Although both agents were effective, but EDTA acting at neutral pH seems to be preferable to citric acid because it selectively removes hydroxyapatite leaving most of collagenous matrix intact and has no necrotizing effect on surrounding periodontal tissues.

**Key Words**

connective tissue attachment, periodontitis, regeneration, root conditioning, smear layer.

## Introduction

The rationale for periodontal therapy is the elimination of periodontal disease, restoration of periodontal tissues to healthy functional state and subsequent maintenance of the restored tissues.[1] Periodontitis affected root surfaces are hypermineralized, pathologically altered and are contaminated by bacterial endotoxin which inhibit growth and vitality of fibroblasts in vitro and may prevent new connective tissue attachment (Hanes PJ et al 1991).[2]

Thus, for regeneration to occur, disinfection and modification of the contaminated root surface in order to restore its biocompatibility and to favour the attachment of regenerated periodontal structures becomes the necessity.[3] Although meticulous root planing by hand instrumentation or by ultrasonic scalers have been advocated, root surface will inevitably be covered by smear layer acts as a barrier for connective tissue attachment to the root surface.

Therefore, to enhance the effectiveness of root planing, chemical root conditioning was introduced in order to detoxify, decontaminate and demineralize the root surface, thereby removing the smear layer and exposing the collagenous matrix of dentin and cementum.[4] A variety of agents have been used that include hydrochloric acid, citric acid ,ethylene diamine tetra acetic acid ,tetracycline ,stannous fluoride, fibronectin, cohnn's factor IV, sodiumdeoxycholate, growth factors, minocycline hydrochloride, phosphoric acid etc.[5]

Citric acid (pH 1) has been proved to be an efficient root conditioning agent. It has been shown to remove smear layer, demineralizes the planed root surfaces, elutes bacterial endotoxins from pathologically altered cementum surfaces, prevent epithelial migration along the denuded root surface and enhance attachment either by connective tissue in growth or by splicing of newly formed collagen to the exposed dentinal fibrils.[6]

Recently, the use of calcium chelators such as EDTA with neutral pH has been shown to hold considerable promise as root conditioning agent. Studies have shown that EDTA selectively removes hydroxyapatite, leaving most of collagenous matrix intact, preserves the adjacent tissue vitality, promotes early cell and tissue colonization by providing a more biocompatible surface for cell and has been reported to give favourable results with respect to less flap failure and more connective tissue attachment.[7]

## Materials and Methods

### Patient Selection

Patients in the age group of 30-50 years (both male & female) suffering from generalized chronic periodontitis were selected amongst those visiting the Department of Periodontology and Implantology, Govt. Dental College and Hospital, Patiala.

### Selection Criteria

1) Cooperative patients, showing acceptable oral hygiene during phase 1 therapy.
2) Patients not having any systemic problem that contraindicate periodontal surgery.
3) Absence of attrition, abrasion or

erosion.
4) Absence of internal or external root resorption.
5) Absence of any root caries or restoration on root surfaces of experimental teeth.
6) Teeth with furcation involvement will not be selected.

**Study Design**
Fifteen patients having two almost identical bony defects with pocket depth ranging from 4-8 mm, one on either side of same arch were selected. Surface of the selected tooth having maximum pocket depth was considered for the study and were randomly divided into two sites.

- Site I: Citric acid (pH 1) was applied as root conditioning agent.
- Site II: EDTA (pH 7-neutral) was applied as root conditioning agent.

**Pre-surgical Management**
All subjects received a full diagnostic work up that included intraoral periapical radiograph according to area of interest and clinical examination to record plaque score, pocket depth and clinical attachment level with occlusal stent as a guide. Subjects were given oral hygiene instructions. Thorough scaling and root planing was performed and, occlusal adjustments were done if necessary to relieve traumatic occlusion.

**Preparation of Citric Acid (pH 1.0)**
Freshly prepared saturated solution of citric acid at pH 1 was used as root conditioning agent on one side. Citric acid solution was prepared by adding citric acid in anhydrous form into distilled water at room temperature under continuous mixing until solution became saturated. pH 1 was attained using pH meter. Solution was then filtered using Whatman filter paper # 1.

**Ethylene diamine tetra acetic acid (EDTA pH 7-neutral)**EDTA liquid at pH 7 was used as root conditioning agent on other side of same arch.

**Disclosing Solution** – 0.075% solution of basic fuchsin. Before scaling, 15 ml of solution was given to each subject to rinse the mouth for 20 seconds followed by two rinses with plain water (6gms of basic fuchsin was dissolved in 100 ml of 95% ethyl alcohol. The concentrated dye alcohol solution was further diluted by adding 7,900 ml of distilled water to get the required 0.075% of dye solution).

**Stent-Preparation**
Occlusal stents for positioning the measuring probe were fabricated with cold-cure acrylic resin on a cast model of each patient obtained from an alginate impression. The occlusal stent was trimmed flat on the bottom edge, and vertical locating groove was made on the facial interproximal aspect with bur for the proper guidance and orientation of the periodontal probe. Using the groove as a guide, the periodontal probe was inserted into the pocket and clinical measurements were obtained.

**Recording of Clinical Parameters**
Following clinical parameters were obtained immediately before surgery (day 0) and subsequently at the end of 6 weeks.
1) Plaque Index (Quigley-Hein and Elliot) using disclosing solution (0.075% basic fuchsin).
2) Probing pocket depth (Using Williams calibrated periodontal probe)
3) Clinical attachment level (Using Williams calibrated periodontal probe and customized acrylic occlusal stent).

**Surgical Management**
A complete and comprehensive medical and dental history examination of all the subjects was taken. Subjects were given an explanation of the study purpose and a signed consent from the patient was obtained.

Area was anaesthetized with 2% xylocaine (1:200,000 adrenaline) and crevicular incision was given from the base of the pocket to the crest of the bone. The muco-periosteal flap was reflected and thorough scaling and root planing was done. The entire area was irrigated with normal saline solution. On experimental tooth in one segment, citric acid solution was applied passively with cotton pellet for 3 minutes and then the area was irrigated with normal saline. During application of citric acid, the exposed surfaces of the flaps were protected with saline moistened gauze. Pellets were changed every 30 seconds to avoid dilution of acid. On experimental tooth of other side of same arch, EDTA solution was applied with cotton pellet passively for 3 minutes and then the area was irrigated. Pellets were changed every 30 seconds to avoid dilution of acid. Flaps were adapted back to their original position and interrupted suturing was done using non-resorbable silk suture (Mersilk 3-0).The surgical area was then covered with Coe-Pak.

**Post-surgical Management**
Following medicines were prescribed orally Antibiotic: Cap symbiotic (Amoxycillin 500mg + Lactic acid bacillus)- 1 tds for 5 days ,Analgesic and anti-inflammatory drug: Tab Brufen 400 (Ibuprofen 400 mg)- 1 tds for 3 days and Capsule B-complex with vitamin C (Becozyme C-forte)- 1 OD for 5 days
Seven days after, surgical dressings and sutures were removed and the site was cleansed.

**Recording and Recall Visits**
Recording of all clinical parameters was carried on day 0 (baseline) and subsequently at the end of 6 weeks.

**Statistical Analysis**
Statistical Analysis was performed using a statistical package, SPSS windows version 15 by applying mean values using analysis of variance (ANOVA) and student-t test.

**Results**
It was observed that both the materials were well tolerated by all the patients

Table 1 : Mean Plaque Scores, Mean Pocket Depth Scores (mm), Mean Scores Of Clinical Attachment Level (mm) Of Site I And Site Ii At Different Time Intervals.

| Sites | N | Time Interval | Particulars | Mean Plaque Scores | Mean Pocket depth Scores | Clinical attachment gain |
|---|---|---|---|---|---|---|
| Site I | 15 | Day 0 | Range | 1-2.5 | 4-7 | 8-10 |
| | | | Mean | 1.86 | 5.40 | 9.20 |
| | | | Sd | ± 0.52 | ± 0.74 | ± 0.94 |
| | | 6 Weeks | Range | 1-2 | 2-4 | 7-9 |
| | | | Mean | 1.43 | 3.47 | 7.67 |
| | | | Sd | ± 0.46 | ± 0.64 | ± 0.82 |
| Comparison | Day 0 vs. 6 weeks | | T-value* | 4.52 | 16.36 | 9.28 |
| | | | P-value | < 0.05 | < 0.05 | < 0.05 |
| | | | Significance | S | S | S |
| Site II | 15 | Day 0 | Range | 1-3 | 5-8 | 8-10 |
| | | | Mean | 1.97 | 5.33 | 9.33 |
| | | | Sd | ± 0.59 | ± 0.82 | ± 0.62 |
| | | 6 Weeks | Range | 1-2 | 3-5 | 7-9 |
| | | | Mean | 1.53 | 3.27 | 7.79 |
| | | | Sd | 0.47 | 0.59 | 0.68 |
| Comparison | Day 0 vs. 6 weeks | | T-value* | 4.29 | 31.0 | 11.5 |
| | | | P-value | < 0.05 | < 0.05 | < 0.05 |
| | | | Significance | S | S | S |

*Student's t-test, p < 0.05: Significant

Table 2 : Showing Comparison Of Reduction In Mean Plaque Scores Of Site I And Site II At Different Time Intervals

| Time | Site | Mean ± SD | t-value* | p-value | S |
|---|---|---|---|---|---|
| Day 0- 6 weeks | I | 0.43 ± 0.37 | 0.64 | = 0.529 | NS |
| | II | 0.44 ± 0.48 | | | |

*Student's t-test, p > 0.05: Non-Significant

Table 3 : Showing Comparison Of Reduction In Mean Periodontal Pocket Depth Scores (in mm) Of Site I And Site II At Different Time Intervals

| Time | Site | Mean ± SD | t-value* | p-value* | S |
|---|---|---|---|---|---|
| Day 0 – 6 weeks | I | 1.93 ± 0.46 | 0.983 | = 0.334 | NS |
| | II | 2.07 ± 0.26 | | | |

*Student's t-test, p > 0.05: Non-Significant

Table 4 : Showing Comparison Of Gain In Clinical Attachment (in mm) Of Site I And Site II Level At Different Time Intervals

| Time | Site | Mean ± SD | t-value* | p-value* | S |
|---|---|---|---|---|---|
| Day 0 – 6 weeks | I | 1.53 ± 0.64 | 0.316 | = 0.754 | NS |
| | II | 1.54 ± 0.52 | | | |

*Student's t-test, p > 0.05: Non-Significant

with no adverse reaction and infection during the course of study. In both sites, a significant reduction in PI, PD and CAL gain was observed at the end of 6 weeks as seen in **Table 1**. On comparison between site I and site II, reduction in PI and PD and CAL gain was more in site II but the difference was statistically non significant (p>0.05) as seen in **Table 2, 3 and 4**.

## Discussion

The nature of the periodontally exposed roots has been identified as one major factor influencing periodontal regeneration. Cementum surfaces exposed by periodontitis are pathologically altered, hypermineralized and contaminated with periodontal pathogens and endotoxins.[4] Such surfaces are not biocompatible with adjacent periodontal cells, the proliferation of which is pivotal for periodontal wound healing (Polson AM et al 1982).[8]

Root surface conditioning has been suggested using a variety of agents in order to detoxify, decontaminate and demineralize the root surface.[9] Detoxification of root surface helps in removing the cementum bound bacterial endotoxins which have been shown to inhibit the growth and viability of fibroblasts in vitro and may prevent new connective tissue attachment. Surface demineralization of the radicular dentin removes the smear layer, uncovers and widens the orifices of dentinal tubules (Polson AM et al. 1984)[10] and exposes the dentinal collagen matrix (Selvig KA et al. 1981).[11] This collagen matrix is thought to provide a substrate which supports the chemotaxis, migration and attachment of cells involved in wound healing and formation of new connective tissue attachment.

A variety of root conditioning agents have been used to enhance the new attachment on root surface that include hydrochloric acid, citric acid, ethylene diamine tetraacetic acid, tetracyclines, stannous fluoride, fibronectin, cohnn's factor IV, sodiumdeoxycholate, growth factors, minocycline hydrochloride, phosphoric acid etc.

In this study, in site I, citric acid solution (pH 1) and in site II, EDTA (pH 7) was used as root conditioning agent along with periodontal flap surgery.

Citric acid has been shown to alter the root surface characteristics of treated root surfaces (Garrett JS et al. 1978),[12] has antibacterial property (Daly CG et al 1982),[13] induce cementogenesis, promote collagen splicing (Garrett S et al. 1978),[12] augment fibronectin-fibrin-collagen binding thereby inhibits the epithelial apical migration (Polson AM & Proye MP 1982)[8] and enhance fibroblast chemotaxis, migration and attachment (Boyko GA et al. 1980).[14]

It has been shown that EDTA acting at neutral pH is as effective as low pH etchants with respect to smear layer removal and superior in exposing root surface collagen (Blomlof J & Lindskog S 1995).[7] EDTA is the only agent which exclusively exerts its demineralizing effect through chelating divalent cations at neutral pH. Studies have shown that chelating agent (EDTA) working at neutral pH appears preferable with respect to preserving the integrity of exposed collagen fibers, early cell colonization, and periodontal wound healing and it also preserves adjacent tissue vitality (Blomlof J et al 1995,[7] 1996,[15] 2000[16] )

In the present study, passive application was preferred over burnishing technique as the latter may itself form smear layer which may partially or completely obliterate the dentinal tubule openings (Wen CR et al. 1992).[6]

## Plaque Scores

In both site I (Citric acid) and site II (EDTA ), reduction in mean plaque score at the end of 6 weeks from baseline (day 0) was statistically significant (p<0.05) as seen in **Table 1**. The results are in accordance with the observations made by (Caffesse RG et al. 1987)[17] and (Mayfield L et al. 1998).[4]

Comparison of mean plaque score reduction between site I and site II was statistically non significant (p>0.05) as seen in **Table 2**. Similar results were recorded by (Blomlof L et al. 2000).[16]

In site I and site II, reduction in supragingival plaque score could be attributed to good oral hygiene practiced by the patients during the entire study period (Jeong et al. 1994).[18]

## Periodontal Probing Depth

In site I (Citric acid ) and site II (EDTA), reduction in mean pocket depth at the end of 6 weeks from baseline (day 0) was statistically significant (p<0.05) as seen in **Table 1**. This is in accordance with the studies conducted by(Blomlof L et al. 2000)[16], (Mayfield L et al .1998)[4] ,(Blomlof PS et al .1996)[15]

In the present study, reduction in pocket depth in both the sites (site I & site II) is due to resolution of gingival inflammation by scaling and root planing and reduction that occurs in healing by tissue shrinkage and attachment gain after application of root conditioning agents along with periodontal flap surgery(Blomlof J et al. 1995 [7] ,2000 [16] & Blomlof PS et al. 1996) [15]

On comparison,although, mean pocket depth reduction was more in site II, but it was statistically non significant (p>0.05) as seen in **Table 3**.

## Clinical Attachment Level

In site I (Citric acid) andsite II (EDTA), Gain in mean clinical attachment level at the end of 6 weeks from baseline (day 0) was statistically significant (p<0.05) as seen in **Table 1**. This is in accordance with the studies conducted by, (Mayfield L et al. 1998)[4] ,(Blomlof L et al. 2000)[16] & (Parasnis et al. 2006)[19].

On comparison,gain in mean clinical attachment level was more in site II, but it was statistically non significant (p>0.05) as seen in **Table 4**. Similar results were recorded by (Blomlof J et al. 1995)[7]

There was more reduction in pocket depth and gain in mean clinical attachment level in site II which may be due to ability of EDTA to selectively expose collagen fibers than etching with citric acid acting at low pH, which may in turn act as a chemo attractant for periodontal fibroblasts. EDTA also preserves the integrity of exposed collagen fibers, adjacent tissue vitality, there by promoting early cell colonization and periodontal wound healing (Blomlof & Lindskog 1995).[7]

Moreover, gain in clinical attachment level might also be due to improved health of surrounding soft tissues after periodontal flap surgery, which offers increased resistance to probe penetration (Paranis et al. 2006).[19]

Within the limits of the study, both citric acid and ethylene diamine tetra acetic acid (EDTA) proved to be beneficial in removing smear layer and facilitating periodontal wound healing and new connective tissue attachment when used as an adjunct to periodontal flap surgery.

Difference between the results of present study and those of other studies may be related to variations in patient selection, patient compliance, time and mode of application of the demineralizing agent or a combination of these variables. Hence, additional studies both in vivo and in vitro of these variables with better standardization and larger sample size are needed.

**Conclusion**

Within the limits of the study, it can be concluded that both citric acid and ethylene diamine tetra acetic acid (EDTA) are beneficial in removing smear layer and facilitating periodontal wound healing and new connective tissue attachment when used as an adjunct to periodontal flap surgery.

Although results of citric acid (pH1) and EDTA (pH7-neutral) were comparable and difference was statistically non-significant but EDTA acting at neutral pH seems to be preferable to citric acid because it selectively removes hydroxyapatite leaving most of collagenous matrix intact and has no necrotizing effect on surrounding periodontal tissues.

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# Effect Of Tooth Brush Sterilizer On Microbial Contamination Of Tooth Brushes.

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**Abstract**

**Purpose:** The purpose of this study was to evaluate the efficacy of tooth brush sterilizer in decontamination of toothbrushes.

**Methods**: Two different methods for testing were employed taking three different microorganisms into consideration. Tooth brush sterilizer was used to check its competence for Echerichia coli, Staphylococcus aureus and Salmonella typhimurium.

**Results**: Toothbrush sterilizer eliminates unwanted intruders with UV Ray & Ozone. Toothbrush Sterilizer functions to eliminate unwanted and harmful bacteria, fungi and viruses that reside on the toothbrush. Using a patented UV and Ozone Sterilising lamp, 99% of these germs are eradicated from your toothbrush in approximately 6 minutes.

**Conclusion**: Toothbrush sterilizer eliminates more than 99.9 percent of bacteria and germs which can lead to illness, disease and bad breath. Toothbrush sterilizer reduces exposure to harmful bacteria and viruses by sterilizing one of the most common breeding grounds: toothbrush. It will sterilizes toothbrush and eliminates unwanted intruders with UV Ray & Ozone.

**Key Words**
Tooth brush sterilizer, sterilization, microorganisms.

## Introduction

Oral health is an integral part of general health. It directly and indirectly reflects the overall well-being of an individual, thus maintaining oral hygiene becomes a crucial factor. Oral cavity is free of micro-organisms at birth because the fetus develops in a well-protected environment, but soon after it is habituated by numerous micro-organisms.[1] It may be due to exposure to polluted environment which contains various micro-organisms or change in dietary habits of the child as it grows. Oral diseases can be greatly controlled by reducing the microbial load in the oral cavity and this can be achieved by maintaining proper oral hygiene. Brushing teeth is the primary mode of oral hygiene practice. In earlier days, chewing sticks like Miswak, Neem and Babul were the sole oral hygiene aids used by different populations.[2] Later, toothbrush crept in as a main component among all oral hygiene aids, as a result of civilization. In 1844, the first toothbrush was manufactured by hand and patented as a three-row brush of serrated bristles with large tufts by Dr. Meyer. L. Rhein.[3] Tooth brushes are the most commonly used oral hygiene aid to promote oral health and prevent dental diseases.[4] Unfortunately, proper care of toothbrush is often neglected and is kept in bathrooms which are a good place to harbor millions of micro-organisms. The reason attributed to this toothbrush maintenance. Retention and survival of micro-organisms on toothbrush after brushing represents a possible cause of re-contamination of the mouth.[5] Prolonged use of the toothbrush facilitates contamination by various micro-organisms such as Streptococcus, Staphylococcus, Escherichia Coli and lactobacilli.[6],[7] These micro-organisms are implicated to cause dental caries, gingivitis, stomatitis, infective endocarditis in an individual, affecting both oral and general health.[5],[8] The average life span of a manual toothbrush is approximately 3 months.[9] Hence, American Dental Association (ADA) recommends change of toothbrushes once in 3–4 months based on fraying of toothbrush bristles as it decreases the cleaning effectiveness.[10],[11] However, attention was not given to the microbial contamination when the recommendation for frequency of change of toothbrush was given. Many studies have been conducted on toothbrush bristles and anchoring filaments to assess the microbial contamination and revealed microorganisms are present in the tooth brush head between the bristle tufts.[12] However, extensive exploration of the literature reveals lack of studies conducted to assess the efficacy of using tooth brush sterilizer on microbial contamination of toothbrush head. Hence, an in vitro experiment study was designed to assess the potential of using tooth brush sterilizer in sterilizing toothbrush head.

## Material & Methods

Two different methods for testing were employed taking three different microorganisms into consideration. Tooth brush sterilizer was used to check its competence for Echerichia coli, Staphylococcus aureus and Salmonella typhimurium.

### Test Method 1:

Bacterial cultures were grown 24 hrs and proper dilutions prepared using sterile saline blanks. Toothbrush was then inoculated into 10ml of the bacterial suspension for 10 minutes. Toothbrush was then removed from bacterial suspension and placed into 10 ml saline for 10 minutes with agitation. This solution was then counted using standard

plate count methods, this being "Control Count CFU/brush".

For second toothbrush, same procedure was carried out but toothbrush was placed into Toothbrush Sanitizer for 1 cycle that lasted up to 6minutes. The toothbrush was then placed into 10ml saline for 10 minutes with agitation to remove any remaining organisms and this solution was counted using same methods for "Remaining Organisms" after 1 cycle. The "Percent Kill" was then calculated. This same procedure was conducted for all three bacterial cultures used.

**Test Method 2:**

Strain to be used in the experiment was pre-cultured, and then same amounts of bacteria solution with constant concentrations were inoculated on toothbrushes. Immediately after the inoculation, sterilizing physiological saline (0.9% NaCl solution) was applied and intensely stirred which was then used as a experimental solution and the number of bacteria was measured using a plate counting method. Inoculated toothbrushes were put into a sterilizing machine (Portable Toothbrush Sterilizer) provided by the client and operated for 7 minutes. Then was the experimental solution prepared by applying the sterilizing physiological saline (0.9% NaCl solution) applied and stirring intensely, the number of viable bacteria was measured using a plate counting method. Sterilizing ability was expressed a percentage according to following equation :

**Sterilizing ability (%) =**

Number of viable bacteria of control – number of viable bacteria of trial x 100

---

Number of viable bacteria of control

**Results**

Results showed that toothbrush sterilizer reduces exposure to harmful bacteria and viruses by sterilizing one of the most common breeding grounds: toothbrush.

Toothbrush is an ideal environment for the growth of salmonella, micrococcus, bacteria, viruses, and other microorganism posing a risk for tooth decay, halitosis, and a variety of illness. Toothbrush sterilizer eliminates unwanted intruders with UV Ray & Ozone. Toothbrush Sterilizer functions to eliminate unwanted and harmful bacteria, fungi and viruses that reside on the toothbrush. Using a patented UV and Ozone Sterilising lamp, 99% of these germs are eradicated from your toothbrush in approximately 6 minutes. **(Table 1)**

Following Result Was Obtained In Test Method 1:

| | Control Count Cfu/Brush | Remaining Organisms After 1 Cycle | % Kill After 1 Cycle |
|---|---|---|---|
| Echerichia Coli | 123,000 | < 100 | 99.9% |
| Staphylococcus Aureus | 89,000 | < 100 | 99.9% |
| Salmonella Typhimurium | 176,000 | < 100 | 99.9% |

The above results showed that tooth brush sterilizer can sterilize tooth brush very effectively by killing 99.9% of the microorganisms in one cycle. **(Table 2)**

Following Results Were Obtained When Test Method 2 Was Employed:

| Sample/ Test Microorganism | Control (no operation) (CFU/ml) | Trial (operation) (CFU/ml) | Sterilizing ability (%) |
|---|---|---|---|
| Escherichia coli | 1.4 x 106 | 3.9 x 104 | 97.23 |
| Staphylococcus aureus | 4.8 x 105 | 7.0 x 103 | 98.54 |
| Salmonella typhimurium | 2.1 x 105 | 6.0 x 103 | 97.15 |

**Discussion**

Toothbrushes are used by millions of people everyday as part of oral hygiene procedure. Toothbrushes do a good job of removing dangerous microorganisms from teeth. Unfortunately many of these organisms remain on the brush afterwards and can re-infect our teeth. Toothbrushes also reside in a germ infested environment, namely the bathroom. Droplets from the toilet can reach the brushes and contaminate them with bacteria. Toothbrushes can get contaminated easily during their use. Retention of moisture and the presence of organic matter that has come from the mouth may promote growth of microorganisms on the toothbrush bristles. Such contamination may lead to colonization of microorganisms in the mouth and possibly infection.**[Figure 1]** It is also possible that contamination of toothbrushes can occur through insects.[5],[13],[14]

Apart from the microorganisms taken into consideration for the study, some of the common microorganisms remaining on toothbrushes include: Mutans streptococcus - the main bacterium causing dental caries, Beta-hemolytic streptococcus - the main bacterium causing strep throat (pharyngotonsillitis), Candida albicans - the main fungus causing thrush in babies throats,

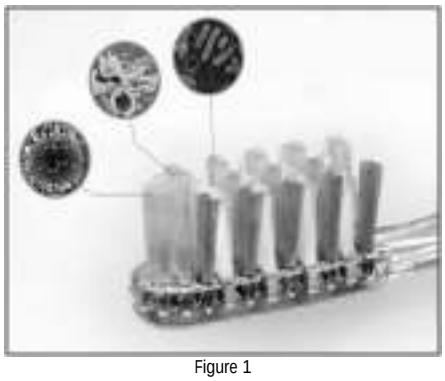

Figure 1

Coliform bacteria - these are found in the bathroom and Herpes simplex virus - they causes cold sores.[5],[15]

Every time a person brushes their teeth, they are developing more bacterial growth on their toothbrushes. This also means that every subsequent brushing introduces new bacteria into the mouths of an individual since fresh bacteria have grown on the toothbrushes bristles and handle. Dentist tell their patients that the optimum usage time for a toothbrush is two months. However, studies conducted have shown that toothbrushes can become contaminated after four to seven days of continuous use and heavily contaminated after seventeen to twenty four days. It is relevant that tooth brushes play a major role in the contribution and retrieval of infections. Fifty five out of fifty nine patients showed improved symptoms by just changing their toothbrush every two weeks. But as consumers, changing toothbrushes every four to fourteen days can be rather impending to the expense account of an individual.[16] Brook and Gober showed that group A -hemolytic streptococci can survive on toothbrushes and suggested that the failure of treating streptococcal pharyngitis may be due to the persistence of the organism on toothbrushes and orthodontic appliances. This is useful information and not surprising since, as they point out, toothbrushes have been shown to become contaminated with other microorganisms. Based on their study, it was suggested toothbrushes be changed at least once a month and after any illness.[17] The retention and survival of microorganisms on toothbrushes pose a threat of recontamination for certain patients at risk. In an study the in vitro retention of three microbial species (Porphyromonas gingivalis, Streptococcus mutans and Candida albicans) was evaluated for three types of toothbrush. Depending on the

microorganism studied, from 0.2% to 2% of the initial inoculum was retained on the brush. The number detected increased with the size of the exposed area. After 24 h, P. gingivalis and S. mutans were found on only one type of brush. C. albicans survived on all three. These results confirm that microorganisms can quickly colonize toothbrushes.[18]

Previous studies have publicized decreased rates of bacterial contamination in toothbrushes after use ofchlorhexidine which was found to be effective in disinfecting contaminated toothbrushes. However, one of the previous studies showed that Listerine was more effective.[1] The higher efficacy of chlorhexidine could be the result of the extended spectrum of action. Also, it is relatively non-toxic, odorless and is commonly used as a mouthwash. These properties may make chlorhexidine a good choice for disinfection of contaminated toothbrushes.[19] But there is always another side of the coin i.e. in general, chlorhexidine does not cause serious side effects but it can stain teeth when used as a mouth rinse and can cause irritation when used on the skin; it is also not recommended to apply this substance to the ears or eyes without medical supervision.Studies have shown that its antibacterial effects can also be neutralized by some toothpaste ingredients.Chlorhexidine in isopropyl alcohol solution has been reported to cause severe complications in neonates, such as extensive chemical burns thought to be due to reduced thickness of the stratum corneum and diminished cohesion between the dermis and epidermis, increasing skin permeability.[20],[21],[22],[23] Hibiclens[R] (4% chlorhexidine in 4% w/w isopropyl alcohol, Molnlycke Health Care Inc.) has been associated with bullous corneal keratopathy in a woman who had it applied preoperatively to her face.[24] Thus, based on the observations of previous studies, it cannot be negated that prolonged use of chlohexidine for disinfecting the toothbrush does not cause any harm to the oral mucosa. We found no clinical studies reporting levels of microbial contamination of toothbrushes whose heads can be covered with plastic caps. In one study, the use of a plastic cap leads to the growth of microorganisms like Pseudomonas aeruginosa, a gram negative aerobe and opportunistic pathogen. Therefore, it is not advisable to cover a toothbrush head with a plastic cap. Use of a cap may help retention of moisture that promotes growth of P.aeruginosa.[25]

Different studies have shown that toothbrushes are contaminated by different bacteria, viruses, and fungi after use. Since modern dentistry emphasizes prevention and infection control, toothbrushes should be correctly stored, disinfected, and changed at regular intervals. However, the literature presents few articles on the disinfection of toothbrushes.[28],[29],[30]

The present study which was done to determine the effectiveness of tooth brush sterilizer in disinfecting the tooth brushes revealed that it sterilizes toothbrush and eliminates unwanted intruders with UV Ray & Ozone. Further more, 99.9% of microorganisms are eradicated in one cycle. It is based on the principle of emission of UV (Ultra Violet) rays and activated oxygen (natural ozone) via UV and ozone lamp which combine to kill pathogenic bacteria & viruses. The UV lamp provides a dual mechanism for sterilization. UV-C, also known as germicidal UV, is most effective at wavelengths of 250-260 nanometers. Sufficient doses within this wavelength range function to create chemical and biological reactions within micro-organisms, which disturb their ability to function and reproduce, thus killing them. A Second wavelength frequency range of 180-200 nanometers generates Ozone (O3) which is a naturally occurring molecule which is the second most powerful sterilant in the world. At this wavelength range, natural Oxygen (02) is activated and links up with a free Oxygen atom (O) thus forming Ozone. Ozone acts by rupturing the cell walls and attacking the nucleus of micro-organisms which kills them. UV-C and Ozone are a formidable force in sterilizing the toothbrush. There are air vents to allow for efficient evaporation of moisture. It has a toothbrush holder that can hold tooth brush firmly in optimal position allowing for maximal sterilization efficiency.

The tooth brush sterilizer uses the same technology dentists and hospitals rely on to clean their instruments. A UV lamp is located inside a compact case, safely sterilizing the bristles and head of the

Figure 2

toothbrush.**[Figure 2]** This auto-sterilization process lasts for about six minutes before the device switches off. Thus, based on the results of the study and the technology used for sterilization, it can be postulated that regular use of tooth brush sterilizer is beneficial and absolutely safe. It should be advocated routinely for maintaining a healthy oral environment and general health status of an individual.

## Conclusion

The toothbrush can act as an incubator for germs and bacteria, since it is located in a warm and moist environment, mainly the bathroom. While the germ-conscious have long been aware of the importance of hand washing and sanitizing kitchen work surfaces and utensils, the toothbrush is often overlooked. Toothbrush is an ideal environment for the growth of salmonella, micrococcus, bacteria, viruses, and other microorganism putting you at risk for tooth decay, halitosis, and a variety of illness.Toothbrush sterilizer eliminates more than 99.9 percent of bacteria and germs which can lead to illness, disease and bad breath. Toothbrush sterilizer reduces exposure to harmful bacteria and viruses by sterilizing one of the most common breeding grounds: toothbrush. It will sterilizes toothbrush and eliminates unwanted intruders with UV Ray & Ozone.

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# Oral Cancer Awareness Among General Dental Practitioners In Amritsar District

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**Abstract**

**Objective:** To assess the general dental practitioners awareness of prevention and early detection of oral cancer in the Amritsar district.

**Materials And Methods:** A cross-sectional questionnaire based survey was conducted between February 2013 to May 2013, among a random sample of 100 general dental practitioners (GDPs') in the Amritsar district. The GDPs' knowledge about the risk factors of oral cancer, diagnostic concepts and the current diagnostic practices followed by them was assessed and responses were analyzed.

**Results**: Of the 100 general dental practitioners surveyed, 84 responded (84% response rate). 100% of participants considered tobacco use as the highest risk factor for oral cancer. Majority of the GDPs' (98.8%) agreed that early detection of oral cancer improves its five year survival rate, 88% of the GDPs' affirmed that they routinely performed systematic examination of the oral mucosa. Despite being proficient in the knowledge of risk factors of oral cancer, only 44% of GDPs' regularly advised patients about the risk factors. Oral and maxillofacial surgeons (94.6%) were their preferred points of referral in case of suspected lesions. Erythroplakia and leukoplakia were identified as the most common types of lesions associated with oral cancer by 85.6% of GDPs', with 80.9% GDPs' considering tongue and floor of the mouth as the two most common sites for intra-oral lesions.

**Conclusions**: Though the survey findings suggest that the GDPs' appear to be generally knowledgeable about the risk factors and diagnostic concepts associated with oral cancer, yet current knowledge and skills must be regularly updated and reinforced by continuing professional education.

**Key Words**

Oral cancer awareness, general dental practitioners, risk factors, diagnostic concepts, current practices.

## Introduction:

Oral cancer in an ideal cancer to identify early by screening[1]. Studies have shown that oral cancer can be silent in symptomology with awareness of early signs being more beneficial in diagnosis[2]. The incidence of oral cancer is increasing[3] with 4,19,000 new cases diagnosed annually world wide[4]. Despite the advances in therapeutic management and increased understanding of the molecular basis of disease, survival rates have not improved in the last few decades, the 5 year survival rate is 50%[5] mostly because of the advanced stage at diagnosis[6]. However, early diagnosis of oral cancer greatly increases the probability of cure with minimum impairment and deformity[7]. Epidemiologic studies suggest that early detected disease has a relative survival rate of 82% but this reduces to 32% due to dental practitioners negative attitude and low level of knowledge that contributes to delayed or inadequate detection of early stages of oral cancer (Sadowsky et al, 1998; Schnetler, 1992; Shafer, 1975). Early, curable stages of oral cancer are small, asymptomatic lesions8 that may be easily missed by the patients, highlighting the important role of dentists in reducing the burden of oral cancer.

Dentists are qualified to opportunistically screen for oral cancer and to provide preventive advice and counseling during routine examinations. It is vital that dentists have accurate knowledge about oral cancer to identify individuals at risk, examine the mouth to document tissue changes and provide appropriate interventions. Thus dentists can play a crucial role in the reduction of oral cancer incidence, morbidity and mortality. With this background; the purpose of this study was to assess the GDPs' awareness of prevention and early detection of oral cancer.

## Materials And Methods

The cross - sectional survey was conducted between February 2013 to May 2013, among a random sample of 100 general dental practitioners (GDPs') in Amritsar district. The self-administered anonymous questionnaires used for this study were handed out, to the general dental practitioners with an information sheet which explained the purpose of this project. Participation was on voluntary basis and all respondents were clearly advised that participation was anonymous and they had the right to comply with or refuse participation. Response to the questionnaire constituted the participants informed consent. The questionnaire was designed to test the GDPs' knowledge of oral cancer under 3 main categories:- 1) knowledge of risk factors, 2) knowledge of clinical diagnostic concepts and 3) current diagnostic practices of oral cancer followed by them. The responses were elicited in either categorical 'yes', 'no' options or in MCQ (multiple choice questions) format with one correct answer. The completed questionnaires were then entered in SPSS version 17 for statistical analysis. The responses were coded as numeric in order to facilitate the data entry. The results were analyzed

Table 1 : Demographic Characteristics Of Respondents (N=84)

| Variable | | N (%) |
|---|---|---|
| Gender | Male | 72 (85.7%) |
| | Female | 12 (14.2%) |
| Age | < 40 years | 56 (66.6%) |
| | > 40 years | 28 (33.3%) |
| No. Of Years Since Graduation | More than 15 Years | 35 (41.6%) |
| | Within 15 Years | 49 (58.3%) |

using Pearson chi-square ($\chi 2$) test.

**Results:**

From a total of 100 questionnaires distributed, 84 general dental practitioners returned completed questionnaires giving a response rate of 84%. Vast majority of respondents were males (85.7%). Mean age of the respondents being 35 years and the mean number of years since graduation was 18. Demographic characteristics of the respondents shown in **Table 1**.

**Knowledge of Risk Factors:**

The results of our study showed that tobacco smoking and smokeless tobacco use (100%) were considered as the most potential risk factors for oral cancer by the general dental practitioners, followed by betel quid chewing (96.4%; n=81) as the second most important risk factor. Prior oral cancer lesions (94%; n=79) and alcohol use (86.9%; n=73) were identified as third and fourth key risk factors respectively. However, lower numbers reported U.V. exposure (69%), older age (64%), viral infection (57.1%) and low consumption of fruits and vegetables (26.1%) as risk factors of oral cancer. Knowledge of risk factors shown in **Figure 1**.

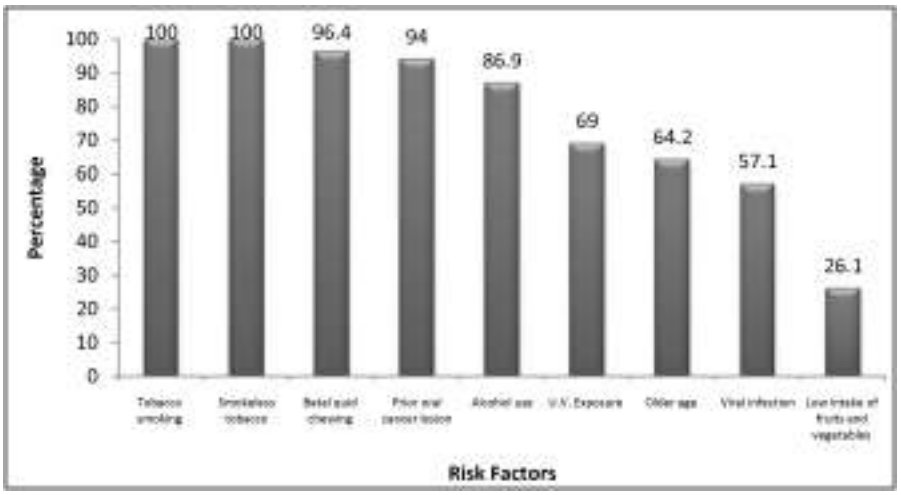


Figure 1 : Knowledge Of Risk Factors

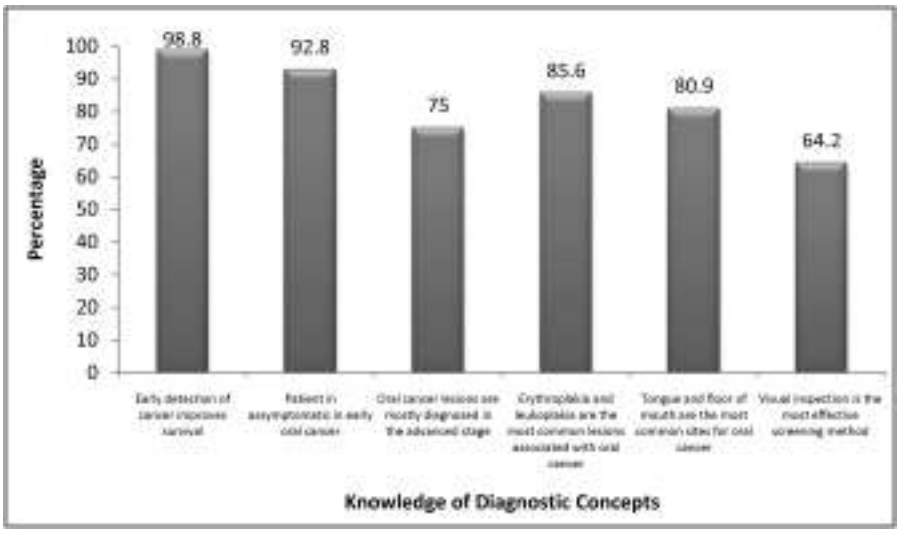


Figure 2 : Knowledge Of Diagnostic Concepts

**Knowledge of Diagnostic Concepts:**

The majority of general dental practitioners (98.8%; n=83) surveyed, agreed that early detection of oral cancer improves its five year survival rate. Patient in usually asymptomatic during the initial stages of the disease was identified by 92.8% (n=78) GDPs' and 75% (n=63) GDPs' believed that oral cancer lesions are mostly diagnosed in the advanced stage.

Erythroplakia and leukoplakia were identified as the most common type of lesions associated with oral cancer by 85.6% GDPs'. However, a higher proportion of dentists identified leukoplakia (92.8%; n=78) than erythroplakia (78.5%; n=66) as the most common premalignant lesion .Only 72% of the respondents identified both lesions.

A total of 73.8% (n=62) GDPs' identified tongue and 88% (n=74) identified floor of mouth as the two most common sites for intra-oral lesions . However, only 64% GDPs' identified both the sites.

Visual inspection was considered as the most effective screening method by 64.2% (n=54) of the general dental practitioners. Knowledge of diagnostic concepts shown in **Figure 2**.

**Current Diagnostic Practices of Oral Cancer:**

Of the general dental practitioners 88.0% (n=74) affirmed that they routinely performed systematic examination of the oral mucosa on every patient .It was found that 67.8% (n=57) of GDPs' routinely asked the patients if they were using tobacco in any form while only 22.6% (n=19) asked the patients about their alcohol intake. Regular advise to the patients about risk factors of oral cancer was delivered by 44.0% (n=37) GDPs'. Regarding the referral of the suspected patients, 94.0% (n=78) GDPs' suggested an oral and maxillofacial surgeon to be the appropriate person for management of such patient. Percent distribution of GDPs' according to current diagnostic practice of oral cancer shown in **Figure 3**.

**Discussion**

A comprehensive oral cancer examination and risk assessment are measures that may lead to early detection and prevention of oral cancer. Many experts agree that the key is not necessarily identifying oral cancer but identifying tissue that is not normal and taking appropriate action[9].

The results of the present study show that general dental practitioners of Amritsar district are generally knowledgeable

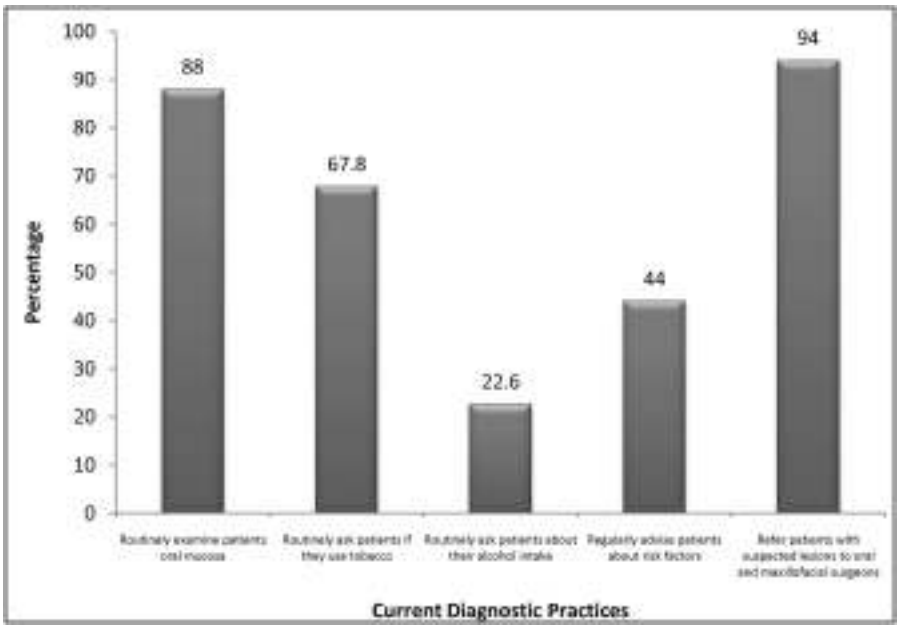

Figure 3 : Percent Distribution Of Gdps' According To Current Diagnostic Practices

regarding oral cancer risk factors and diagnostic concepts, however, similar to other studies[10],[11],[12],[13] there is variability in their knowledge. Although the vast majority of dentists identified tobacco, alcohol, betel quid chewing and prior oral cancer lesion as the main risk factors, similar to other studies conducted in the US[10],[11],[14],[15],[16], Canada[12] and Europe[13] a smaller proportion of GDPs' were aware that viral infection, U-V exposure and low consumption of fruits and vegetables are also potential risk factors of oral cancer. Only 57.1%. of dentists identified older age as a risk factor for development of oral neoplasia. This figure is low in comparison to similar studies carried out in US[10],[14], Canada[12] and Spain[13].

Dentists knowledge of oral cancer diagnostic concepts was found to be better compared to the knowledge of risk factors. The majority of dentists (98.8%) knew that early detection improves survival which is similar to results seen among dentists surveyed in USA[14], Canada[12] and Germany[17]. Three fourths of the dentists knew that oral cancers are most often diagnosed in the advanced stage in contrast to only 50% in most of the other surveys[10],[12],[14],[18]. Oral visual screening can reduce mortality in high risk individual and has the potential to prevent at least 37000 oral cancer deaths per year world wide[19]. In the present study 64.2% of GDPs' recognized visual inspection as the most effective screening method.

Over 80% of GDPs' knew that erythroplakia and leukoplakia are the main pre-cancerous lesions associated with oral neoplasia. However, a higher proportion (92.8%) identified leukoplakia is comparison to erythroplakia (78.5%). Although both lesions have malignant potential, erythroplakia, and the red component of erythroleukoplakia, known as speckled erythroplakia, have a greater chance to progress to oral cancer[8],[20]. In addition, it has been reported that on histopathological assessment over half of erythroplakias were invasive carcinoma, and 40% showed carcinoma in situ[21].

Although 88%, GDPs' considered floor of mouth and 73.8% identified tongue as the most common sites of oral cancer, only 64% recognised both sites as high risk. Similarly some dentists were not aware that the ventral and lateral border of the tongue is a high risk area for suspicious lesions is the case of tongue carcinoma[8],[20].

It has been reported in previous studies that increased referral is significantly associated with greater knowledge of oral cancer[14]. In our study similar finding were obtained, with 94% GDPs' referring patients with suspected lesions to oral and maxillofacial surgeons.

Inspite of their knowledge of risk factors, in the present study only 67.8%. GDPs' routinely asked patients about their tobaccos habit. However, dentists should ask the patients about tobacco use and advise in order to ensure early prevention.

In this study only one fifth of the dentists reported that they routinely ask patients about their alcohol intake however, dentists have been encouraged to screen and counsel patients about alcohol use[22].

Although the general dental practitioners present with a good knowledge of risk factors of oral cancer, a relatively small proportion of dentists were found regularly advising the patients about risk factors (only 44% of GDPs'). This finding is similar to the other surveys[15],[16] and suggest that dental practitioners find counseling their patients regarding risk factors as challenging. On the contrary, patients have been found to be receptive of dentists advice on such matters[23]. Therefore, dentists should advocate healthy life style behaviour and actively participate in oral cancer prevention emphasizing the importance of risk factors.

The present study also showed that number of years since graduation and age of dentists are factors which have quite an impact on their knowledge. Although there was no significant difference, the dentists of younger age group and recent graduates demonstrated better knowledge. This emphasizes the need for continuing education (CE) on the topic.

**Conclusion:**

This study highlighted the importance of improving educational methods for general dental practitioners, on oral cancer detection and premalignant lesions of the oral cavity because the dental practitioners are capable of and have an excellent opportunity to bring about positive change in reducing the rising incidence of oral cancer and ultimately saving lives..

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# Evaluation Of Enamel Surface Characteristics Following Debonding Of Ceramic Brackets Using Various Debondibg Techniques

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**Abstract**

**Background**: Ceramic brackets have high bond strength and brittle nature which results in increased tendency for bracket failure and enamel damage during debonding.

**Aim**: To evaluate the site of bond failure, rate of bracket failure and enamel surface characteristics following debonding of ceramic brackets using different debonding techniques.

**Materials & Methods**: 60 extracted maxillary premolars were bonded with ceramic brackets (Chirpan Orthodontics) using Transbond XT light cure adhesive. Samples were divided into four groups and were debonded with four debonding techniques. Group 1, using conventional debonding plier (Skodi), Group 2, using electrothermal debonding unit (Poze electronics), Group 3, using ultrasonic scaler tip (TFI 1000, 25K, Dentsply) and Group 4 were debonded after immersion in peppermint oil (Falcon essential oils). ARI, SF and BF were evaluated under stereomicroscope and the values were tabulated. Two specimens from each group with high ARI scores were further evaluated under scanning electron microscope.

**Statistical Analysis**: one way ANOVA followed by Tukey's post hoc procedure.

**Results**: Mean ARI and SF scores were significantly different among the 4 study groups ($p<0.001$) with highest mean ARI scores of $4.07 \pm 0.88$ and $4.13 \pm 1.13$ for conventional and chemical debonding. Electrothermal debonding and ultrasonic debonding techniques showed lower ARI scores of $2.27 \pm 0.08$ and $2.41 \pm 0.52$ respectively.

**Conclusion**: Chemical debonding technique though had bond failure at enamel-adhesive interface, SEM showed minimal enamel damage indicating it as better technique for debonding ceramic brackets.

**Key Words**
Ceramic Brackets, Debonding, Adhesive Remnant Index (ARI), Site of bond failure (SF), Bracket failure (BF).

## Introduction:

Increased demand for esthetics resulted in the evolution of ceramic brackets[1],[2]. Besides the high esthetic value ceramic brackets have poor fracture toughness[3],[4]. Enamel has little ability to absorb stress and is likely to be damaged during debonding of ceramic brackets[5]. Enamel fracture or the appearance of fracture lines during debonding is related to the high bond strength of ceramic brackets and seems to be associated with sudden impact loading [3],[6],[7],[8].

Various techniques for debonding ceramic brackets were developed[9],[10],[11]. However, an evaluation of effects of various debonding techniques on the enamel surface is required to gain knowledgeof their clinical success. Hence this study was undertaken with the aim to evaluate the enamel surface characteristics following debonding of ceramic brackets using different debonding techniques.

## Materials & Methods:

Sixty extracted human maxillary premolar teeth which are free of caries, restorations and wasting disorderswere collected, cleaned using ultrasonic cleaner and stored in normal saline.

All the samples were examined for surface defects under stereomicroscope (SZX10 Olympus)with 10X magnification. Teeth with surface defects were eliminated and final sample of 60 teeth were mounted in the wax blocks **(Figure 1)** and prepared for the bonding procedure.

### Bonding Procedure

1. Enamel surface was etched with 37% phosphoric acid (d-tech) for 30 seconds, rinsed thoroughly with water and dried with moisture free air until enamel had frosty appearance.
2. Primer (Transbond XT, 3M Unitek) was applied to the etched enamel surface in a thin film and photo polymerized for 10 seconds.
3. Adhesive (Transbond XT, 3M Unitek) was applied and the brackets were positioned properly on samples, excess flash was removed and polymerized for 20 seconds.

After proper bonding, the samples were randomly divided into 4 equal groups.

### Group 1:

The first group of 15 teeth was debonded with conventional debonding plier (Skodi Orthodent) **(Figure 1)**. The stainless steel blades of the plier were wedged at the bracket adhesive interface

Fig 1: Conventional Debonding.

Fig 2: Electrothermal Debonding.


Fig 3: Ultrasonic Debonding.


Fig 4: Chemical Debonding.

and a gentle squeezing action was applied until bond failure occurred.

**Group 2:**
In the second group brackets were debonded by application of heat using customized electrothermal debonding unit (25Watt soldering unit, Poze electronics , New Delhi) which was a 25Watt soldering rod that can produce a temperature of about 400 – 500 °c as measured using the thermocouple(Data Logger AI – 800 D, ACE Instruments, Hyderabad) **(Figure 2)**. The tip of the unit was placed over the bracket for a period of 5 to 6 seconds for heat application and the heat generated was recorded with a digital meter attached to thermocouple. After application of heat for a brief period, the brackets were debonded with the conventionl debonding plier.

**Group 3:**
In this group TFI-1000, 25K Ultrasonic tip and the Cavitron Ultrasonic unit (Dentsply) were used to debond the brackets **(Figure 3)**. The tip was placed at the adhesive bracket interface with the bevel of the scalar tip towards the bracket and was moved in a mesiodistal direction until a groove or "purchase point" approximately 0.5 mm in dimension was created in the composite between the bracket base and the enamel surface. A rocking motion was then applied to break the bond and facilitate bracket removal.

**Group 4:**
In the fourth group the teeth were placed in the peppermint oil (L-Menthol: 37-40%, Falcon Essential Oils, Banglore) for 5min followed by debonding the brackets using conventional plier **(Figure 4)**.

After debonding, Adhesive Remnant Index (ARI) was scored using stereomicroscope at 10X magnification.
Score 1 – All the composite remained on the tooth
Score 2 – More than 90% of composite remained on the tooth
Score 3 – More than 10% but less than 90% of composite remained on tooth
Score 4 – Less than 10% of composite remained on the tooth surface
Score 5 – No composite remained on the enamel

A note was made on the site of bond failure (SF) during debonding as a part of scoring the remnant adhesive as follows.
Type 1: Ninety percent or greater of the bracket pad was exposed and 10% or less of the bonded enamel was free of composite resin.

Type 2: Less than 90% but more than 10% of the bracket pad was exposed or more than 10% but less than 90% of the bonded enamel surface was free of composite resin.
Type 3: Ten percent or less of the bracket base was exposed and 90% or more of the bonded enamel was free of composite resin.
Type 4: Fracture of the bracket during removal left a portion of the bracket still bonded to the enamel.
Type 5: A portion of the enamel was removed with the bracket base without loss of more than 10% of the composite resin from the bracket pad.

During the process of deboning the failure rate of the brackets (BF) was also recorded on a scale of 0 to 4, where 0 = no fracture, 1 = 1-wing fracture, 2 = 2-wing fracture, 3 = 3-wing fracture, and 4 = total fracture.

Following debonding, two teeth from each group having highest ARI scores were examined using scanning electron microscopic (SEM) (Hitachi, S - 3400N, Japan)to record the enamel surface details such as fractures, cracks or surface gouging.

**Statistical Analysis:**
Descriptive statistics were calculated individually for ARI, SF & BF in each group which included Mean and Standard Deviation.

One way ANOVA test followed by Tukey's post hoc procedure was done for the comparison among the four groups. The data management was done in Statistical Package for Social Science, version 17(SPSS Inc., Chicago, Illinois, USA) and the 'p' value was set at 0.001 for all tests.

**Results:**
In the present study, enamel damage following debonding was assessed using ARI, site of bond failure and bracket failure indices. The enamel surface topographic details were evaluated under scanning electron microscope at 25X and 40X magnifications.

The results of the Adhesive Remnant Index, Bracket Failure and Site of bond Failure were shown in **(Table 1)**. Mean ARI, BF, SF were calculated and compared among the study groups with ANOVA.

**(Table 2)**, shows the comparison of ARI among the four study groups. The results

Table 1 : Ari, Bf, Sf Scores In Various Debonding Techniques

| | Conventional Group – 1 | | | Electrothermal Group – 2 | | | Ultrasonic Group – 3 | | | Chemical Group – 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ARI | BF | SF | ARI | BF | SF | ARI | BF | SF | ARI | BF | SF |
| 1 | 4 | 0 | III | 2 | 0 | I | 2 | 0 | I | 5 | 0 | III |
| 2 | 4 | 0 | III | 3 | 0 | II | 3 | 0 | II | 4 | 0 | II |
| 3 | 4 | 0 | III | 3 | 0 | II | 3 | 0 | II | 2 | 0 | IV |
| 4 | 3 | 0 | II | 2 | 0 | I | 2 | 0 | I | 2 | 0 | IV |
| 5 | 4 | 0 | III | 2 | 0 | I | 2 | 0 | I | 5 | 0 | III |
| 6 | 4 | 0 | III | 2 | 0 | I | 2 | 0 | I | 5 | 0 | III |
| 7 | 5 | 0 | III | 2 | 0 | I | 3 | 0 | II | 5 | 0 | III |
| 8 | 3 | 0 | II | 4 | 0 | III | 3 | 0 | II | 5 | 0 | III |
| 9 | 5 | 4 | III | 2 | 0 | II | 3 | 0 | II | 5 | 0 | III |
| 10 | 2 | 0 | II | 3 | 0 | II | 2 | 0 | I | 3 | 0 | IV |
| 11 | 4 | 0 | III | 1 | 0 | I | 2 | 0 | I | 4 | 0 | III |
| 12 | 4 | 0 | IV | 1 | 0 | I | 3 | 0 | II | 5 | 0 | III |
| 13 | 5 | 0 | III | 2 | 0 | I | 2 | 0 | I | 4 | 0 | III |
| 14 | 5 | 0 | III | 2 | 0 | I | 2 | 0 | I | 5 | 0 | III |
| 15 | 5 | 0 | III | 3 | 0 | II | 3 | 0 | II | 3 | 0 | IV |

showed that Mean ARI was significantly different among the 4 study groups ($p<0.001$) with highest ARI scores of 4.07 ± 0.88 and 4.13 ± 1.13 for conventional and chemical debonding techniques respectively. The electrothermal and ultrasonic debonding techniques had scores of 2.27 ± 0.08 and 2.42 ± 0.52 respectively. Post-hoc analysis was done to evaluate inter-group comparisons. The Mean ARI was significantly more for group 1 than group 2 and 3. Similarly group 4 had higher mean ARI than group 2 and 3. No significant difference in the mean ARI was seen between group 1 and 4, group 2 and 3.

**(Table 3)**, shows the comparison of the Bracket Failure (BF). In Conventional debonding technique one sample was fractured completely including the bracket base and tie wings and two other samples showed minor bracket base fracture. No BF was recorded in other groups.

**(Table 4)**, shows the comparison of site of bond failure among the four groups. The results showed that Mean SF was significantly different among the 4 study groups ($p<0.001$) with chemical debonding group having the highest mean score of 3.20 ± 0.56 followed by conventional debonding group with a mean score of 2.87 ± 0.52. Electrothermal and ultrasonic debonding groups had mean scores of 1.47 ± 0.64 and 1.47 ± 0.52 respectively. The Post-hoc Tukey's test showed that the mean SF

Table 2 : Comparison Of Ari Scores Among The 4 Study Groups

| | Conventional[1] | | Electrothermal[2] | | Ultrasonic[3] | | Chemical[4] | | p-value | Post-hoc test |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | | |
| ARI | 4.17 | .88 | 2.27 | .80 | 2.47 | .52 | 4.13 | 1.13 | <0.001 | 1>2,3 |
| 95% CI | 3.58 | 4.56 | 1.82 | 2.71 | 2.18 | 2.75 | 3.51 | 4.76 | Sig | 4>2,3 |

Table 3 : Comparison Of BF Scores Among The 4 Study Groups

| | Conventional[1] | | Electrothermal[2] | | Ultrasonic[3] | | Chemical[4] | | p-value | Post-hoc test |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | | |
| ARI | 0.27 | 1.03 | .00 | .00 | .00 | .00 | .00 | .00 | 0.4 | - |
| 95% CI | -0.31 | 0.84 | 0 | 0 | 0 | 0 | 0 | 0 | | |

Table 4: Comparison Of SF Scores Among The 4 Study Groups

| | Conventional[1] | | Electrothermal[2] | | Ultrasonic[3] | | Chemical[4] | | p-value | Post-hoc test |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | | |
| ARI | 2.87 | .52 | 1.47 | .64 | 1.47 | .52 | 3.20 | .56 | <0.001 | 1>2,3 |
| 95% CI | 2.58 | 3.15 | 1.11 | 1.82 | 1.18 | 1.75 | 2.89 | 3.51 | Sig | 4>2,3 |

was significantly more for group 1 than group 2 and 3. Similarly group 4 had higher mean SF than group 2 and 3. No significant difference in the mean SF was seen between group 1 and 4, group 2 and 3.

SEM examination of the conventionally debonded samples showed enamel cracks and complete loss of perikymata at 40X magnification. The samples in electrothermal debonding group showed remnants of the adhesive, disturbance in the perikymatous structure and few areas of enamel surface loss. Ultrasonically debonded samples had gouging of the surface enamel where the scalar tip was placed for the purpose of debonding. Enamel surface of the chemically debonded samples showed remnants of adhesive with ill defined perikymata.

**Discussion:**

It is an important consideration that the entire bracket be removed in full while debonding because any sort of fracture of bracket will result in patient discomfort, increased chair side time and the possibility of swallowing or aspirating a bracket fragment[12]. Different manufacturers have come forward with a variety of debonding techniques, claiming the safety of ceramic bracket debonding.

The ARI scoring was based on the criteria followed by Samir Bishara et al[13] in their study in 1995 which was later adopted by Marc.E.Olsen et al[14] and Lina.P.Theodorakopoulou et al[15].

Fig 5: Sem Images Of Conventionally Debonded Sample At 20 & 40 X Magnification.

Bracket failure during debonding was scored based on the criteria given by Pramod.K.Sinha et al[16]. And for determination of the location of bond failure the samples were classified into 5 types based on the scoring criteria given by Hyer.K.E[17] which was later followed by Joseph M. Bordeaux et al[18] in 1994 and Vittorio Cacciafesta et al[19] in 1998.

**Conventional debonding technique**

The delamination technique as advocated by Swartz ML[5], Samir E. Bishara et al[20] and Pramod K.Sinha et al[16] was used. The pliers work either through the deformation of the bracket, breaking the bond at the bracket adhesive interface or by stressing the adhesive to its ultimate strength causing a cohesive failure within the composite resin and sometimes the failure may occur at the adhesive–enamel interface as stated by Samir Bishara et al[21].

About 46.6 % of the brackets had ARI score of 4 and 33.3% had a score of 5 which is in agreement with the ARI scores reported by Bishara et al[20],[21]. Bracket failure rate was very minimal however Bishara et al[20] in 1990 registered a bracket failure rate upto 35%. About 90% samples had bond failure at the enamel adhesive interface with more chance of enamel damage.

When viewed under Scanning electron microscope at 25X and 40X magnification **(Figure 5)**, the enamel surface of the conventionally debonded samples showed enamel cracks and loss of surface enamel. These findings were similar to those of Keith V.Krell et al[10], where the conventional debonding plier (Unitek) was used. However, Samir E.Bishara et al[20] (1990) showed no evidence of enamel damage though the site of bond failure was at adhesive enamel interface.

**Electrothermal debonding technique (EDT)**

Several authors Margurite Crooks et al[22], Thomas.B.Redd et al[6], Joseph.S.Dogvan

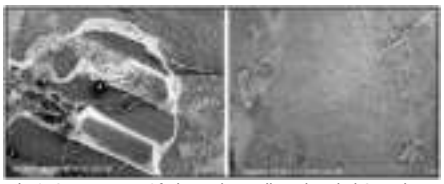

Fig 6: Sem Images Of Electrothermally Debonded Sample At 20 & 40 X Magnification.

Fig 7: Sem Images Of Ultrasonically Debonded Sample At 20 & 40 X Magnification.

Fig 8: Sem Images Of Chemically Debonded Samples At 20 & 40 X Magnification.

et al[23], Edwin M.M.Brouns et al[24] etc., in the past used a variety of electrothermal debonding equipments. However, at present no commercially produced electrothermal debonding equipment is available. Arthur L.Wool[25] used a wood burning pen that was capable of producing 400º - 500ºC of heat. Similar to Arthur L. Wool a 25 watt soldering rod was used for electrothermal debonding.

Samir E. Bishara et al[20] showed that the EDT gave an ARI score of 1 in about 85% of the samples. Marguerite Crooks et al[22] in 1997 showed similar findings. In the current study, about 60% of the samples have complete adhesive remained on enamel surface. There were no incidences of bracket failure, similar to S.Dogvan et al[23]. The site of bond failure ranged between type I to III with 60% of samples having type I bond failure, indicating less chance of enamel damage[26].

The SEM images of the electrothermally debonded samples **(Figure 6)** showed minor patches of enamel loss in the composite denuded regions. Kearns et al[27] observed no gross enamel fractures following SEM examination of debonded enamel. This clearly indicates that in the electrothermal debonding technique with most samples having type I bond failure, the damage of the enamel would be minimal.

**Ultrasonic debonding techniques**

About 53% of the samples debonded ultrasonically had ARI score 2 and the rest had score 3. The Site of bond failure was of type 1 and type 2, indicating bracket failure at the adhesive-bracket interface or within the adhesive, similar to the findings of Daniel.B.Boyers et al[28]. With ultrasonic technique, the likelihood of enamel damage and bracket failure was minimal because of relatively low debonding force levels. Study by Daniel.B.Boyers et al[28] showed that the force required to remove ceramic brackets with ultrasonic tip was 0.28MPa. No bracket failure was noted which was similar to the earlier studies by Samir Bishara et al[20] and Daniel.B.Boyers et al[28].

SEM examination **(Figures 7)** showed minimal loss of surface architecture with distinctly seen perikymata. However enamel gouging was observed at the margins of the adhesive where ultrasonic tip was used. These findings were similar to Keith Krell et al[10].

Ultrasonic debonding was associated with excessive wear of the expensive tip and the need for a water spray to reduce the heat buildup which could cause pulpal damage[20],[29]. It also had a distinct drawback on the time consumed for debonding which was in sharp contrast to other debonding techniques as described by Bishara et al[22].

**Chemical Debonding Technique**

Chemical debonding of the ceramic brackets showed that 60% of the samples have complete adhesive removed from the enamel surface. Site of bond failure for most of the samples was type 3 and 4, indicating that the bond failure was at the enamel adhesive interface, which was similar to the findings of Larmour et al[30].

Waldron and Caustron[11] (1991) suggested that peppermint oil could have an effect when applied for very short periods (1–2 minutes) but work by Larmour and Chadwick[31] (1995) found no appreciable composite softening effect at such short periods. However Larmour et al[30] in 1998 showed that with both 5 minute and 1 hour placement of the bonded ceramic brackets in peppermint oil to facilitate ceramic bracket debonding did increased the incidence of bond failure at the enamel/resin interface. The enamel surface topography **(Figure 8)** showed no major enamel damage (cracks, gouging) except for mild loss of surface perikymata. This suggests that though in the chemically debonding technique, bond failure occurred at the enamel-adhesive interface the likelihood of the enamel damage was minimal, which might be due to the softening effect of the peppermint oil on the adhesive decreasing the bond strength.

**Limitations of the study:**

1) Conventional debonding plier used in the study showed highest incidence of enamel damage. However several manufacturers have come out with a variety debonding pliers, which were claimed to cause less enamel damage.
2) The temperature produced by the electrothermal unit might raise the intrapulpal temperature leading to pulpal damage which needs to be evaluated.
3) The debonding forces which might be different among the study groups were not measured.

**The conclusions of the present study are as follows:**

1) Conventional and chemical debonding techniques with high ARI scores had most common site of bond failure at enamel-adhesive interface which is detrimental to enamel surface. However SEM showed minimal enamel damage with chemical debonding.
2) Bracket failure rate was negligible.
3) Conventional debonding showed greater enamel damage than other methods.
4) Electrothermal and ultrasonic debonding techniques had bond failures at adhesive-bracket interface with minimal enamel damage.
5) Chemical debonding technique, with minimal enamel damage would be a better technique for debonding ceramic brackets.

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# Estimation Of Fibrinogen And Esr – Hemostatic Markers In Patients With Mild, Moderate And Severe Periodontitis.

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**Abstract**

**Background and Objectives:** Epidemiological studies have demonstrated an association between periodontal disease and cardiovascular diseases. Evidences confirm fibrinogen and ESR as independent predictors of coronary heart diseases. However studies focusing fibrinogen and ESR as markers of systemic inflammatory response in patients with periodontitis are inconclusive. This study estimated the plasma levels of fibrinogen and ESR as markers of systemic inflammation in periodontitis patients.

**Material and Methods:** Group I – 30 patients with healthy periodontium. Group II - 20 patients with mild to moderate periodontitis. Group III - 20 patients with severe periodontitis. Parameters like Plaque index, Probing Pocket Depth, Clinical Attachment Level, BMI, ESR, lipid profile and plasma levels of fibrinogen were measured for all patients.

**Results:** The results showed that mean plasma levels of fibrinogen were significantly higher for patients with severe chronic periodontitits [415.45± 171.90 (SD)] as compared to patients with mild to moderate periodontitis [305.85± 63.64 (SD)] and controls [296.90± 134.49 (SD)]. However, there were no statistically significant differences in the ESR values among the three groups. There was also no statistically significant correlation of fibrinogen with ESR values.

**Conclusion:** Fibrinogen is a definite marker for presence and severity of systemic inflammatory response in chronic periodontitis patients and its elevated levels may be the indicator of the link between cardiovascular diseases and periodontitis.

**Key Words**
Periodontal disease, Fibrinogen, Erythrocyte Sedimentation Rate, Marker, Cardiovascular diseases

## Introduction

Periodontitis is a gram-negative anaerobic infection of the tooth-supporting structures characterized by chronic inflammation and immune reactions that result in loss of tooth supporting structures. This may be due to the direct action of periodontal pathogens or their products via transient bacteremia or indirectly through the acute phase response. The acute phase response is triggered by action of cytokines IL-1, IL-6 and TNF-α that act on the liver to produce acute phase proteins, altering the cellular and molecular blood chemistry. Three acute phase proteins of importance are C-reactive protein (CRP), Fibrinogen and serum Amyloid A.[1]

Fibrinogen is a type II, moderate, positive acute phase protein, produced in the liver and is often elevated in chronic inflammatory conditions.[1] It plays a vital role in coagulation process,blood viscosity, inflammation and atherogenesis.[2] Though secreted primarily by hepatocytes, extra hepatic secretion of fibrinogen by epithelial cells of lungs, intestine and human cervical epithelial cells has been reported in response to pro-inflammatory cytokines (IL-6).[2],[3] Gingival epithelial cells and fibroblasts in response to cytokines may also produce fibrinogen.[4] Excessive fibrinogen production can increase pro-inflammatory cytokines and attract more leukocytes at the sites of inflammation. Fibrinogen can also interact with bacteria promoting colonization and adhesion. Elevated fibrinogen levels can contribute reciprocally to inflammation further potentiating the inflammatory response. [4]

Fibrinogen is one of the important determinants of Erythrocyte sedimentation rate. ESR is a measure of an acute inflammatory response and ongoing coagulation process. Elevated ESR also alters the blood viscosity. [5],[6],[7] Evidence indicates that fibrinogen and ESR are intermediate risk factors for cardiovascular diseases.[8],[9],[10],[11] There is also evidence confirming the relationship between periodontal disease and cardiovascular disease.[12] Thus Fibrinogen and ESR may be possible systemic factors that may link periodontal disease and cardiovascular diseases.

Diseased periodontal tissues represent sites of localized activation of blood coagulation cascade.[4] However, involvement of blood clotting factors in the periodontal disease process has not been extensively investigated.It is possible that fibrinogen and ESR may serve as markers for the presence and severity of systemic inflammatory response in periodontitis patients.

The aim of this study was to evaluate whether periodontitis contributes to increased systemic inflammatory response reflected by elevated levels of fibrinogen & ESR.

## Materials And Methods

### Study Population

Subjects reporting to the Department of Periodontology, Vokkaligara Sangha Dental College and Hospital, Bengaluru, between October 2010 and April 2011 meeting the selection criteria were recruited for the study. The protocol for the study was approved by an institutional review board and all subjects signed a consent form to participate in the study.

Subjects were screened for suitability of the study based on the following criteria. Patients with age ranging from 25-55 years and with no systemic disease and history of blood transfusion within 4 weeks were included in the study. Also patients on any systemic drug, pregnant and lactating mothers, smokers and those who had undergone any periodontal treatment within six months of study were excluded from the study.

70 subjects (males & females) fulfilling these selection criteria were enrolled in the study.The subjects were categorized into three groups. Group I was the control group of 30 patients with healthy periodontium, no probable pocket and no signs of clinical attachment loss. Group II consisted of 20 patients with mild to moderate periodontitis, with clinical attachment loss of 1- 4 mm, in at least 6 teeth. Group III consisted of 20 patients with severe periodontitis, with clinical attachment loss = 5 mm, in at least 6 teeth.

A detailed medical & dental history was compiled for all the subjects. Complete oral examination was carried out. The periodontal parameters included the assessment of Plaque index (Silness and Loe 1964), Probing Pocket Depth (PPD) and Clinical Attachment Level (CAL) in all the groups. PPD and CAL were measured at 6 surfaces of each tooth using UNC -15 probe. Themeasurements were added and divided by six to obtain the mean PPD and CAL for the individual tooth.

### Determination Of Fibrinogen, ESR and Lipid Parameters

8 ml of blood was drawn following overnight fasting from anti-cubital fossa by a clean veni- puncture using 20 gauge needles and a 10 ml syringe. 3 ml of blood was used for fibrinogen assay, 2ml for ESR and the other 3ml for lipid profile analysis.

### (a).Measurement of plasma fibrinogen (FBG)

3ml of blood was transferred to a plastic vial containing 3.2% of buffered sodium citrate (anticoagulant) in the ratio of 9:1 and was mixed well. The specimen was then centrifuged at 1500x g for 15 minutes. Plasma was removed from the tube using a plastic pipette and was stored in a plastic tube at -70°C until analyzed. The specimens were thawed prior to analyses. Fibrinogen was assayed by Clauss method.

### (b).Measurement of ESR

ESR was measured by Westergren method.

### (c) Assessment of Lipid Parameters

Total Cholesterol, serum Triglycerides and high-density lipoprotein - Cholesterol were assessedusing A25 Biosystem auto analyzer. Other parameters assessed were VLDL, LDL & ratio of TC to HDL & LDL to HDL

Data obtained was subjected to statistical analysis

### Statistical Analysis

Descriptive statistical analysis was carried out in the present study. Results on continuous measurements were presented as Mean ±SD (Min-Max) and results on categorical measurements were presented as Number (%). Significance was assessed at 5 % level of significance. Analysis of variance (ANOVA) was used to find the significance of study parameters between the three groups. Pearson correlation was used to establish the relationship between fibrinogen with ESR.

Table 1 Showing Comparison of Age, gender and BMI in Group I, Group II and Group III.

| Parameters | Group I | Group II | Group III |
|---|---|---|---|
| Age in years( Mean ± SD) | 31.17 ± 7.63 | 37.60 ± 10.05 | 39.45 ± 6.22 |
| Gender (%) | 63.3(males) | 60 | 60 |
| | 36.7(females) | 40 | 40 |
| BMI(Mean ± SD) | 22.32 ± 3.61 | 23.15 ± 2.97 | 23.93 ± 4.50 |

Table 2 Showing Comparisons of Lipid parameters in Group I, Group II and Group III.

| Lipid Parameters | Group I | Group II | Group III | P value |
|---|---|---|---|---|
| Total Cholesterol | 183.10 ± 31.17 | 191.50 ± 45.97 | 189.65 ± 44.33 | 0.731 |
| HDL | 39.13 ± 7.19 | 40.50 ± 8.42 | 43.55 ± 12.17 | 0.254 |
| Triglycerides | 128.53 ± 88.53 | 143.70 ± 66.44 | 117.10 ± 30.43 | 0.487 |
| VLDL | 24.79 ± 24.49 | 28.39 ± 13.57 | 22.10 ± 6.23 | 0.533 |
| LDL | 119.07 ± 34.31 | 122.75 ± 38.08 | 123.85 ± 45.37 | 0.904 |
| TC/HDL | 6.87 ± 7.49 | 4.77 ± 1.13 | 4.24 ± 1.61 | 0.151 |
| LDL/HDL | 3.22 ± 1.01 | 3.05 ± 0.98 | 3.17 ± 1.33 | 0.857 |

Table 3.Comparison of Clinical parameters pocket depth (PD), clinical attachment level (CAL) and Plaque index (PI) in Group I, Group II and Group III.

| Clinical Parameters | Group I | Group II | Group III | P value |
|---|---|---|---|---|
| PD (mean) | 2.19 ± 0.78 | 2.84 ± 0.44 | 4.42 ± 0.86 | < 0.001** |
| CAL | 0.94 ± 1.39 | 2.01 ± 0.72 | 4.39 ± 1.02 | < 0.001** |
| PI | 0.96 ± 0.54 | 1.63 ± 0.42 | 1.99 ± 0.46 | < 0.001** |

Table 4 : Comparison of Fibrinogen and ESR in Group I, Group II and Group III

| | Group I | Group II | Group III | P value |
|---|---|---|---|---|
| Fibrinogen | 296.90 ± 134.49 | 305.85 ± 63.64 | 415.45 ± 171.90 | 0.006** |
| ESR | 12.24 ± 12.43 | 11.40 ± 10.28 | 20.00 ± 19.42 | 0.109 |

## Results

### Study Population

There was no statistically significant difference in the mean age, gender distribution and BMI & lipid parameters among the three groups indicating that the groups were matched with respect to these factors (p=0.961) **(Table 1 & 2)**.

### Periodontal Parameters

There was a statistically significant difference in the mean Plaque scores, Periodontal pocket depth & Clinical attachment level (CAL) between the groups (p< 0.001) **(Table 3)**.

### Fibrinogen

Mean level of plasma fibrinogen in Group I was 296.90± 134.49 (SD), in Group II was 305.85± 63.64 (SD) and in Group III was 415.45± 171.90 (SD). The values showed gradual increase from control group (Group I) to mild moderate periodontitis group (Group II) to severe periodontitis (Group III) indicating that patients with moderate to severe periodontitis had higher mean levels of plasma fibrinogen than control group. The difference in values between Group I and Group II were not statistically significant (P=0.970). However, the difference in values between Group I and Group III and between Group II and Group III were highly statistically significant. Overall difference in levels of plasma fibrinogen were highly significant among groups (p<0.006) **(Table 4)**.

### Erythrocyte Sedimentation Rate

Table 5

| Pair | r value | Group I | Group II | Group III |
|---|---|---|---|---|
| Fibrinogen vs ESR | p value | 0.270 | -0.160 | 0.130 |
| | | 0.157 | 0.501 | 0.585 |

**(ESR)**
Mean values for ESR was estimated as 12.24±12.43 (SD) for Group I, 11.40±10.28 (SD) for Group II and 20.00 ±19.42 (SD) for Group III. Values were numerically higher in Group I than in Group II and were highest in patients with severe periodontitis (Group III). However, there was no statistically significant difference in the ESR values among groups (p=0.109). **(Table 4).**

**Correlation of fibrinogen with ESR**
There was no statistically significant correlation of fibrinogen with ESR in all the three groups **(Table 5)**.

**Discussion**
Periodontitis is a chronic inflammatory condition that results in elevated levels of haemostatic, lipid and protein markers.[1] Increased levels of these markers play a role in the development of cardiovascular diseases and may be associated with an increased risk of coronary events.[2] Several recent studies have emphasized that even moderately elevated levels of fibrinogen and ESR are predictors of increased cardiovascular risk even among apparently healthy individuals.[8],[9],[10],[11] Therefore this comparative study examined fibrinogen and the erythrocyte sedimentation rate as markers of systemic inflammatory response in patients with chronic periodontitis.

Fibrinogen levels have been reported to be influenced by age, gender, smoking, systemic diseases, inflammatory conditions like Rheumatoid arthritis, and concurrent use of antibiotics and anti-inflammatory agents.[2] Therefore such patients were excluded from the study.

The levels of fibrinogen are also influenced by BMI and lipid parameters. [2] Therefore, BMI and lipid parameters were assessed and all the three groups were matched with respect to age, gender, BMI and lipid parameters.

Plaque index, probing pocket depth and clinical attachment levels were recorded for all the subjects. There was a statistically significant difference in mean plaque scores among the three groups. Group I individuals showed good score (0.1-0.9), Group II individuals showed fair score (1- 1.9) and Group III individuals showed poor score (2-3). [13]

Probing Pocket Depth (PPD) and Clinical Attachment Level (CAL)was measured using UNC-15 probe at mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual and distolingual surfaces of the tooth. All the six measurements were added and divided by number of sites examined to obtain the mean probing depth for the individual tooth. Clinical Attachment Level (CAL)measured as the distance from the cement-enamel junction (CEJ) to the base of the sulcus or the pocket is a better indicator of periodontal destruction. As expected periodontal parameters were significantly different in control, mild to moderate and severe periodontitis groups.[14]

Fibrinogen levels have been known to be influenced by intake of meal[2], therefore fasting blood samples were collected for all the patients. A variety of different tests and assays of @257;brinogen have been used by clinical laboratories. The assays vary in the degree of expertise and time required, and the equipment available. [15]

There are four methods for measuring fibrinogen levels which can be classified into two groups, 'functional' and 'direct'. The first category involves tests based on the determination of the coagulation time, which in turn is proportional to the fibrinogen concentration. The most widely used method for the functional fibrinogen assay in most clinical laboratories is the Clauss method, which records the time taken to reach the coagulation end point (i.e. the formation of a clot).[15] The Clauss assays are generally reproducible but the normal reference interval must be determined for each laboratory for each assay, and is not a general value.[15]

This study measured fibrinogen levels using Von Clauss clotting method by a TriniClot fibrinogen kit (Trinity Biotech, Ireland). Reference value was established as 200-400 mg/dl. Reference curves were prepared at periodic intervals and measurements were made in duplicate on a log-log paper. Mean ± SD for fibrinogen in Group I was 296.90±134.49, in Group II was 305.85±63.64 and in Group III was 415.45±171.90. The values showed gradual increase from control patients (Group I) to moderate periodontitis group (Group II) with a marked difference in the values from moderate to severe periodontitis (Group III). The gradual increase in values of plasma fibrinogen from control group, to moderate periodontitis group and with maximum values in severe periodontitis group supports the evidence of plasma fibrinogen as a marker for the presence and severity of systemic inflammatory response in periodontitis patients. This is consistent with other observational studies.[4],[16],[17],[18],[19],[20]

A statistically significant difference in fibrinogen values between healthy controls and periodontitis patients has been reported by Bizarro, et al (2005).[16] Similarly a significant association between indicators of poor periodontal status and increased fibrinogen levels has been reported by Wu, et al (2000).[17] A meta-analysis by Danish, et al (1998) reported a significant association of elevated fibrinogen levels in periodontitis patients with a subsequent risk of cardiovascular diseases.[18] Higher levels of fibrinogen has been reported in patients with periodontitis and 455G/A-fibrinogen gene polymorphism.[4] However, a cross-sectional study by Joshipura J, et al (2004) did not report a statistically significant association in levels of plasma fibrinogen and self reported periodontal disease.[21]

Effects on Fibrinogen levels in the plasma as a measure for a decrease in systemic inflammatory response after treatments like full mouth extraction [22] and non-surgical therapy [23], [24] have also been evaluated but with conflicting results.

Fibrinogen differs from other acute-phase proteins in its ability to be constitutively expressed at a moderate level.[2] During an acute-phase response, this effect can be initiated by IL-6, inflammatory mediators like PGE2, as well as by lipopolysaccharides from various periodontal pathogens. Additionally although, the liver is the primary site of @257;brinogen (FBG) synthesis, epithelial cells from diverse tissues like pulmonary, intestinal and cervical cancer have been reported to respond to local in@258;ammation by increased transcription of the ?-FBG gene.[2],[3],[4] It is possible thatsimilar process may be responsible for local production of FBG from gingival epithelium and fibroblast and thus contribute to significant increase in systemic plasma fibrinogen levels in

severe periodontitis patients.[4]

Fibrinogen also plays a critical role in exacerbation of inflammatory periodontal disease.[4] Elevated fibrinogen levels interact with periodontal bacteria favouring their colonization and adhesion.[4] Also fibrinogen favours increased leukocyte recruitment and cytokine production at the site of infection as evidenced by positive correlation between increased levels of fibrinogen and the number of leukocytes.[2] Fibrinogen serves as a native ligand for CD11b/CD18 surface receptors of polymorphonuclear leukocytes (PMNs) (Walzog et al, 2000).[4]

Fibrinogen also reciprocally contributes to inflammation through facilitating a chemotactic response by binding to its integrin receptor (MAC-1) on leukocytes (macrophages and myelocyte). This results in differential expression of 'proinflammatory' cytokines. Interaction with the cytokines results in conformational changes within the fibrinogen molecule and conversion into 'proinflammatory' fibrinogen, resulting in the exposure of the epitope that interacts with the MAC-1 receptor for macrophages.[2]

There is evidence for a functional link between clotting and inflammatory responses. Fibrinogen has been found to enhance the adhesion of cells of myeloid and lymphoid lineage to endothelium by 2- to 5-fold by binding to intercellular adhesion molecule-1 (ICAM-1). Authors also demonstrated that fibrinogen could regulate expression of the IL-1 beta gene, causing increased IL-lß production both at the mRNA and protein level.[4] IL-1 has a central role in periodontal tissue destruction.[26]

The reported value of fibrinogen as a risk factor for cardiovascular diseases is 286 mg/dl by Clauss method; 57.1% of the subjects in our study had plasma fibrinogen levels higher than 286mg/dl. 40% of subjects in Group I, 60% in Group II and 80% in Group III exhibited values above this level. These values could contribute in part to increased risk of cardiovascular diseases.[2]

The ESR is a traditional parameter of any given inflammatory process.[5],[6],[7] It provides a multifactorial measure of the systemic response to an infectious or inflammatory disease. Fibrinogen levels affect the erythrocytes rouleaux formation and subsequently precipitation (sedimentation).[5],[6],[7]

ESR was assessed by Westergren method which is a standard method as recommended by International Committee for Standardization in Hematology (ICSH).[27] Mean values for ESR for Group I were 12.24±12.43 (SD), for Group II were 11.40±10.28 (SD) and for Group III were 20.00±19.42 (SD). Values were numerically higher in Group I than in Group II and were highest in patients with severe periodontitis (Group III). However, there was no statistically significant difference in the ESR values among the three groups. The results of the present study are in accordance with earlier studies in which measurement of ESR as a diagnostic tool for periodontitis was assessed. ESR was found to be of only limited significance.[28]

Although fibrinogen is an important determinant of ESR[5], no correlation could be established between the fibrinogen and ESR values possibly because hematocrit and other non-fibrinogen proteins also influence ESR.[6],[7]

CRP is considered as a diagnostic tool for assessment of systemic inflammatory response.[29] However, for cardiovascular diseases which are haemostatic as well as rheologically influenced diseases fibrinogens holds greater importance as its values give greater insight on the inflammatory, thrombotic and atherosclerotic status of an individual. Longitudinal studies suggest that fibrinogen and ESR are intermediate risk factors for cardiovascular diseases like atherosclerosis, myocardial infarction and stroke.[8],[9],[10],[11],[12] A recent study showed that elevated ESR was a strongest and most significant predictor of risk of cardiovascular disease among several plasma variables.[11] Although periodontal disease is not established as causal factor for CHD, observational studies establish it as an independent definitive risk factor for CVD.[30],[31] Therefore elevated levels of fibrinogen and ESR serve as a marker of presence and severity of systemic inflammatory response in patients with periodontitis and may be possible intermediate factors that may link periodontal disease and cardiovascular diseases.

## Conclusion

Although significance of ESR as a marker of presence and severity of systemic inflammatory response was limited, fibrinogen served as a definite marker of systemic inflammatory response in chronic periodontitis. As cardiovascular diseasesare haemostatic as well as rheologically influenced diseases fibrinogen holds greater importance than other variables in linking possible risk for cardiovascular diseases.


## Financial & competing interests disclosure

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# Effect Of Different Concentrations Of Glass Fibres On Transverse Strength Of Four Different Brands Of Heat Cure Denture Base Resins – A Comparative Study

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**Abstract**
Acrylic resin dentures are susceptible to fracture which is a problem of concern in Prosthodontics. Flexural fatigue failure and impact failure are two most important causes of fracture of denture bases. Reinforcement of denture base resins with glass fibres had shown a positive effect on the transverse strength of dentures base resins. Purpose of the study- Study was carried out to assess the effect of different concentration of glass fibre reinforcement on transverse strength of four different brands of heat cure denture base resins. Material and methods - A total number of two hundred test specimens were prepared in this study. They were divided into four groups A, B, C & D each having fifty samples. On the basis of different concentration of glass fibres, the groups were further divided into five subgroups having ten specimens each. All the samples were tested on universal testing machine and three point bending test was done. Results -The mean transverse strength obtained for each subgroup from the three point bending test was statistially analyzed. One way ANOVA was done for comparison between the groups. Post –hoc Tukey HSD test was done for comparison between the subgroups
**Conclusion:** Result indicate that up to 2% increase in glass fibre concentration in denture base resins showed a marked improvement in the transverse strength . Further increase in concentration of glass fibres showed weakening effect on the transverse strength of heat cure denture base resins.

**Key Words**
Reinforcement, Glass fibres, Polymethyl methacrylate, Transverse strength

## Introduction

It is a very important and essential requisite for a denture base to resist fracture. Fractures can be prevented by improving the strength of the Polymethyl methacrylate. Various approaches for strengthening acrylic resin prosthesis have been suggested. Chemical modification has been performed to produce graft co-polymers or rubber methacrylate known as high impact resins[3]. Reinforcement has also been attempted through the incorporation of metal wires in fracture prone areas. Reinforcement of resins with various fibers like carbon fibres, polyaramide fibers, glass fibers and nylon fibers has also been studied[4]. Fibre reinforcement has been found to be more economical and esthetically acceptable mode of strengthening the denture base.

Polymethyl methacrylate is the most commonly used material in denture fabrication because of its ease of processing, favorable working characteristics, accurate fit, stability in oral environment, superior esthetics, use with inexpensive equipments and adequate mechanical properties[1]. Although this material is widely used as a main component of denture base polymer for many years, it gets fractured or sometimes gets cracked in use due to accidental dropping or from fatigue. This is often seen in maxillary complete dentures, where continual flexing of the denture base during function leads to crack development[2]. Sudden breakage of the denture is a situation that deprives the denture wearers of their dentures and is a source of great inconvenience.

Today the most acceptable fibers for dental polymer reinforcements are glass fibers because of their good aesthetics and better bonding with polymers[5]. They can also be easily adapted to the desired shape and length which is then suitable for incorporation into denture base polymer material. These fibres come in various forms, thickness and qualities. Glass fibres have porous prepolymer matrix and when pre-impregnated with monomer they show better bonding with PMMA. To strengthen dental polymers, glass fibers have been used in different forms such as woven, loose, and continuous such as roving or fibers bundles. Addition of glass fibers has shown to result in higher transverse strength, flexural modulus, fatigue strength and impact strength[6]. In this study four brands of heat cure resins were selected and their transverse strength was evaluated after glass fibre addition in different concentrations i.e. 1%, 2%, 5% and 10% by weight.

## Materials And Method

Total two hundred test samples were prepared using four different brands of heat cure **(Fig 1)** denture base resins as shown in **Table 1**. Each group was further divided into five subgroups comprising of ten samples each depending upon the concentrations of glass fibres used **(Fig 2)** as shown in **Table 2**.

The test was conducted in accordance with ADA specification no 12 / ISO:

Fig 1 : Heat Cure Denture Base Resins Used In The Study

Fig 2 : Glass Fibres Used In The Study

Table 1

| Sr No | Name of Groups | Name of Materials | Manufacturers' Name And Address |
|---|---|---|---|
| 1 | A | Acralyn | Asian Acrylates, Mumbai, India |
| 2 | B | Trevalon | Dentsply, Gurgaon, India |
| 3 | C | DPI | Dental Product of India, Mumbai |
| 4 | D | Pyrax | Pyrax Polymars, Roorkee, India |

Table 2

| Groups | Control group without glass fibers (n = 40) | 1% by weight glass fibers (n = 40) | 2% by weight glass fibers (n = 40) | 5% by weight glass fibers (n = 40) | 10% by weight glass fibers (n = 40) |
|---|---|---|---|---|---|
| A (Acralyn) | A0 | A1 | A2 | A3 | A4 |
| B (Trevalon) | B0 | B1 | B2 | B3 | B4 |
| C (DPI) | C0 | C1 | C2 | C3 | C4 |
| D (Pyrax) | D0 | D1 | D2 | D3 | D4 |

1567-1981(ISO 6887-1986) for denture base polymers at room temperature.

**Preparation Of The Mold**

For standardization of specimens, a stainless steel die plate of dimension 60mm in length, 10mm in width and 4mm in thickness was fabricated as per ADA specification no. 12 for denture base resins. Dental stone was used for flasking purpose. Lower portion of dental flask was filled with freshly mixed dental stone. The stainless steel die plate was coated with petrolatum jelly and placed over this mixture. Upper portion of the flask was then positioned atop the lower portion of flask and a second mix of dental stone was poured and allowed to set for 30 minutes. Upon completion of the setting process, the flask was opened and metal die was carefully removed from the surface of the mold. Mold cavity was cleaned with boiling water. The mold cavity thus obtained was used for the preparation of acrylic resin samples.

Preparation of control group specimens- Control groups had no concentration of glass fibers. In this study, four different control groups were prepared as shown in **Table 2**. A mixture of polymer and monomer in the ratio of 3:1 by volume was measured and mixed in a porcelain jar. Acrylic dough was packed by compression molding technique. Finally the flasks were clamped and final closure was done under pressure. Heat cure resin was processed with short curing cycle (boiling at 740c approximately for 2 hours and then increasing the temperature of the water bath to 100oc and processed for 1 hour) and bench cooled for 30min. Cured acrylic resin plates were carefully removed from the mold. Acrylic resin plates were cut lengthwise into equal strips with the help of a fret saw. Stripes were finished to specific dimension of 60+_0.03 mm in length, 10+_ 0.03mm in width, and 4+_ 0.03mm in thickness and were marked at the end. Any specimen strip that did not fulfill these criteria was discarded.

All the control group specimens A0, B0, C0 and D0 containing ten specimens each were prepared in the same manner and finished.

Preparation of specimen with different concentrations of glass fibres : All brands of conventional heat cure denture base resins were first reinforced with 1% by weight glass fibres. For this 0.48 gm of glass fibres were weighed which amounts to 1% by weight of the total mixture. The measured quantity of glass fibres were immersed in a beaker with a predetermined volume of monomer liquid, then the required mass of powder was added to the mix and stirred so that the fibres were randomly oriented. After the material reached the dough stage, it was kneaded and packed into the mould. The specimens were trial packed, polymerized, recovered, cut into stripes, finished and polished as stated for the control group. Same technique was used with each brand of PMMA denture base resin materials by adding 1% by weight glass fibres to obtain the samples of A1, B1, C1 and D1 subgroups, with ten samples each.

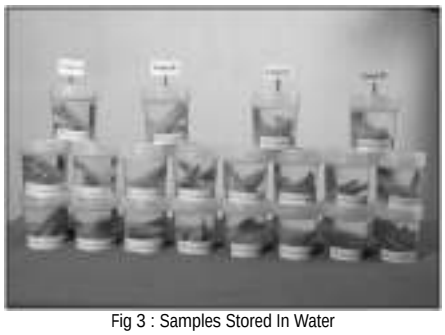

Fig 3 : Samples Stored In Water

Fig 4 : Samples Loaded In Universal Testing Machine

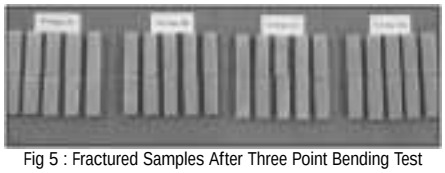

Fig 5 : Fractured Samples After Three Point Bending Test

Similarly for concentration of 2% by weight 0.96gm of glass fibres for 5% weight 2.4gm of glass fibres and for 10% weight 4.8gm glass fibres were incorporated into the mixture. Same procedures for packing, flasking, polymerization, curing, finishing and polishing were carried out and samples for all the subgroups were obtained. All the samples were stored in water for two weeks in their respective marked containers **(Fig 3)**.

The specimens were mounted on Hounsfield universal testing machine **(Fig 4)**. Each specimen was placed on the bending fixture consisting of two parallel supports 50mm apart, which represented the distance between the molars in complete maxillary denture. Load was applied at the centre of the specimen at a cross head speed of 0.5cm/min. Machine had a digital monitor which indicated the amount of force applied. The specimens were kept under load and the reading on the digital scale indicated the force applied until the specimens fractured **(Fig 5)** indicating the breaking load of the

Table 3 .Comparative Evaluation Of Transverse Strength (Mpa) Of Heat Cure Denture Base Resins After Addition Of Glass Fibres

| Glass fibres concentration | Group | N | Mean (mpa) | SD | P-value | Post-hoc |
|---|---|---|---|---|---|---|
| Control (No glass fibres added) | A0 | 10 | 73.92 | 1.67 | 0.45 | N.A |
| | Bo | 10 | 74.27 | 2.16 | | |
| | Co | 10 | 73.65 | 1.84 | | |
| | Do | 10 | 72.87 | 2.21 | | |
| Transverse strength at 1% by weightglass fibres | A1 | 10 | 92.62 | 4.79 | 0.89 | N.A |
| | B1 | 10 | 92.70 | 3.75 | | |
| | C1 | 10 | 91.78 | 3.56 | | |
| | D1 | 10 | 91.40 | 5.59 | | |
| Transverse strength at 2% by weight glass fibres | A2 | 10 | 82.11 | 3.42 | 0.88 | N.A |
| | B2 | 10 | 82.46 | 4.10 | | |
| | C2 | 10 | 81.55 | 3.79 | | |
| | D2 | 10 | 80.95 | 5.96 | | |
| Transverse strength at 5% by weight glass fibres | A3 | 10 | 72.43 | 1.53 | 0.92 | N.A |
| | B3 | 10 | 72.48 | 1.70 | | |
| | C3 | 10 | 72.34 | 2.14 | | |
| | D3 | 10 | 72.06 | 1.19 | | |
| Transverse strength at 10% by weight glass fibres | A4 | 10 | 71.97 | 0.99 | 0.007** | A4 > D4** |
| | B4 | 10 | 72.00 | 1.65 | | B4 > D4** |
| | C4 | 10 | 71.69 | 1.98 | | C4 > D4** |
| | D4 | 10 | 69.84 | 1.20 | | |

material. Then the transverse strength of the materials were calculated using the following formula:

**Statistical Analysis**

One way Analysis of variance (ANOVA) was used in this study to find the significant difference in the transverse strength between the groups. Where F indicates, Fisher value and p indicates probability value. The Post-Hoc Tukey test was used to find the pair-wise significance of transverse strength increase between all the twenty subgroups.

**Discussion**

The present study was undertaken to compare the transverse strength of our heat cure denture base resins at different glass fibre concentrations. Transverse strength is a collective measurement of tensile, compressive and shear strength simultaneously[7]. Higher the value of transverse strength of heat cure denture base resin, superior will be its clinical performance.

For standardization of specimens, a stainless steel die plate of dimension 60mm in length, 10mm in width and 4mm in thickness was fabricated as per ADA specification no. 12 for denture base resins[8]. Method used to calculate transverse strength was in accordance with the previous studies done by Gulay Uzun & Nur Hersek. They made PMMA samples of the 60 x 10 x 4 mm dimensions[9]. These samples were kept in water for 2 weeks before testing. Water storage was used to determine the longevity of the obtained mechanical properties of dental materials in the demanding environment of the oral cavity. The prime and most frequent fracture of the upper denture occurs in mid line and the fracture mechanism and the influence of the masticatory load which is applied onto the dentures are very similar to the three point bending test. So the samples were tested for the transverse strength at Universal Testing Machine at a cross head speed of 0.5cm/min where each sample was placed on two supports 50 mm apart. This dimension represente the space between maxillary molars in a complete denture. A load was applied using a centrally located rod until fracture occurred.

**Table 3** shows the mean transverse strength of Group A to Group D samples before and after glass fibre reinforcement. It can be observed that there is increase in transverse strength after glass fibre reinforcement upto the conccentrationsof 2% where 1% weight show highest transverse strength.

**Table 3** also shows the between group comparison of transverse strength at 1%, 2%, 5% and 10% by weight glass fibres concentration. It is evident from this table that at concentration of 5% the transverse strength starts decreasing and at 10% concentration there is significant decrease in transverse strength which became even lower than the control group. Post Hoc Tukey HSD test for comparison between also groups shows that decrease in transverse strength in D4 subgroup is highly significant with respect to A4, B4 & C4 subgroup at 10% by weight glass fibre concentration.

When 1% concentration of glass fibres was used, improvement in transverse strength was noticed. Increase of young modulus with carbon or glass fibres incorporation was noted in the investigation by Inamura et al[10]. It is also seen that, the modulus of elasticity for the 1% treated specimens after repair was found significantly higher than the plain unreinforced specimens[11]. Silanized glass fibres also shown the significant strengthening effect this was probably due to improved adhesion between fibres and resins which enhances the resistance[12]. The microscopic investigartion should be carried out in conjuction with other studies of glass fibre reinforced resin as the interface between the fibres and matrix can play an important role in the sucess of the overall reinforcement[13]. e.g fibres that are well integrated within the matrix may not prevent crack propagation,and fibres that demonstrate poor interfacial bonding may be plucked out of the matrix or act as areas of stress concentration,weakening rather than strengthening the acrylic resin.

But as the glass fibre conentration kept on increasing, there was a drop in transverse strength because at higher concentration glass fibres tend to clump together when mixed with monomer increasing porosity. This form void spaces and act as inclusive bodies that brake the homogeneous matrix of the PMMA[4]. As the concentration of glass fibres increases, chances of porosity are increased in the PMMA samples.

According to present study, addition of glass fibre at lower conc. has shown positive effect on the transverse strength of denture base resins. However further studies are required to evaluate health hazards of glass fibre on dental personal and patients, subsequently properties other than transverse strength can also be studied.

**Conclusion**

This study was focused to evaluate the effect of glass fibres at different concentration on transverse strength of heat cure denture base resins. There appeared to be a specific limit of glass fibre concentration above which, the level of enhancement in transverse strength was reduced. High concentration of glass fibres actually reversed the effect and weakened the resin. These findings display a favourable combination of properties that might be of clinical importance. On the basis of the results of the present study, following conclusion can be drawn. 1) Reinforcing heat cure denture base resins with glass fibres mixed in random form proved to be a useful and simple laboratory technique to strengthen heat cure denture base resins. 2) However it was observed that

low concentration of glass fibre (1% & 2% by weight) increased the transverse strength of heat cure denture base resins. High concentration of glass fibre 10% by weight decreased the transverse strength of heat cure denture base resins.

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# To Evaluate Association Between Periodontal Disease And Chronic Obstructive Pulmonary Disease

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**Abstract**

**Background** : A relationship between periodontitis and chronic respiratory disease has been suggested by recent studies. The aim of this study is to explore the association between periodontitis and chronic obstructive pulmonary disease (COPD).

**Materials and methods** : Case group consisted of 25 patients with COPD and control group consisted of 25 patients without COPD .Oral hygiene index,plaqueindex,gingivalindex,pocket probing depth and clinical attachment loss was recorded in all the patients for assessing periodontal health. A history of COPD was recorded.Lung function was assessed by spirometry by calculating ratio of fev1/fvc.

**Results** : Results suggested that case group had significantly greater OHI,PI,GI ,PPD , CAL than control group . Lung function diminished as attachment loss increased.

**Conclusion** : Findings suggested an association between chronic Periodontitis and COPD.

**Key Words**
Periodontitis ,COPD,lungfunction,attachment loss

## Introduction

Periodontal Disease (PD) is a group of inflammatory diseases that affecting the supporting tissues of the teeth. Based on the theory of "focal infection" which emerged at the beginning of the twentieth century, many studies have investigated a possible role for PD as a risk factor for systemic conditions over the past two decades[1], including cardiovascular diseases[2], diabetes[3], adverse pregnancy outcome[4], osteoporosis[5], rheumatoid arthritis[6], and Chronic obstructive pulmonary disease (COPD).[7],[8]

COPD is also an inflammatory disease characterized by the progressive deterioration of pulmonary function and increasing airway obstruction, includes chronic bronchitis and emphysema[9]. In line with the relationship between the anatomical position of oral cavity and pulmonary infection, oral bacteria can be easily carried into the lung and cause infection[10]. In addition, PD and COPD share the same risk factors, including smoking, age, obesity, socioeconomic status, and living conditions[1]. These data strongly suggest that PD may be a risk factor for COPD and that oral bacteria may play a key role in its progression.

Associations between respiratory diseases and oral health in community-dwelling populations were first determined by analysis of the National Health and Nutrition Examination Survey I data set.[11]. Logistic regression analysis revealed that poor oral hygiene and smoking status were statistically associated with chronic respiratory disease. The study of Hayes et al[12] found periodontitis, measured as alveolar bone loss assessed from periapical radiographs, to be an independent risk factor for COPD in adult males enrolled in the VA Normative Aging Study. Associations between respiratory diseases and oral health incommunity-dwelling populations were first determined by analysis of the National Health and Nutrition Examination survey.

Several biologically plausible mechanisms have been put forth to explain how periodontitis can lead to respiratory disease. Salivary enzyme activity is increased in periodontitis and can promote the adhesion of pathogenic bacteria to the oral surfaces, thereby altering oropharyngeal colonization patterns.[13],[14] In addition, oral bacteria involved in periodontitis can stimulate oral tissues and periodontium to release cytokines, which are proteins involved in cellular interactions and immune responses. These cytokines can promote adhesion of respiratory pathogens to mucosal surfaces, thereby leading to oropharyngeal colonization.

Periodontitis may also affect pathogen adhesion to respiratory epithelium. In vitro studies indicate that the presence of Streptococcus gordonii, a key bacteria in dental plaque formation, enhances the ability of pathogens such as H. influenzae to adhere to respiratory epithelial cells.[17] In response to bacterial adhesion, respiratory epithelial cells may release cytokines and attract neutrophils, which in turn release proteolytic enzymes that damage the epithelium and increase its susceptibility to infection.[15],[16] In addition, cytokines released from inflamed periodontal tissues may enter the respiratory tract in aspirated saliva, triggering the same sequence of events, including neutrophil recruitment, epithelial damage, and infection.[16]

Therefore, an attempt to find out the relation between periodontal diseases and COPD has been made.

## Materials And Methods

In this study, 25 patients were selected on following selection criteria from the hospitalised patients from the Department of General Medicine from

Rohilakhand Medical college Bareilly. The patients were in the age more than 20 years with at least 6 natural teeth present with exacerbation of COPD (case group) .Patients with no past or present history of COPD were included in the control groupand were selected from institute of dental sciences bareilly.Exclusion criteria for control groupwas edentulous patients, if patients had undergone periodontal therapy for last 6 months, patients on medications (antibiotics) known to influence the periodontal tissues other than COPD, patients with any other systemic diseases other than COPD, patients in intensive care unit.Exclusion criteria for case group was patients with any systemic diseases, patients under any medication for last six months, patients under any medication.

The physician made the diagnosis of respiratory diseases and non-respiratory diseases. A detailed case history, physical examination and investigations like chest X-ray and Pulmonary Function Test, complete blood count, urine examination, and sputum examinations were done. After confirmation o f COPD as diagnosis, these patients were taken for the study.Lung function was estimated by spirometry in both the groups by calculating the ratio of forced expiratory volume in 1 sec and forced vital capacity FEV1/FVC < 70% was diagnosed as COPD.

All 50 patients of cae and controlgroup were examined for gingival and periodontal status by recording the following indices: oral hygiene index, plaque index(Silness and Loe1964),gingival index (Loe and Silness 1963), pocket probing depth and clinical attachment loss.Periodontal health was assessed by measuring (a) probing pocket depth (PPD) from the crest of the gingival margin to the base of periodontal pocket; (b) Mean clinical attachment loss (CAL) from cements enamel junction to the base of the periodontal pocket using William's graduated periodontal probe; and (c) Oral hygiene index (OHI, Greene and Vermilion; 1964),[18] which comprises debris index and calculus index.

**Statistical Analysis**

Data were summarized as Mean ± SD. Groups were compared by independent Students t test while discrete (categorical) observations were compared by Fisher's exact test. The association of periodontal disease (CAL levels) with respiratory infections (FEV1/FVC ratio) was compared by one way analysis of variance (ANOVA) and the significance of mean difference between the groups (levels) was done by Tukey's post hoc test. A two tailed ($\alpha$=2) P<0.05 was considered statistically significant.

Table 1: Basic Characteristics Of Two Groups

| Characteristics | Controls (n=25) | Cases (n=25) | P Value |
|---|---|---|---|
| Genders: M<br>F | 19 (76.0%)<br>6 (24.0%) | 17 (68.0%)<br>8 (32.0%) | 0.754 |
| Age (yrs): Mean ± SD | 56.60 ± 6.83 | 55.80 ± 6.66 | 0.677 |
| Smoking habits: No<br>Yes | 21 (84.0%)<br>4 (16.0%) | 17 (68.0%)<br>8 (32.0%) | 0.321 |

Table 2: Periodontal Parameters Summary (Mean ± SD) Of Two Groups

| Parameters | Controls (n=25) | Cases (n=25) | p value |
|---|---|---|---|
| OHI (S) | 2.79 ± 0.38 | 3.43 ± 0.37 | P<0.001 |
| PI | 1.42 ± 0.15 | 1.73 ± 0.24 | P<0.001 |
| GI | 1.44 ± 0.14 | 1.74 ± 0.19 | P<0.001 |
| PPD (mm) | 3.18 ± 0.44 | 4.52 ± 0.32 | P<0.001 |
| CAL (mm) | 3.63 ± 0.64 | 5.11 ± 0.28 | P<0.001 |
| FEV1/FVC (%) | 85.26 ± 5.51 | 62.55 ± 8.43 | P<0.001 |

OHI: oral hygiene status, PI: plaque index, GI: gingival index, PPD: probing pocket depth, CAL: clinical attachment level, FEV1: forced expiratory volume, FVC: forced vital capacity

## Results

**Basic Characteristics**

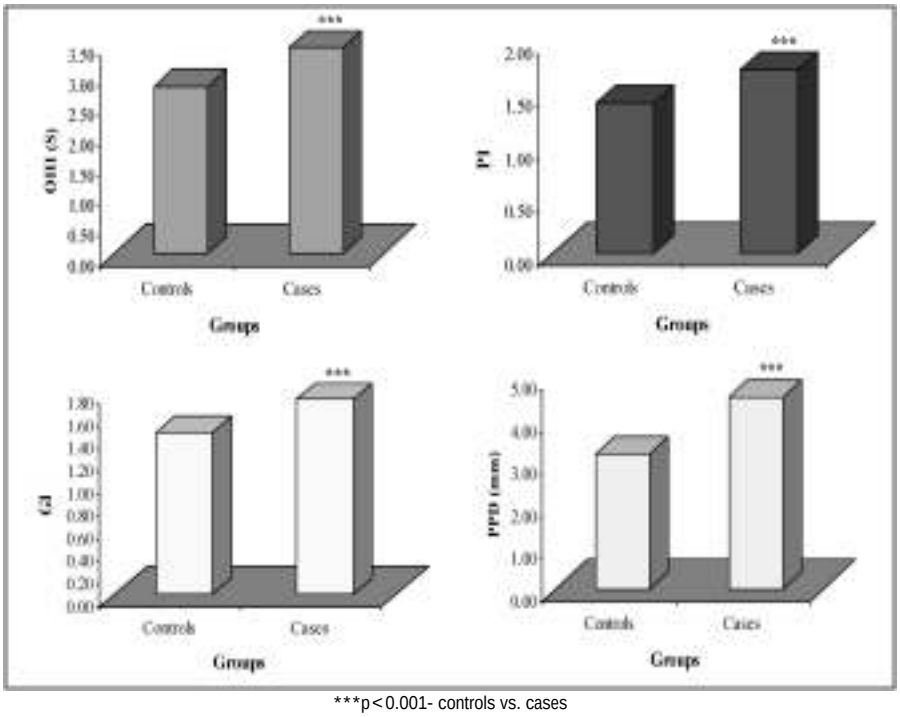
The basic characteristics viz. genders, age and smoking habits of two groups were summarized in **[Table 1]**. In both groups, the frequency (% age) of males was higher than females. The age of both controls and cases ranged from 40-65 yrs with mean (± SD) 56.60 ± 6.83 yrs and 55.80 ± 6.66 yrs, respectively with slightly higher being in controls. Similarly, in both groups, the frequency of non smokers was higher than the smokers. However, the frequency of smokers in cases (32.0%) was higher than the controls (16.0%). On comparing, all basic characteristics of two groups were found to be the same i.e. did not differed significantly (P>0.05). In other words, subjects of two groups were gender and age matched and also matched with the smoking habits.

**Periodontal Parameters**

The levels of different periodontal parameters viz. OHI, PI, GI, PPD, CAL and FEV1/FVC ratio of two groups were summarized in **Table 2** and also shown graphically in **Fig. 1. Table 2** and **Fig. 1** both showed that the mean levels of OHI, OHI, PI, GI, PPD and CAL were significantly (P<0.001) higher in cases while FEV1/FVC ratio was significantly (P<0.001) lower as compared to controls.

**Association between periodontal disease and respiratory infections**

To see the association between periodontal disease and respiratory infections, the FEV1/FVC ratio was




***p<0.001- controls vs. cases

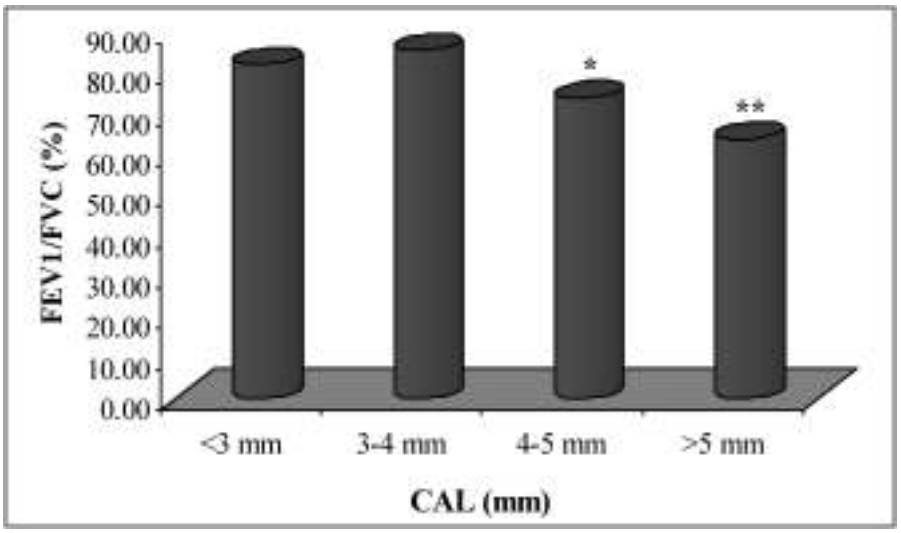
Fig. 1: Bar Graphs Showing Mean Levels Of Different Periodontal Parameters Of Two Groups.

Table 3: Association Between Periodontal Disease (Cal Levels) And Respiratory Infections (FEV1/FVC Ratio)

| CAL levels | FEV1/FVC (%) | |
|---|---|---|
| | N | Mean ± SD |
| < 3 mm | 3 | 82.00 ± 3.00 |
| 3-4 mm | 13 | 85.12 ± 6.71 |
| 4-5 mm | 18 | 73.72 ± 14.89 |
| > 5 mm | 16 | 63.49 ± 8.09 |

p < 0.05 or p < 0.001- as compared to < 3 mm
p < 0.05 or p < 0.001- as compared to < 3-4 mm
p < 0.05 or p < 0.001- as compared to < 3-4 mm

further average according to CAL levels and summarized in **Table 3** and also shown graphically in **Fig. 2. Table 3** and **Fig. 2** both showed that as CAL levels increases mean FEV1/FVC ratio decreases. It suggests that there may be an inverse relation between CAL (periodontal disease) and FEV1/FVC ratio (respiratory infections). On comparing, the mean FEV1/FVC ratio at 4-5 mm and > 5 mm of CAL were found to be significantly ($p<0.05$ or $p<0.001$) different and lower as compared to CAL at < 3 mm and 3-4 mm. Further, the mean FEV1/FVC ratio at > 5 mm of CAL was also found to be significantly ($p<0.05$) different and lower as compared to CAL at 4-5 mm.




*p < 0.05 or **p < 0.001- as compared to < 3 m3
Fig. 2: Bar Graph Showing Mean Fev1/Fvc Ratio According To Cal Levels.

## Discussion

Patients were demographically matched . Smoking status was evaluated in both groups .A significant difference was seen in CAL in control group but not in case group between smokers and non-smokers similar to the findings by V.Deo (2009).[19] The findings of present study suggest chronic periodontitis as a potential risk factor for COPD A significantly higher mean OHI , PI , GI, PPD and Clinical Attachment Loss was found in individuals with COPD (case group) compared to control group. Similar findings - Scannapieco et al (1998),[20] Gracia and Hayes et al(1998)[14]. Notwithstanding, Scannapieco and Ho[20] and Hayes et al. found a tendency toward diminished pulmonary function with increasing clinical attachment loss. In a retrospective longitudinal study Dental plaque can serve as a reservoir for potential respiratory pathogens. (Yuan A et al 1994).[21] Poor oral hygiene results in an increase in mass and complexity of dental plaque ,which may foster bacterial interactions between indigenous plaque bacteria (P.gingivalis, F. nucleatum) and acknowledged respiratory pathogens (P.aeruginosa, Klebsiellapneumoniae) which are shed into saliva. (F A Scannapieco1998).[14] As Clinical Attachment Loss increased, the mean FEV1/FVC (%) decreased - an inverse relation between CAL ( periodontal disease ) and FEV1/FVC% (COPD).Subjects with more clinical attachment loss had a higher prevalence of diminished lung function . Similar results by Scannapieco and Ho(1998).[21] In untreated periodontal disease cytokines produced by epithelial and connective tissue in response to these bacteria include IL-1a.IL-1ß, IL-6, IL-8 and TNF-a Theyrecruite neutrophils to infiltrate airway parenchyma and release proteolytic enzymes and toxic oxygen radicals damage respiratory epithelium making it more susceptible to COPD (Travis et al1994). Oral hygiene maintenance by chemical and mechanical means leads to reduction in progression of COPD (Azrpazooh 2006).Smoking has also been reported to be a residual confounding factor in studies of associations between oral conditions and respiratory infections, given that this compromises the mucociliary barrier and phagocyte activity. Some studies have shown that the worse the periodontal condition, the greater the risk of chronic obstructive pulmonary disease among smokers [22],[23]. Good oral hygiene seems to diminish the levels of enzymes that degrade fibronectin, which originate in the dental biofilm or polymorphonuclear leukocytes found in saliva[24],[25]. DeRiso et al.testedoropharyngeal decontamination using 0.12% chlorhexidinedigluconate in patients who would be undergoing surgical procedures. They obtained a reduction in the nosocomial infection rate of 65%.[26]

## Conclusion

Present analysis substantiates chronic periodontitis as a potential risk factor for periodontal disease.

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# The Effect Of Incorporation Of Non – Metallic Fillers On The Strength Of Polymethymethacrylate

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**Abstract**

**Context:** The strength of denture base resin is of great concern & many approaches have been used to strengthen acrylic resin dentures.

**Aims:** To study the effect of incorporation of polyethylene, polyaramid, carbon, nylon fibers & glass (fibers & flakes) on the strength of PMMA and evaluate the relative effectiveness of different fibers in providing the reinforcement.

**Settings and Design:**

**Methods and Material:** Rectangular specimens of Polymethylmethacrylate (PMMA) and PMMA reinforced with different types of fibers and flakes, having standardized proportion were prepared for testing tensile and impact strength. For testing compressive strength, cylindrical specimens of standardized size were prepared. All the fillers had a concentration of 5% by weight and were tested for their respective tensile, compressive & impact strength.

**Statistical analysis used:** Significance difference between groups was calculated by using ANOVA and unpaired 't' test and p? 0.05 was taken as statistically significant.

**Results:** The highest values for the tensile strength were obtained for PMMA reinforced with polyethylene fibers and minimum for specimens with the glass flakes. Highest impact strength values were obtained for polyethylene reinforced PMMA and lowest for PMMA reinforced with nylon fibers. There was a drop in compressive strength for the entire specimen having different types of fibers & flakes as fillers.

**Conclusions:** Polyethylene fiber incorporation significantly increased the tensile & impact strength of PMMA whereas the nylon fiber incorporation led to a decrease in strength. Inclusion of in-organic fillers resulted in a generalized decrease in the compressive strength when compared to the control group suggesting that in the areas of high stress concentration, selective reinforcement by fibers can be resorted to.

**Key Words**

Polymethylmethacrylate resin, Polyethylene, Polyaramid, Carbon & Nylon fibers & Glass (fibers & flakes), Tensile strength, Compressive strength, Impact strength.

## Introduction:

The quest for an ideal denture base material has ever remained a challenge to the dental profession. Several materials have been tried with varying degrees of success & acceptance. The search, however, is still on to develop an ideal denture base material.

Denture bases are primarily made of metal or resins. Metal is not an ideal material since it is not aesthetic, has high co-efficient of thermal expansion and its fabrication is costly & technique sensitive. In contrast, resins have good aesthetic properties and they do not cause allergic reactions [1].

Since its introduction in 1937, Polymethylmethacrylate (PMMA) resin has maintained its superiority over the other denture base materials[2]. Although, many improvements have been made it sometimes fractures or crack in clinical use due to its low resistance to impact, flexural strength or fatigue failure [3].

Various approaches have been tried to improve the strength of (PMMA) resin, especially for its use in high stress areas in oral cavity. One such approach is to add a cross-linking agent such as polyethyeneglycol dimethacrylate. Others reinforce denture base polymer with fibers, metal wires or nets. Though these may increase the flexural and impact strength of denture base polymer, their use is limited because of the adverse effect on aesthetics [4].

The methods of incorporation of metal fillers into PMMA are difficult and the increase in flexural and tensile strength is not appreciable. Different workers have tried several non-metallic fillers such as nylon, rayon, glass, polyaramid, polyethylene, and carbon fibers as reinforcing agents. However there is no consensus regarding the exact improvement in enhancement of strength of PMMA.

Therefore, the present study was undertaken to accurately evaluate the increase in strength of PMMA by the incorporation of nylon, polyaramid, polyethylene, carbon fibers and glass (fibers & flakes).

## Subjects and Methods:

In the present study, strength characteristics of PMMA and PMMA incorporating 6 types of non-metallic fillers were studied. Specimens of unfilled PMMA and those reinforced with glass fibers, glass flakes, carbon, nylon, polyaramid and ultra high modulus polyethylene fibers were prepared and designated as group A, B, C, D, E, F and G respectively. They were tested for tensile, compressive & izod impact strengths. These specimens were prepared using PMMA (Trevalon*).

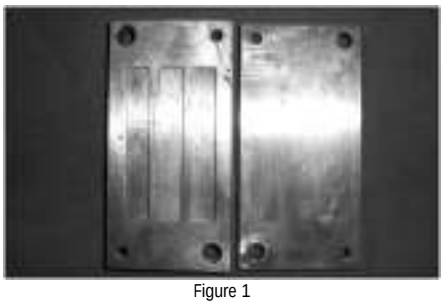

Figure 1

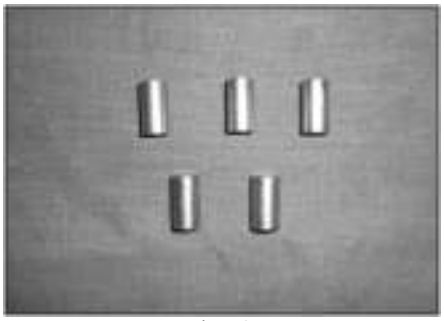

Figure 2

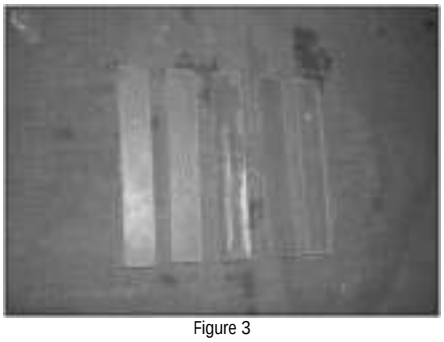

Figure 3

**Preparation of Samples:**

a) Preparation of standardized stainless steel moulds:

To have all the test specimens of similar dimensions stainless steel moulds were prepared according to ISO standards**(fig. 1).**

A stainless steel cylindrical (Diameter = 15mm, Length = 8mm) was prepared for testing compressive strength and a rectangular mould (Width = 6.5mm, Length = 10mm, Thickness = 3.3mm) was prepared for testing izod impact and tensile strength**(fig. 2)**.

**b) Preparation of wax patterns:**

i) For impact & tensile strength:

140 wax patterns (70 each for impact and tensile strength) were prepared by pouring molten wax in the stainless steel mould**(fig. 3)**. Any defect after wax was hardened was corrected to get the accurate dimensions. The patterns were then removed from the mould.

ii) For compressive strength:

70 wax patterns (10 for each group) were prepared. Cast metal (nickel-chromium) ingots of uniform size were used to make the specimens. The impression of the metal ingots was made in silicon based impression material and filled with molten wax, defects if any was corrected. The wax patterns were then flasked and cured.

iii) Preparation of PMMA Test Specimens:

The wax patterns were flasked and dewaxing was done. A single coating of even thickness of separating medium was applied on each half of the flask using a hairbrush.

Acrylic resin powder and liquid were taken in the ratio of 2:1 by weight and were mixed in a porcelain-mixing jar with a lid. When the mix reached the dough stage it was packed in the moulds. After trial closure, the two halves of the flask were finally closed ensuring metal-to-metal contact. Polymerization was carried out by a long curing method employing a temperature of 74°C for 9hrs in an automatic thermostatically controlled curing unit.

The PMMA specimens were then removed from the flasks, finished to remove flash and any roughness present. These specimens were used as control and designated as Group A.

The procedure was repeated to obtain 30 PMMA specimens, ten each for testing tensile, izod impact & compressive strengths.

iv) Preparation of PMMA Reinforced Test Specimens:

Six types of non-metallic fillers (fibers & flakes) were used namely, Glass fibers, Glass flakes, Polyacrilononitrile (PAN) based high tensile type II carbon fibers, Nylon fibers, wholly aromatic poly paraphenylenderphalamide aramid fibers and Ultrahigh-modulus polyethylene (UHMPE) fibers.

**Incorporation of fibers:**

All the fibers were wrapped in aluminium foil and were cut into 5mm length with the help of sharp BP blade in order to have uniformity in length.

The amount of polyaramid, polyethylene, glass, nylon, carbon and glass flakes incorporated into the PMMA was 5 % by weight in each case. The powder and liquid were taken in the ratio of 2:1 by weight. Prior to mixing of the fibers the amount of powder equal to the weight of the non-metallic fillers was reduced, to ensure 5% concentration of the fibers in the mix.

Polymer & monomer were weighted individually in digital weighting machine and 5% of total weight fibres were incorporated. The fibers were thoroughly wetted with monomer for at least 5minutes prior to adding the polymer. The components were mixed thoroughly to disperse the fibers uniformly. Once the dough stage was reached, it was packed into the moulds and processing and finished in manner similar to the control group. In all 30 test specimens of PMMA reinforced with various types of fibers were obtained for each group and designated as:

Group B - PMMA + Glass fibres.
Group C - PMMA + Glass flakes.
Group D - PMMA + Carbon fibres.
Group E - PMMA + Nylon fibres.
Group F - PMMA + Poly Aramid fibres
Group G - PMMA + Polyethylene fibres.

**Testing of specimens:**

20 specimens from each group were selected at random and tested for tensile strength **(Fig. 4)** and compressive strength **(Fig. 5)** by Universal Testing Machine (Instron)*. Remaining 10 specimens were tested for izod impact strength **(Fig. 6)** using impact tester.

The mean values for tensile, compressive & izod impact strength was calculated. These were recorded, studied, compared & statistically analyzed.

**Statistical Analysis:**

SPSS version 12.0 software carried the


Figure 4

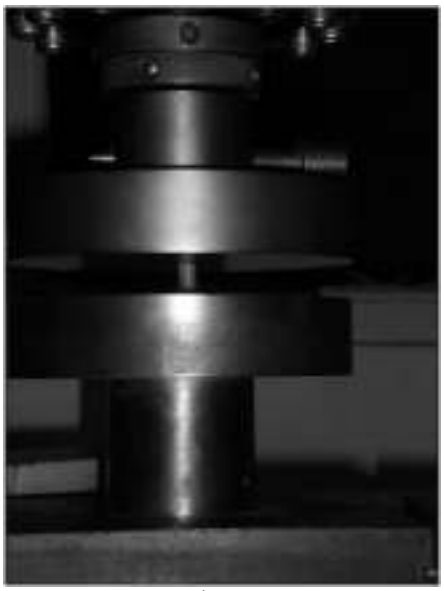

Figure 5

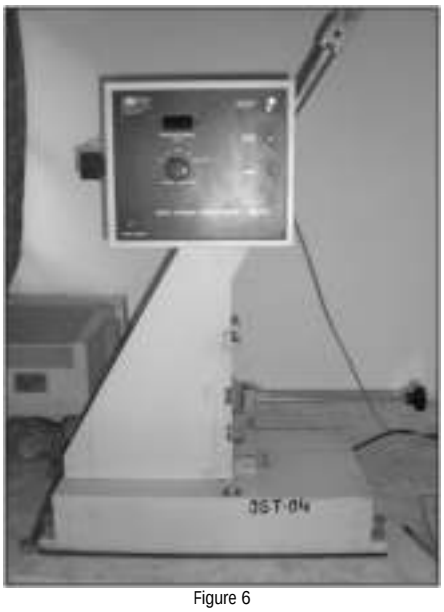

Figure 6

Table 1 : Shows The Values Of Mean ± Standard Deviation Of Each Group For The Tensile, Compressive & Impact Strengths.

| Groups | Tensile Strength | Compressive Strength | Izod Impact Strength |
|---|---|---|---|
| Group A | 34.91 ± 1.8905 | 109.268 ± 8.40 | 0.3405 ± 0.03342 |
| Group B | 43.24 ± 7.8987 | 98.92 ± 2.8621 | 0.3957 ± 0.0974 |
| Group C | 38.06 ± 3.8726 | 97.34 ± 3.6255 | 0.352 ± 0.1523 |
| Group D | 41.61 ± 4.2432 | 101.46 ± 4.7574 | 0.321 ± 0.0758 |
| Group E | 40.63 ± 4.0257 | 99.79 ± 3.0739 | 0.284 ± 0.0650 |
| Group F | 46.77 ± 6.4232 | 99.07 ± 3.2782 | 0.422 ± 0.1030 |
| Group G | 46.94 ± 7.0593 | 97.49 ± 13.5725 | 0.575 ± 0.1135 |

statistical analysis. Significance difference between groups was calculated by using ANOVA and unpaired't' test and $p<0.05$ was taken as statistically significant.

**Results:**

**(Table I)** shows the values of mean ± standard deviation of each group for the tensile, compressive & impact strengths. **(Table II)** shows significant difference among all groups at 0.01% & 0.05%.

Results indicated that the reinforcement of PMMA with fillers resulted in significant increase in tensile & impact strengths and decrease in compressive strengths respectively when compared to unfilled PMMA. When compared to the control group, experimental groups did not show statistically significant difference in impact strength except for group G & F.

**Discussion:**

Charles Goodyear developed the art of vulcanizing rubber in 1839. One early use of this material was for making denture bases. Vernonite was the first of the acrylic resin compounds formulated for dentistry to be introduced in United States and was perhaps the first application of the monomer-polymer principle anywhere [5].

The Academy of Denture Prosthetics in 1967 gave guidelines for the denture base materials to be used. Physiological compatibility was judged the most important factor and cost to be least important for selection of a denture base material [6].

Acrylic resins have been used extensively for the fabrication of denture bases because they provide large number of advantages than any other material. However, one of the major drawbacks to use acrylic resin as denture base material is its susceptibility to fracture. The PMMA-denture base is far from being a satisfactory denture material in fulfilling the mechanical requirements of prostheses [7].

Acrylic denture base resins are available in two forms:

- Gel or plastic cakes; with the gel or plastic cake, the monomer & polymer have been premixed & packaged as soft, rubbery, one-unit cakes ready for immediate use.
- Powder-liquid; the powder-liquid is more common. The liquid is mixed with the powder, the monomer plasticizes the polymer to a dough stage, which is packed into the mold prior to polymerization of the monomer. The resulting denture base is composed of solid, homogenous resin [8].

Beyli[9] said that deformation and or movement of the denture during function will affect both supporting tissues and denture base itself. Maxillary dentures are subjected to bending deformation, with tensile stresses occurring at the labial aspect and lingually to the incisors, then onto the polished surfaces. Compressive stresses occur towards the tissue surface, with greater values beneath the teeth and on the ridge than those toward the palate.

Johnston[10] concluded that the fractures in dentures result from two different types of forces viz. impact and flexural fatigue. While impact may occur when denture is dropped, flexural due repeated flexing from chewing ultimately fatigues the dentures in the mouth.

Stress concentration in the material may be present in the unloaded state when thermal changes have occurred. Differential thermal contraction between an inclusion and the denture material or between the surface and the interior of the material itself produces residual forces due to the local restriction of the shrinkage of the polymer. The residual stresses reveal themselves as crack formation[11].

The intrinsic strength of the material is affected by the composition, which depends partly on the curing technique used. It is the amount of the residual monomer remaining after curing[12].

The inclusion of the metal strengtheners in the form of wires, meshes, plates usually resulted in the development of plane of coverage between the acrylic & the reinforcement because of greater thermal contraction of the metal, which could lead to early failure of the prosthesis[13].

Table II: Two Way Repeated Measure Anova For Statistical Significance Between Study Groups At 0.01% & 0.05%.

| Source of Variation | d.f | Sum of Square | Mean of Sum of Squares. | F-ratio | F-tabulated | P value |
|---|---|---|---|---|---|---|
| Between groups | 7-1 = 6 | 16020.19 | 2670.30 | 81.71 | 6.4 at 1% | P < 0.1 |
| Residual | 14 | 457.13 | 32.65 | - | 4.68 at 5% | P < 0.5 |
| Total | 21-1 = 20 | 16477.32 | - | - | - | - |

Reinforcement of dental resin with short or long fibers has been described in the literature for nearly half a century now. Several different types of fibers have been used, with varying results but fiber reinforcement has never been adapted to routine clinical practice. Effective fiber reinforcement is dependent on many variables, including the type of fibers in the matrix, the modulus and distribution of the fibers, fiber length, orientation, forms, and interfacial bond.

Orthopedic acrylic resin-based bone cements have successfully been reinforced with glass, carbon, and aramid fibers. In periodontics, glass & polyethylene have been tested as additives to BIS-GMA resin for temporary splints to immobilize teeth. In orthodontics, the use of aramid fibers has been studied useful in reinforcing orthodontic appliances. In prosthodontics, fibers have been used to improve the fracture resistance or moduli of elasticity of polymer materials.

In the present study, five percent concentration of 5mm length of glass, carbon, nylon, polyaramid, UHMPE fibers were used to reinforce the PMMA heat cure denture base resin. The 5% concentration of fibers produced dry, friable dough which was difficult to pack at the recommended powder-liquid ratio of 2.5:1 by weight, so to avoid this 2:1 ratio of the mix was taken for proper wetting and mixing of the fibers.

On comparing tensile strength of the study groups, PMMA reinforced with Ultra High Modulus Poly Ethylene (UHMPE) showed maximum values and control group minimum values respectively. Therefore it is suggested that we choose such fillers for the reinforcement of acrylic resin in areas where there is maximum stress concentration. (Ex: in case of maxillary labial notch to provide relief for labial frenum.)

The control group exhibited higher compressive strength values than all the experimental groups suggesting that the reinforcement of PMMA with different types of fibers resulted in decrease of its compressive strength.

The impact strength when compared showed the maximum value for group G (PMMA + UHMP) i.e. 0.575 J/m2, group E 0.284 J/m2 having minimum value. The fibers prevent the propagation of the cracks as a result of higher concentration of stresses.

In case of compressive strength there was statistical difference in between all the groups but in the case of izod impact strength statistical difference was found only in group F & G. The mode of failure is when the material is stressed past its limits. The mode of failure for glass fibers is due to the splintering (breakage), whereas in case of the polyethylene fiber is due to their bending i.e they don't fracture. Nylon & aramid fibers proved difficult, because during packing of reinforced acrylic resin, some fibers spread out laterally in the mold. This could be observed by opening the flask after the trail closure. In order to overcome this problem, through kneading of the monomer-fibers-polymer was carried out prior to packing.
Results of the present study indicate that reinforcement of acrylic resin by ultra high-modulus polyethylene, polyaramid, carbon & nylon fibers & glass (fibers & flakes) especially UHMPE results in significant increase in tensile & impact strength of PMMA. Areas in complete denture where there is likelihood of fracture (eg. upper complete & lower natural teeth) selective reinforcement of maxillary denture is advisable to prevent or minimize the chances of fracture as a result of stress concentration.

PMMA, which is most extensively used as a denture base material, does not fulfill all the desirable properties especially those regarding the strength & polymerization shrinkage. In foreseeable future another material, which can overcome the shortcoming of acrylic resin, could be developed, in view of the ongoing research.

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# Evaluation Of The Use Of Gothic Arch Tracing Width As A Guide For Positioning Of Artificial Teeth: A Clinical Study

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**Abstract**

**Purpose :** Several guidelines for positioning of artificial teeth in complete denture fabrication exist. Anatomical landmarks, although much discussed, are not solely reliable indicators of tooth position. Scant information is present in the literature regarding the use of mathematical ratios for arrangement of artificial teeth. The purpose of this investigation was to determine if any relationship existed between the width of a Gothic arch tracing and the intercanine width in an Indian population.

**Materials and Methods :** Twenty subjects participated in this study and performed mandibular movements to record an arrow-point tracing on an intraoral tracing plate using a stylus embedded in a palatal plate made of autopolymerizing acrylic resin. The width of the tracing was measured. The intercanine width of the subject determined from an accurate diagnostic cast was divided by the tracing width to obtain a ratio.

**Results :** A mean ratio of 2.13 (s.d. = 0.26) was calculated for the given sample. No significant differences were seen between the male and female groups ($p<0.05$).

**Conclusions :** The width of the Gothic arch tracing can probably be used as in indicator for artificial tooth positioning.Results of this study may be tested in a larger study sample to evaluate reliability for use as a mathematical index for anterior teeth arrangement.

**Key Words**
Ratio, Mathematical Index, Intercanine Width, Gothic Arch Tracing Width, Intraoral Tracing, Arrow-point tracing

## Introduction

The arrangement of artificial teeth during complete denture fabrication constitutes a critical decision-making step in prosthodontics in that, objective scientific principles must be followed to realize the patient's largely subjective expectations of what the eventual appearance of the prosthesis might be. Pre-extraction records such as good quality photographs and diagnostic casts, all of which provide valuable information about previous tooth positions, are rarely available to the attending operator, except for when the patient has previously received an immediate denture prosthesis. As a result, the task of first selecting and then correctly arranging the artificial teeth is made difficult.

While several methods are available to aid in selecting the "correct" tooth mold[1],[2],[3],[4],[5], artificial teeth arrangement remains, for the most part, guided by either anatomical landmarks in the immediate vicinity of the denture teeth[6], or by means of prefabricated templates[7],[8], or even by arbitrary means based on one's experience and idea of a final esthetic result.[9]

Amongst the various anatomical landmarks, the incisive papilla has been the subject of much study with regards to its validity as a stable landmark for artificial teeth arrangement.[10],[11],[12],[13] However, the shape, positional relation to natural teeth prior to extraction and post-extraction position of the papilla has been shown to be variable. Latta and others, while investigating the reliability of some routinely used facial measurements in 109 edentulous subjects, concluded that the inter-alar width, inter-pupillary distance and bi-zygomatic width show great variations and, consequently, are unreliable for use as guides for positioning denture teeth.[3]

El Gheriani and Winstanley correlated the distance between the side-arms of Gothic arch tracings obtained from 25 subjects of different races, with maxillary inter-cuspid distances measured from the same subject. Their findings showed that the inter-cuspid distance was almost twice the side-arm width of the tracing record.[14]

Further attempts at deriving mathematical relationships for tooth positioning have been made. The same authors examined the relationship between the distance between the buccal cusps of natural maxillary teeth and the side arms of a Gothic arch tracing and found a constant ratio between the measured variables.[15] When applied clinically, the authors found that 38 out of 40 patients who received dentures fabricated by using the mathematical index for teeth arrangement were more satisfied at the end of a 1-week trial, when compared with dentures in which teeth were arranged conventionally.[16]

Keshvad and Winstanley studied the relationship between the intercondylar width and interdental widths of the maxillary and mandibular canines and first molars. A strong correlation was found between the measured variables and a set of indices was developed from the results to be used for the positioning

of complete denture teeth.[17]
The purpose of the present study was to determine if there was any relationship between the width of the side-arms of the Gothic arch tracing (GATW) and the inter-arch distance between the maxillary canines in an Indian population (ICW).

**Materials and Methods**
20 adult Indian subjects (10 males & 10 females) aged 19-29 years were selected for this study. All subjects had a full complement of natural teeth (up to 2nd molars), with no history of orthodontic treatment, orthognathic surgery, Temporomandibular Joint (TMJ) pain or dysfunction, no full veneer restorations on the maxillary canine teeth and no evidence of attrition or periodontal disease.

Maxillary and mandibular full-arch impressions were made using irreversible hydrocolloid impression material (Zelgan, Dentsply India) in perforated rim-lock stock metal impression trays (Addler Co., Germany). The impressions so obtained were then poured in dental stone (White Gold Dental Stone; Rajkot, India) to obtain diagnostic casts.

A palatal plate was fabricated using autopolymerizing acrylic resin (RR; DPI, Mumbai, India) by the sprinkle-on technique on the maxillary cast and a stylus with an adjustable height-screw **(Fig. 1-A)** was embedded on the plate using heated modeling plastic impression compound (Pinnacle; DPI, Mumbai, India) such that the point of the stylus rested on the intersection of an imaginary line passing between the first and second premolars on each side and the midline of the cast **(Fig. 1-B)**. A metal intraoral tracing plate was then coated with soot to serve as the tracing medium. The plate was immobilized intraorally by means of heated modeling plastic impression compound placed laterally on the under-side so that when pressed against the occlusal surface of the mandibular teeth and cooled, it would maintain the stability of the plate while the tracing procedure was in progress **(Figs. 1-C, D)**. Intraorally, the stylus screw was adjusted to eliminate occlusal contacts between opposing natural teeth during lateral and protrusive movements with minimal tooth separation. The subjects were then instructed to move the mandible from a retruded position forward into protrusion

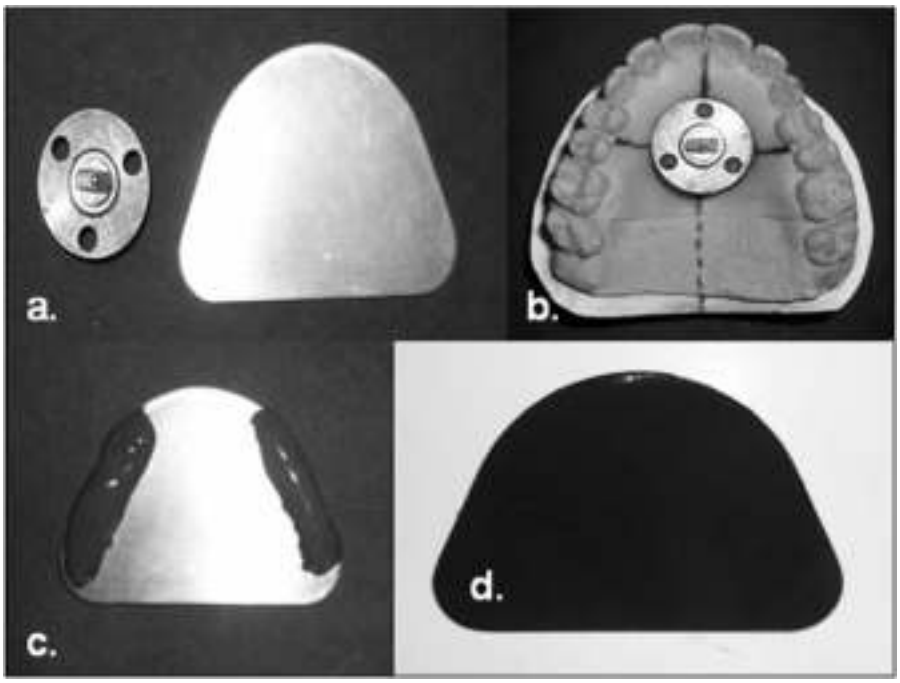

Figure 1: Preparation Of Gothic Arch Tracing Plates:
1a. Stylus / Central Bearing Point And Intraoral Tracing Plat, 1b. Stylus Attached To Palatal Plate Made Of Autopolymerizing Acrylic Resin Using Modeling Plastic Impression Compound, 1c. Intraoral Tracing Plate With Softened Modeling Plastic Impression Compound On Underside, 4a. Intraoral Tracing Plate Covered By A Layer Of Candle Soot.

Figure 2: Mandibular Movements Performed By Subject:
2a. Maximum Right-lateral Excursion
2b. Maximum Protrusion
2c. Maximum Left-lateral Excursion

and then back again. Lateral movements of the mandible were then introduced and the subjects were asked to make excursions to both right and left extremes of mandibular movement **(Figs. 2-A, B, C)**.

The plate bearing the arrow-point tracing was then retrieved from the mouth and a digital caliper (Zoom, accurate up to 0.01mm) was used to make the following measurements (in millimeters):

1. The distance between the ends of the right and left arms of the Gothic arch tracing **(Fig. 3-A)**.
2. On the maxillary cast, the distance between the lingual inclines of the tips of the natural canine teeth **(Fig. 3-B)**.

Mean values for ratio between intercanine width and Gothic arch tracing width were then calculated.

**Results**
The results are presented in Table 1. The intercanine widths of the subjects were divided by the distance between the arms of the Gothic arch tracing and in each case a ratio was obtained. Male subjects showed a mean ratio of 2.18 (S.D. = 0.30) as against females who recorded a mean ratio of 2.07 (S.D. = 0.23). The mean ratio for both sexes was 2.13 (S.D. = 0.26). No significant differences were found between the mean ratios obtained for

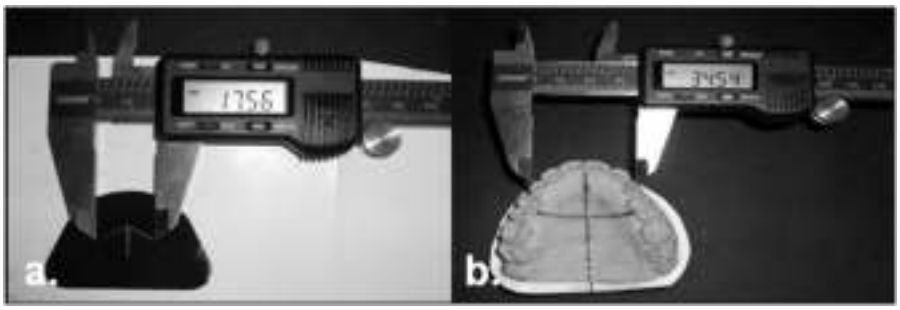


Figure 3: Measurements
3a. Distance Between End-points Of Lateral Arms Of Tracing Measured In Millimeters Using A Digital Caliper, 3b. Distance Between Lingual Inclines Of Cusp Tips Of Maxillary Canine Teeth On Diagnostic Cast Measured In Millimeters Using A Digital Caliper.

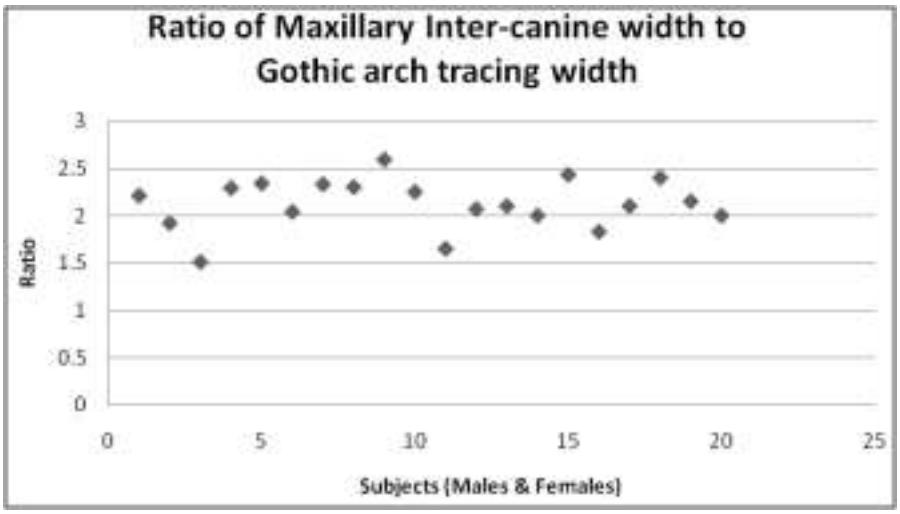


Figure 4: Ratio Of Maxillary Inter-canine Width To Gothic Arch Tracing Width

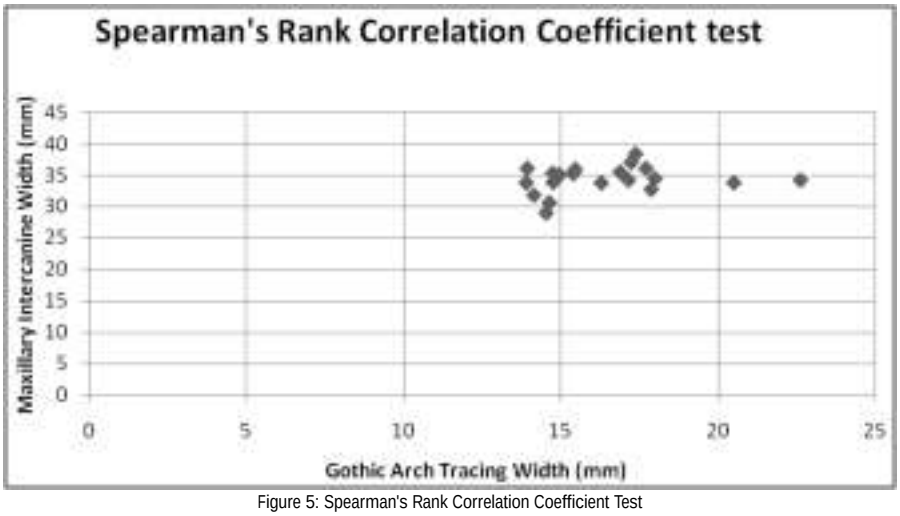


Figure 5: Spearman's Rank Correlation Coefficient Test

male and female subjects (Mann Whitney U = 36, n1 = n2 = 10, P < 0.05 two-tailed) **(Fig. 4)**. To examine the correlation between the maxillary intercanine widths and the Gothic arch tracing widths, a Spearman's rank correlation coefficient test was performed **(Fig. 5)**. A moderate positive correlation was found to exist between the measured variables for the given sample (r=0.23).

## Discussion

The use of tracing devices to record a Gothic arch was first suggested by Gysi in the early 1900s.[18] The Gothic arch tracing represents the border movements of the mandible in the horizontal plane with its apex indicating the most retruded position of the mandible.[19] Its principal application in prosthodontics has been to verify the centric relation position recorded at the time of the jaw relation appointment. While this practice continues to hold on, few attempts have been made to obtain additional information from the tracing itself. This study has attempted to evaluate any relationship that might exist between the intercanine width of the maxillary arch and the width of the subject's Gothic arch tracing.

Table - 1

| Subject No. | Sex | Age (Years) | Maxillary Intercanine Width (mm) | Gothic Arch Tracing Width (mm) | Ratio |
|---|---|---|---|---|---|
| 1 | M | 25 | 38.42 | 17.36 | 2.21 |
| 2 | M | 25 | 34.51 | 17.97 | 1.92 |
| 3 | M | 22 | 34.26 | 22.59 | 1.51 |
| 4 | M | 23 | 35.29 | 15.38 | 2.29 |
| 5 | M | 22 | 35.09 | 14.95 | 2.34 |
| 6 | M | 22 | 36.09 | 17.69 | 2.04 |
| 7 | M | 26 | 35.99 | 15.44 | 2.33 |
| 8 | M | 26 | 33.93 | 14.74 | 2.3 |
| 9 | M | 21 | 36.14 | 13.92 | 2.59 |
| 10 | M | 22 | 31.87 | 14.13 | 2.25 |
| 11 | F | 21 | 33.86 | 20.48 | 1.65 |
| 12 | F | 25 | 33.83 | 16.27 | 2.07 |
| 13 | F | 20 | 30.71 | 14.62 | 2.1 |
| 14 | F | 26 | 34.27 | 17.13 | 2 |
| 15 | F | 25 | 33.85 | 13.89 | 2.43 |
| 16 | F | 19 | 32.79 | 17.85 | 1.83 |
| 17 | F | 21 | 35.54 | 16.87 | 2.1 |
| 18 | F | 20 | 35.39 | 14.73 | 2.4 |
| 19 | F | 20 | 37.09 | 17.22 | 2.15 |
| 20 | F | 26 | 29.06 | 14.52 | 2 |
| Mean | | 22.85 | 34.40 | 16.39 | 2.13 |
| S.D. | | 2.41 | 2.15 | 2.26 | 0.26 |

As seen from **(Table 1)**. a mean ratio of 2.13 was found to exist between the previously mentioned variables. No significant differences were found to exist between the mean values for male and female subjects. This result is in agreement with those of El Gheriani and Winstanley where it was found that the Gothic arch tracing width was on an average half of the maxillary intercanine width (mean ratio : 2.04).[14] In that study, Caucasian, Malaysian and Arabic subjects were assessed using a similar methodology and mean ratios for ICW:GATW of 1.9, 1.98 and 2.2 were obtained respectively.[14] The authors did not group subjects based on sex and consequently any differences that might have existed therein were not statistically analyzed.

In this study, a positive correlation, although weak (r=0.23), was found to exist between the measured variables

suggesting that the Gothic arch tracing width increased with increases in the intercanine distance, contributing to the similar ratios obtained for a majority of the subjects. Further studies are required to validate and generalize the results of this study by considering a larger and more diverse sample of the Indian population. Additionally, other variables such as effect of arch form on the derived ratio may also be investigated.

Although not comparable, it may be noted that mathematical indices or ratios of the type obtained here have been derived independently, and tested for reliability, by Keshvad and Winstanley while studying the relationship between the intercondylar and intercanine widths.[17]

**Conclusion**

Within the limitations of this study, it can be concluded that a mean ratio of 2.l3 exists between the maxillary intercanine width and the width of a Gothic arch tracing obtained from subjects of an Indian population.

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# A Study To Compare The Accuracy Of Three Interocclusal Registering Materials

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**Abstract**
The precise relation of maxillary and mandibular casts is an essential step in developing accurate occlusion in prosthodontics. When an adequate number of opposing teeth and stable intercuspation exist, direct occlusion of the casts is the most accurate method of articulation. In the absence of definitive occlusal contacts for direct relation of the casts, an interocclusal record is required. The introduction of different interocclusal recording materials has put clinicians in dilemma that which material should be used in routine clinical practice for precise recording and transferring of accurate existing occlusal records for articulation of patient's diagnostic or working casts in the fabrication of good satisfactory prosthesis.

**Key Words**
Interocclusal records, wax, zinc oxide eugenol, vinyl polysiloxane, Buhnergraph.

## Introduction:

Interocclusal registration materials record the occlusal relationship between natural and/or artificial teeth for planning occlusal rehabilitation and for construction of removable and fixed partial dentures. According to Dawson[6], criteria for accuracy in making interocclusal records include the following points (1) the recording material must not cause any movement of teeth or displacement of soft tissues, (2) the recording material must fit casts as accurately as the teeth intraorally (3) the accuracy of the jaw relation record should check in the mouth and on the casts. The cause of occlusal discrepancies attributable to the interocclusal record can be divided into three categories one cause is related to the biologic characteristics of the somatognathic system, and a second cause is attributed to iatrogenic errors related to manipulation of the material[9]. The third cause is associated with the properties of the interocclusal recording material and an inappropriate relationship of the maxillary to the mandibular casts on an articulator[2],[7],[11],[12],[13],[14],[15],[16]. An inaccurate transfer of the interocclusal records results in poor mounting of the casts in the articulator with concomitant diagnostic and treatment errors[2].During the process of transferring the relations, changes are common in the vertical and horizontal dimensions of the position of the jaws. A material inserted between the maxillary and mandibular teeth can cause deviation from a normal intercuspal position in the vertical, anteroposterior, mediolateral and combined directions[1]. Ideally the material used to obtain precise interocclusal records should offer no resistance to closure, have desired flow and permit the masticatory mechanism to operate free from any interference. Plaster, modeling compound, wax, and acrylic resin are materials routinely used for the registration of the occlusal relationship. Some are difficult to use; that is, they are brittle, unstable, and/or inaccurate[3]. Zinc oxide pastes and elastomers are the most popular materials for making interocclusal records[2],[16] polyvinyl siloxane material for inter dental records was reported to have high dimensional accuracy and ease of manipulation[5]. In the present study, an attempt has been made to evaluate and compare the clinical accuracy of three interocclusal recording materials and to find out the most accurate material that can be used in routine clinical practice.

## Materials And Methods:

The subjects for this study were selected from the department of Prosthodontics. Ten subjects of both the sexes were included in the study. Subjects were in the age group of 21 to 30 years. The criteria for selection were that the subjects possessed a full complement of teeth (excluding third molars); there was no history of TMJ dysfunction or MPD syndrome, no carious, hypoplastic or broken teeth, with sparse restorative treatment and adequate posterior and anterior occlusal stops. The following materials and equipments were used in this study: Rim-Lock impression trays-used for irreversible hydrocolloid impressions of the subjects. Bite registration trays[1]-used for carrying interocclusal registration materials. Irreversible hydrocolloid impression material[1] was used for impressions of each arch of the subjects studied. All casts were poured in, Dental stone[2] plaster Class-Ill. A Whip-mix articulator (Semi adjustable arcon type) and a whip-mix arbitrary face bow were used in this study. Three types of interocclusal registration materials were used. Pink modelling wax sheets, Zinc OxideEugenol Bite Registration Paste and Vinyl Polysiloxane Bite registration Material were used for interocclusal records. Graph paper with 1 mm squares reinforced with card-sheet was also used. The reinforcement reduced distortion on the graph paper while the recordings were being made. Inks of different colours were used to designate individual recording. Red ink was used to record position of hand articulated casts on graph paper. Black ink was used to record position of casts with wax interocclusal records. Blue ink was used to record position of casts with vinyl polysiloxane interocclusal records. Green ink was used

to record position of casts with zinc oxide eugenol interocclusal records.

**Method:**

Irreversible hydrocolloid impressions of each arch were taken for each patient. These were immediately poured in stone and mounted on a Whip-Mix articulator with the arbitrary face-bow. With hand articulation the mandibular cast was mounted to the maxillary cast in maximum intercuspation. The interocclusal record with each material was taken three times, for each subject i.e. for each subject three wax interocclusal records, three Zinc oxide eugenol records and three Vinyl Polysiloxane records were made.The condylar spheres were removed from the articulator and replaced by the attachment of a Buhnergraph **(Fig. 1)**. Maxillary casts of each patient were mounted with an arbitrary face-bow on an arcon articulator and the mandibular casts were carefully hand-mounted to the upper casts in maximum intercuspal position **(Fig. 2)**. Graph paper with 1 mm squares was attached to card sheet for reinforcement and placed on the outer surface of the condylar housing of the articulator **(Fig. 3)**. Red ink was placed on the Buhnergraph styli. The position of the tips of the inked styli was marked on the graph paper. This point was designated as point O. The styli were then removed and cleaned, and a different colour of ink was placed on them. An interocclusal record was placed on the maxillary cast, the mandibular cast was set in the record and both casts were carefully supported in the imprints of the record **(Fig. 4)**. Again the positions of the tips of the styli were marked on the graph paper and the point obtained was designated as point R. The procedure was repeated for each interocclusal record. Measurements of the right and left condyle were recorded for each interocclusal record. In order to obtain precise results, the graph paper obtained after recording from samples were scanned and the size of image was increased proportionately. The enlarged images were then exported to CorelDraw for further measurement of the distance between two points i.e. point O and point R. **(Fig. 5)**. The centers of the points were assumed as the centers around which the density of the pixels was highest. Now two perpendiculars were dropped each from the center of each point. The point where they crossed each other was taken as base point for measurement. The vertical distance from this base point to the center of one point was taken as distance in Y-axis direction (vertical displacement) while the horizontal distance from this point to the center of the other point was measured as distance in X-axis direction (anteroposterior displacement). The values were measured upto three decimal points **(Fig. 6)**. Deviations measured (distance from Point O to Point R in mm) with different interocclusal records were divided into three groups:

Fig 1 : Showing Buhnergraph Attached To Whip-mix Articulator

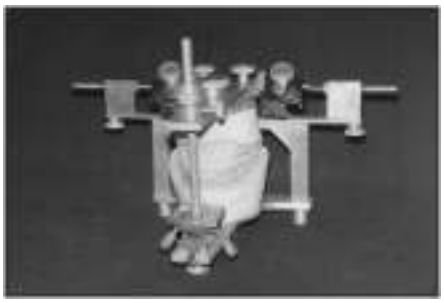

Fig 2 : Showing Maxillary And Mandibular Casts In Maximum Intercuspal Position

Fig 3 : Showing Inked Styli, Recording Position Of Casts On Graph Paper

Fig 4 : Showing Maxillary And Mandibular Cast With Interocclusal Record

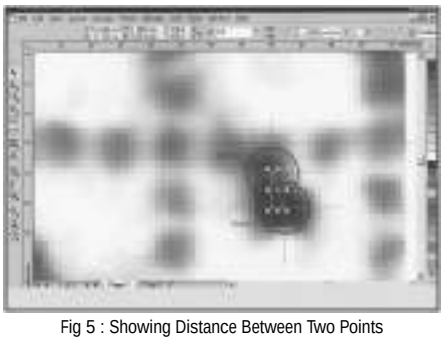

Fig 5 : Showing Distance Between Two Points

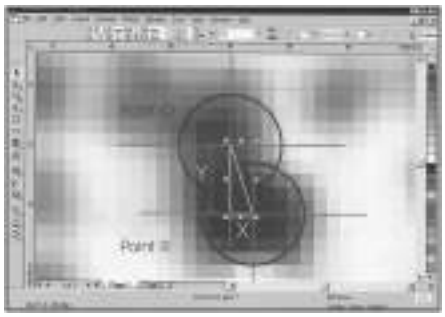

Fig 6 : Showing Distance Between Two Points On Y-axis And X-axis

Table - 1 : Comparison Of Vertical And Anteroposterior Deviation Of Different Groups On The Right And Left Side Of The Subjects

| Groups (Gr) | Anteroposterior Deviation | Vertical Deviation | 't' Value | 'p'value |
|---|---|---|---|---|
| Gr.Ar | 0.2956 + 0.3658 | 1.3492 + 0.6735 | 4.3992 | < 0.001 |
| Gr.Al | 0.2024 + 0.2085 | 1.0340 + 0.4866 | 5.0266 | < 0.001 |
| Gr.Br | 0.2328 + 0.3908 | 0.7384 + 0.6423 | 2.1521 | < 0.05 |
| Gr.Bl | 0.2042 + 0.1118 | 0.5848 + 0.4953 | 2.4173 | < 0.001 |
| Gr.Cr | 0.0864 + 0.069 | 0.1892 + 0.0649 | 3.1093 | < 0.01 |
| Gr.Cl | 0.0524 + 0.0425 | 0.2206 + 0.0776 | 6.0071 | < 0.001 |

**Group A:** Deviation measured with Wax interocclusal records

**Group B:** Deviation measured with Zinc oxide eugenol interocclusal records

**Group C:** Deviation measured with Vinyl polysiloxane interocclusal records
Each group was further divided in two subgroups as for each subject deviation on right and left side was measured separately.

Group A- (1) GroupAR (2) GroupAL

Group B- (1) GroupBR (2) GroupBL

Group C- (1) GroupCR (2) GroupCL

Statistical analysis of the available data was carried out to ascertain the level of significance of various observations.

**Discussion:**

Recording maxillomandibular relationship is an important step in oral rehabilitation. There are various methods of recording maxillomandibular relationships[18]. Direct interocclusal record is the most commonly used method because of its simplicity. Ten subjects with full complement of teeth and sparse restorative treatment were selected for this study. This was done to reduce the probability of any occlusal prematurity. As the proprioceptors in the periodontal ligaments of the prematurely contacting teeth will reflexly guide the mandible into the undesired centric occlusion position[23]. It was also considered that the subjects did not have any history of TMJ dysfunction as in mandibular dysfunction patients, the mandible may not assume a stable comfortable position before making a centric jaw registration[8],[10],[22]. Because materials for recording interocclusal relationships are used to transfer the position of the jaws to an articulator, the choice of material is important. Wax was used as an interocclusal recording material in the present study because it is one of the oldest and most useful materials in dentistry, its thermoplastic properties make its application simple. When waxes are compared with other available recording medium, they are decidedly inferior. However, waxes are still the most popular material because of cost and ease of manipulation[1]. Zinc oxide eugenol bite registration paste was used because it is a reliable interocclusal recording material. It shows low resistance to closure (0.5 to 0.6 N) than silicones, polyether and acrylic resin materials. The volumetric changes during registration and up to 30 minutes of storage were less than 0.5%[12]. Addition type silicones were introduced as an accurate and dimensionally stable interocclusal recording material[5]. The vinyl polysiloxane interocclusal registering material was used in the study with the help of auto mixing system. The material comes as a twin barreled syringe, each side of which extrudes an equal volume of material simultaneously through a disposable mixing tip, when loaded on a dispensing gun. The auto mixing concept is an improvement over the traditional method of mixing two pastes by hand spatulation. Uniform ratios of catalyst and base are always dispensed, which results in consistent mixing every time.

After selection of material, interocclusal record of each subject was taken three times with each material. This was done to minimize the iatrogenic errors i.e. related to manipulation of materials and errors related to the subjects i.e. deviation from the centric occlusion position after placing the interocclusal recording material[9].

The maxillary casts of all subjects selected for the study were mounted on a whip mix articulator with the help of arbitrary facebow. This facebow transfer allowed a more accurate arc of closure on the articulator when the interocclusal records are removed and the articulator is closed[4]. After mounting the maxillary cast on the whip-mix articulator with the help of facebow, the mandibular cast was mounted in maximum intercuspation ensuring adequate anterior and posterior occlusal stops in position thereby eliminating any possibility of instability[19],[20],[21].

The accuracy of recording material was evaluated by measuring the displacement of articulator hinge axis from its original position (the position without interocclusal record). To record thisdisplacement, a Buhnergraph was used in the present study. A Buhnergraph can record the vertical and anteroposterior displacement of articulator hinge axis while the other methods can record only the vertical change induced by the interocclusal recording material[1],[15].

**Group A** (wax interocclusal records) showed highest mean vertical deviation (1.3492 mm) and highest mean anteroposterior deviation (0.2956 mm) on both right and left side of subjects **(Table 1)**. The higher deviation observed with group A could be because of its greater resistance to closure, low dimensional stability and distortion on removal[11]. The dimensional stability of wax is also difficult to maintain because of its high thermal coefficient. Wax had the highest coefficient of thermal expansion (350 x 10-6/OC). Many studies[13],[14],[15],[17] were conducted on wax regarding its properties as an interocclusal recording material confirmed the present results. Group B (Zinc oxide eugenol interocclusal records) occupied an intermediate position between group A and group C for mean vertical deviation (0.7384 mm) and mean anteroposterior deviation (0.2328 mm) on both right and left side of subjects **(Table-1)**. Despite its good physical properties considerable deviation was observed with zinc oxide eugenol interocclusal records. Some of the factors responsible for the observed deviation could be: - (1) it, cracks and sticks to the teeth on removal from the mouth. Therefore the vital portions of record were lost through breakage; (2) the flash around the teeth prevented the accurate seating of casts. It is advisable to use a minimum amount of zinc oxide eugenol to avoid excess flash; (3) Interference from the carrier was also one of the factors responsible for the observed deviations. Carrier interferes with centric jaw closure by touching the inner surface of cheeks, tongue and other soft tissues[7].

**Group C** (Vinyl Polysiloxane interocclusal record) exhibited least mean deviation in the vertical and anteroposterior direction **(Table-1)**. Although polyvinyl siloxane interocciusal recording material showed least deviation (0.1892 mm in vertical direction and 0.0524 mm in anteroposterior direction), it has certain shortcomings, which may be responsible for the deviations observed. Polyvinyl siloxane material has a brief working time. An increase in viscosity coupled with the development of elasticity could cause distortion in interocclusal registration[12]. Polyvinyl siloxane material showed low initial resistance to closure but a rapid rise of resistance was seen during the working time[11].

**Conclusion:**

The present study was a clinical study therefore; certain factors could not be controlled although they had a pronounced effect on the accuracy of the recording materials. These factors are (1) temperature; (2) humidity; (3) closing pressure of the patient.

From the observation and analysis done in the study following conclusions had been drawn:

1. Vinyl polysiloxane was the most accurate interocclusal recording material. The deviation with vinyl polysiloxane was found statistically non-significant.
2. Zinc oxide eugenol bite registration paste was the next most accurate recording material. The deviation observed was 0.7384 mm to 0.5818

mm in vertical direction and 0.2328 mm to 0.2042 mm in anteroposterior direction.

3. Wax was found consistently unreliable interocclusal recording material. The deviation observed was 1.0340 to 1.3492 mm. in vertical direction and 0.2024 to 0.2956 in anteroposterior direction.
4. The deviation was found more in a vertical direction, followed by an anteroposterior direction for all the materials.
5. No significant difference was found in vertical and anteroposterior deviation when compared for right and left side of subjects.

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# A Comparative Evaluation Of The Fracture Resistance Of Teeth Restored With Glass Fiber Post And Biological Dentin Post Cemented With Adhesive Resin: An In - Vitro Study

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**Abstract**
**Aim:** The aim of this study was to evaluate and compare the fracture resistance of endodontically treated permanent maxillary central incisors restored with glass fiber post biological dentin post cemented with adhesive resin.
**Materials and Methods:** Root canal treatment was performed on all 80 maxillary central incisors and samples were divided into four groups of 20 each. Group 1: Restored as a positive control group without post space preparation and post cementation. Group 2: Restored with fiber post cemented with adhesive resin Group 3: Restored with biological dentin posts cemented with adhesive resin and Group 4: Restored as negative control group with post space preparation but no post placement. The teeth were loaded at 135° angle to their long axis after core build-up and the failure loads were recorded.
**Results:** One-way Analysis of Variance (ANOVA) and Bonferroni multiple comparisons revealed a significant difference among test groups with the positive control group showing the highest fracture resistance, followed by the dentin post group and lastly the FRC post group. The negative control group showed the least fracture resistance among the groups.
**Conclusion:** Teeth restored with dentin posts exhibited better fracture resistance than those restored with FRC posts.

**Key Words**
Dentin Post, Biological post, Flexural strength

## Introduction

Fracture of root filled teeth can be prevented by their proper restoration and reinforcement. The amount of remaining tooth structure is an important consideration for treatment planning. In case of badly broken down teeth where little tooth structure remains the root canal space is utilized for support of the crown restoration[1]. The resultant post and core provides the required retention and resistance form for the final restoration. The post and core equally distributes the torquing forces within the radicular dentin to the supporting tissues. It disperses the forces along the root and provides retention for the core that replaces the lost coronal tooth structure. [2],[3]

The fracture resistance of an endodontically treated tooth can be determined by the amount of remaining tooth structure. The post material and design plays a significant role in determining strength. Different posts have different physical properties. The post material should ideally exhibit physical properties like modulus of elasticity, compressive strength and thermal expansion as well as aesthetics similar to that of dentin. It should also bond predictably to root dentin.[4] The only material that fulfills all these requirements is none other than dentin itself. Biological posts made of root dentin exhibit properties similar to the tooth.[5] Hence its use as a post should be investigated.

The aim of this ex vivo study was to evaluate and compare the fracture resistance of endodontically treated maxillary central incisors restored with prefabricated fiber reinforced composite (FRC) posts and experimental dentin posts.

## Materials & Method:

Eighty freshly extracted maxillary central incisors with inclusion criteria of completely formed roots of similar sizes and exclusion criteria of absence of caries, visible fracture lines or cracks were selected for the study. Root canal treatment was performed on all the 80 specimens. Obturation was carried out by the cold lateral condensation method using a 40-size gutta percha (Dentsply) as master cone and AH-plus (Dentsply-Kronstaz, Germany), a non-eugenol endodontic sealer. The crown of each tooth was reduced to a height of 2 mm above the cemento-enamel junction in order to simulate the clinical situation of a reduced tooth structure so that the resistance to fracture of the post system used would be more relevant clinically. Post space was prepared for all the 60 specimens (20 specimens kept as a control group without post and post space preparation). A post space of depth 10 mm was standardized from the cut tooth surface that was taken as the reference point. A thin coat of polyvinylsiloxane (Aquasil ultra LV, Dentsply, Germany) was painted on the root surfaces of all teeth to within 1 mm of the CEJ, to simulate the effect of periodontal ligament. Samples were embedded

obliquely in triangular shaped acrylic blocks of 3×3×4 cm. During the procedure, samples were kept in distilled water to provide moist environment to avoid dehydration of the dental tissues. The prepared teeth were divided into four groups of twenty specimens each.

**Grouping of teeth and post insertion:**

Group 1: Twenty teeth which were obturated but with no post space preparation. The restoration of access openings done was with composite restoration (3M ESPE). (Positive Control group)

Group 2: Twenty teeth restored with prefabricated glass fiber-reinforced composite tapered posts (REFORPOST, Angelus)

Group 3: Twenty teeth restored with biological dentin posts.

Group 4: Twenty teeth in which post space preparation done without any post cementation and without restoration. (Negative Control group)

The posts were cemented using adhesive dual cure resins (Panavia F, Kuraray Co. Ltd., Japan). The core was fabricated with composite resin (3M ESPE FiltekTM Z 350 XT) for all groups.

**Preparation of experimental dentin posts:**

Ten healthy maxillary canines freshly extracted for periodontal reasons were selected. Each tooth was sectioned longitudinally (mesiodistally) into two halves along the root canal. Template was made of Pre-fabricated glass fiber posts which were selected for the study on putty impression material. Cylindrical dentin blocks were prepared out of each section using diamond drills under intense water cooling and were then subjected to generate twenty dentin posts of standardized shape and dimensions (12 mm length, 1.6 mm diameter) similar to FRC posts. **(Fig : 1)**

**Investigation of fracture resistance**

The samples were subjected to thermocycling (5000 cycles between $50^0$C to $55^0$C with a dwell time of 30 sec at each temperature) and stored in distilled water for 24 hrs at $37^0$C in a humidor (100% relative humidity) to simulate conditions in the oral cavity prior to the fracture test. A compressive load was applied using universal loading machine at CEJ on the palatal aspect, at an angle of $135^o$ to the long axis of the tooth at a crosshead speed of 5 mm/min. The load at fracture was measured and the mean was calculated using statistical analysis of Post Hoc Tests and Bonferroni testand the significance among the four groups was analyzed. The failure threshold was defined as the point at which the loading force reached the maximum value for fracturing the root, post or core. Mean failure load values were calculated for all groups. Data was analyzed using SPSS 14 software.

The descriptive statistics like mean and standard deviation of the fracture of positive control group, resistance of teeth restored with fibre reinforced composite (FRC) posts, experimental dentin posts and negative control group were identified. Prevalence of an outcome variable along with 95% confidence interval for mean was calculated.

**Results**

Positive Control group (Group 1) showed the maximum mean failure load value at 147.04 Kg, followed by the dentin post group (Group 3) and FRC post group (Group 2) at 116.20 Kg and 97.10 Kg respectively. Negative control group (Group 4) showed the least mean failure load at 68.20 Kg **[Table 1]**. Oneway ANOVA showed significant difference ($P < 0.001$) among the test groups **[Table 2]**. Post Hoc Testsmultiple comparison test **[Table 3]** revealed a significantly higher fracture resistance for the control group.

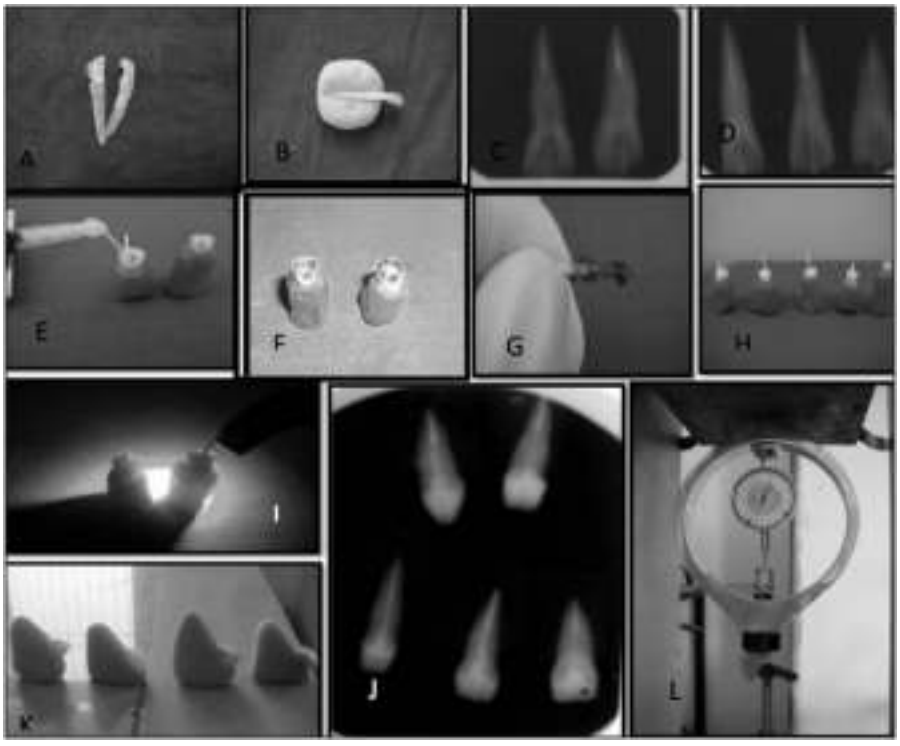


Figure 1

Table 1: Mean failure load values for fracture resistance of tooth (in Kg)

| Group | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| Positive control group | 147.04 | 0.918 | 4.107 | 145.204 | 148.876 |
| Fiber reinforced | 97.10 | 0.739 | 3.307 | 95.622 | 98.578 |
| composite posts | | | | | |
| Biological dentin posts | 116.20 | 0.766 | 3.427 | 114.668 | 117.732 |
| Negative control group | 68.20 | 1.204 | 5.386 | 65.792 | 70.608 |

Table 2: One-way Analysis of Variance (ANOVA)

| Group | Sum of Squares | D F | Mean Square | F-value | p-value |
|---|---|---|---|---|---|
| Between Groups | 65827.57 | 3 | 21942.52 | 1280.156 | 0.001** |
| Within Groups | 1302.68 | 76 | 17.141 | | |
| Total | 67130.25 | 79 | | | |

Table 3: Multiple Comparisons by Post Hoc Test

| (I) Group | (J) Groups | Mean Difference (I-J) | Std. Error | p-value | 99% Confidence Interval for Mean | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| Positive | FRC posts | 49.94* | 1.309 | 0.001 | 45.73 | 54.16 |
| Control | Dentin posts | 30.84* | 1.309 | 0.001 | 26.63 | 35.06 |
| | Negative Control | 78.84* | 1.309 | 0.001 | 74.63 | 83.06 |
| FRC | Positive Control | -49.942* | 1.309 | 0.001 | -54.16 | -45.73 |
| posts | Dentin posts | -19.10* | 1.309 | 0.001 | -23.32 | -14.89 |
| | Negative Control | 28.90* | 1.309 | 0.001 | 24.69 | 33.12 |
| Dentin | Positive Control | -30.84* | 1.309 | 0.001 | -35.06 | -26.63 |
| posts | FRC posts | 19.10* | 1.309 | 0.001 | 14.89 | 23.32 |
| | Negative Control | 48.00* | 1.309 | 0.001 | 43.79 | 52.22 |
| Negative | Positive Control | -78.84* | 1.309 | 0.001 | -83.06 | -74.63 |
| Control | FRC posts | -28.90* | 1.309 | 0.001 | -33.12 | -24.69 |
| | Dentin posts | -48.00* | 1.309 | 0.001 | -52.22 | -43.79 |

All the groups differed significantly from each other. Group 2 had a significantly lower fracture resistance than Groups 1 and 3 whereas group 4 had least fracture resistance among groups.

**Discussion**

The aim of this study was to evaluate the fracture resistance of teeth restored with glass fiber post and dentin post. The teeth selected for this in-vitro study were maxillary central incisors with the mean size of roots 13.45±0.22 mm in length, 6.35±0.12 mm in mesiodistal, and 6.95 ±0.25 mm in buccopalatal width. Thus standardization of the samples was maintained.

The sectioned roots were not embedded directly into the resin blocks. A thin layer of polyvinyl siloxane covered the roots. As this has modulus of elasticity very similar to natural periodontal ligament it simulated the same. The external reinforcement of embedded roots by the rigid acrylic resin was avoided. [6]

The standardization for post space preparation was achieved by use of calibrated low-speed drill provided by the manufacturer of FRC post to maintain the dimensions of the dentin post and post space same as that of FRC post. To eliminate any procedural technique sensitivity, a custom transparent matrix was used to standardize the dimensions of core build-ups. Dual-cure cement was used for the cementation of the post and for core build-up. This dual-cure resin cement has combined properties of both photo curing (sufficient time and control for proper seating of the post into the canal) and auto curing (polymerization without the influence of post space depth) systems. Moreover, this cement does not require any surface pre-treatment of the substrate such as silanation or etching. [7]

The compressive load was applied at a speed of 5 mm/min at an angle of 135°to the long axis of experimental teeth. This angle reflects the positions, contacts and loading characteristics of upper anterior teeth in Class I occlusion.[8] Guzy and Nicolls reported that for incisors, a loading angle of 130-135º is chosen to simulate a contact angle found in Class I occlusion between maxillary and mandibular anterior teeth[9]

The mean failure load value of the positive control group in our study was more than the experimental dentin post group because of more amount of remaining tooth structure.

Negative control group (tooth with post space prepared but without post cementation) showed the least fracture resistance among groups. This may be because of the hollow space, which did not allow even distribution of the load applied thus leading to fracture of the tooth. It has been suggested that remaining dentin thickness is a critical factor in the resistance of the dentin/root restorative complex during function. [10]

The determination of fracture resistance is of great importance after post cementation as, if the root fractures the tooth is invariably lost. A rigid post has a high modulus of elasticity which causes more stress to root dentin leading to irreparable damage.[10] In an attempt to reduce stresses on the root structure a post having modulus of elasticity similar to the dentin should be used. Carbon fiber, glass fiber posts having modulus of elasticity nearly identical to the dentin have been reported to cause less stress in the tooth and fewer root fractures[11, 12]. This results in a homogeneous unit causing reduction of stresses on the root.[13] A similar homogeneous unit is formed with a dentin post that results in uniform stress distribution. As the property of root dentin and dentin post are similar, both the units flex in a similar manner. The dentin post acts as a shock absorber, transmitting only a fraction of the stresses to the dentinal walls.[14] Gianluca Plotino et al in 2007 reported that flexural strength of FRC post and metal posts was respectively four and seven times higher than root dentin.[15] Metal posts have a high modulus of elasticity (110 GPa), which means that they are stiff and able to withstand forces without distortion. When a force is placed on a tooth containing a stiff post, it is transmitted to the less rigid root dentin, and concentrates at the apex of the post. Stress concentration in the post/root complex increases the chances of fracture. To overcome the concerns about unfavourable stress distribution generated by metal posts, fiber-reinforced composite resin posts were introduced in 1990, with the aim of providing more elastic support to the core.[16] The reduced stress transfer to tooth structure was claimed to reduce the likelihood of root fracture.Posts made of materials with a modulus of elasticity similar to dentin are more resilient, absorb more impact force, and distribute the forces better than stiffer posts.[17]

The failure of the FRC post group in this study may be attributed to the difference in the biomechanical properties between the FRC post and the root dentin. The modulus of elasticity of glass fiber posts is ~ 40 GPa whereas the modulus of elasticity of root dentin is ~ 14.2 GPa and of core material is ~ 13.5 GPa. This difference might create stresses at different interfaces and the possibility of post separation and failure. An added reason for failure at the post cement interface is the presence of interfacial gaps. Moreover, since the resin chemistry of the epoxy resin based posts and methacrylate-based adhesive resin differs completely, the adhesion achieved may not be reliable.[18] In the present study, teeth restored with solid dentin posts exhibited higher fracture resistance than those restored with FRC posts This is in accordance with a study conducted by Craig et al.[19] This can be explained on the basis that the Physiomechanical properties of dentin post are similar to dentin causing uniform stress distribution.[20] The potential advantages of dentin or biological post are: (1) does not promote dentin stress, (2) preserves the internal dentin walls of the root canal, (3) presents total biocompatibility and adapts to conduct configuration, favouring greater tooth strength and greater retention of these posts as compared to premanufactured posts, (4) presents resilience comparable to the original tooth, and (5) offers excellent adhesion to the tooth structure and composite resin and at a low cost. [21]

The limitations to the use of natural biological post made from extracted teeth are (1) Difficulty of finding teeth with a similar color and shape as that of the destroyed tooth, (2) Patient may refuse to accept a tooth fragment obtained from another patient, which prevents the execution of the restoration. [22]

**Conclusion**

Within the limitations of this study, it can be concluded that:

Teeth restored with dentin posts exhibit better fracture resistance than those restored with FRC posts. This pilot study opens an introductory gate in support of the clinical implications of dentin posts.

Dentin post may be a successful alternative to currently available post materials. However, further in vivo trials are required in this direction.

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# Peripheral Neurectomy For Trigeminal Neuralgia: A Retrospective Study Of 15 Patients

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**Abstract**
**Aim:** To evaluatethe efficacy of peripheral neurectomy as a surgical procedure in the treatment of trigeminal neuralgia in 15 patients.
**Materials and Methods:** Fifteen patients who underwent peripheral neurectomy were retrospectively reviewed for four years. The factors analyzed were the demographic details of the patients, side of involvement, branch of nerve involved, procedure used, postoperative complications, prognosis and any additional procedure used in cases of recurrences.
**Results:** There were no significant complications. Pain recurred in one patient who became more responsive to carbamazepine after the procedure while 14 patients achieved excellent pain control.
**Conclusion:** Peripheral neurectomy is an effective, safe method of pain control in trigeminal neuralgia.

**Key Words**
Facial pain, neurectomy, tic douloureux, trigeminal neruralgia

## Introduction

Trigeminal nerve is the largest of all the cranial nerves. It transmits sensory sensation to the face, oral and nasal cavities and most of the scalp and carries motor supply to the muscles of mastication. It has three major branches, the ophthalmic nerve, the maxillary nerve and the mandibular nerve. Disease involving the nerve can cause trigeminal neuralgia or loss of sensory or motor function in the distribution of the nerve. It can cause intense shooting pain along its distribution. Neuropathy can affect the nerve from its origin in brainstem to its peripheral branches. The commonest cause is vascular compression by superior cerebellar artery. An inflammatory cause like meningitis can also cause trigeminal neuralgia. After all conservative treatment modalities have been exhausted; various surgical methods may be advocated for the treatment of trigeminal neuralgia [1], [2], [3], [4].

The aim of this study is to investigate the efficacy of peripheral neurectomy as a surgical procedure in the treatment of trigeminal neuralgia and to evaluate the results obtained by this procedure and their recurrences in a period of 4 years follow up.

## Materials and Methods

Retrospective analysis of 15 patients with trigeminal neuralgia who underwent peripheral neurectomy from October 2008 to December 2012 was carried out **(Table 1)**. Patients with persistent pain after conservative treatment or intolerance to carbamazepine therapy and those who could not afford the cost of the drug were selected for neurectomy. The diagnosis was based on a detailed history, clinical examination and control of pain by Tab Carbamazepine. All these patients were taking Tab Carbamazepine (average 600–800 mg/day) for 2-3 years. The branch of nerve involved was identified according to the site of pain and confirmed with diagnostic block with 2% Lignocaine **(Table 2)**. All patients were investigated pre-operatively with OPG/computerized tomography scanning (CT) or magnetic resonance imaging (MRI), to rule out any underlying pathology. The follow-up period covered by this study ranged from 1 to 4 years. Intra- and post-operative complications, relief and recurrence of pain, any additional procedures used, were noted during the follow-up period.

Table 1: Summary of demographic, follow up and outcome characteristic of 15 patients treated for trigeminal neuralgia

| Sr. No. | Age | Sex | Side involved | Nerve involved | Follow-up (years) | Result |
|---|---|---|---|---|---|---|
| 1 | 61 | F | Right | Infraorbital | 3 | Good |
| 2 | 54 | M | Left | Inferior alveolar | 4 | Fair |
| 3 | 69 | M | Right | Inferior alveolar | 4 | Good |
| 4 | 67 | F | Right | Inferior alveolar | 4 | Good |
| 5 | 47 | F | Left | Supraorbital | 3 | Good |
| 6 | 66 | M | Right | Inferior alveolar | 2 | Good |
| 7 | 70 | F | Left | Inferior alveolar | 4 | Good |
| 8 | 52 | M | Right | Infraorbital | 1 | Good |
| 9 | 48 | M | Right | Inferior alveolar | 4 | Good |
| 10 | 65 | F | Right | Inferior alveolar | 4 | Good |
| 11 | 53 | F | Left | Inferior alveolar | 2 | Good |
| 12 | 65 | F | Right | Inferior alveolar | 4 | Good |
| 13 | 59 | M | Right | Inferior alveolar | 3 | Good |
| 14 | 56 | F | Right | Inferior alveolar | 4 | Good |
| 15 | 72 | F | Right | Inferior alveolar | 3 | Good |

The technique of peripheral neurectomy was:

1. Access to the infraorbital nerve was

Table 2: Summary of involvement of branches of trigeminal nerve.

| Sr. No. | Branch involved | Total | Percentage |
|---|---|---|---|
| 1 | Inferior alveolar | 12 | 80 |
| 2 | Infraorbital | 2 | 13.33 |
| 3 | Supraorbital | 1 | 6.66 |

through intra-oral approach. After taking upper vestibular incision, infraorbital foramen was visualized & infraorbital nerve and its peripheral branches were identified & avulsion of the nerve was performed from the soft tissues and from the infra orbital canal by reeling on haemostat.

2. Inferior alveolar nerve was approached intra-orally by Dr Ginwalla's incision[5], identified and avulsed from the distal end. Vestibular incision in premolar region was taken; the mental nerve was identified & avulsed from the mental foramen and from the soft tissues.
3. Supra orbital nerve was approached extra-orally by upper eyebrow incision. The nerve was identified and peripheral neurectomy was performed by avulsing the nerve.

All operations were performed under local anesthesia. Antibiotics and anti-inflammatory therapy was prescribed post-operatively. The outcomes were assessed in terms of relief of pain, recurrences of pain and the need for any other procedure to overcome pain. The complications specifically sought were infection at the site of operation, bleeding & suture dehiscence. They were graded as good, fair and poor.

- Good when there was no recurrence of pain,
- Fair when there was recurrence of pain after certain period of time,
- Poor when there was no improvement in pain episodes even after neurectomy.

**Results**

15 patients underwent neurectomies of which 9 were females and 6 were males and whose average age was 60.2 years (range 47–72 years) **(Table 1)**.

The third division (inferior alveolar) was most commonly affected by the disease, in 12 patients (80%) **(Table 2)**. The second division (infra orbital) was afflicted in 2 patients (13.33%) and the first division was involved in only one patient (6.66%). The right side was affected in 11 patients (73.33%), while left side in 4 patients (26.66%). Both facial sides were not affected in any patient in this series. The mean follow-up period was 3.26 years (range 1–4 years). There were no intra-operative or post operative complications. All patients were relieved of pain and had discontinued the medications. Only one patient (6.66%) had recurrence of pain after a period of 1 year. He was prescribed Tab Carbamazepine 200 mg 8 hourly and was relieved of symptoms.

**Discussion**

Trigeminal neuralgia, also known as tic douloureux or Fothergill's disease, is a clinical syndrome characterized by brief paroxysms of unilateral lancinating pain that is triggered by cutaneous stimuli, such as wind on the face, talking, chewing or brushing of teeth [6],[7],[8]. Many of those who are affected experience multiple attacks daily and though, free of pain during attacks, live in constant dread of recurrence [8].

Since its introduction in 1963, carbamazepine has become the treatment of choice in trigeminal neuralgia. However, experience shows 20-30% of patients require alternative treatment through failure of response or intolerance [9]. For them, a variety of procedures to modify or interrupt afferent impulses along the trigeminal pathway have been devised. Most authors agree that it should be gradual, from pharmacological therapy to very invasive, intracranial procedures[5],[8],[10],[11],[12]. Currently available surgical options are

**1. Non-invasive technique**

- Peripheral neurectomy,
- Alcohol injections,
- Cryotherapy,
- Selective radio frequency thermocoagulation

**2. Invasive technique**

- Open: microvascular decompression,
- Percutaneous:
  i. Radiofrequency rhizotomy,
  ii. Retrogasserian glycerol rhizotomy,
  iii. Balloon compression of trigeminal nerve,
  iv. Sterostatic radiosurgery - Gamma knife [13].

Any treatment of idiopathic neuralgia is successful as long as it eliminates the pain[14],[15]. The persistence of pain after pharmacological and injection (alcohol) therapies requires surgical intervention; these are the neurectomy of peripheral divisions of the trigeminal nerve and various neurosurgical procedures [15],[16],[17],[18]. Though alcohol block injections are also considered as minimally invasive procedures but they have severe draw backs & cause local edema, high risk of recurrent pain combined with moderate risk of dysthesia & necrosis of the surrounding tissues[16]. Neurectomy of the peripheral branches of the trigeminal nerve is the simplest, safest and minimally invasive surgical method craniotomy and neurosurgical procedures are costly, highly invasive, available at select centers and have higher rated of mortality and morbidity. [3],[4].

In the present study, an intra-oral approach to the infraorbital & inferior alveolar nerves has been employed. This access is found to be better, primarily due to avoidance of post-operative facial scars. Some authors use trans-facial access to the V2 division[19], due to lower chances of post-operative wound and edema.

Most of the studies done for neurectomy were published 20–50 years ago [20],[21]. Quinn[22] reported a retrospective case series of 63 patients with 112 neurectomies. A follow-up period of 0–9 years was noted, and the pain relief period of 24–32 months was reported. Grantham[20] also reported on 55 patients, who had neurectomies. The follow-up was for 6-months to 8 years and the average pain relief period was 33.2 months.

Several authors discuss the number of repeated neurectomy of peripheral divisions of the trigeminal nerve[2]. In the present study there was a single case of recurrence of neuralgic pain after a period of one year. The patient was prescribed 200 mg carbamazepine 8 hourly following which the symptoms were relieved. In addition, some authors state that the response of patients to carbamazepine in case of recurrence, improves after neurectomy[23] and lower doses of the medication are needed[2], which was also noted in the present study.

**Conclusion**

Trigeminal neuralgia is the most common cause of neuralgic pain in the facial region. Accurate diagnosis followed by low-dose carbamazepine is the first line of treatment. Surgery is reserved for patients refractory to the drug or adverse effects sufficient to mandate cessation. Peripheral

neurectomy consists of surgical avulsion of terminal branches of the trigeminal nerve. Loss of sensation along the branch of the trigeminal nerve is the sole disadvantage. However, it is one of the oldest, minimal invasive forms of surgery, well tolerated by the patient and can be done under local anesthesia, thus making it more cost effective. Due to the limitations of small sample size and short term follow-up in the present study, long term studies with large sample size are required to validate the results.

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# In-Vitro Comparative Study Of Mechanical Properties Of Type V Die Stone And Epoxy Resins

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**Abstract**

**Background:** Since the advent of elastomeric impression materials, the use of indirect technique for fabrication of the prosthodontic restorations has become almost universal. Success of these techniques is dependent on the availability of a die material that meets certain mechanical criteria. Little published information is available comparing the properties of recently developed epoxy resin die materials and newly available type V die stone, which are claimed to be superior to conventional type IV gypsum, die materials.

**Aims:** This study compared the properties of two new die materials.

**Methods and Material:** The surface hardness, abrasion resistance, compressive and transverse strength of two recently introduced, type V die stone (Denflo HX) and new epoxy resin die material (Epoxy-Die), were studied.

**Results:** The epoxy resin exhibited much better abrasion resistance, compressive and transverse strength than the gypsum materials, which were similar in these properties. The type V gypsum exhibited the highest surface hardness, whereas the epoxy resin had the lowest value.

**Conclusion:** The resin products were significantly superior to the conventional type IV gypsum die materials. In general, the epoxy resin exhibited the best properties of the materials studied; however, its setting shrinkage may necessitate alterations in technique to achieve well-adapted castings

**Key Words**
Epoxy resin die materials, Type V die stone, Abrasion resistance, Compressive strength, Transverse strength

## Introduction

The requirements of die material[1] include dimensional accuracy, acceptable detail reproduction, abrasion resistance, surface hardness, ease and efficiency of manipulation, compatibility with impression material and transverse strength. Dies are subjected to considerable flexural constraint when removed from impressions, duplicated to make refractory casts for dental ceramics or when dental restorations are seated. While no single die material possesses all the ideal properties for an indirect working model, gypsum products[2] have gained general acceptance because of their close approximation of critical properties of an ideal die material. The different die materials which are available today are type IV gypsum, Type V gypsum, epoxy resin, polyurethane resins, resin modified gypsum, electroformed dies etc. One of the most commonly used die material is Gypsum based, i.e. Type IV (high strength, low expansion) and Type V (high strength, high expansion) dental stones.

The purpose of this study is to evaluate and compare surface mechanical properties of commercially available improved gypsum product i.e. Type V die stone and a new epoxy die material. Each of these is claimed to have improved properties as compared with conventional Type IV gypsum die stone.

## Methods And Materials

**Materials used:**

- Soft putty Poly vinyl siloxane impression material (AquasilTMsoft putty, Dentsply, Caulk)
- Light body polyvinyl siloxane impression material (AquasilTMLV, Dentsply, Caulk)
- Type V dental stone (Denflo HX)
- Epoxy resin (Diemet-e, Erkodent, Germany)
- Tray adhesive

**Instruments and armamentarium:**

- Stainless steel rectangular die (50 X 15 X 7mm)
- Stainless steel cylindrical die (10mm diameter and 30mm height)
- Instron testing machine
- Wear Testing Machine
- Microvicker Hardness Tester
- Precision Balance (ConTech)
- Vibrator

**Vacuum mixer**

This study was conducted to compare the surface mechanical properties (transverse strength, compressive strength, abrasion resistance, and surface hardness) of two die materials namely Epoxy resin and Type V die stone at the Department of Proshodontics, A.B. Shetty Memorial Institute of Dental Sciences, Mangalore(India) and at the Dept of Mechanical Engineering, NITK, Surathkal. Included in this study is a newly marked type V gypsum die stone, Denflo HX and a new epoxy resin die material, Diemet-e, Erkodent, Germany.
Specimen preparation and all tests are to be performed at room temperature. Forty specimens for each material are prepared and subjected to test for surface hardness, abrasion resistance, transverse and flexural strength. To conduct this study one master metal die and one cylindrical mould of a definite dimension were prepared. A custom impression tray was machined to fit over the master metal die. Individual impressions were made with polyvinyl siloxane impression material and the dies were prepared with: Type V die stone and Epoxy resin.

Figure-1: Rectangular Die

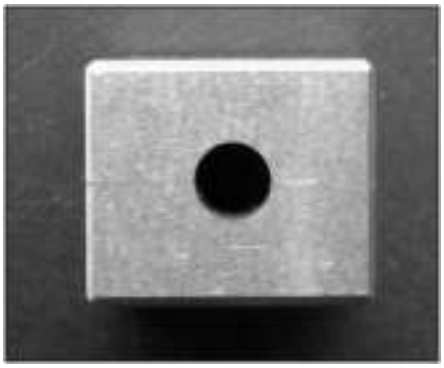


Figure-2: Top View Of Cylindrical Die

Figure-3: Die After Separation

Figure-4: Measurement Oflength Of The Specimen

Figure-5: Measurement Ofwidth Of The Specimen

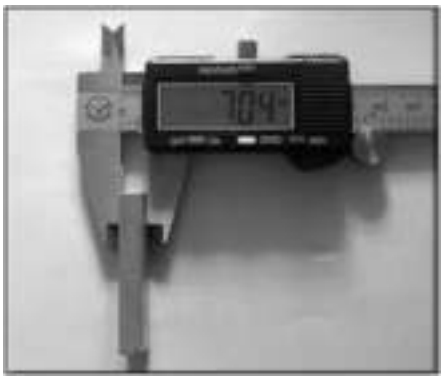


Figure-6: Measurement Ofthickness Of The Specimen

**Fabrication of the Master die**

Two master die were prepared by machining a medical grade 304, stainless steel. The prepared cylindrical master die **(Fig.-2 and 3)** had the following dimensions: height 20mm and diameter of 10 mm and used for evaluating compressive strength and abrasive resistance and another rectangular one 50 X 15 X 7 mm for evaluating surface hardness and flexural strength. **(Fig.-4, 5 and 6)**. The dies were finished and polished to provide a smooth, shiny polished and non corresponding surface to obviate any adhesion of the polyvinyl siloxane impression materials to the surface of the metallic die.

**Fabrication of the Impression Tray**

In order to make impressions of the master die, a custom impression tray was made from a 304 medical grade stainless steel. The master metal die was fixed on a base having elevated margins at its periphery, which acted as sleeves. These sleeves aided in guiding and stabilizing the custom impression tray while making impressions of the die. Four escape ways were made on the sleeves of the base to facilitate the flow of excess impression material out, while making the impression. The custom impression tray was designed to provide a uniform space of 3mm around the master die. The open end of the custom impression tray had four grooves which were to be aligned along the escape ways of the base, in order to facilitate easy flow of excess impression material out and to establish a metal to metal contact **(Fig-1)**.

**Fabrication of the Models**

Eighty specimens, (ten for each mechanical properties) of two different materials namely Epoxy resin die material and Type V die stone, were made from individual impressions of the master die. The impressions of the die were made with soft putty polyvinyl siloxane impression material (AquasilTMsoft putty, Dentsply, Caulk) in the custom impression tray with light body polyvinyl siloxane impression material (AquasilTMLV, Dentsply, Caulk) syringed onto the master die. Tray adhesive (Caulk Tray Adhesive, Dentsply) was used to retain the impression material on the custom impression tray provided by the manufacturer. The impressions were polymerized at 37°C and were stored at room temperature for about 60 minutes before pouring the die material.

Group I comprised of 40 Epoxy resin dies (Diemet-e, Erkodent, Germany) fabricated from individual impressions of the master metal die. Epoxy resin die material comprised of a resin, hardener and filler material. The resin and hardener were supplied in two dosing syringes by the manufacturer. The resin and hardener were dispensed into a measuring / mixing bowl until the graduation lines on the dosing syringes were reached. Two scoops of the filler material were then added to the mixture of resin and hardener as recommended by the manufacturer. The mix was then spatulated for 30 seconds in the measuring / mixing bowl supplied by the manufacturer. The epoxy resin die material was vibrated into the impression using a vibrator at a frequency of 50-60 Hz and was allowed to cure for 6-8 hours at ambient room temperature, after which the dies were recovered from the impressions.

Group II constituted forty Type V (Denflo HX, India) dies made from individual impressions of the machined master die using a standard water-powder ratio of 0.20. Type V die stone was initially hand mixed for 45 seconds to incorporate the powder and then a mechanical vacuum mixer (Multivaco4, Degussa) was used for 30 seconds to ensure a homogenous, bubble free mix. The resultant mixture was vibrated, painted on the entire impression surface

with a brush and then the remaining mixture was poured into the impression. The stone was allowed to set for 1 hour at ambient room temperature.

**Transverse Strength:**
Transverse strength, flexural strength or modulus of rupture, as this property is variously called is essentially a strength test of abeam supported at each end, under a static load.

A stainless steel die of dimensions 50 X15X7 mm was used in this study. The custom impression tray was used, on which perforations were made at random and tray adhesive applied, for making impressions. The impression material was allowed to set and die was removed after the manufacturer recommended time period. Ten specimens were prepared for each die material and stored for 48 hours before testing. The finished width and thickness of each specimen were measured with a digital micrometer. The specimens were tested with a 3-point loading apparatus in a universal testing machine (Instron.) to failure at a crosshead speed of 1 mm/min. The ground side of each specimen was positioned so that it was in compression during the test. The span length used in the test was 40 mm. Load at fracture was used to compute transverse breaking strength in MPa. Means and standard deviations for the breaking strength were calculated from the 10 specimens in each group.

**Compressive Strength**
Cylindrical mould of 30mm height and 10mm internal diameter were used to fabricate the epoxy resin and type V die stone specimens. Specimens were removed after the materials were set and finished with by means of grinding in order to obtain flat parallel ends. These were then tested in universal testing machine (Instron) and subjected to compression loads at a crosshead speed of 1 mm per minute.

**Surface Hardness**
Vickers indentations were made on the lateral surfaces of the dies. Five indentations, 5 mm apart, were made on each die with a Microvickers Hardness Tester with a diamond indenter and a 300-gm load applied for 20 seconds. The average of the 5 readings for each specimen was used to calculate a group mean and standard deviation for 5 specimens of each die material.

**Abrasion Resistance**
Five specimens were poured with each die material and the dies were stored for 24 hours before testing. The abrasion apparatus is depicted in Figure 3The apparatus moves the abrader in a circular motion at 900RPM. Specimens are supported in a holder, so that a long line angle of the specimen is held in a vertical position for abrasion. Each specimen was run for 15sec on abrading wheels with a load of 100 Gm. Weight loss per unit area is reported for each cycle and averaged.

**Results**
1. The compressive strength of epoxy resin (59.4960MPa) was far better than that of type V die stone (17.7310MPa). **(Table I)** These mean difference were tested statistically by using student‘t’ test. The difference between type V die stone and Epoxy Resin happened to be highly significant ($p < .0001$). Epoxy resin showed about 3 times increased compressive strength compared to the type V die stone.
2. The results also showed that the flexural strength of epoxy resin (56.2630MPa) was far better than that of type V die stone (13.9040MPa). **(Table II)** These mean difference were tested statistically by using student‘t’ test. The difference between type V die stone and Epoxy Resin happened to be highly significant ($p < .0001$). Epoxy resin showed about 4 times increased transverse strength compared to the type V die stone.
3. The abrasion resistance in form of volume loss per unit area of epoxy resin (0.13280 mg/mm2) was less than that of type V die stone (0.24860mg/mm2).**(Table III)**. These mean difference were tested statistically by using student ‘t’ test. The difference between type V die stone and Epoxy Resin happened to be highly significant ($p < .0001$). Epoxy resin showed about 2 times increased abrasion resistance when compared to the type V die stone.
4. It is also seen type V die stone had the highest value for the hardness (49 HV) than that of epoxy resin which had hardness value of 27 HV. The mean hardness value of the three groups **(Table IV)** that had been compared and was found highly statistically significant ($p <.0001$). Thus with regards to hardness, Type V die stone was superior to epoxy resin.
5. The abrasion resistance of Epoxy resin and the die stone has been

Table 1 : T-test (Group Statistics)

| | Compressive Strength | | | | Transverse Strength (Mpa) | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Mean | Std. Deviation | Std. Error Mean | N | Mean | Std. Deviation | Std. Error Mean |
| Epoxy Resin | 10 | 57.7860 | 5.7862 | 1.8298 | 10 | 54.9150 | 6.7440 | 2.1326 |
| Die Stone | 10 | 17.6310 | 2.0432 | 0.6461 | 10 | 13.9040 | 1.2622 | 0.3992 |

Table 2: Independent Samples Test (Compressive Strength, Transverse strength)

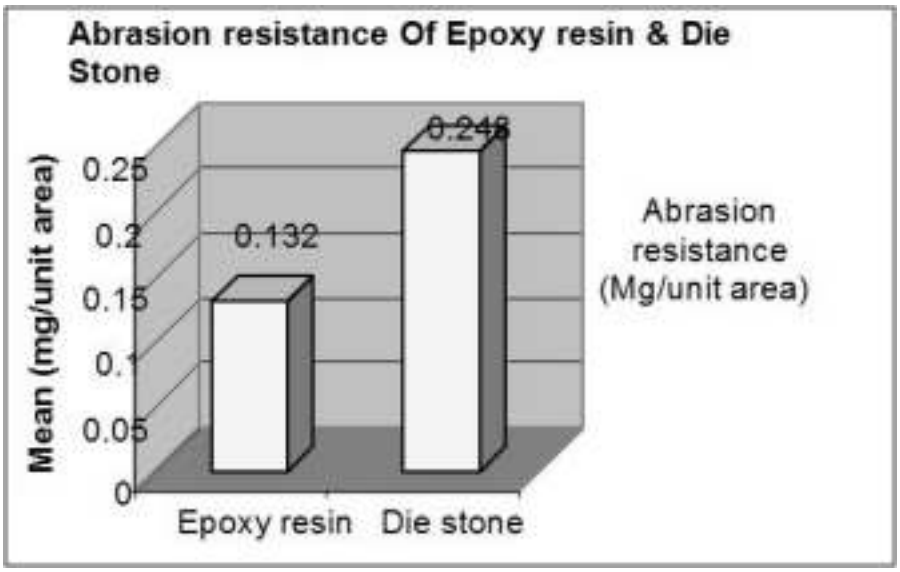
| | t- test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|
| | t | d.f | Sig. (2- tailed) | Mean Difference | Std. Error Difference | 95% confidence interval of the difference | |
| | | | | | | Lower | Upper |
| Compressive Strength | 20.69 | 18 | 0.0001 | 40.1550 | 1.9405 | 36.078 | 44.232 |
| Transverse Strength | 18.90 | 18 | 0.0001 | 41.0110 | 2.1697 | 36.453 | 45.569 |

Table 3: Group Test (Abrasion Resistance, Surface Hardness HV Vickers Hardness Number)

| | Abrasion Resistance (mg/unit area) | | | | Surface Hardness HV Vickers Hardness Number | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Mean | Std. Deviation | Std. Error Mean | N | Mean | Std. Deviation | Std. Error Mean |
| Epoxy Resin | 5 | 0.13280 | 0.0164 | 0.0073 | 5 | 27.00 | 3.39 | 1.52 |
| Die Stone | 5 | .24860 | 0.267 | 0.0119 | 5 | 49.00 | 3.39 | 1.52 |

Table 4: Independent Samples Test (Abrasion Resistance, Surface Hardness HV Vickers Hardness Number)

| | | t- test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | t | d.f | Sig. (2- tailed) | Mean Difference | Std. Error Difference | 95% confidence interval of the difference | |
| | | | | | | | Lower | Upper |
| Epoxy Resin | Materials | -8.27 | 8 | 0.0001 | -0.11580 | 0.0140 | -0.1481 | -0.0835 |
| Die Stone | Equal variance assumed | -10.26 | 8 | 0.0001 | -22.00 | 2.14 | -26.95 | -17.05 |




Bar Chart -1: The Abrasion Resistance Of Epoxy Resin And The Die Stone


Bar Chart -2: The Compressive Strength, Flexure Strength And Surface Hardness Of Epoxy Resin And Die Stone

depicted **(Bar Chart 1)**

6. The compressive strength, Flexure strength and Surface hardness of Epoxy Resin and Die Stone have also been depicted **(Bar Chart 2)**

**Discussion**

The ultimate goal of a Prosthodontist is to fabricate a successful restoration. The contributory factors for this success include a perfect diagnosis, treatment planning and proper execution of the clinical and laboratory steps along with patient education and motivation followed by a thorough follow-up and maintenance. In order to achieve a satisfactory restoration, the working cast or die must be dimensionally accurate[10], able to reproduce fine detail, resistant to abrasion, hard and of enough strength, as casts are subjected to considerable flexural constraints when removed from impressions, if duplicated to make refractory casts for dental ceramics, or when dental restorations are seated. When we describe the strength of an object or a material we are most often referring to the maximum stress that is required to cause fracture or a specified amount of plastic deformation. In the present study two aspects of strength i.e. the flexural and compressive strengths, were assessed in order to secure a satisfactory guide to the total strength characteristics.

**Flexural Strength**

Type V die stone has limited flexural strength, and this may predispose working casts to fracture when they are removed from impressions. By making casts harder, manufacturers have encouraged brittleness[4]. This fragility is particularly obvious with long and narrow tooth preparations. Epoxy resins, on the other hand, have traditionally exhibited superior mechanical qualities and acceptable dimensional stability[10] and the degree varied with the type of impression materials and epoxy resin used[3]. In the present study, the mean flexural strength exhibited by the Type V die stone specimens (13.904 MPa) was significantly less than that of the epoxy die material specimens (56.263 MPa). This ratio difference (1:4) is in concurrence with two studies conducted where they concluded that epoxy resin had four times the flexural strength than that of dental stone.

All the gypsum-based die materials tested were brittle and exhibited very limited deformation before fracture[11]. The epoxy die material, however, was much less stiff than the gypsum products and displayed significant elastic deformation before failure. Clearly, the epoxy resin will absorb much more energy before fracturing and should be less susceptible to breakage if dropped or handled roughly.

**Compressive Strength**

The principal requisites of a die are strength, hardness, abrasion resistance and minimum setting expansion.

**Hardness**

The Vickers micro hardness test was chosen for this study, because one of the materials tested was an epoxy resin. Epoxy resins are known to exhibit elastic recovery after indentation. Because this elastic recovery occurs mainly along the shorter diagonal of the vickers indentations, a more accurate measure of the hardness is obtained from the length of the long diagonal that exhibits very little elastic recovery. This study reported **(Table 3)** Vickers hardness values ranging from 45 to 51 for the type V die stone and 29 to 39 for epoxy resin die material. These values are in relative agreement to those in another study[5] investigating type IV that found Knoop values of 21.6 for Vel-Mix and Silky-Rock. The resin-containing gypsum die materials, epoxy resin, were not more resistant to indentation than type V die-stone. The results of this study also are in agreement with other studies.[6],[7] which concluded that epoxy resin die materials

are less resistant to indentation than type V gypsum-based die materials.

**Abrasion Resistance**

The results of this study agreed with other studies.[8] which concluded that the abrasion resistance of epoxy resin die materials was higher than that of gypsum-based die materials.

As confirmed by other studies.[8],[9] no correlation between hardness and abrasion resistance was encountered in our study. The die material that was the least resistant to indentation, Epoxy-Die was the most resistant to abrasion. Conversely Die-Stone, which was the most resistant to indentation, was the least resistant to abrasion. Hardness may be of limited value for comparing die materials for clinical use. Among the die materials tested, epoxy resin was the most resistance to wear test done i.e. most abrasive resistant whereas Denflo HX was almost half the resistant to abrasion than epoxy resin. To obtain these properties α-hemihydrate of the Densite type is used. The cuboidal shaped particles and the reduced surface area produce such properties without undue thickening of the mix. Type V die stone meets most of these requirements. The chief disadvantage of Type V die stone is its susceptibility to abrasion during carving of the wax pattern. Inspite of this disadvantage, it is the most widely used die material. Types V die stones exhibit a higher compressive strength as well as a higher setting expansion than does Type IV die stone. The rationale for this increase in setting expansion is that certain newer alloys, such as base metal, have a greater casting shrinkage than do the traditional noble metal alloys. Thus, higher expansion is required in the stone for the die to aid in compensating for the alloy solidification shrinkage. The use of a Type V die stone may also be indicated when inadequate expansion may have been achieved during the fabrication of cast crowns. The use of Type V die stones should be avoided in the production of dies for inlays since the higher expansion may lead to unacceptably tight fits [3].

**Conclusions**

Within the limits of this study, the following conclusions were drawn:

- The properties of the resin-modified gypsum die materials were significantly different than those of type V die stone.
- The epoxy resin die material was markedly superior in abrasion resistance, compressive and transverse strength to type V die stone studied.
- The epoxy resin die material has a lower surface hardness than that of type V die stone.
- Surface hardness does not correlate with the other properties tested and may not be a good measure of performance for these materials.

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# Peripheral Ossifying Fibroma In Post Menopausal Woman With Generalised Chronic Periodontitis: A Rare Case Report.

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**Abstract**
Peripheral Ossifying Fibroma is a reactive lesion of the gingival tissues. It is a non-neoplastic tumor like growth in the oral cavity that is more frequently seen in the maxillary anterior region and less frequently encountered in the mandibular anterior region. Trauma from local irritants like subgingival calculus, dental appliances , faulty restorations have been implicated as the etiological factors that influence the development of this lesion. It is frequently seen as an asymptomatic swelling predominantly in female patients in 2nd or 3rd decade of life and is rarely encountered in postmenopausal years.

**Key Words**
Peripheral Ossifying Fibroma, Post menopausal , Ossifying Fibroma.

## Introduction

Gingival growths are among the most frequently encountered lesions of the oral cavity. One of the infrequently occurring gingival tumour is Peripheral Ossifying Fibroma. It is an uncommon non neoplastic tumour like growth of the gingival tissues that represents up to 9.6% of all gingival tumors and up to 3.1% of all oral lesion that are biopisied.[1] Other terms used to describe this lesion are peripheral fibroma, fibrous epulis, ossified fibrous epulis or peripheral cementifying fibroma etc[2]. They are two types of ossifying fibromas: the central type and the peripheral type. The central type arises from the endosteum or the periodontal ligament adjacent to root apex and causes expansion of the medullary cavity. The peripheral type occurs solely on the soft tissue covering the tooth bearing areas of the jaws. Peripheral Ossifying Fibroma lesions appear as nodular masses either pedunculated or sessile .The colour of the growth ranges from red to pink and the surface is frequently but not always ulcerated. Intraoral ossifying fibromas often occurs in female patients (Female :male ratio =1.22:1) and predominantly in the 2nd or 3rd decade of life. There is high predilection of maxillary anterior region as compared to mandible .

Oral Peripheral ossifying fibroma usually present as focal, reactive, non-neoplastic tumor-like growth of the soft tissue that often arises from the interdental papilla[3]. These are slowly growing painless growths in the gingiva. Trauma or local irritants such as dental plaque, calculus, micro-organisms, masticatory forces, ill-fitting dentures and poor quality restorations have been implicated in the etiology of peripheral ossifying fibroma.[4] There is uncertainity regarding the etiopathogenesis of these lesions and they are initiated due to overproduction of the fibrous tissues in the periodontal connective tissues. It is believed to derive from the multipotential mesenchymal cells of the periodontal ligament which are able to form cementum, bone and fibrous tissue.[5]

## Clinical Case Presentation

A 60 year old female patient reported to the Out Patient Department of Periodontology and Implantology DAV ( C ) Dental College and presented with the chief complain of a painless firm swelling in the lower anterior teeth region since 2 years, the lesion started as a very small nodule and had gradually increased to attain the present size **(Figure 1 & Figure 2)**. Patient had problem during mastication, speech as well as aesthetics due to its present giant size. The medical history was unremarkable and a thorough examination revealed incompetent lips and otherwise normal facial features. Introral examination showed that there was an oval, hard, pedunculated growth located on the labial surface of the gingiva in relation to 31-43 region; measuring approximately 2x 1.5 cm in diameter. The overlying mucosa was reddish pink in color, On palpation, the mass was firm in consistency, pedunculated, non-tender and no bruit or pulse was felt. The oral hygiene status of the patient was also very poor.

Figure 1 : Preoperative Photograph

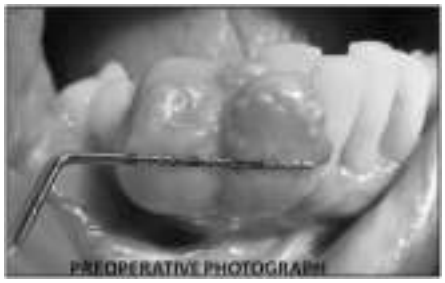

Figure 2 : Preoperative Photograph

On periodontal examination underlying teeth had bands of supragingival and subgingival calculus and probing pocket depth of 6mm in relation to 31,32,41,42 and 43 region. All the records were made using digital radiographs & photographs.

A diagnosis of Chronic Generalised periodontitis with a tumour like growth in the mandibular anterior region was made.

The patient was made aware of all the possible treatment options for the lesion. The treatment plan included initially scaling and root planing (Phase I therapy) and subsequently excision of the lesion was planned. Surgery was performed only following re-evaluation of the Phase I therapy. A written informed consent was saught and under local anaesthesia, an extensive excisional biopsy was performed and the underlying surface was thoroughly curetted up to the bone. After controlling the bleeding, the surgical site was sutured and covered using Coe-pack. Post-operative instructions were given and the patient was recalled for post operative re-evaluation after 1 week. The one week follow up was uneventful with the surgical site showing signs of healing. The entire tumour mass excised **(Figure 3)** was subjected to histopathology examination which confirmed the diagnosis of oral peripheral ossifying fibroma. A six month postsurgical follow-up of the patient showed no evidence of recurrence **(Figure 4)**.

**Discussion**

Intraoral ossifying fibromas have been described in the literature since 1940's . Many names have been given to similar lesions, such as epulis, peripheral fibroma with calcification, peripheral ossifying fibroma, calcifying fibroblastic granuloma, peripheral cementifying fibroma, peripheral fibroma with cementogenesis and peripheral cemento-ossifying fibroma.[6]

Figure 4 : Post Operative Photograph

Figure 3 : Excised Tumour Mass

Gardner in 1982 coined the term peripheral ossifying fibroma for a lesion that is reactive in nature and is not the extraosseous counterpart of central ossifying fibroma[7]. Peripheral Ossifying Fibroma is a non-neoplastic enlargement of the gingiva with randomly distributed calcifications, immature bone and osteoid. It is found exclusively on the gingiva and does not arise in other oral mucosal location. Ossifying Fibroma is a slow growing well circumscribed painless mass usually presenting itself in the 2nd or 3rd decade of life. Clinically, it resembles a peripheral fibroma, but histopathologic analysis always reveals immature bone and osteoid within the lesion.

Peripheral Ossifying Fibroma is an uncommon lesion of the gingival tissues that chiefly arises from the interdental papilla and represents upto 9.6% of all gingival tumors. It accounts for up to 3.1% of all oral lesion that are biopisied . It varies from pale pink to cherry red in color, can be either pedunculated or sessile and is typically located in the interdental papilla region and surface may occasionally show ulceration[8]. The tumour may cause a separation of the adjacent teeth, and occasionally minimal bone resorption can be seen beneath the lesion. The peak incidence is found most frequently in teenagers and young adult females(Female:Male=1.22:1) and some studies have reported that women are 2-4 times more likely to be affected than men.[3] These lesions have high predilection for occurrence in maxillary anterior region compared to mandible.[9]

The etiopathogenesis of Ossifying Fibroma is unclear, trauma or local irritants such as subgingival plaque and calculus, dental appliances, poor-quality dental restorations, microorganism, masticatory forces, food lodgment and iatrogenic factors are known to influence the development of the lesion. Hormonal influences may play a role, given the higher incidence of Peripheral Ossifying Fibroma among females, increasing occurrence in the second decade and declining incidence after the third decade[10]

An origin from cells of periodontal ligament has been suggested because of exclusive occurrence of Ossifying Fibroma from Interdental papilla, the proximity of gingiva to PDL, the presence of oxytalan fibers within the mineralized matrix of some lesions, the age distribution, and the fibro cellular response similar to other reactive gingival lesions of periodontal ligament origin . Early Perpheral Ossifying Fibroma presents as ulcerated nodules with little calcification allowing easy misdiagnosis as a pyogenic granuloma. It should be differentiated from fibrous dysplasia, cemento-osseous dysplasia etc.

In our case the lesion presented in an unusual location, in the mandibular anterior region involving the incisors and it originated from the interdental papilla between 42- 43, in a female patient aged 60 with chronic generalized periodontitis. She presented with poor oral hygiene and exhibited moderate amounts of supra and sub-gingival calculus in the proximity of the lesion. Peripheral Ossifying Fibroma can produce migration of teeth with interdental bone destruction. In our patient the teeth exhibited spacing between 42-43 and the growth appeared to originate from the interdental papilla between 42-43. The large lesions may occasionally cause displacement of the mandibular canal if encountered in the posterior mandibular region.[11]

The differential diagnosis for peripheral ossifying fibroma included pyogenic granuloma, central ossifying fibroma, peripheral odontogenic fibroma, irritational fibroma. On histopathological examination peripheral ossifying fibroma exhibits fibrocellular connective tissue stroma surrounding mineralized mass. This fibrocellular proliferation is accompanied by an inflammatory component of lymphocytes, plasma cells and multinucleated giant cells. Lesion was not encapsulated and revealed bone forming osteoblasts and cementoblasts in the fibrous connective tissue stroma. The calcified mass comprises of woven bone ,cellular cementum or a mixture of woven and lamellar bone. These features support the theory that peripheral ossifying fibroma develops from undifferentiated mesenchymal cells. These cells are derived from periodontal ligament or periosteum of the adjacent teeth and have inherent proliferative potential to form

bone or cementum[12]

Treatment of Ossifying Fibroma consists of aggressive surgical excision along with involved periodontal ligament and periosteum along with elimination of etiological factors, scaling of adjacent teeth in an attempt to minimize the possibility of recurrence . Studies have reported high rate of recurrence (8% to 20%) of peripheral ossifying fibroma. Various reasons for the reoccurrence of peripheral ossifying fibroma have been suggested. They include the incomplete removal of the lesion, the failure to eliminate local irritants and difficulty in accessing the lesion during surgical manipulation as a result of the intricate location of the lesion (usually an interdental area). Close postoperative monitoring is required in all cases of Peripheral Ossifying Fibroma that have been treated with surgical excision.

**Conclusion**

The peculiarity of the presented case is the intriguing since the predilection of peripheral ossifying fibroma is in maxillary anterior region than in mandibular area. Also the occurrence of Ossifying Fibroma in an elderly female patient in her post menopausal phase is in contrast to its common occurrence in a young females. The clinician therefore has to look beyond the usual norms of gender, age and site predilection to arrive at a clinical diagnosis. Further, histologic investigations are integral for its confirmation.

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# Cutaneous Sinus Tract Of Odontogenic Origin: A Misdiagnosed Lesion

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**Abstract**
Although the most common cause of the intermittently suppurating cutaneous sinus tract in the face and neck area is chronic dental infection, chronic draining sinus tracts of the face and neck continue to be a diagnostic challenge. Misdiagnosis of the lesion can lead to cumbersome treatment planning including multiple surgical excisions and biopsies, systemic antibiotic regimens with eventual recurrence. Variety of lesions i.e. Osteomyelitis, actinomycosis, malignancy etc. mimic such a clinical picture. Case of cutaneous facial sinus tract related to mandibular premolar was diagnosed clinically. Nonsurgical endodontic therapy was done as the treatment of choice resulting in successful healing of lesion without any cosmetic treatment. So aim of this report is to present a case report of this common misdiagnosed lesion showing healing of same without any surgical intervention.

**Key Words**
Cutaneous Sinus Tract, Mandibular Premolar, Management

## Introduction

Cutaneous sinus tracts of dental origin are often initially misdiagnosed and inappropriately treated because of their uncommon occurrence and the absence of symptoms[1]. A review of several reported cases reveal that patients have undergone multiple surgical excisions, radiotherapy, multiple biopsies, and multiple antibiotic regimens, all of which have failed, with recurrence of the cutaneous sinus tract, because the primary dental aetiology was never correctly diagnosed or addressed. Few received cancer-directed therapy before having lesions correctly diagnosed [2],[3]. Even a case which took over 15 years to recognize a dental origin has been reported[4]. Because these lesions are often diagnosed incorrectly, they are also treated ineffectively. This report involves a case of cutaneous facial sinus tract of dental origin, its diagnosis and treatment.

## Case Report

A 32 year old woman with no known co-morbidity presented to the department of Conservative, Luxmi Bai Dental College Patiala, for the evaluation of a periodically draining, crusted, fixed, non tender, cord-like, elevated nodule palpable on her right cheek just below the right lower border of mandible. Physical examination revealed a small retracted skin lesion **(Fig. 1), (Fig. 2)** on her lower part of right cheek which was about 5mm in diameter. She stated that she had felt an induration on her cheek about one year ago and left it untreated because she had no pain. However, as the lesion started to discharge pus during the following months, she then received several treatments from a dermatologist. Inspite of taking large number of antibiotics and antifungal medications both orally and topically, the lesion did not heal and the surgeon had recommended surgery now.

Fig. 1 : Showing Skin Lesion On Right Side Of Face And Neck

Fig. 2 : Showing Skin Lesion On Right Side Of Face And Neck

Fig. 3 : Gutta Percha Passes Through Sinus

Intraoral examination revealed good oral hygiene and grossly carious right mandibular canine. Patient had been wearing a fixed partial denture prosthesis in relation right mandibular first pre molar, second pre molar and first molar from the past one year. Upon examination no tooth was tender to percussion or painful on biting and did not respond to electrical pulp testing. Radiographic examination showed periradicular radiolucency in relation to canine and roots of first premolar, second premolar and first molar. Sinus tract was tracked with a gutta percha cone to the root lesion of first premolar **(Fig. 3)** as seen in the confirmatory radiograph. **(Fig. 4)**.

Based on these findings, the patient was diagnosed as having an odontogenic cutaneous sinus tract secondary to

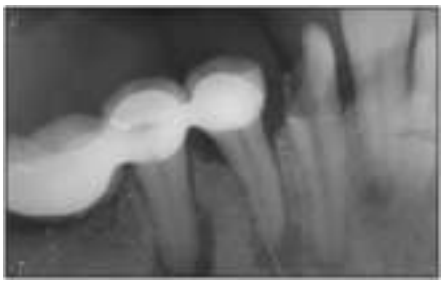

Fig. 4 : Confirmatory Radiograph Showing Origin If Sinus Present From Root Of Right Mandibular First Premolar

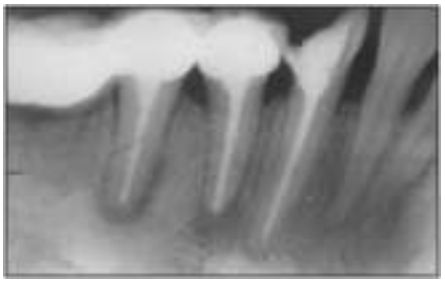

Fig. 5 : Post Operative Radiograph

chronic periradicular periodontitis of the right mandibular first pre molar tooth. Her consent for endodontic treatment was taken and root canal treatment started. Patient was explained the dental etiology of the sinus formation and its possible management.

After local anaesthesia and rubber dam placement, root canal treatment was initiated with pulp chamber access and biomechanical preparation of the root canals was done. Irrigation during instrumentation was carried out with 1% sodium hypochlorite and EDTA. Calcium hydroxide mixed with chlorhexidine paste was used as the intra canal medicament. After 2 weeks, lesion showed signs of healing. The canal filling with gutta percha and AH plus root canal sealer was performed 3 weeks after the initial appointment **(Fig 5)** and the lesion showed further healing **(Fig 6)** After 1month, skin lesion healed **(Fig 7)** and radiographic examination showed the repair of periapical tissues too.

The present case report showed the healing of long standing cutaneous sinus and the large skin lesion (may be caused due to suprainfection from the draining pus) and thus lay stress on need of thorough knowledge about the possible dental etiology of cutaneous sinus tract in head and neck area.

**Discussion**

A sinus tract is an abnormal channel that originates or ends in one opening. An orofacial fistula is a pathologic

Fig. 6 : Skin Lesion Showing Signs Of Healing After 2 Weeks

Fig. 7 : Healed Skin Lesion

communication between the cutaneous surface of the face and the oral cavity. Chronic dental periapical infections or dentoalveolar abscesses cause the most common intraoral and extraoral fistulas[6]. As the lesion develops it is usually disregarded to be of dental origin, patient seeks treatment from a dermatologist or general surgeon and often undergoes multiple antibiotic regimens, surgical excisions, biopsies and even radiotherapy[2]. Misdiagnosis adds to the chronicity of the lesion and has profound effect on facial esthetics due to unnecessary treatment resulting in cutaneoues scarring and dimpling. Only 50% of patients with cutaneous odontogenic sinus tracts have a history of toothache. Most patients are unaware of an associated dental problem[1],[5], thus delaying the correct diagnosis of the cutaneous lesion with its primary odontogenic origin. The sites of dentocutaneous fistula are usually anatomically close to the causative tooth. Of reported cases, 80% involved mandibular teeth of which half were anterior teeth, producing sinus tracts in the submental and chin sites[7].

Other sites of extra-oral drainage of odontogenic origin are the cheek, canine space, nasolabial fold, nose, upper lip, and inner canthus of the eye [1],[3],[7]. Mandibular incisors and cuspids typically drain to the chin or submental region, and premolar and molar infections typically drain above the inferior border in the submandibular region of the anterior triangle of the neck [8]. Occasionally the opening of the sinus tract may be found at a far distance from the dental infection. Endelman[9] described a patient in whom a sinus from a tooth infection opened on the chest wall and another on the upper one third of the thigh. Carious exposure with bacterial invasion of the tooth pulp leading to a periapical abscess is the most common cause of dentocutaneous sinus tracts. The inflammation destroys the cancellous alveolar bone and proceeds along the periosteum until perforation occurs. An intraoral or extraoral sinus can develop, depending on the path of the inflammation, which is dictated by surrounding muscular attachments and fascial planes. The cutaneous lesion may develop as early as a few weeks [10] or as late as 30 years [11]. Evaluation of a cutaneous sinus tract must begin with a thorough history and awareness that any cutaneous lesion of the face and neck could be of dental origin.

Dentocutaneous sinus tracts appear as soft, slightly depressed nodules, often fixed to underlying structures, with a central opening from which fluid can be expressed. Palpation of the surrounding tissue may produce pus, which supports the diagnosis. Intraoral and dental examinations are critical for making the diagnosis. In particular, the examiner should look for dental caries or restorations and periodontal disease. Early radiographs can prevent unnecessary surgeries when the teeth appear clinically normal. A panoramic or periapical radiograph will show radiolucency at the apex of the infected tooth. Recognition of a sinus tract origin is the first step in diagnosis. Intraoral periapical radiographs should be taken routinely when such lesions are present, preferably with a gutta-percha cone threaded into the sinus tract. Because of gutta-percha's radiopacity, the source of the infection will be revealed. Any chronic suppurative lesion on the middle or lower portion of the face should be investigated for possible dental cause. Most infections are polymicrobial, and culture often yields growth of anaerobes or facultative anaerobes. The differential diagnosis[1],[10] should include traumatic lesions, fungal and bacterial infections, neoplasms presence of a foreign body, local skin infection (carbuncle and

infected epidermoid cyst), pyogenic granuloma, chronic tuberculosis lesion, osteomyelitis, actinomycosis, and gumma of tertiary syphilis. Rare entities to be included in the differential diagnosis are developmental defects of thyroglossal duct origin or branchial cleft, salivary gland and duct fistula, dacryocystitis, and suppurative lymphadenitis.

Root canal therapy is the treatment of choice if the tooth is restorable. Extraction is indicated for nonrestorable teeth. Once the primary odontogenic aetiology has been properly eliminated or removed, the sinus tract and cutaneous lesion usually resolve within a few weeks without treatment. Systemic antibiotic administration is neither necessary nor recommended in patients with cutaneous odontogenic sinus tracts who have an intact immune system. Antibiotics may be used as an adjunct to endodontic therapy in the cases of diabetes, immunosuppression, or systemic signs of infection such as fever. Antibiotic therapy alone will not be effective in these cases because of the absence of adequate circulation in a necrotic pulp system and abscess. After root canal therapy, the cutaneous lesion usually resolves in 1 to 2 weeks.

**Conclusion**

Chronic dental infection is one of the most common causes of fistulae of the face and neck. An understanding of the pathogenesis of cutaneous fistulae arising from dental infections will lead to proper early diagnosis and treatment without unnecessary surgery. The case presented here shows that cutaneous odontogenic sinus tracts are still being misdiagnosed and that treatment applied is inappropriate. The case illustrates the need for cooperative diagnostic referrals between physicians and dentists, and highlights the need for thorough diagnostic procedures that should always include a dental examination.

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Case Report

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# Esthetic And Functional Rehabilitation Of Mutilated Mandibular Premolar With Fractured Endodontic Post: A Case Report

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**Abstract**
The present case describes the successful removal of the fractured endodontic post and esthetic rehabilitation of a over contoured non esthetic metal crown. Retrieval of the post was done by using ultrasonics, rotary instruments and masserann extractor kit. Root canal was reinforced by fiber reinforced composite and coronal restoration was done with porcelain fused to metal.

**Key Words**
endodontic retreatment, masserran kit, ribbond

## Introduction

Endodontic retreatment has a predictable success rate in the hand of experienced operator.[1] Removal of the obturation material from the root canal system can be achieved by a variety of techniques. The removal is often complicated by presence of separated instruments, posts, ledges or canal blockade. Endodontic retreatment will be successful only if all the material in the root canal is removed and obturation with bacteria impervious seal is obtained in the apical region following thorough cleaning and shaping.

Endodontic posts are often used to retain the core for a full coverage restoration in a mutilated tooth which has lost most of its coronal tooth structure. Custom cast, prefabricated metal and prefabricated fiber posts are frequently used and all gives good success rate. In case of endodontic failure, removal of the endodontic post is often a complicated procedure with probability for unsuccessful removal, perforation of the root, partial removal, weakening of the root structure and root fracture.[2],[3] The removal procedure is more complicated if the endodontic post is fractured as the apical segment is far from the orifice to see, appreciate and remove. Removal of threaded endodontic post is complicated by the presence of threads engaging the dentinal surface with increased retention. This paper reports a case of mandibular premolar with a fractured threaded metal endodontic post which was removed successfully with masserrann instrument retrieval kit and restored with ribbond reinforced endodontic post and esthetic crown restoration.

## Case Report

A male patient, 20 years old reported to Department of Conservative Dentistry and Endodontics with the chief complaint of food lodgment and bleeding from gingiva in the right back teeth region. Clinical examination revealed a full metal crown with overhanging margins on mandibular right second premolar (45) and secondary caries in the distal proximal gingival margin of the tooth, under the crown, **(Figure 1)**. Intraoral periapical (IOPA) radiograph of the tooth revealed a fractured endodontic post and the coronal fragment was malaligned compared to the apical part and the root canal obturation was not satisfactory **(Figure 2)**. It was decided to remove the metal crown and excavate the secondary caries, remove the fractured post, reobturate the apical third of the root canal, fabricate a ribbond post and core and finally replace the metal crown with an esthetic crown.

Full metal crown was removed with crown remover. Secondary caries on the distal margin was excavated with round carbide bur in a slow speed hand-piece. Using a round diamond point, the tip of the coronal fragment was exposed. Then using a tapered fissure diamond point a narrow slot was made around the fractured post and was retrieved by holding with narrow artery forceps. In order to gain access to the apical segment, the canal was widened with number 3 gates glidden drill. With a thin tapered fissure bur, a narrow slot was prepared around the post. Ultrasonic vibrations were used to dislodge the post in counter clockwise direction to the threads. The tip of the post was narrowed by cutting the threads in the most coronal portion to engage the masserann instrument removal kit. Once it was engaged, rotating in the counter clockwise direction, the fractured segment was removed**(Fig 3)**. The remaining root canal obturation material was removed using H-Files and Endosolv (gutta percha

Figure 1. Full metal crown with bulbous gingival margins are seen.

Figure 2. IOPA radiograph reveals over contoured crown and fractured endodontic post.

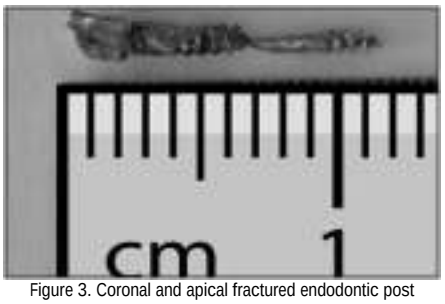

Figure 3. Coronal and apical fractured endodontic post removed.


Figure 4. PFM crown cemented and healthy free gingival margin seen.


Figure 5. IOPA radiograph reveals proper marginal adaptation and proximal contour.cording Of Neutral Zone Impression

solvent). Working length was determined, cleaning and shaping was performed and sectional obturation was done using gutta percha as obturation material and AH Plus as sealer.

Patient was advised for oral prophylaxis and the same was done next day. Patient was recalled after 5 days.

Clinical examination of the root canal revealed oval shaped canal that was wide and irregular. So it was decided to restore and reinforce the root with ribbond (Poly ethylene fiber) and make a composite core. 3 mm wide ribbond fiber of about 20 mm length was taken and folded. It was moistened in adper single bond 2 (Bonding agent).The canal was etched with 37% phosphoric acid, bonded with adper single bond 2 and flooded with flowable composite. The folded end was placed inside the canal and the free ends were placed coronally. Light curing was done with high intensity LED (light emitting diode) light curing unit (Elipar, 3M ESPE) for 1 minute to ensure complete polymerization of the composite. Core build-up was done with composite resin (Filtez Z-350) and tooth preparation for porcelain fused to metal (PFM) crown was made. PFM crown was fabricated and cemented in the subsequent visit **(Fig 4)**. IOPA radiograph was taken to check the marginal adaptation and contour of the cemented crown **(Figure 5)**.

## Discussion

The goal of ideal root canal treatment is not only to clean, shape and obturate the root canal space but to restore the mutilated tooth back to its proper form, function and esthetics. Apart from the operators effort, there are chances of endodontic mishaps that could adversely affect the treatment outcome. In case of endodontic treatment failure, retreatment could be performed orthrograde (from the coronal aspect) or retrograde by endodontic surgery. It is preferable to choose orthograde treatment if previous orthograde treatment was not performed, the cause for failure could be treated orthograde with a expected predicatable success rate. In this case orthograde treatment was selected because of the presence of secondary caries in the margin and ill fitting metal crown which mandatorily dictates the removal of crown, close proximity of tooth root to mental foramen and mandibular canal and improper root canal obturation.

The purpose of endodontic post is to provide retention to the core and distribute the occlusal load uniformly along the root surface. Torbjorner et al[4] reported on the frequency of three technical failures (loss of retention, root fracture, and post fracture). Post fracture alone contributes least to the failure of restoration, but the distribution of forces may become uneven and eventually root fracture may result.

In the present case ultrasonics and masserann kit was used for the removal of the fractured post as ultrasonics is the easiest, reliable technique with fewer incidences of root fracture and perforations.[5] The threaded post poses serious difficulties as they are engaged deeply inside the dentine. So masserann instrument removal kit was used to hold the fractured segment and to retrieve it.[6],[7]

Polyethylene fiber has shown to reinforce the weakened root structures. In this case pre fabricated post was not selected because the canal anatomy was oval and irregular. The prefabricated post which are round in cross section and the weakened root structure contraindicate the use of custom cast post and core.[8] It is difficult to identify ribbond (Poly ethylene fiber) in radiograph because of their radio-lucent nature so care should be taken while placement. The core build-up was done with direct composite as it is compatible with ribbond fibers.

By replacing with a properly contoured crown, the normal health of the gingiva was maintained. Tooth coloured porcelain fused to metal crown enhanced the esthetic value also.

## Conclusion

If performed with utmost care, restoring a mutilated tooth back to function is time consuming but, possible. Ultrasonics remains as the best technique for removal of endodontic post. Placement of ribbond fiber to reinforce the root and restore coronal tooth structure seems to be ideal, less time consuming and reliable treatment.

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# Neutral Zone Technique For Severely Resorbed Mandibular Ridge – Case Report

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**Abstract**
When all of the remaining natural teeth are removed; there exists within the oral cavity a void that may be called the potential denture space. The denture space is bounded by the tongue, medially or internally, and by the muscles and tissues of the lips and cheeks laterally or externally. Within the denture space there is an area that has been termed the neutral zone.
In summary, the neutral zone philosophy is based on the concept that for each individual patient there exists within the denture space a specific area where the function of the musculature will not unseat the denture, and at the same time where the forces generated by the tongue are neutralized by the forces generated by the lips and cheeks.

**Key Words**
Denture Space, Stability, Neutral zone

## Introduction

If the teeth are lost despite all efforts to save them, a re-establishment should be made in such a manner as to function efficiently and comfortably in harmony with the stomatognathic system.

The lower denture commonly presents the most difficulties with pain and looseness being the most common complaint[1]. This is because the mandible atrophies at a greater rate than the maxilla and has less residual ridge for retention and support[2]. The neutral zone technique is most effective for patients who have had numerous unstable, unretentive mandibular complete dentures. These patients usually have a highly atrophic mandible and there has been difficulty in positioning the teeth to produce a stable denture.[3]

Neutral Zone is defined as the potential space between the lips and cheeks on one side and the tongue on the other; that area or position where the forces between the tongue and cheeks or lips are equal[4]. It is also known as dead zone[5], stable zone[6], zone of minimal conflict[7], zone of equilibrium[8], zone of least interference[9], biometric denture space[10], denture space[11], and potential denture space[12]. The neutral zone is that area in the mouth where, during function, the forces of the tongue pressing outward are neutralized by the forces of the cheeks and lips pressing inward.

As the surface area of the impression surface decreases due to bone resorption and the external surface area increases, the development and contour of the external surface becomes more critical.

## Clinical And Laboratory Procedures

After a thorough examination of the patient, primary & final impressions of the patient are made followed by jaw relation & articulation in usual conventional manner.

## Construction Of The Acrylic Base

After the articulation acrylic resin base is constructed on the mandibular cast on which an acrylic resin vertical stop is made to preserve vertical dimension at the time of neutral zone impression **(Fig. 1)**.


Fig. 1: Acrylic Resin Base With Vertical Stop

## Manipulation Of Compound

To develop the body of the denture and to register the neutral zone by the use of modeling compound, there are three important factors to be considered. First the compound must be very securely attached to the tray. Secondly the compound must be thoroughly and uniformly softened for the muscles to mold the material. Third, it must be hard enough so that it will not flow and will maintain its shape as an occlusion rim until inserted into the mouth. Instead of impression compound, low fusing green stick wax or the mixture of two[13] can be used to record the neutral zone depending on operator's choice to modify the properties.

A water bath, preheated to the adequate temperature, is used to soften the material. It is then kneaded and rolled into 'U' shaped and adapted on the temporary denture base. A Hanau torch can be used to heat and sear the compound so that it will completely adhere to the tray. The compound is tempered in the water bath. This keeps the compound soft so that it can be molded. Repeated flaming, tempering, and shaping, keeps the compound soft while it is shaped into the form of an occlusion rim.

## Locating The Neutral Zone

To locate the neutral zone for the lower arch, the patient's lips are lubricated with petroleum jelly. Maxillary bite rim is first seated in the mouth followed by the mandibular tray with the softened modeling compound is carefully seated.

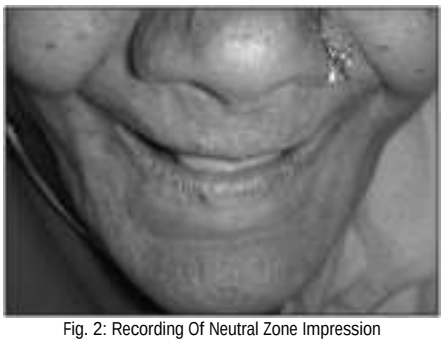
Fig. 2: Recording Of Neutral Zone Impression

Care must be used so that the lips do not press against the compound until it is completely seated. The patient is instructed to swallow and then purse the lips as in sucking. Patient is asked to perform physiologic movements as in phonetics and swallowing **(Fig. 2)**.

It is important to instruct the patient to keep the lips together and swallow. We should not tell the patient to close and swallow. By doing so, the patient may overclose and press the compound into the maxillary ridge, distorting the compound. Proper swallowing actions will mold the compound rim into the neutral zone. Sufficient time is allowed for the compound to harden and it is then removed from the mouth and inspected.

If initially an excessive amount of compound is used, it will be forced upward above the normal height of the occlusal plane and because of excessive bulk of compound, the tongue, lips and cheeks will be unable to mold the compound into a neutral zone of proper width. Therefore, any excess compound above the usual height of the occlusal plane is removed with a sharp knife and the compound is resoftened, placed back in the mouth and the patient is instructed to suck and swallow.

In all cases, the compound will exhibit similar shapes and contours, but there will be definite differences for each patient. The lingual surface of the compound rim will be shaped to the contour necessary to avoid interference with functional tongue movements. The anterior segment of the compound rim may have a labial, straight or lingual inclination depending on the tonus of the muscles in the lower lip and also the action of the tongue during swallowing. The buccal surface will generally be inclined to the lingual with a narrowing in the bicuspid area where the modiolus functions. The lingual surface will be inclined to the buccal.**(Fig. 3)**

**Testing The Stability**

The impression is placed back into the patient's mouth and checked for stability by having the patient open wide, wet the lips with the tongue, count from 1 to 100, and say exaggerated "oh" "ahs" and "ees". If these movements raise the rim, the lack of stability must be caused by an improper molding of the compound, as the tray or base was proved to be stable. In such cases, the compound is resoftened and the procedure is repeated until a stable rim is achieved.

The next procedure is to test the outer edge of the impresson with the tip of the index finger in the bicuspid and incisor regions. If pressure on the outer edges causes the opposite side to lift up, then the impression must be narrowed from the labial or buccal to where the vertical pressure will not cause the base to tilt. This will occur where there has been extensive ridge resorption and where the residual ridge is narrow bucco-lingually and labio-lingually. After the labial contour and curvature of the impression have been established and if the width of the anterior section is thicker than the incisal edges of the anterior teeth, the impression should be narrowed by trimming from the lingual.

The final test is to have the patient speak, swallow, wet the lips and open wide without the impression moving or being dislodged. We have therefore created a tray or base that is not dislodged by muscle function and have placed on it a body that is also not displaced by muscle function.

**Fabrication Of Tongue, Lip And Cheek Matrices**

With the lower neutral zone impression in place, the lower model is lubricated and rubber base putty material is placed on the lingual portion of the model, forming an artificial tongue, and on the labial and buccal of the lower model, completely encasing the impression. These matrices are trimmed to the exact height of the lower occlusal plane, which was established in the mouth. This preserves the height of the lower occlusal plane. **(Fig. 4)**

After the putty is set, when neutral zone impression is removed, the matrices can be placed back into position. **(Fig. 5)**

The space between the matrices on the lower rim represents the neutral zone and indicates where the teeth should be positioned. In this space a wax occlusal rim is fabricated for arrangement of teeth. **(Fig. 6)**

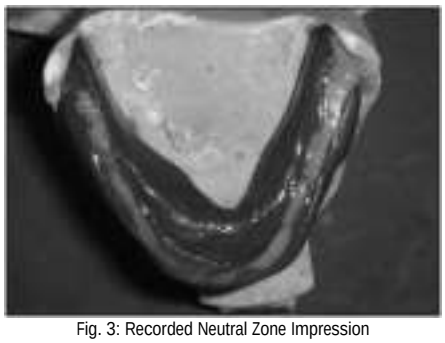
Fig. 3: Recorded Neutral Zone Impression

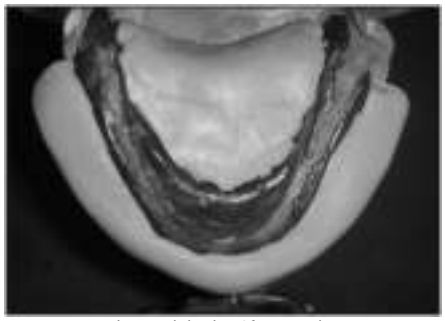
Fig. 4: Fabrication Of Putty Index


Fig. 5: Putty Index On The Model


Fig. 6: Fabrication Of Occlusal Rim

After selection of the proper size, occlusal morphology and material of the teeth to be used, we go in for the arrangement of teeth with in the matrix formed by putty.

**The Trial Denture**

After the verification and correction of the stability, retention, vertical dimension, phonetics, centric relation and esthetics is done. There is an important step to be completed during the trial denture try in is the making of external impressions on the labial, buccal and lingual surfaces of the dentures.

These will determine the thickness, contours and shape of the polished surfaces of the denture. By means of external impressions, a physiologic molding is made so that the external surfaces are functionally compatible with muscle action.

The trial denture acts as a tray to be used for the accurate secondary impression for forming the contours of the external surface of the denture. The trial dentures are waxed up so that there is just enough wax to hold the tooth, in position. The materials for the external impressions are either zinc oxide eugenol, one of the conditioning materials or light body addition silicone impression material.

The impression material is placed on the lingual surfaces of the lower denture, between the necks of the teeth and the denture periphery. The upper trial denture is placed in position, and the lower is then rotated into the mouth, taking care not to wipe off any material on the lips. With the lower trial denture in position, the patient is asked to close, purse the lips as in sucking and swallow. This is repeated several times. After the material has set, the trial dentures are removed from the mouth, and the gross excess is cut away. The impression material is then placed on the buccal and labial surfaces of the lower trial denture, and sucking and swallowing motions are repeated **(Fig.7)**.

By duplicating these impressions in the final denture, the operator has reproduced functionally contoured external surfaces of the denture that will aid immeasurably in the retention and stability of the dentures.

**Processing Of The Dentures**

The laboratory procedures for investing, packing and processing of the dentures using the neutral zone technique are generally the same as for conventional dentures. However, because of the materials used for the external impressions, it is necessary to be especially careful in some of the procedures.

Fig. 7: Light Body Secondary Impression Of Polished Surface

Fig. 8: Processed Denture

When zinc oxide eugenol paste has been used for taking the impression of the polished surface, the flasks should not be allowed to remain in the boil out tank for not more than 5 minutes. Reason being the zinc oxide eugenol paste gets liquefied if left for a longer time. This results in bleached appearance of the processed denture.

After the dentures are being processed, they are mounted on the articulator. Occlusal discrepancies are checked and corrected. The dentures are finished, polished and ready for insertion. **(Fig. 8)**

**Conclusion**

The neutral zone philosophy is based on the concept that for each individual patient there exists within, the denture space, a specific area where the function of the musculature will not unseat the denture, and at the same time where the forces generated by the tongue are neutralized by the forces generated by the lips arid cheeks.

The neutral zone has not been given enough importance, in the literature, but complete and partial denture failures are often related to non compliance with neutral zone factors. Fahmy et al[14] has also found in his study that the comfort & speech performance is better in the patients having dentures made with neutral zone technique.

Regardless of the method of treatment, any part of the dentition out of harmony with the neutral zone will result in instability, interference with function, or some degree of discomfort to the patient. Thus the neutral zone must be considered as an important factor while rehabilitating the edentulous patients. The operator should try to neutralize forces acting on complete dentures, which will make the prostheses more functionally physiologically and psychologically acceptable to the patient.

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# Charcateristic Dentofacial Features In Apert's Syndrome (Acrocephalosyndactyly) - A Case Report

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**Abstract**

Apert's syndrome is a rare congenital anomaly characterized by acrocephaly, syndactyly, midface hypoplasia, pharyngeal attenuation, ocular manifestations and abnormalities of other organs. It has characteristic features in the orofacial region like early craniosynostosis of coronal suture, cranial base and an agenesis of the sagittal suture. These characteristics predispose the patients to maxillary transverse and sagittal hypoplasia, pseudo cleft palate as well as prominent skeletal and dental anterior open bite. In this case report, the features of Apert syndrome, particularly in relation to the orofacial region, are discussed with an emphasis on the need for multidisciplinary care in such patients.

**Key Words**

Apert's syndrome, acrocephalosyndactyly, pseudo cleft palate, mid facial hypoplasia

## Introduction

We ought not to set them aside with idle thoughts or idle words about "curiosities' or "chances". Not one of them is without meaning; not one that might not become the beginning of excellent knowledge, if only we could answer the question- why is it rare, or being rare, why did it in this instance happen? **James Paget, 1882**[1]

Over the past several decades tremendous advances have been made in the prevention and treatment of developmental anomalies. This metamorphosis in our conceptualization of developmental malformations has led to an improved ability to handle and prevent them. Despite such improvements, developmental malformations remain a significant cause of morbidity worldwide. Even when the mode of inheritance is well established, some conditions continue to exhibit a large number of sporadic occurrences, which makes their eradication virtually impossible. As such, it is incumbent on us to learn us much as possible about these conditions. In this way, we can become better clinicians and impart better care to those who so desperately need it.[2]

Acrocephalosyndactyly is a rare developmental deformity characteristically affecting the head, hands and feet. Eugene Apert[3] in 1906 reported nine cases and since then his name has been associated with acrocephalosyndactyly. Apert described a triad of craniosynostosis, syndactyly and maxillary hypoplasia. It is known to be inherited in an autosomal dominant fashion, but most cases are sporadic. The sporadic cases are postulated to be associated with advanced paternal age. The incidence of Apert syndrome is approximately one in 50,000 births. Some investigators state that 4.5 percent of all craniosynostosis represent Apert syndrome.[4]

Apert's syndrome has been rarely reported from India.[5] With the rare exceptions, Apert's syndrome in all reported cases has been caused by recurrent missence mutations of the fibroblast growth factor receptor 2 gene involving 2 adjacent aminoacids.[6] Apert's syndrome is thought to occur as a result of androgen end organ hyper-response affecting the epiphyses and sebaceous glands.

This results in early epiphyseal fusion resulting in short stature, short and fused digits and acrocephaly. The clinical features are characterized by early fusion of skull bones, mainly coronal sometimes lambdoid, midface regression and webbed digits (syndactyly). Syndactyly always involves fusion of the soft tissues of the first, middle and ring fingers. Thumb may be fused with the rest or may be free.[7]

The middle third of the face is retruded and hypoplastic. The calvarial coronal synostosis and the saggital and metopic suture agenesis coupled with early synostosis of the cranial base results in a hypoplastic midfcae and a vertically accentuated craniofacial complex. Proptosis, downslanting laterla canthi are seen and often there is some degree of optical hypertelorism. The ears are often low set. The nose can have a parror beek shape with a depressed nasal bridge. The maxilla is hypoplastic in all three dimensions and is retropositioned. The palate is high arched and narrow due to poor aeration of maxillary antra. There are bulbous lateral palatal swellings (containing hyaluronic acid) which make the central furrow of the palate very prominent and difficult to cleanse. Pseudo cleft palate along with an anteriorly tipped palatal plane is very common. The maxillary arch is V shaped and there is severe dental crowding. The maxilla slants down posteriorly as a result there is anterior open bite. Impactions, severe crowding of developing teeth within the alveolus, delayed eruption, thick gingiva and sometimes supernumerary or congenitally missing teeth are the hallmarks of the maxillary dental development in Apert's syndrome patients. In the mandible these findings are less pronounced. The lips are characterized by the crossbow shape of the upper li or the trpezoidal shape of both the lips. The lips range from non competent to competent depending upon

their ability to form seal.[8]

Patients affected with acrocephalosyndactyly usually have a norma lifespan. Therefore it is imporatnt to remember that facial defects which develop qquite early can lead to various types of social maladjustments. Surgical intervention in such cases is for morphological, functional and psychological benefits. Paul Tessier[9] has presented a comprehensive system of craniofacial surgery for the definitive and radical correction of deformities in Apert's syndrome.[10]

Treatment involves multidisciplinary teamwork including Craniofacial surgeon, Neurosurgeon, Pediatrician, Speech pathologist, and an Orthodontist. Correction of hypertelorism can be undertaken by a facial advancement operation. These children invariably need speech therapy after the surgical correction of abnormalities is done.[11]

Fig 1. Extraoral Frontal View

Fig 2. Extraoral Profile View

**Clinical Synopsis**

A twelve year old female patient had presented to the Dental OPD with a chief complaint of pain in the lower right back too since few days. The patient presented with unusual craniofacial and dental features, which prompted a further detailed analysis of the case. On questioning the parents it was found that the patient was known case of Apert's syndrome.

This child Sheeshna was the second in the family, born to non-consanguinous parents after a normal labour. The mother's age was 28 years and the father was 35 years old. The patient was the product of a full term uneventful pregnancy with no known exposure to infection, drugs or irradiation. No similar malformations were known in either parent's family. Both parents and their other children were examined and found to be normal clinically.

The facial appearance was peculiar due to lateral displacement of both medial canthi and associated epicanthic folds, with prominent downthrust proptopic eyes and a flat nasal bridge. There was a flexion deformity of the elbows and knees with symmetrical deformity of both hands, which were short and stubby, and showed complete syndactyly of all the fingers with a short displaced thumb and a synonychia of the index, middle and ring fingers. The palmar aspect was spoon shaped. The feet showed a varus deformity with syndactyly of all toes. The other systems revealed no abnormality.

Extraoral examination revealed that she had an abnormal facies with acrocephaly, brachycephaly, flat occiput and a high prominent forehead. A mild facial asymmetry was present in this case. There appeared to be facial flattening with maxillary hypoplasia and anterior open bite. "Crossbow" shape of the upper lip and a protruding lower lip were noticed. The lips were potentially competent. Ears were low set and down sliding of the palpebral fissures were present with shallow orbits and exopthalmos (strabismus). Nasal bridge was depressed **(Figures 1, 2)**.

Fig 3. Intraoral Front View

Fig 4. Maxillary Arch

Fig 5. Mandibular Arch

Typical dental and skeletal findings of Apert's syndrome **(Figures 3, 4, 5)** were observed on intraoral examination. The palate was high arched with a pseudo cleft in its posterior third. The patient had set of permanent teeth. There was severe maxillary crowding, anterior open bite, ectopic eruption and poor oral hygiene. Her face showed a dolicocephalic pattern. The over bite was - 4 mm and the overjet was - 1 mm due to forwardly placed lower anteriors. The maxillary dental arch was V shaper where as the mandibular arch was wider. Since the patient had reported with the chief complaint of pain in the lower right back tooth an IOPA radiograph was taken and which suggested deep caries involving the pulp. The tooth in question (46) was tender on percussion. Oral prophylaxis was done and Root canal treatment was performed on 46 and then it was permanently restored with amalgam post obturation.

**Discussion**

A deformity of the osseous system is the most conspicuous feature of the syndrome of acrocephalosyndactyly. It is recognisable at birth and characteristically affects the head and extremities.[12] The major manifestations include premature closure of the cranial sutures, and syndactyly affecting the hands and feet.

In most of the reported cases, the age

incidence varies from 4 months to 9 years although the oldest patient reported has been 27 years of age.[13] In our case however, these deformities were noticed by the parents since birth.

The infant Apert skull is characterized by premature fusion of the coronal sutures and by a wide calvarial midline defect that starts at the glabella and ends at the posterior fontanelle. Many of those affected also have agenesis of the corpus collosum, progressive hydrocephalus, and hippocampal abnormalities[14]. Early surgical intervention to correct the craniosynostosis is crucial in order to realize the highest chances for normal development. The ocular orbits are shallow and the accompanying exophthalmia may lead to blindness. The ocular manifestations, hypertelorism and exophthalmia, seem to be present in most of the case reports and in this particular case as well.

Due to closure of the coronal sutures, the calvarium is lengthened vertically and shortened in the antero-posterior dimension, resulting in a flattened occiput and a prominent frontal area. There is hypertelorism with an antimongoloid slant and bulging of the eyes secondary to the shallow orbits. Facial dysostosis consisting of hypoplasia of the maxillae, a prominent mandible, high arched narrow palate, crowded teeth, an open mouth secondary to nasal obstruction, and occasionally a cleft palate are pre-sent.

The syndactyly is marked and resembles a `mitten hand' or `sock foot'. There is usually a complete fusion of the distal soft tissues, and occasionally of the bones. The thumbs and big toes may or may not be involved in the fusion. Other less frequent skeletal anomalies may be present.

Some mental impairment is present in almost every case, but its true incidence is not known. Most cases show no visceral abnormality. In this case no mental abnormality was found in the patient as her IQ score fell well within the normal range.

The oral cavity of Apert patients is also characteristic. The findings include a reduction in the size of the maxilla, particularly in the anterioposterior direction. This reduction may result in tooth crowding. Pseudo cleft palate or bifid uvula is found in approximately 75 percent of those affected. Dental anomalies such as impacted teeth, delayed eruption, ectopic eruption, supernumerary teeth, and thick gingiva are also common.[4] Most of these findings were observed in this patient.

The etiological factors prominent for this condition remain controversial. Previous reports favor the idea of a dominant mutation, and such an accident might happen as result of consanguinity.[15] In our case there was no relevant family history or other maternal problems.

Recent years have brought about an upsurge in the study of fibroblast-growth-factor receptors, FGFRs, as they pertain to human development. At least fifteen different genetic dysplasias such as Apert syndrome have been linked to FGFRs[16]. The mutation is known to be a Ser252 Trp mutation in the FGFR2 gene[17]. The epidemiology of Apert syndrome is such that the incidence of sporadic births increases exponentially with increasing paternal age, and some investigators have found that this mutation is more common in the sperm of older men[18]. Experiments have indicated that FGFR2 may act as a negative regulator of bone growth.

## Conclusion

Until there is a means to correct the molecular defect, we must rely on a strong multidisciplinary approach to patients with Apert syndrome. Neurosurgeons, plastic surgeons, otorhinolaryngologists, orthodontists, pedodontists, ophthalmologists, radiologists, geneticists, pediatricians, and dermatologists must all work in concert to care for patients with Apert syndrome. Early surgical intervention is imperative for optimal outcomes. Subsequent treatment should be tailored to each individual patient's needs.

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# Wooden Foreign Body In Symphysis Region Of Mandible: A Rare Case Report

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**Abstract**
A wooden piece was retrieved from symphysis region of the mandible after one year of injury. The case presented here underlines the importance of thorough history, proper investigations and considerations of presence of foreign body in cases of long standing infections.

**Key Words**
Symphysis, foreign Body, Hyperdense, chin, CT scan

## Introduction

Head and neck infections occur frequently, common causes include odontogenic and cutaneous lesions[1]. Foreign bodies are sometimes encountered in the face[2], occasionally foreign bodies may be retained for some time causing persistent and distressing symptoms[3], Most cases occur in infants and children and are usually accompanied by poor history and difficulty in clinical examination, which may be a problem to establish an accurate diagnosis[4].

## Case Report

A 14 year old male patient reported to the Department of Oral & Maxillofacial surgery with chief complaint of non healing wound in chin area since last one year.

According to the parents the patient was apparently well one year ago when he fell from a tree and sustained injury in chin region. Patient was taken to a nearby community health centre where dressing of wound was done after suturing of laceration and antibiotics were prescribed. But after a week pus started oozing from the wound. The wound was re-explored and again dressing was done. This time intravenous antibiotics were prescribed. The wound healed but after 3 months again there was a pus discharge. This time radiograph was taken. Patient was diagnosed with osteomyelitis and was prescribed antibiotics for 15 days. The wound healed but after about 2 months again pus discharging sinus appeared. Patient was referred to District Hospital but patient preferred to come to Department of Oral & Maxillofacial Surgery at Himachal Pradesh Government Dental College Shimla.

Patient was not a known case of Diabetes mellitus/Hypertension/Asthma/Epileps.

On extra oral examination, a 2x2 c.m. single sinus in the submental region with granulation tissue at the opening of sinus and discharging pus was present. Sinus was tender, mobile and with thick walls.

On intraoral examination no abnormality was detected.

Based on examination OPG and C.T. scan was taken.

In OPG nothing abnormal was detected but C.T. scan showed increase in soft tissue in chin region anteriorly. There was an evidence of hyperdense irregular 9x7m.m. foreign body focus with a density of 156 H.U. **(Fig 1 - a, b, c)**, however there was no evidence of any erosive destruction or fracture of mandible.

Based on C.T. scan observations, surgical exploration of soft tissue with removal of foreign body was planned under local anesthesia.

**CT scan showing hyperdense area in anterior chin region**

Fig 1b: Axial View

Fig 1a: Sagittal View

Fig 1c: Coronal View

Fig 2: Surgical Exposure

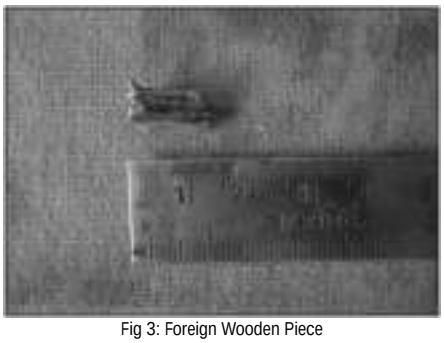

Fig 3: Foreign Wooden Piece

**Operative Procedure**

Surgical exploration was done with mandibular vestibular incision in the anterior region under local anesthesia, layer by layer blunt dissection was done, wooden piece was removed and curettage was done. Communication between intra and extraoral wound was explored and epithelial lining was removed. Layer by layer suturing intraorally was done with vicryl 3-0 and mucosa with 4-0 silk. Medications were prescribed and regular follow up was done. **(Fig 2, 3)**

**Discussion**

A few reports on wooden foreign bodies in head or neck have appeared in international literature, most involving pieces of wood or branches, fish bones, incisor fragments, fragments of smoking pipes, disposable broken bur[5],[3]. Tissue reactions from foreign bodies are commonly encountered in oral cavity[6]. Retained foreign bodies are capable of causing inflammation, abscess formation as well as chronic pathologies including granulomatous tissue reaction, fistula formation and osteomyelitis[7]. Wood and bamboo, with their porous consistency and organic nature, provide a good medium for microbial agents[8]. Foreign bodies made from metal, plastic, glass are easily detected with an ordinary x-ray. However wooden foreign bodies are difficult to detect in ordinary x-ray, so their diagnosis is often missed or delayed [9],[10]. C.T. is considered the gold standard for detection of foreign bodies[11]. Magnetic resonance imaging (MRI) may be more sensitive when the wooden foreign body is embedded in fat (i.e. orbital fat). If C.T. scans do not reveal a suspected wooden fragment, MRI should be carried out[10]. The correct diagnosis of a retained wooden foreign body is often difficult because it may follow relatively minor trauma, and may not be identified clinically[10].

Penetrating foreign bodies may present diagnostic challenge to the trauma surgeon and foreign body should always be considered in the differential diagnosis of a case presenting with a draining sinus apart from osteomyelitis and fracture.

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# Restoring Aesthetics

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**Abstract**
Amelogenesis imperfecta has been described as a complex group of inherited conditions that disturbs the developing enamel structure and exists independent of any related systemic disorder. It is a rare dental disease but represents a great restorative challenge for dentists. A 17-year-old girl presented with sensitive, discolored, and mutilated teeth. Prosthodontic measures were undertaken to improve her aesthetics. The two month recall examination revealed no pathology associated with the rehabilitation, and the patient's aesthetic and functional expectations were also satisfied. The rehabilitation included anterior composite resins veneering, post and core with porcelain fused to metal crowns to eliminate tooth sensitivity, improve the aesthetics and restore function.

**Key Words**
amelogenesis imperfecta , aesthetics, function, ceramic

## Introduction

Amelogenesis imperfecta (ai) is a hereditary disorder that affects enamel on primary and permanent teeth. It is reported to have an incidence of one person in every 14,000[1],[2]. Although amelogenesis imperfecta has been categorized into 4 broad groups primarily based on phenotype—hypoplastic, hypocalcified, hypomaturation, and hypomaturation-hypoplastic - at least 15 subtypes of ai exist when phenotype and mode of inheritance are considered [2],[4]. According to the literature, ai patients, regardless of subtype, have similar oral complications: teeth sensitivity, poor dental aesthetics, and decreased occlusal vertical dimension. Other dental anomalies associated with ai include, but are not limited to, multiple impacted teeth, congenitally missing teeth, open occlusal relationship, and taurodontism [3].

Historically, patients with ai have been treated with multiple extractions and the fabrication of complete dentures [5],[6],[7],[8]. Recently, several studies have illustrated the use of stainless steel crowns, adhesive casting, over denture, porcelain veneers, ceramics, and composite resin veneers to restore dentitions mutilated by severe attrition[9],[10],[11]. Besides, the advances in the field of aesthetic dentistry, especially in bonding to dentin, help practitioners to restore function and aesthetics to an acceptable level.

This clinical report describes treatment of a 17-year-old girl patient diagnosed with hypomature amelogenesis imperfecta by using composite resin veneers, post and core and ceramic crowns.

## Case Report

A 17-year-old girl was referred to the department of prosthodontics including crown and bridge, for examination, evaluation and treatment of gross discolouration, fractures and considerable sensitivity of her teeth **(Fig 1)**.

A detailed medical, dental, and social history was obtained. She was both self-conscious and unhappy as regard to the appearance of her teeth.

Clinical examination revealed that the enamel layer was very thin and brown (Pigmented), the cuspal structure was completely absent in the occlusal portion of the molars and enamel pit defects (pigmented stains deep) were present in the anterior teeth **(Fig 2)**. However, the clinical appearance of cervical and approximal enamel seemed to be normal. It was thought that the patient likely suffered from a hypomature type of ai. The exposed dentin was hypersensitive. Radiographic examination of the patient revealed deep carious lesions in the maxillary, and the mandibular molars and fractured maxillary left anterior incisors and canine **(Fig 3)**.

A treatment plan was developed with the following aims: to reduce the reported sensitivity of the teeth, to restore fractures and to improve the aesthetics. The patient was informed of the diagnosis and all treatment plans were discussed with her and his parents.

Fig 1 : Before Treatment

Fig 2 : Before Treatment (Intraoraly)

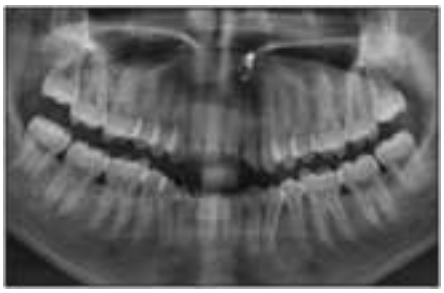

Fig 3 : Opg

Fig 4 : Root Canal Treatment Done On Left Lateral & Central Incisor Followed By Custom Made Post Placement On Left Lateral Incisor

Fig 5 : Tooth Preparation Done On Left Incisors And Canine For Placement Of Porcelain Fused To Metal Crowns

Fig 6 : Composite Veneering Done On Right Incisors And Canine

**Steps of treatment followed-**

- First, root canal treatment were done for maxillary anterior left incisors, followed with custom made post placement in maxillary left lateral incisor **(Fig 4)**.
- Then ,tooth preparation was done for porcelain fused to metal crowns on left maxillary incisors and canine and futher on right maxillary incisors and canine for composite veneers **(Fig 5)**.
- Metal try-in done for ceramic crowns and shade matching was then done .

Fig 7 : After Treatment

Fig 8 : After Treatment (Intraoraly)

- Finally composite veneering was done on right maxillary anteriors and porcelain fused to metal crowns on left maxillary anteriors.**(Fig 6)**

The patient was recalled at 2-month intervals. On recall clinical and radiographic examination revealed no pathology associated with the rehabilitation, and the patient's aesthetic and functional expectations were satisfied **(Fig 7, 8)**.

**Discussion**

The term "amelogenesis imperfecta" describes a diverse group of hereditary conditions primarily affecting the quality and/or quantity of dental enamel. The affected teeth show a soft enamel of normal thickness that chips and wears easily and has a radiodensity similar to that of dentin[2],[3]. The results of clinical and radiographic evaluations indicated that the patient in the present case had hypomaturation form ai. All the teeth are misshapen, and spotted. Occlusion and vertical opening are rapidly affected by attrition. The insufficiency of the enamel makes the teeth extremely sensitive to contact and thermal stimuli. These problems combine to make early diagnosis essential and immediate treatment a necessity, even for the youngest patients[4],[6].

In some types of ai, the patient's enamel not only is thin but also may display abnormal mineral content. The axial surfaces may be chalky, weak, and highly susceptible to carious breakdown. Such teeth require complete coverage with preformed crowns until precision cast crowns can be provided in the patient's late teens or early adulthood.

A complex case will challenge any direct composite system. A quality aesthetic direct composite system must contain a wide variety of shades and include multiple opacities to ensure the restorations will mimic natural dentition. As teeth are not monochromatic and the colors come from within, the color must be developed from the inside out [7],[8],[9]. The polish of a quality direct composite system should provide high gloss and should be maintained in the oral environment.

Walter[8] applied composite resin restorations for anterior teeth to 10-year-old child with ai as provisional treatment. Similarly, in the present case the treatment was completed with direct composite resin. Although this case could have been treated with indirect restorations, direct resin treatment was chosen to preserve tooth structure and for financial reasons. When all the teeth had been restored direct composite resin, the patient' aesthetic complaints disappeared completely, and normal eating habits were established. Temporary restorations provide satisfactory aesthetic and protective features with minimum preparation, made difficult by crown height and lack of enamel in untreated amelogenesis imperfecta, to be performed under excellent conditions. This temporary treatment allows the normal development of the dentition to continue unimpaired and, last but not least, is affordable for the parents.

It is very important in that it prevents the development of psychological problems arising from the appearance of teeth affected by amelogenesis imperfecta[11]. The shy and taciturn 17-year-old girl first brought forcefully to the department, became a willing and talkative patient. The psychological transformation was

spectacular, as was the physiological change, evidenced by a weight gain within weeks.

**Conclusion**

This clinical report describes the oral rehabilitation of a 17-year-old girl patient affected by hypomature amelogenesis imperfecta. The treatment plan for cases of ai is related to many factors: the age of the patient, the socioeconomic status of the patient, the type and severity of the disorder, and the intraoral situation at the time the treatment is planned. The rehabilitation included anterior composite resins veneers and ceramic crowns to eliminate tooth sensitivity, improve the aesthetics and restore function.

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# Prosthetic Rehabilitation For A Case Of Papillon-lefevre Syndrome

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**Abstract**
Papillon-lefevre syndrome is a rare syndrome of autosomal recessive inheritance characterized by palmo-plantar hyperkeratosis and a precocious progressive periodontal disease that results in premature loss of primary and permanent dentition. Here, is a case report of prosthodontic rehabilitation of a 15-year-old female with Papillon-lefevre syndrome.

**Key Words**
Cast partial denture, Hyperkeratosis.

## Introduction

Papillon-lefevre syndrome was first described by Papillon & Lefevre in 1924.[1] The clinical manifestations include palmo-plantar hyperkeratosis and rapidly progressing periodontitis which results in premature exfoliation of primary and permanent dentitions. Gorlin et al suggested that calcification of duramater is the 3rd component of the syndrome. Prevalence of Papillon-lefevre syndrome is 1-4 per million individuals with no sex predilection and racial predominance. A greater frequency of occurrence is noticed in consanguineous offspring.

The eruption of primary teeth occurs at the normal age in a normal sequence with normal form and structure. Following eruption of primary teeth, severe gingival inflammation and a generalized aggressive periodontitis occur resulting in premature loss of primary teeth. Gingiva resumes its normalcy after exfoliation of the primary teeth. Permanent dentition is also followed by same events and if not intervened most of the permanent teeth are lost by 15-17 years of age. Severe resorption of alveolar bone gives the teeth a floating in air appearance on radiographs. Plamo-planar hyperkeratosis varies from psoriasiform scaly skin to hyperkeratosis and this can also affect other areas such as the elbows and knees.

## Case Report

A 15-year-old female patient came to the dental office with a chief complaint of mobility of upper and lower anterior teeth and pain while taking food. Family history revealed consanguineous marriage of their parents. She is the second of the three siblings born after a full term normal delivery and none of her siblings showed similar findings.

She is thin built with a steady gait with normal physical and mental development. Dermatological examination revealed hyperkeratotic, well demarcated asymptomatic plaques extending on to the dorsal surfaces of hands and feet. She also gave a repeated history of skin infections.

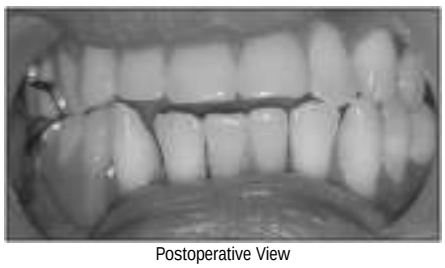
Dental history revealed early loss of primary teeth. Intraoral examination revealed grade II mobility of 21, 31, 32 & 41. Deep pockets i.r.t 16, 26, 36 & 46. Panoramic view showed generalized loss of alveolar bone with complete loss of bone support giving a floating in air appearance.

Blood investigations and liver function tests showed values within normal range. Based on these findings the condition was diagnosed as Papillon-lefevre syndrome.

## Treatment And Management

Since the patient is a teenage girl in order to satisfy the esthetic and functional needs extraction of the mobile teeth, periodontal therapy combined with prophylactic antibiotics of remaining teeth and replacement of missing teeth by using upper and lower cast partial dentures were planned.**(Figure 1, 2)** Course of antibiotics helps to control active periodontitis in an effort to preserve the teeth a and to prevent bacteremia and subsequent pyogenic liver abscess The patient was referred to a dermatologist for the management of skin lesions.

Preoperative View



Postoperative View

## Discussion

Papillon-lefevre syndrome is a rare disorder of keratinisation affecting children between ages of 1-5 years. The reported incidence is 1-4 per million. The exact etiology and pathogenesis is unknown but three main factors are responsible for initiation and progression

of Papillon-lefevre syndrome.[1]

Genetically loss of function, mutations of the lysosomal protease cathepsin C[2],[3],[4],[5],[6]. gene are associated with Papillon-lefevre syndrome and related conditions. The cathepsin C gene is expressed in the epithelial regions and in various immune cells including polymorphonuclear leucocytes, macrophages and their precursors. This gives better understanding of the signs and symptoms associated with Papillon-lefevre syndrome.[1]

Immunologically alteration of the host defense because of decreased function of PMNLs or monocytes.

Microbially gram negative microbial polysaccharides are recognized as the primary factors in the etiology of periodontitis in Papillon-lefevre syndrome. Actinobacillus actinomycetemcommitans constituted more than 50% of colony forming units.[1]

Plamo-planar keratosis starts within 4 years of life with sharply demarcated erythematous keratotic plaques involving palms and soles, sometimes extending on to the dorsal surfaces of hands and feet. The cutaneous lesions have a tendency to worsen in winter.[7],[8],[9]. Oral manifestations of Papillon-lefevre syndrome appear almost simultaneously with the onset of palmo-plantar hyperkeratosis. The primary teeth erupt at the expected age and in normal sequence.

Usually, the teeth are of normal form and structure. Rapidly progressing periodontits ensues, after the eruption of the primary dentition, manifested by markedly reddened, inflamed and swollen gingival associated with extensive bone resorption and deep periodontal pockets from which pus exudes in response to slight pressure. Chewing is very painful because of the mobility of teeth. Fetid mouth odour and regional lymphadenopathy are observed commonly.[10]. Increase susceptibility to infections was reported in 20 per cent patients due to dysfunction of leucocytes and neutrophils.[11]. Pyogenic liver abscess is increasingly recognized as a complication PLS associated with impairment of immune system.[12].

The dental features of Papillon-lefevre syndrome are the looseness, hyper mobility, drifting, migration and exfoliation of teeth without signs of root resorption. Primary teeth are exfoliated or extracted and child becomes completely edentulous by the age of 4-5 years with gingival returning to normal healthy state. Same cycle begins with the eruption of permanent teeth and by the age of 13-15 years if not intervened all permanent teeth are lost. Radiographic examination reveals severe loss of alveolar bone and teeth appear to be "floating in air"[1].

Differential diagnosis includes chediak-higashi syndrome, juvenile periodontitis and Haim – Munk syndrome. Features associated with chediak-higashi syndrome are absent in this case. Skin lesions are present by which only juvenile periodontitis can be ruled out. In haim – munk syndrome apart from features seen in PLS archanodactyly, acroosteolysis, atophic changes of nails and radiographic deformity of fingers can be seen.[5].

The Papillon-lefevre syndrome can adversely affect growing children psychologically, socially and aesthetically. A multi-disciplinary approach may improve the prognosis and quality of life of these children. Thus, oral rehabilitation in such patients is a must. Prosthetic replacement in Papillon-lefevre syndrome is age specific, specialty job involving initial replacement with complete or partial dentures with future consideration for implant supported prosthesis. In this case we have selected upper and lower cast partial dentures for prosthetic replacement because she is still young and loss of any tooth can be added to the framework in future. After the completion of growth we have recommended her for implant supported dentures.

## Conclusion

Early recognition and a multi-disciplinary approach helps in improving the prognosis of patients with Papillon-lefevre syndrome. Prosthetic rehabilitation provides a psychological boost up to the patient and parents by restoring not only the esthetic appearance but also the function.

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# Endodontic Management Of Bilateral Taurodontism In Impacted Permanent Molars: A Rare Case Report

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**Abstract**
Taurodontism can be defined as a change in tooth shape caused by the failure of Hertwig's epithelial sheath diaphragm to invaginate at the proper horizontal level. An enlarged pulp chamber, apical displacement of the pulpal floor, and no constriction at the level of the cemento-enamel junction are the characteristic features. Although permanent molar teeth are most commonly affected, this change can also be seen in both the permanent and deciduous dentition, unilaterally or bilaterally, and in any combination of teeth or quadrants. Despite the clinical challenges, taurodontism has received little attention from clinicians. This case report presents a case of a twenty seven year old male patient presented with taurodontism involving the molars of two quadrants, which was not associated with any other anomalies or syndromes.

**Key Words**
dens in dente, dens invaginatus, pulp necrosis, periapical pathology, MTA retroseal.

## Introduction:

Taurodontism is a developmental disturbance of a tooth that lacks constriction at the level of the cementoenamel junction (CEJ). It is characterized by vertically elongated pulp chamber, apical displacement of the pulpal floor and bifurcation or trifurcations of the roots.[1] The term "taurodontism" ('bull tooth') was coined from the Latin word "tauros", which means 'bull' and the Greek word "odus", which means 'tooth'. Sir Arthur Keith in 1913 coined the term "taurodontism" and defined taurodontism as "a tendency for the body of the tooth to enlarge at the expense of the roots".

Shaw (1928) further classified taurodont teeth according to their severity into hypo-, meso- and hypertaurodont forms, hypotaurodontism being the least pronounced form, mesotaurodontism the moderate form and hypertaurodontism being the most severe form in which the bifurcation or trifurcation occurs near the root apices[2] **( Fig 1)**.

Later in 1978 Shiffman and Chanannel established mathematical criteria which areadopted by various authors for assessing their cases. According to this criteria, a tooth is considered as a taurodont if the distance from the lowest point of roof of the pulp chamber (A) to the highest point of the floor (B), divided by the distance from A to the root apex (C) is equal to or greater than 0.2 mm, and when the distance from B to the CEJ (D) is greater than 2.5mm **(Fig 2)**.

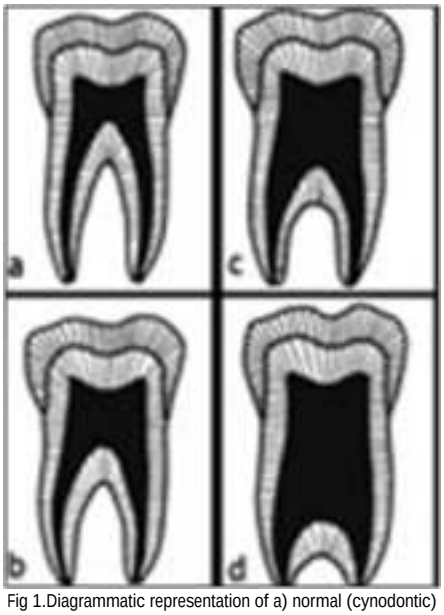

Fig 1.Diagrammatic representation of a) normal (cynodontic) tooth b) hypotaurodont c) mesotaurodont d) hypertaurodont

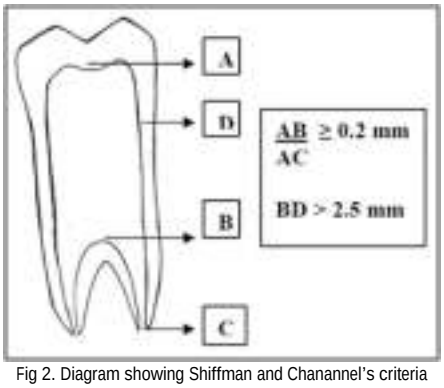

Fig 2. Diagram showing Shiffman and Chanannel's criteria for diagnosing Taurodontism.

The etiology of taurodontism is unclear. The possible causes of taurodontism have been enumerated by Mangion[3] as follows: 1) A specialized or retrograde character, 2) A primitive pattern, 3) AMendelian recessive trait,4) An atavistic feature, and 5) A mutation resulting from odontoblastic deficiency during dentinogenesis of the roots.

According to Hamner et al., taurodontism is caused by the failure of Hertwig's epithelial sheath diaphragm to invaginate at the proper horizontal level.[4] In addition, it has been reported that many patients with the Klinefelter syndrome exhibit taurodontism, but it is not a constant feature of this syndrome. Today, it is considered as an anatomic variant that could occur in a normal population. The prevalence of taurodontism is reported to range from 2.5% to 11.3% of the human population. This range is accounted for by variations in race and differences in diagnostic criteria.

## Case Report:

A twenty seven year old male child was brought to dental clinic, sirsa with

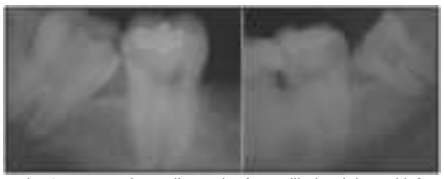

Fig. 3 Preoperative radiograph of mandibular right and left third molar teeth

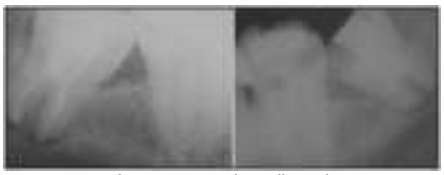

Fig 4. Post operative radiograph

complain of pain related to left and right posterior tooth region of mandible for last two weeks. There was no significant dental or medical complaint in the past. His intraoral examination revealed normal soft tissue appearance with a large carious lesion in impacted mandibular left and right third molar and patient was not willing for extraction. At the time of examination, the teeth were tender on percussion.

Intraoral periapical radiograph of both sides revealed large pulp chambers and short roots. There were periapical lesions involving both the teeth **(Fig 3)**.

No other remarkable dental findings were observed clinically or radiographically. Past medical history was non contributory. General physical examination did not reveal any significant findings. Patient's physical and mental development was with in normal rates for his age.

Based on clinical and radiographic findings, a diagnosis of chronic apical periodontitis was made in relation to mandibular left and right third molar teeth. The right molar was mesotaurodant and the left was hypotaurodont. The right molar was first anaesthetized, the access was opened under isolation and the access cavity was modified. The remaining pulp tissue was extirpated. The pulp was voluminous, to ensure complete removal, 2.5% sodium hypochlorite was initially used as an irrigant to soften the pulp.

Once the pulp was extirpated, further irrigation was done with normal saline. The pulp chamber was huge and the floor of the chamber could not be visualized. At the furcation area, three canal orifices were found: mesiobuccal, mesiolingual, distal. A working length radiograph was taken with #15 file in all the canals and biomechanical preparation was done with Protaper system.

After completion of instrumentation, a calcium hydroxide dressing was given for two weeks. A modified obturation technique was used because of the proximity of the orifices. After drying the canals, AH plus

(Dentsply International) sealer was applied onto the root canal walls with a lentulospiral. The premeasured master cone was coated with sealer and slowly moved to full working length.

Thus, all the canals were obturated. After that, the elongated pulp chamber was obturated with vertical compaction of warm gutta percha.Similarly treatment was done for the left side mandibular molar. Both the obturations could be seen in the radiographs.**(Fig 4)**

**Discussion**

A taurodont tooth shows wide variation in the size of the pulp chamber, varying degrees of obliteration and canal configuration, apically positioned canal orifices. Endodontic treatment in taurodontism teeth has been described as a complex and difficult procedure. Pulp therapy for taurodonts is a challenging treatment, with increased incidence of haemorrhage during access opening which may be mistaken for perforation. Since the roots are short and pulpal floor is placed apically, care should be taken to prevent perforation.[1],[5]

Taurodontism is a dental anomaly characterized by large pulp chambers and short roots. Roots often bifurcate or trifurcate at a low level. They are thought to result from failure of the Hertwig's epithelial root sheath to invaginate at the proper time. The most frequently affected teeth are the molars. The distance between the baseline connecting the two CEJ and the highest point in the floor of the pulp chamber are used in determining taurodont teeth. Taurodontism is diagnosed in molars when this distance exceeds 2.5 mm.[6]

Taurodontism is associated with several developmental syndromes and anomalies including amelogenesis imperfecta, Down's syndrome, ectodermal disturbance, Klinefelter syndrome, tricho-dento-osseous syndrome, Mohr syndrome, Wolf-Hirschhorn syndrome and Lowe syndrome.'[7]

From an endodontist's view, taurodontism presents a challenge during negotiation, instrumentation and obturation in root canal therapy.

**Conclusion:**

It is very important for a general dental practitioner to be familiar with taurodontism not only with regards to clinical complications but also its management. Taurodontism also provides a valuable clue in detecting its association with many syndromes and other systemic conditions.

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# Comparison Of Pulp Revascularization & Mta Apexification In Adjacent Central Incisors With Immature Apex - A Case Report

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**Abstract**
Endodontic treatment options for immature, nonvital teeth conventionally include surgical endodontics, apexification with calcium hydroxide, or single visit mineral trioxide aggregate plug. A new treatment option of revascularization has recently been introduced. The aim of this case report was to compare MTA apexification and pulp revascularization induced maturation procedures in the same patient, in two different teeth. A 9 year old patient reported to the out patient department with a chief complaint of pain in broken upper front teeth region. After clinical examination & radiographic evaluation , it was diagnosed as Ellis class III fracture with immature apices.The right maxillary central incisor in this individual was treated by pulp revascularization & the left maxillary central incisor was treated by conventional MTA apexification procedure followed by gutta-percha obturation .Teeth were kept on regular follow- up . Root elongation and apical closure was seen in tooth treated with revascularization along with lateral dentinal wall thickening on radiographic examination. In case of MTA, an apical barrier was formed . No root elongation and lateral dentinal thickening was noticed in MTA apexification.

**Key Words**
Revascularisation , Apexification, MTA

## Introduction

The anterior teeth tend to bear the brunt of many impact injuries. The position of maxillary incisors and their eruptive pattern carries a significant risk for trauma.[1] In many cases, the injury causes cessation of tooth development. Treatment of the immature nonvital anterior tooth presents several treatment challenges. The mechanical cleaning and shaping of a tooth with blunderbuss canal are difficult ; the thin fragile lateral dentinal walls can fracture during mechanical filing, and the large volume of necrotic debris contained in a wide root canal is difficult to completely disinfect.[2] Endodontic management of such teeth includes surgery and retrograde sealing, calcium hydroxide–induced apical closure (apexification) and more recently, placement of an apical plug of mineral trioxide aggregate (MTA) and gutta-percha obturation.[3] Most of the clinicians rely on traditional apexification .Mineral trioxide aggregate (MTA) has been used to provide an artificial barrier; however, it also has the limitations of non-reinforcement of root canal dentin and a high cost[4]. A novel concept of revascularization of immature nonvital, infected teeth was introduced to overcome the limitations. The authors have termed this regenerative process as revascularization, revitalization or maturogenesis. The common aspect of all regenerative modalities is intra canal disinfection using copious irrigation, placement of antibiotic pastes and formation of a sterile blood clot inside the pulp cavity[5]

Till date few cases have been reported using pulp regeneration as a therapeutic therapy for the treatment of immature non vital teeth.[4] It is difficult to clinically find bilateral non-vital, immature, infected teeth with approximately similar root development stage. A case report is presented with bilateral immature central incisors treated with apical barrier formation with MTA and pulp revascularization induced maturation procedures.

## Case Report

A 9 year old male child reported to the out patient department of Pediatric and Preventive Dentistry in Guru Nanak Dev Dental College & Research Institute, Sunam with severe pain in upper front teeth region. Child had suffered a traumatic injury to the maxillary central incisors about one month ago with loss of coronal fragments. He went to the local dentist & was given symptomatic treatment for the same . His medical history was non contributory .Radiographic examination revealed pulp exposures in both the incisors with immature apices **(Figure 1)**. Restoration was seen in right maxillary central incisor .A diagnosis of immature non-vital maxillary central incisors was made. It was planned to perform apexification with MTA followed by gutta-percha obturation in left maxillary central incisor and revascularization procedure in right maxillary central incisor. Patient was explained all risks and benefits of procedures and an informed written consent was obtained.

In the first appointment , After proper isolation with rubber dam ,Access opening was done in both the incisors & minimal instrumentation was done with k-type files. Irrigation was done with 5%

Fig 1 : Pre-operative radiograph showing teeth (21,11) with open apex.

Fig 2 : Radiovisiograph after MTA plug & post placement in 21.

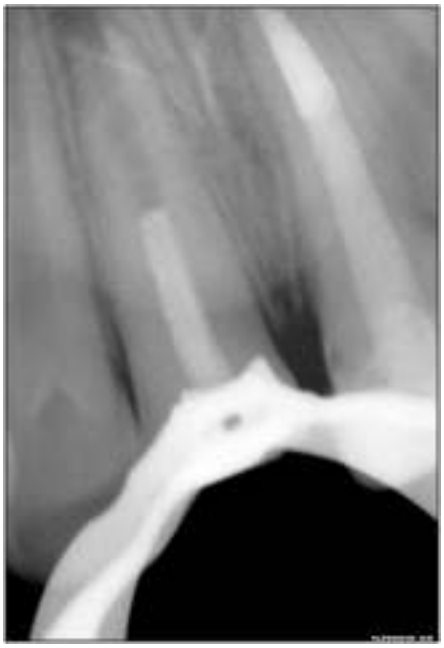

Fig 3 : Base line radiovisiograph showing revascularization wrt 11 .

NaOCl and 3% hydrogen peroxide. A sterile cotton pellet was placed in the pulp chamber & access cavity was sealed with a temporary restorative material. After 3 days patient was recalled & root canal system was reentered. Working length was estimated with the help of intra-oral peri-apical radiographs. In left maxillary central incisor , MTA (Dentsply) was placed in apical region and a 4mm barrier was made **(Figure 2)** In maxillary right central incisor triple antibiotic paste with antimicrobial agents of equal parts of metronidazole, minocycline and

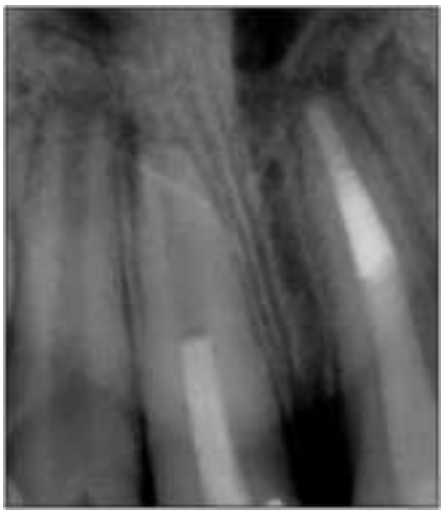

Fig 4 : Radiovisiograph taken after 6 months. Signs of apical closure and dentin bridge formation were observed in 11 .

Fig 5 : Radiovisiograph after 12 months .

ciprofloxacin was placed carefully with the help of hand plugger. The access cavity was sealed. The patient was recalled after 3 weeks for next appointment of revascularization procedure in right maxillary incisor. In the following appointment, the revascularization process was completed as follows; after rubber dam application , the intracanal medicament was flushed with saline and 5.25% sodium hypochlorite solution. The canal system was dried with absorbent paper points. A sterile 23-gauge needle was taken and a rubber stopper was placed at 2 mm beyond the working length. With sharp strokes, the needle was pushed past the confines of the canal into the periapical tissue to intentionally induce bleeding into the canal. When frank bleeding was evident at the cervical portion of the root canal system, a tight dry cotton pellet was inserted at a depth of 3– 4 mm into the canal and the pulp chamber and held there for 7–10 minutes to allow formation of clot in the root canal. The access opening was sealed with MTA extending 4 mm into the coronal portion of the root canal system. An intraoral radiograph was taken for a baseline record **(Figure 3)** . Mean while, conventional gutta percha obturation was done followed by Fibre post (3M) placement in left maxillary central incisor . Both the central incisors were kept on regular follow up. After 6 months, lateral dentinal thickening was first noticed in 11, whereas no such thickening was noticed in 21 **(Figure 4)**. Both the teeth were kept on regular follow up for 6, 9,12, 15 & 18 months. **(Figure 5 & 6)** At the end of 18 months, Complete root formation was seen in 11 with lateral dentinal wall thickening .No such thickening was seen in 21 but both the teeth were healthy and symptom free.

**Discussion**

Recent advances in the field of regenerative medicine have inspired the dental researchers to look beyond just replacement of damaged tissues, and the researchers are now trying to develop methods to regenerate them, rather than just replacing.[4] A major challenge faced by most the dentists is the treatment of thin, fragile blunderbuss canals in non vital teeth.[2] Traditionally, the only regenerative therapy available in such

Fig 6 : Post-operative radiovisiograph at 18 months .Completion of root apex and lateral dentinal wall thickening were seen in 11 & no such changes were seen in 21.

cases was apexification using long term calcium hydroxide therapy. Various clinical studies had demonstrated the efficacy of Ca(OH)2 in apexification.[6] However, all the case reports and studies have documented only apical closure. There was no root elongation or maturation and all cases required subsequent root canal obturation. Ca(OH) 2 therapy was also shown to pose a threat of root fracture in 77% of immature teeth. Also because of its high pH, it could damage the cells with regenerative capacity. [7] Various other materials have been tried to induce apexification, such as tricalcium phosphate, collagen calcium phosphate, osteogenic protein-1 and mineral trioxide aggregate.[8] However, none of the above mentioned methods lead to root elongation or maturation. Apical plug of mineral trioxide aggregate (MTA) and guttapercha filling is currently the clinician's choice and it has several advantages over calcium hydroxide induced apexification.[9], [10], [11], [12] MTA is a biocompatible material, has osteo-inductive properties, sets in the presence of moisture and the treatment can be completed in a single sitting. However, it does not strengthen the remaining tooth structure. The novel procedure of revascularization exploits the full potential of the pulp for dentine deposition and produces a stronger mature root that is better able to withstand fracture[13]

The revascularization of non vital teeth has been demonstrated earlier in replanted teeth with open apices. Using the same concept, revitalization of a non vital immature tooth was attempted in the present study by creating a sterile blood clot in the pulp space. The blood clot acted as a matrix onto which the vital cells from peri-apex could get seeded and reestablish the pulp vascularity.[4] The most plausible mechanism of the root development is the isolation of stem cells from SCAP. It has been hypothesized that SCAP can be the source of primary odontoblasts forming the root dentin.[2],[9]

The present case simultaneously evaluated MTA apexification and obturation, with revascularization induced maturogenesis. Response to pulp vitality tests, clinical examinations and purulent discharge on access opening indicated pulpal necrosis and infection.

A critical step in regenerative therapy is complete disinfection of the root canal space using copious irrigation, minimal instrumentation and placement of antibiotic pastes.[14],[15]

This regenerative therapy can provide advantage over traditional apexification as there is elongation as well as strengthening of the root due to reinforcement of lateral dentinal walls, with deposition of new dentin/hard tissue. There are certain limitations to this approach such as: Bleeding into the canal space is necessary, and this treatment option is not indicated in cases where post and core is the final restorative treatment plan, as the vital tissue in apical 2/3 rd of the canal cannot be violated for post placement [2],[16]

In conclusion, revascularization induced maturogenesis, where indicated, can provide several advantages over conventional apexification procedures. A detailed histo-pathological study is necessary to demonstrate the actual contents of pulp space after revascularization procedures.

## Conclusion

Although MTA has excellent sealing ability and is a promising material for apical barrier formation ,it does not allow lateral dentinal wall thickening. Revascularization helps in development and reinforcement of dentinal walls by deposition of hard tissue, thus strengthening the root against fracture. It is also very cost-effective, because no additional material (such as TCP, MTA) is required . Still further studies should be carried out to prove the efficacy of this procedure over MTA apexification.

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# Rehabilitation Of An Edentulous Patient With Tooth Supported Overdenture – A Case Report

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**Abstract**
Overdenture has been a proven mainstay of conservative prosthodontic treatment when proper diagnosis,treatment planning, and most importantly, patient compliance are achieved. Despite recent developments indental implantology, the conservative approach to root preservation followed by an overdenture is still valid. The many advantages of root retention include- alveolar bone maintenance, better prosthesissupport, proprioceptive feedback, aesthetics and psychological benefits. This paper presents a case report ofrehabilitation of an edentulous patient with a tooth supported overdenture.

**Key Words**
Edentulous, Rehabilitation, Coping, Tooth supported overdenture

## Introduction

Overdenture is a complete or removable partial denture that covers and rests on one or moreremaining natural teeth, the root of natural teeth, or dental implants.

Overdentures offer many advantagesover conventional complete dentures. The most important benefits are preservation of the remaining alveolar supporting bone along with increased stability and retention of the prosthesis.Retaining natural teeth under an overdenturepreserve sensory input from the periodontal receptors which are more precise than that obtained from oral mucosa. Periodontal receptors also play important role in the masticatory-salivary reflex by regulating the range and type of the masticatory stroke.

Thus, overdentures are more beneficial as they provide psychological, functional as well as biological advantages for the patients.

## Case Report

This article presents two case reports inwhich overdenture applications were planned. Both the patients visited Department of Prosthodontics and Crown & Bridge, Himachal Dental College Sundernagar, Himachal Pradesh.

### Case 1

A fifty four years old male patient presented with the chief complaint of difficulty in chewing food due to missing teeth. There was no relevant medical history affectingprosthodontic treatment. Extra oral examination showed no gross abnormality. Intraoral examination revealed well formed maxillary edentulous ridge. In mandibular arch, 33,42, 43&44teeth were present. Maxillary and mandibular ridgeswerein class I ridge relationship **(Fig 1)**. Grade three mobility was present in 42. Therefore it was advised to extract42 as a part of the treatment.

The different treatment options available for this patient were -

1. Extraction of remaining teeth followed byconventional complete denture in both maxillary and mandibular arches.
2. Total extraction followed by implant supported overdenture in both the arches.
3. Tooth supported overdenture in mandibular arch opposing complete denture in maxillary arch.

Fig 1 : Pre-operative Intraoral View

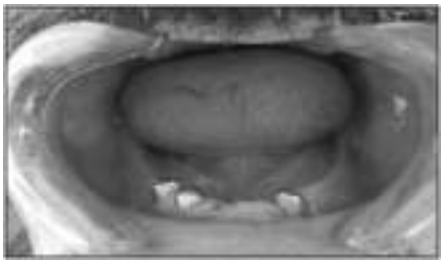

Fig 2 : Metal Copings Cemented Over Prepared Teeth

It was decided to use the remaining teeth as abutments and fabricate an overdenture.The location of the remaining teeth wasfavourable for an overdenture. Thepatient was motivated to retain the remaining teeth in the mandibular arch.Due to economical reasons, complete denture was planned in maxillary arch.

The remaining teeth were enodontically treated. The abutment teeth were reduced in vertical height to 2mm above the crest of the ridge. The preparationwas rounded to minimize the horizontal torque on the roots. Thetooth preparation was doneto receive copings. Impression of theprepared teeth was made to obtain a cast. Wax pattern was made over the prepared teeth. Metal copings were obtained by casting and cemented over the prepared teeth **(Fig. 2)**. Final impression, with coping in place on their respective abutment was made using a

Fig 3 : Impression Surface Of The Denture

Fig 4 : Overdenture Over Restored Abutements

Fig 5 : Pre-operative

Fig 6 : Post-operative

custom tray. The jaw relationwas recorded. Teeth arrangement was made and try-in was done.

Maxillary and mandibular complete dentures were fabricated following the conventional method except that the recess was created on the impression surface of the mandibular denture to accommodate the abutments **(Fig. 3)**. The dentures were finished, polished and inserted into the patient mouth **(Fig 4)**. The patient was given instruction about insertion and removal as well as maintenance of the dentures.**(Fig 5)** The post operative appearance is shown in **(Fig 6)**. Periodic follow-up was carried out.

**Case 2**

A 46 years old male patient presented himself with the chief complaint of difficulty in chewing food. He wanted to get his missing teeth replaced.There was no relevant medical history to affect the course of prosthodontic treatment.Extra oral examination showed repaired cleft lip. Intraoral examination revealed a repaired defect in hard andsoft tissue involving the premaxilla. This defect was present due tooperatedcleft lip and palate at the age of fifteen years. In themaxillary arch13, 24 were the only remaining teeth.In the mandibular arch 31,32,33,34,35,37,41,42.43,44&45 teeth were present **(Fig 1)**. Maxillary and mandibular ridges were in class I ridge relationship.

The different treatment options available for this patient were –

1. Extraction of remaining teeth in the maxillary arch followed by conventional complete denture in the maxillary arch and removable partial denture in mandibular arch.
2. Tooth supported overdenture in the maxillary arch and removable partial denture in the mandibular arch.

Fig 1 : Pre-operative Intraoral View

Fig 2 : Metal Copings Cemented Over Prepared Teeth

It was planned to retain the remaining teeth in the maxillary arch and use them as overdenture abutments.The location of the remaining teeth was favourable for the overdenture abutments. The patient was motivated for the treatment.

The remaining maxillary teeth were enodontically treated. Enodontically treated teeth were prepared to receive copings.Impression of the prepared teeth was made to obtain a cast. Wax pattern was made over prepared teeth. Metal copings were obtained by casting the wax pattern. Coping was finished polished and cementedover the abutments **(Fig 2)**. Final impression was taken with copings in place on their respective abutments using a custom tray. The jaw relationswas recorded. Teeth arrangement was made and try-in was done. Complete denture was fabricated in the maxillary arch following the conventional method except that the recess were created on the

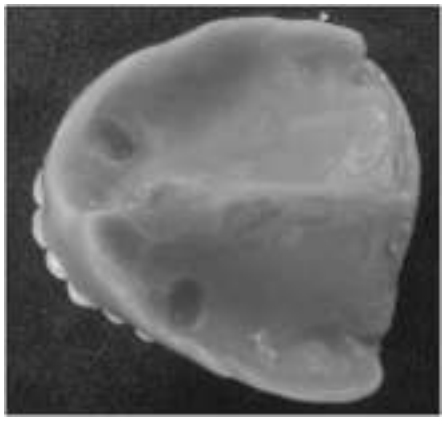

Fig 3 : Impression Surface Of The Denture

Fig 4 : Overdenture Over Restored Abutements

Fig 5 : Pre-Operative

Fig 6 : Post-Operative

impression surface of the denture to accommodate the abutments **(Fig 3)**. The dentures were finished, polished and inserted in the patient mouth. Patient was given instruction about insertion and removal as well as maintenance of the dentures **(Fig 4), (Fig 5)**. The post operative appearance is shown in **(Fig 6)**. Periodic follow-up was carried out.

**Discussion**

Fabrication of tooth supported over denture is a step in the direction of preventive prosthodontics[1]. Theresidual ridge reduction coupled with reduced dexterity at advanced age impairs the adaptation to denture prosthesis. The obvious way to prevent denture problems is to save the natural teeth.[2] Healthy teeth with compromised periodontal status can be modified and retained for biomechanical and psychological advantages. This preventive approach can be achieved by means of overdentures.[3]

Two most significant factors for the success of the overdenture are proper selection of the patient and establishing careful mode of treatment that will satisfy both the patient and the dentist.[4] Simple approach to the problem i.e. patients with congenital defects such as cleft palate, partial anodontia, microdontia, amelogensis imperfecta etc is available in the form of overdentures which will be relatively fast and inexpensive mode of treatment.[5] According to Zarb et al the advantages of overdentures include retention and stability especially the mandibular dentures[5]. The maxillary overdenture is of great value when it opposes remaining mandibular anterior teeth, because it aids in conserving the ridge against resorption from masticatory stress.[1]

Root canal therapy is a necessary phase of preparation for the selected teeth; single rooted or double rooted teeth with readily accessible canals are preferred.[6] Teeth that are mobile because of bone loss can become acceptable for overdenture support when the clinical crown is reduced to near ridge height.[6] The short coping design showed least amount of stress than any of the other design like tapered coping design& tapered coping with occlusal bearing design. This design minimizes horizontal torque on the roots[7] and provides ease of maintenance of oral hygiene.[1]

Various techniques used in the treatment of teeth to serve as abutment for overdenture ranges from simple tooth modification and reduction, tooth preparation with cast coping to endodontic therapy with amalgam plugor cast coping utilizing some form of attachments.[8] Attachments like ceka attachement and bischof-dosenbach attachement can be used but economic reasonssometime restrict their use.

The main objective in using tooth-supported overdenture is to preserve the remaining supporting tissue and to restore missing structures in such a way as to provide maximum service for maximum amount of time. A major premise of tooth supported overdenture treatment is to transfer occlusal forces along the long axis of the supporting tooth, to minimise the horizontal torque and to allow for a more optimum situation for periodontal ligaments.[7]

According to Robert L Defranco tooth supported overdenture accomplishes three important goals. It maintains the abutment as a part of the residual ridge which in turn provides more support than a conventional complete denture. When the teeth are retained, alveolar bone integrity is maintained as they support the alveolar bone. However when teeth are removed alveolar bone resorption process begins. With the preservation of the teeth there is also preservation of the periodontal membrane and this in turn preserves propioceptive impulses resulting in better occlusal awareness, biting forces and consequent neuromuscular control.[5] In routine clinical practice, overdenture should also be considered as a treatment modality for a patient who has few teeth left in the oral cavity.

Thus it can be said that the application of overdentures is unlimited and its successdepends on the dentist judgement and skill and patient motivation to maintain good oral hygiene.

**Summary**

Tooth supported overdentures are still an excellent and economic therapeutic concept. In this study use of root abutment as an aid to support complete denture is presented. Use of overdentures has been favoured often because of mechanical advantages. Even though the retained teeth may be periodontally compromised, they still may provide sufficient support for the transmission of masticatory pressure and periodontal ligament receptors to initiate a jaw opening reflex. The abutments enhance support and stability of the dentureand slow the rate of alveolar resorption. The clinical procedure is straightforward and can be readily applied in general dental practice.

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# Gingival Depigmentation: A Comparison Between Three Techniques

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**Abstract**
Gingival hyperpigmentation due to melanin deposition is seen as a genetic trait in most of the population irrespective of age and gender hence it is termed physiologic or racial gingival pigmentation. Many people are unhappy with their unaesthetic gingival appearance and find the discoloration to be very unappealing and detracting from their smile and speech. Usually, this condition is a cosmetic issue and not necessarily a sign of a dental health problem. The problem can be treated by number of surgical techniques selection of which might be based on clinical experiences and individual preferences, of the operator.

**Key Words**
Depigmentation, scalpel technique, bur abrasion, electro surgery.

## Introduction:

It is not uncommon to find pigmented lesions in the oral cavity. Such lesions represent a variety of clinical entities, ranging from physiologic changes (e.g., racial pigmentation) to manifestations of systemic illnesses (e.g., Addison's disease) and malignant neoplasms (e.g., melanoma and Kaposi's sarcoma). Oral pigmentation may be exogenous or endogenous in origin. Exogenous pigmentation is commonly due to foreign-body implantation in the oral mucosa. Endogenous pigments include melanin, hemoglobin, hemosiderin and carotene. Melanin, a brown pigment, is the most common natural pigment contributing to endogenous pigmentation of gingiva. Melanin pigmentation is the result of melanin granules produced by melanoblasts intertwined between epithelial cells at the basal layer of gingival epithelium.[1]

In this day and age people have become increasingly aware of their physical appearance. Correspondingly aesthetic treatment modalities have become more and more popular. There has been a rise in the number of patients who are dissatisfied with the pigmentation of their gingiva, finding it unappealing and detracting from their smile. They find it a cause of embarrassment and seek different forms of treatment in order to attain what they consider a 'perfect' smile.

Gingival depigmentation is a periodontal surgical procedure in which the gingival hyperpigmention is eliminated or reduced by different techniques[2].

Selection of technique should be based on clinical experiences and individual preferences.

This case report presents a comparison between three depigmentation procedures.

## Case Description:

A 23 year old male patient reported to the OPD of Periodontology MRDC, with the chief complaint of "black" colored unaesthetic gums whichinterfered with his smile. On intraoral examination, generalized blackish pigmentation of gingiva was observed from right premolar to left premolar on both maxillary and mandibular arches. **(Figure 1).** The patient's history revealed that the blackish discoloration of gingiva was present since birth suggestive of physiologic melanin pigmentation. His medical history was non-contributory. Considering the patient's concern, a split mouth surgical gingival de-epithelization procedure was decided for both the arches.

Before depigmentation procedure complete scaling and polishing were done and patient was given oral hygiene instructions. The entire procedure was explained to the patient and written

Table 1 - Methods To Remove The Pigment Layer

| | |
|---|---|
| 1. | Surgical Methods To Control Pigmentation |
| a. | Scalpel Technique[3] |
| b. | Bur Abrasion[3] |
| c. | Electrosurgery[4] |
| d. | Cryosurgery[5],[6] |
| e. | Lasers<br>Nd:Yag Laser[7],[8]<br>Semiconductor Diode Laser [9]<br>Co2 Laser[10] |
| 2. | Chemical Method[11] |
| a. | 90% Alcohol |
| b. | 95% Phenol |
| 3. | Method To Mask The Pigmented Gingiva[12] |
| a. | Free Gingival Graft |
| b. | Acellular Dermal Matrix Allografts |

Figure- 01 Unaesthetic Blotchy Black Gingiva.


Figure- 02 Depigmentation With Scalpel And Blade.


Figure- 03 Depigmentation With Bur Abrasion


Figure- 04 Post-Operative.

consent was obtained and he was also informed about the recurrence rate of repigmentation. Complete medical and family history was recorded and blood investigations were carried out to rule out any contraindication(s) for surgery.

**Visit 1:**

**Scalpel Technique:**
A scalpel surgery was planned to perform the depigmentation on right side in maxillary arch. Local anesthesia was infiltrated in the maxillary anterior region from right premolar to left premolar (Lignocaine with adrenaline in the ratio 1:100000 by weight). A partial split thickness flap was raised on right side using a Bard Parker handle with a No.15 blade, maintaining the normal architecture of gingiva. Bleeding was controlled using pressure pack with sterile gauze. **(Figure 2 depigmentation with scalpel and blade)**.

**Bur Abrasion Technique:**
The bur abrasion technique was used on left side for deepithelization of heavily pigmented gingiva using high speed rotary instrument. After adequate local anesthesia, large straight bur was used along with copious saline irrigation. Pressure was minimal with feather light brushing strokes without holding bur in one place to avoid pitting of the gingival surface or to remove too much tissue. Care was taken to remove all the remnants of melanin pigment as thoroughly as possible and a scraping procedure using the scalpel blade was used for the purpose, but at one point the tissue was fenestrated. **(Figure 3 & Figure 4 )**.

The surgical area was covered with periodontal dressing. Post-surgical antibiotics (Amoxicillin 500mg, thrice daily for five days) and analgesics (Ibuprofen with Paracetemol, thrice daily for three days) were prescribed. The patient was advised to use Chlorhexidine mouthwash 12 hourly for one week.

After 2 weeks, the pack was removed and the surgical area was examined. The healing was uneventful without any post-surgical complications. The gingiva appeared reddish pink and firm giving a normal appearance. The patient was happy and satisfied with the outcome of the procedure.

**Visit 2:**
For mandibular arch, a combination of scalpel de-epithelization, and electrosurgery was planned.

**Electrosurgery:**
Electrosurgery was performed for mandibular right side using loop electrode and ball electrode. Minimal bleeding with a clean field increased the efficacy of the procedure. Light brushing strokes were used and the tip was kept moving all the time. Prolonged or repeated application of electrode to the tissues was avoided as it induces heat accumulation; enough care was taken to avoid contact with the periosteum and vital teeth. Patient was more comfortable with this procedure, as he kept saying during the procedure. **(Figure - 05, 06, 07, 08)**.

**Scalpel Technique:**
Deepithelization on mandibular left side was performed with scalpel technique. Post operative instructions were given to the patient. **(Figure 6, Figure 7)**.


Figure- 05 Depigmentation With Electro Cautery, Bloodless Surgical Site Can Be Appreciated.


Figure- 06 Depigmentation With Scalpel And Blade.


Figure- 07 Post-Operative.


Figure- 08 Post-operative 6 Months, Healthy Firm Pink Gingiva Can Be Appreciated.

Patient was recalled after 15days for checkup.Healing was satisfactory.

The gingiva was healthy firm pink even at the end of 6 months, repigmentation has not started **(Figure 8)**.

**Discussion**
The color of the gingiva is determined by several factors, namely number and size

of the blood vessels, epithelial thickness, quantity of keratinization and pigments within the gingival epithelium[13]. Hyperpigmentation of the gingiva is caused by excessive melanin deposition by the melanocytes mainly located in the basal and suprabasal cell layers of the epithelium.[14] Melanin pigmentation may be seen across all races and at any age, and has no gender predilection.[15] A positive correlation between gingival pigmentation and the degree of pigmentation in the skin, seems, however, evident.[16] Demand for treatment is usually made for esthetic reasons.To treat depigmentation and to enhance esthetics, numerous techniques have been employed from time to time. Selection of a technique should be based on clinical experience and individual preferences. This case report compares three different techniques commonly used to treat depigmentation and compiles the advantages and disadvantages of each technique.

**Scalpel Technique:**

It is the most simple and effective method of depigmentation which does not require any sophisticated instruments.The procedure essentially involves surgical removal of the gingival epithelium along with a layer of the underlying connective tissue under adequate local anesthesia and allowing the denuded connective tissue to heal by secondary intention. The new epithelium that forms is devoid of pigmentation. [17],[18]

However, it results in unpleasant hemorrhage during or after surgery. Hence, it is necessary to cover the lamina propria with periodontal dressing for 7-10 days.[4] It also has chances of infection or recurrence. Results reported are excellent. [19]

**Bur Abrasion:**

It is a simple and easy method that does not require any sophisticated equipment. Healing occurs by secondary intention thus pre- and post-surgical care is similar to that of the scalpel technique. However, extra care should be taken to control the speed and pressure of the handpiece bur so as not to cause unwanted abrasion, fenestration or pitting of the tissue. Minimum pressure with feather light brushing strokes and copious saline irrigation should be used without holding the bur in one place to achieve good results. [20]

**ElectroSurgery:**

Electrosurgery has advantages of minimal bleeding and a cleaner work field. According to Oringer's "Exploding cell theory,"[21] it is predicted that electrical energy leads to the molecular disintegration of melanin cells of the operated and surrounding sites. Thus, electrosurgery has a strong influence in retarding migration of melanin cells. However, electrosurgery requires more expertise than the techniques mentioned. Prolonged or repeated application of current to the tissues induces heat accumulation and undesired tissue destruction.[4] Contact of current with the periosteum and vital teeth should be avoided.[22]

Though the initial result of the depigmentation surgery is highly encouraging, repigmentation is a common problem. The exact mechanism of repigmentation is not known. Different studies shows variation in the timing for early repigmentation.[22] To return to full clinical baseline repigmentation it takes about 1.5 to 3 years.[13] This variation may be due to the techniques performed or due to the patient's race. Thus, gingival depigmentation procedure, if performed primarily for cosmetic reason, will not be of permanent value. However, even if gingival repigmentation occurs in the patient, depigmentation can be repeated in the same region.

In the present case report three different depigmentation surgical procedures were performed in same patient. While performing the surgical procedure, electrosurgery appeared to be the most convenient technique, as it was quick and without hemorrhage, followed by scalpel blade because in this procedure we were able to control the depth of incision. Although depigmentation with bur abrasion was quick but hemorrhage during surgical procedure was more and it was difficult to control the depth, in our case fenestration occurred in the area with thin gingiva in the left maxillary canine region. Post operatively patient was most comfortable with electrosurgery.

**Conclusion:**

This case report describes simple and effective surgical procedures for the treatment of gingival melanin hyperpigmentation resulting in improved esthetics and cosmetic appearance, thereby increasing the self confidence of the patient. The above mentioned procedures can be performed by general dental practitioners to improve dark pigmented gingival appearance, but patient should be informed of high chances of repigmentation.

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# Non Syndromic Occurrence Of Mandibular Mesiodens With Congenitally Missing Mandibular Central Incisors – A Rare Case

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**Abstract**
Supernumerary teeth are developmental anomalies of number observed during routine dental examination. Mesiodens is the most common supernumerary teeth located mainly in maxillary central incisor region but rare in mandible. Also, agenesis of bilateral mandibular central incisors is not well documented in the literature. The aim of this paper is to report of a rare association of mandibular mesiodens with congenitally absent permanent central incisors. This is only the second case report of such an association in the literature.

**Key Words**
Hypodontia, Supernumerary, Mandibular, Mesiodens

## Introduction

Supernumerary teeth are a relatively frequent disorder of odontogenesis characterized by the presence of tooth in addition to the normal series. Supernumerary or extra teeth constitute approximately 15% of teething anomalies. They are often found in the area of incisor teeth in the maxilla, second premolar teeth in the mandible and maxilla, and molar teeth.Extra teeth may present in both permanent and primary dentitions, but are five times less frequent in the primary dentition. The literature reports that 80 to 90% of all supernumerary teeth occur in the maxilla, of which half are found in the anterior region . The lateral incisor is the most frequently observed supernumerary tooth in primary dentition.[1]

The most common type of supernumerary tooth as indicated by Alberti[2] is mesiodens accounting for 80% of all supernumerary teeth[1]. It is found mainly in the premaxilla between the two central incisorsand rarely in the mandible. Mesiodens may occur as single, mutiple, unilateral or bilateral. They can, On the basis of its morphology, be supplemental, conical, or tuberculate[3],[4]. The presence of multiple supernumerary teeth is called 'mesiodentes'[5].

various studies have reported the incidence of mesiodens between 0-1.9% for deciduous teeth and between 0.15-3.8% for permanent teeth with male to female occurrence ratio of 2:1[6],[7].Reports of supernumerary teeth are quite common in dental literature. These are discovered on a complaint by a patient or when the patient seeks treatment for malocclusion.

Congenital lack of one or more tooth is another common anomaly, mostly involving second premolars and maxillary lateral incisors. Terms like hypodontia, oligodontia and anodontia have been used to describe various presentations of this anomaly. It can be unilateral or bilateral, but reports of bilateral missing teeth are rare.

The present case reportdescribes an unusual association of two dental anomalies: a rare presentation of mandibular mesiodens and bilateral congenital absence of the mandibular central incisors.

## Case Report

A 22 year-old male reported with a complaint of dirty teeth and bleeding gums. Intraoral examination revealed a mesiodens between the permanent mandibular lateral incisors with congenitally missing cental incisors **(Fig. 1)**. The coronal portion of the mesiodens exhibited conical shape. Spacing was observed between lateral incisors and mesiodens.

Intraoral periapical radiograph revealed a single conical root with a single root canal with absence of cental incisors **(Fig. 2)**.

No other teeth were missing. Soft tissues were normal. There was no relevant medical and family history and the patient was otherwise healthy.

The patient was normal in his facial appearance, did not exhibit any physical

Fig 1 : Mesiodens Between The Permanent Mandibular Lateral Incisors With Congenitally Missing Cental Incisors

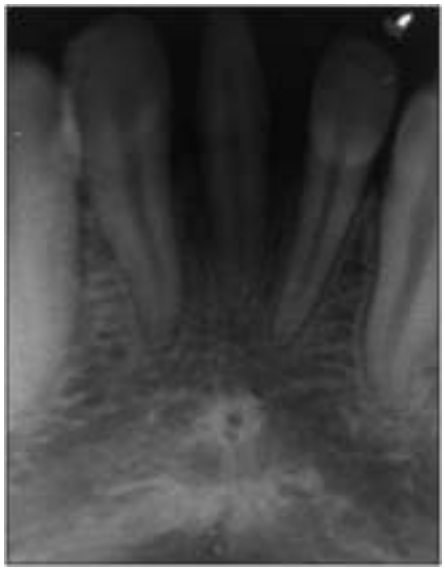

Fig 2 : Intraoral Periapical Radiograph Revealed A Single Conical Root With A Single Root Canal With Absence Of Cental Incisors

or skeletal abnormality and showed no signs of mental retardation. No such anomaly was observed in his two sisters and parents when called for examination. As the patient was asymptomatic and was not bothered about spacing, no treatment other than oral prophylaxis was rendered.

**Discussion**

Supernumerary teeth are a developmental disturbance occurring during odontogenesis resulting in the formation of teeth in excess of the normal number. They occur both in the deciduous and permanent dentition.

The first report of a supernumerary tooth appeared between AD 23 and 79[8].The first documented report of supernumerary teeth has been found in the ancient human skeletal remains of the Lower Pleistocene era. Until recently, the most primitive evidence of the presence of mesiodens goes back to 13,000 years, when it was found among the remains of an Australian aborigine[9]. Balk (1917) defined mesiodens as the most common among supernumerary teeth, located mesial to both central incisors; appearing peg shaped, in a normal or inverted position[10]. Regezi and Sciubba[11] mentioned that the anterior midline of the maxilla is the most common site of the supernumerary tooth, hence the supernumerary tooth is known as mesiodens. Very few supernumerary teeth have been reported in the primary dentition[12].

The etiology of the supernumerary teeth is not completely understood. It was originally postulated that mesiodens represented a phylogenetic relic of extinct ancestors who had three central incisors[13]. The presence of supernumeraries in family members suggests heredity as an etiological factor; however, it does not follow a simple Mendelian pattern. Autosomal dominant inheritance with incomplete penetration has been the proposed genetic theory. A sex-linked pattern has also been proposed as males are affected twice as frequently as females[14]. A second theory known as dichotomy suggests that the tooth bud is split to create two teeth, one of which is the mesiodens[15]. The third theory involving hyperactivity of the dental lamina is the most widely supported. According to this theory, remnants of the dental lamina or palatal offshoots of the active dental lamina are induced to develop into an extra tooth bud, which results in a supernumerary tooth[16]. Supernumerary teeth may occur as a single isolated anomaly or in association with syndromes like cleft lip and palate, Downs syndromes, Cleidocranial dysplasia, etc[17].

Few studies on the prevalence of mesiodens involving certain ethnic or racial populations have been published to date. The prevalence of mesiodens has been estimated to be 0.45% in Caucasians, 0.4% in Finnish, 1.43%in Norwegians, 2.2% in Hispanic populations, and 8.3% in a group of Turkish children. In a study by Kaan, the prevalence in Turkey has been found to be 0.3%[18]. The prevalence of supernumerary teeth in the permanent dentition of the Caucasian general population has been reported to be between 0.1 and 3.8%. The estimated prevalence in the sub-Saharan Africa and Asian population is reported to be between 2.7 and 3.4%. The general prevalence of mesiodens in Iranian children has been seen to be 1.6%, as reported by Mieghani[19].

Supernumerary teeth are usually classified on the basis of their occurrence in the permanent dentition (rudimentary mesiodentes) or the primary dentition (supplementary mesiodentes) andtheir morphology together with their location in the dental arches.According to the shape and size, two subclasses are considered in the classification of mesiodens; namely, eumorphic and dysmorphic. The eumorphic subclass is usually similar to a normal-sized central incisor, whereas, the dysmorphic teeth have different shapes and sizes and are categorized into conical, tuberculate and molariform[20]. Conical mesiodens are the most commonly observed and appear as peg-shaped and are located palatally between the maxillary central incisors. They have a completely formed root and can erupt into the oral cavity. However, they may also be inverted with the crown pointing superiorly in which case they are less likely to erupt into the oral cavity.Tuberculate mesiodens are barrel-shaped with several cusps or tubercles and have incomplete or abnormal root formation. They rarely erupt into the oral cavity. A much rarer type of mesiodens is the molariform mesiodens, which has a premolar-like crown and a completely formed root[21].

Microscopically, changes have been observed in the structure of dentine and enamel of supernumerary teeth - mesiodenses. The highest incidence of changes was observed in radicular dentine, where tubules in a vestigial form were found suggesting inhibited development of mesiodens radicular part[22].

A mesiodens may erupt normally, stay impacted, appear inverted or take a horizontal position. Only 25% of all mesiodentes spontaneously erupt into the oral cavity. Asymptomatic unerupted mesiodens may be discovered during radiological examination of the premaxillary area[23]. Kaan found 37.6% in the inverted position and 7% in a horizontal position in a radiographic study[18]. The presence of mesiodens often results in complications including, retention of primary teeth, delayed eruption and ectopic eruption of permanent teeth, closure of the eruption path, rotations, retention, root resorption, pulp necrosis, crowding, and diastema, as well as nasal eruption and formation of dentigerous and primordial cysts[1],[4]. According to Tashima, the prevalence of inter-incisal diastema is seven times higher in the presence of mesiodens[24]. Therefore, early detection and management of all supernumerary teeth becomes a necessary part of preventive dentistry. However, symptomless cases could be left untreated along with regular check-ups. Less common complications involving the permanent incisors include dilacerations of the developing roots and loss of tooth vitality. Therefore, early diagnosis of mesiodens has particular importance in terms of preventing such complications.

There is limited evidence indicating mesiodens as a risk factor in trauma. The only case suggesting mesiodens as a risk factor was reported by Kupietzky[25] and more recently by A. Alacam, where the mesiodens was considered as a risk factor for causing as well as complicating dental trauma[26].

Hypodontia is the congenital absence of less than six teeth because of agenesis. The most frequently occurring congenitally missing permanent teeth, apart from third molars, are the mandibular second premolar (3.4%) and the maxillary lateral incisor (2.2%)[27]. The absence of teeth may be unilateral or bilateral. There are reports showing unilateral occurrence of permanent mandibular central incisors[28]. But agenesis of bilateral mandibular central incisors is not well documented. The first report of congenitally missing two mandibular incisors was given by Newman in 1967[29]. It has been reported that missing mandibular incisors is common in certain populations like Japanese, Korean and Chinese[30].

Although the exact etiology of congenital agenesis of both central incisors is

unknown, but it has been attributed to several factors like trauma, radiation, infection, metabolic disorders and idiopathic changes[31]. Newman and Newman have given four main theories mainly for the cause of agenesis of incisors. Heredity or familial distribution is the primary cause. Second, anomalies in the development of the mandibular symphysis may affect the dental tissues forming the tooth buds of the lower incisors. Third, a reduction in the dentition regarded as nature's attempt to fit the shortened dental arches (an expression of the evolutionary trend) and finally, localized inflammation or infections in the jaw and disturbance of the endocrine system destroying
the tooth buds[28]. It has also been reported that genes MSX1, TGFA and PAX9 interaction sometimes play a role in human tooth agenesis[32].

The present case is rare due to a rare combination of two dental anomalies was observed in mandible with presentation at a much rarer location. The medical and family history ruled out any association with any syndrome or genetic abnormality.Only one such case has been published in literature till date.

**Conclusion**

Hypodontoia and supernumerary teeth in permanent dentition are common anomaliesaffecting the normal development of dentition. Early diagnosis of these anomalies is important for the preservation of the dentition and the development of the occlusion.

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# Combined Non-surgical And Surgical Endodontic Therapy In The Treatment Of Dens In Dente Type III With Mta Retroseal- A Case Report

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**Abstract**
Dens invaginatus is a maldevelopment of the dental germ which occurs as a result of the invagination of the enamel organ. Dens invaginatus requires early diagnosis and treatment, as it may result in radicular and periapical pathosis. Treatment may vary from case to case. The successful management of dens invaginatus depends mainly on the ability to gain access to and disinfect the root canal system in light of its complex and variable presentation and unpredictable morphology. This study describes a clinical case of type III dens invaginatus with an extensive periradicular lesion and open apex treated successfully.

**Key Words**
dens in dente, dens invaginatus, pulp necrosis, periapical pathology, MTA retroseal.

## Introduction

Dens invaginatus is a variation in the development of tooth which is thought to occur when there is infolding of the enamel organ during the bell stage before beginning of calcification.[1] The term synonymous with this malformation are telescopic tooth, dilated odontoma, dens in dente, dilated composite odontoma and tooth inclusion.[2] It's a rare developmental malformation with frequency of 0.04-10%.The teeth most commonly affected are maxillary lateral incisor with a prevalence of 0.25%-5% followed by central incisors, premolars, canines and molars.[3] Bilateral occurrence is not uncommon and occurs in 43% of all cases.

Numerous mechanisms have been proposed as a cause of this phenomenon including local delay in enamel formation, infolding of the enamel organ with in dental pulp and local external influences on tooth germ. The etiology is still not entirely known.

Ohler has classified dens invaginatus in three types depending on its extent in crown (type I), root (type II) and up to apex (type III)[4]. Clinically the crown of this tooth can be of normal morphology but can also have unusual forms. A deep palatal groove can be the first sign indicative of dens invaginatus. In this type of developmental anomaly there may be direct communication between the pulp and the oral cavity. When this is the case, microorganisms from saliva infect the pulp and necrosis may lead to the formation of an apical lesion. Many investigators have reported the occurrence of pulpal and periapical pathosis related to dental invaginations, which suggest that apical pathosis from pulpal death is a common occurrence related to caries or defects within invagination.[2]

Several treatments of pathosis associated with dens invaginatus has been suggested which include endodontic therapy, endodontic surgery, combined treatment or extraction. This article presents a case report of a type III dens invaginatus with open apex and a large periradicular pathology which is managed successfully by combined non surgical and surgical endodontic therapy with MTA retroseal.

## Case Report

A-24–year male patient reported with a complaint of swelling on left side of face. During an extraoral examination a slight facial asymmetry was observed with edema on middle third of left side of face including maxillary region, nostril, and upper lip. Intraoral examination revealed swelling in vestibular region of maxillary left lateral incisor (Tooth no 9) and an anatomic anomaly of the lingual surface of the tooth in the form of an accessory cusp. The tooth did not respond to pulp vitality tests suggesting pulp necrosis. The radiographic examination revealed the presence of dens invaginatus type III with large periapical radiolucency in the involved tooth. Apex of the tooth was wide open indicative of blunderbuss canal **(Figure - 1)**. Endodontic treatment followed by surgical enucleation of the lesion and retrograde filling of the root to seal the apex was therefore planned for this tooth.

Figure-1: Pre Operative Occlusal Radiograph Showing Left Maxillary Lateral Incisor With Dense In Dente Type Iii Having Large Periapical Radiolucency And Open Apex.

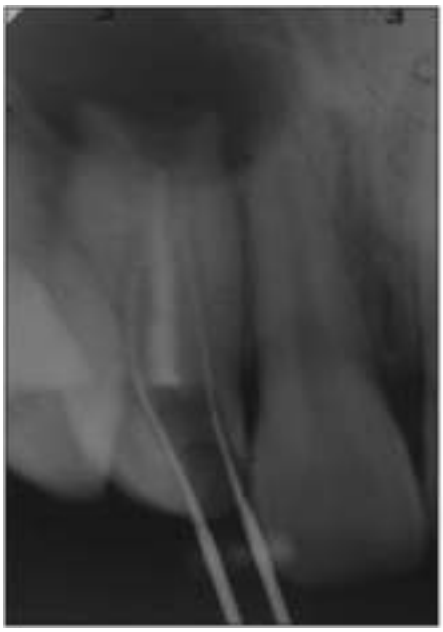

Figure-2: Radiograph Showing Central Canal And Rudimentary Canals.

Figure-3: Radiograph Showing Obturated Root Canals And Mta Retroseal.

Figure-4: One Year Follow Up Radiograph Showing Healing.

For endodontic treatment following isolation of tooth with rubber dam, pulp chamber was opened. As access opening was made, a normal shaped root canal and adjacent very narrow rudimentary canals were found. There did not appear to be any connection between central root canal and the rudimentary canals. As the canals were opened pus drainage from the canals occurred. Working lengths of the canals were then established and the chemo-mechanical preparation was carried out using manual coronal apical instrumentation technique with manual stainless steel k- file. (Denstply, Ballaigues, Switzerland). Canals were flushed copiously with 2.5% sodium hypochlorite. The final irrigation was done with 17% EDTA, followed by 1% sodium hypochlorite. Sterile paper points were used to dry the canals and a calcium hydroxide paste was placed. The coronal access was sealed with GIC (GC 2,GC Corporation, Tokyo, japan). Patient was recalled for the medication change every week for a month. However intracanal exudates were present suggesting resistant infection in apical region. Periapical surgery was therefore planned as a complimentary approach. Prior to surgery root canal obturation was carried out by gutta percha using lateral condensation technique **(Figure - 2)**. The surgical intervention consisted of apical curettage, root end resection, root end preparation with ultrasonic tips and retrofilling. A vestibular flap was raised, granulation tissue was removed, root end prepared and retrofilling with proroot MTA was done **(Figure - 3)**.

At 1 year follow up examination, the patient was asymptomatic and radiographic evidence of satisfactory healing was confirmed by decrease in size of radiolucency **(Figure - 4)**.

**Discussion**

Dens invaginatus is a tooth abnormality of clinical significance due to the possibility for the pulp to be affected which may further lead to radicular and periapical pathosis. In dens invaginatus the invaginated area is separated from the pulpal tissue with a thin layer of dentin thus a carious lesion can easily reach the pulp chamber. Therefore pulpitis and pulp necrosis are frequently associated with this anamoly.[3] Many investigators have reported the occurrence of pulpal and periapical pathosis related to dental invaginations, which suggests that apical pathosis from pulpal death is a common occurrence related to caries or defects with in invagination. In this case tooth no 9 was clinically healthy, caries free and without history of trauma. Thus the etiology of the chronic periapical lesion was probably pulp necrosis caused by the passage of bacteria through the invagination defect, creating direct communication between the oral cavity and the pulp chamber.

The treatment options for an invaginated tooth include prevention treatment by sealing or filling in the invagination, endodontic treatment, apical endodontic surgery, intentional reimplantation and exodontics.[5] In the current case radiograph revealed invagination on maxillary lateral incisor extending from crown to the apex of the root (Ohler's type III), the involved tooth was also associated with a large periapical pathosis and wide open apex. So a combination of orthograde endodontic treatment and endodontic surgery was planned for its treatment.

Root canal treatment is based primarily on the removal of microbial infection from the complex root canal system. Since the pulp of this tooth was necrotic as it did not respond to pulp vitality tests, orthograde endodontic treatment was done to clean and disinfect the root canals and to seal them permanently to avoid further infection. During endodontic treatment the different root canals were instrumented separately as there did not seem to be any communication between the different root canals. Unnecessary merging the canals would lead to tooth weakening because of more dentin removal. So merging of the canals was deemed unnecessary. During chemo-mechanical preparation, the use of rotary instrument is not recommended because of the presence of an enamel lining in the lumen of the invagination and an inconsistent shape of the canal which may increase the likelihood of instrument

fracture. Therefore canals were instrumented using hand files. Irrigants aid in reducing the microflora of infected canals and if a tissue solvent is used, can help to dissolve the necrotic tissue. Therefore 2.5% hypochlorite was used as an irrigating solution because of its tissue dissolving property.[6] However studies have revealed that instrumentation and irrigation with sodium hypochlorite alone is not sufficient to leave the root canal free from cultivable bacteria and their endotoxins. Thus in order to compliment the actions of the instruments and irrigating solutions, the use of intracanal medicament is recommended. Calcium hydroxide has commonly been used, which has antimicrobial activity and can inactivate endotoxins[7].

Considering the need for the complete removal of all the irritants from the root canal system, the use of an irrigating solution associated with successive change of intracanal medication based on calcium hydroxide was essential for the success of the treatment.

Surgical intervention was done for two reasons. First the apex of the tooth was wide open so a retrograde sealing of the apex with a root end filling material was required. The purpose of root end filling is to establish an impermeable seal of all the apical avenues of the root canal system and prevent the percolation of bacteria or their products between the root canal systems and periradicular tissues. Second reason for periradicular surgery was the large size of the lesion as suggested by the large periapical radiolucency in the radiographs. Literature suggests when apical radiolucency is very large (diameter >20mm or cross sectional ares >200mm2), surgical removal may be the best option[8]. According to Pai et al ,the complex anatomy of dens invaginatus makes it difficult and usually complicates the conservative endodontic treatment, especially when large apical lesion exists.[9]

In the present case because of the large size of the lesion, radiographic appearance suggesting lesion being cystic and long standing nature of the infection surgical intervention was done. MTA was chosen as a retrograde filling material because of its better physical and chemical properties as a retrograde filling material.[10]

Therefore orthograde endodontic treatment was done to clean, disinfect and to seal the root canals. The surgery was done to debride the periapical lesion and to provide an additional retrograde seal to the root canals which may remain a source of irritation.

**Conclusion**

Because of complication presented by dens invaginatus type III, open apex of the root and a large periapical lesion combined nonsurgical and surgical endodontic therapy was indicated in this case. Follow up radiograph over 1 year showed evidence of healing.

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# Interception Of A Developing Class III Malocclusion With Chin Cup Therapy

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**Abstract**
Skeletal Class III type malocclusions are least common among North Indian population children. Many of them show a genetic predisposition and are due to an inherent growth abnormality. However many Class III malocclusions may result from premature occlusal contacts causing forward functional shifting of the mandible. These postural or pseudo Class III relations are to be corrected as early as possible.The most common manifestation of a Class j4; malocclusion is anterior cross bite.This report discusses a simple technique for correcting an anterior crossbite during the deciduous dentition stage with a chin cup appliance.

**Key Words**
Classj4; malocclusion,North Indian population,Anterior crossbite,Deciduous dentition,Chin cup

## Introduction

Malocclusion is defined as an irregularity of the teeth or a molar relationship of the dental arches beyond the normal accepted range. It is a developmental problem determined mainly by hereditary and environmental factors. Any of these factors may influence the type and frequency of malocclusion in a given population. Most of the malocclusions can be corrected if detected early by correctional methods. Angle classified malocclusion as Class g0;,i5; and j4;,based on the relationship of the mesiobuccal cusp of the maxillary first molar and the buccal groove of the mandibular first molar.Class III malocclusion is considered to be one of the most difficult and complex orthodontic problems to treat. Prevalence of Class III malocclusion in North Indian population is stated to be 3.4% of the population in a study by Kharbanda et al in 1995.[1]

Class III malocclusion with an anterior crossbite is identified by the parents earlier than any other types of malocclusions. Many studies have reported that an early correction of anterior crossbite is of great significance for preventing the deterioration of the horizontal jaw relationship.[2] Timing of orthodontic treatment, especially for children with developing Class III malocclusions, has always been controversial.Therefore a definitive treatment plan tends to be delayed for severe Class III cases. The interaction between environmental and innate factors in the development of a Class III malocclusion has not been completely understood.Young Class III patients with moderate to severe anterior crossbite and deep bite do need early intervention in some selected cases.It is known that both anteroposterior and vertical maxillary deficiency can contribute to Class III malocclusion.If the maxilla does not grow vertically, the mandible rotates upward and forward, producing an appearance of a mandibular prognathism that may be attributed to both the position and the size of the mandible. In these cases, the mechanical interference by the overclosure of the mandible may influence the growth of maxilla and the alignment of the maxillary dentition. Also,many young children can benefit from treatment because it reduces the psychological burden of facial and dental disfigurements during some of their most formative years.[3]

Fig 1 : Pre Treatment Extraoral Photograph

This case report attempts to correct a developing Class j4; malocclusion at 2.5years of age.

## Case Report

A 2.5 year old male child was brought to the Department of Paediatric and Preventive dentistry by his parents who complained of unesthetic appearence due to forward positioning of the child's mandible. **(Figure 1, 2)**

Clinical examination revealed an anterior crossbite in the deciduous dentition with a negative overjet of -1mm **(Figure 3, 4)** , a mild concave profile and a mesial step molar occlusion.

On examination,the parents of the patient exhibited a normal class 1 occlusion.
The patient exhibited the following positive factors-
a) A-P functional shift

The study of the pretreatment cephalogram(Figure 5) revealed the following values-

| Serial No. | Cephalometric References | Value |
|---|---|---|
| 1. | ANB | -1 M8; |
| 2. | Interincisal Angle | 158.5 M8; |
| 3. | Jaraback's ratio | 61.4% |

b) Symmetrical condylar growth
c) Young with growth remaining
d) Mild skeletal disharmony
e) ANB<-2
f) No familial prognathism

The familial and medical history of the patient were not relevant.
Hence early treatment was initiated.

A cutomised acrylic chin cap was given with head support **(Figure 6, 7)** . This extraoral appliance has a head cap which is firmly seated on the posterosuperior aspects of the cranium as anchorage and has attachments for the placement and activation of a chin cup. A force module of elastic was used to provide desired tension levels on the chin cup itself **(Figure 8, 9, 10)**.

The appliance was fabricated so that the pull on the chin cup was oriented along a line from the mandibular symphysis (pogonion) to the mandibular


Fig 5 : Pre Treatment Cephalogram


Fig 2 : Pre Treatment Extraoral Photograph


Fig 6 : Chin Cap Made Of Acrylic


Fig 7 : Chin Cap Made Of Acrylic


Fig 3 : Pre Treatment Intraoral Photograph


Fig 4 : Pre Treatment Intraoral Photograph


Fig 8 : Etra-oral Photograph Of Patient With Chin Cap


Fig 9 : Etra-oral Photograph Of Patient With Chin Cap


Fig 10 : Etra-oral Photograph Of Patient With Chin Cap


Fig 11 : Intra-oral Mid-treatment Photograph

Fig 12 : Mid-treatment Extraoral Photograph

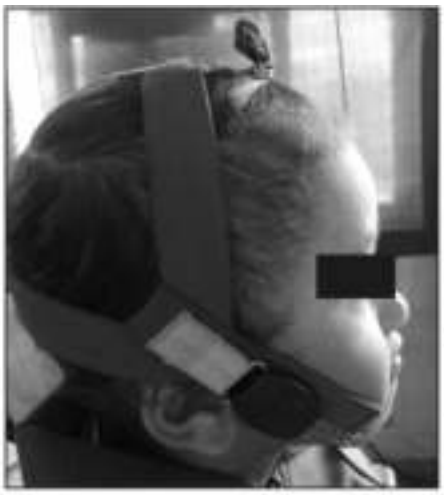

Fig 15 : Mid-treatment Extraoral Photograph With Chin Cap

Fig 18 : Chin Cap Made Of Cloth

Fig 19 : Chin Cap Made Of Cloth

Fig 13 : Mid-treatment Extraoral Photograph

Fig 16 : Mid-treatment Extraoral Photograph With Chin Cap

Fig 20 : Chin Cap Made Of Cloth

Fig 14 : Mid-treatment Extraoral Photograph

Fig 17 : Mid-treatment Extraoral Photograph With Chin Cap

Fig 21 : Chin Cap Made Of Cloth

condyle.The patient was advised to wear the appliance continuously for 24 hours a day.

After 3 months of treatment an edge to edge bite was established,following which the chin cap appliance was tightened.**(Figure 11, 12, 13, 14, 15, 16, 17)**

The child started developing allergic rashes due to the acrylic chin cap which was changed to a customised chin cap made of cloth.**(Figure 18, 19, 20, 21)**.

A positive overjet of 1mm was established after another 5 months **(Figure 22, 23, 24)**.

**Result**

After 5 months of treatment the following results were obtained –

**The post treatment cephhalogram showed**

1) An increase in the ANB angle from -1 M8; to +1 M8; -Indicating a correction of the crossbite **(Figure25)**.
2) An increase in the Interincisal angle from 158.5 M8; to 166 M8; - Indicating the uprighting of the upper and lower incisors.
3) An increase in the Jaraback's ratio from 61.4% to 64.8% -Indicating a shift from vertical growth pattern to horizontal growth pattern **(Figure 26, 27, 28)**.
4) The anterior crossbite was corrected to a positive overjet of +1mm.

**Discussion**

Many researchers have claimed the effectiveness of early treatment for Class j4; malocclusions. Nevertheless when analysing the studies in detail the initial age of Class j4; patients undergoing the 'early' treatment differs widely in the literature. A few authors have also reported the treatment of studies that were initiated as early as the deciduous dentition (Graber,1977;Ritucci and Nanda,1986;Stensland et al,1988)[4],[5],[6]. Sakamoto(1981)[7] noted a greater improvement of skeletal sagittal relationships in Japanese children with Class III malocclusions treated with chin cap from age of 3-5 years as compared to children treated at later ages. Mutschisch and Droll found that the very early treatment of Class III malocclusion offered the best chance for normal

Fig 22 : Post Treatment Intraoral Photograph

Fig 23 : Post Treatment Intraoral Photograph

Fig 24 : Post Treatment Intraoral Photograph

Fig 25 : Post Treatment Cephalogram

Fig 26 : Post Treatment Extraoral Photograph

Fig 27 : Post Treatment Extraoral Photograph

Fig 28 : Post Treatment Extraoral Photograph

skeletal relationships[8]. Turpin(1981)[9] developed guidelines when to intercept Class III malocclusion. He suggested that if the patient showed characteristics in the positive column, early treatment should be considered. However if any characteristics fall in the negative column, delaying treatment until condylar growth has ceased may be the better alternative.

Chin cup therapy contributes to the correction of Class III malocclusion in several ways. First, by rotating the mandible posteriorly, the ramus is placed in a more vertical orientation to the upper craniofacial structures. Secondly, by overcoming the changes introduced by backward mandibular rotation, the gonial angle is decreased and the condylar growth is inhibited. Finally, vertical condylar growth is inhibited.[5],[10]

**Conclusion**

The aim of treating all developing Class j4;malocclusion is to enable the patient to close his jaws in normal centric relation without anterior interlock, thus permitting normal growth. This study demonstrated the achievement of significant results, and the stability of the corrected anterior crossbite associated with a developing Class III malocclusion treated with a chincup. Good results were achieved in this case. However,further long-term clinical investigations are necessary to assure the stability of Class III treatment.

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# Full Mouth Rehabilitation Of A Patient With Amelogenesis Imperfecta: A Case Report

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**Abstract**
Amelogenesis Imperfecta is a group of developmental conditions affecting the structure as well as clinical appearance of enamel involving all or nearly all teeth. It involves both primary as well as permanent dentition and cause significant tooth structure damage further causing various pulpal symptoms, compromised function and esthetic disfigurement. All these problems present a great challenge to the dentist while rehabilitating a patient with amelogenesis imperfecta. This case report describes a sequential approach for restoring the dentition affected by Amelogenesis Imperfecta. The patient came with a chief complaint of discoloured teeth and unpleasant esthetics. No abnormalities were detected in her past medical history. On clinical examination, the crowns of all teeth were small, discoloured worn out and hypoplastic. The roots appeared normal on radiographic examination. The aim of the treatment was to preserve the tooth structure, restore the vertical dimension, improve esthetics and masticatory function.

**Key Words**
Amelogenesis Imperfecta, Full mouth Rehabilitation, dental anomalies.

## Introduction

Amelogenesis imperfecta (AI) is a hereditary disorder expressing group of conditions that cause developmental alterations in the structure of enamel. A complex inheritance pattern gives rise to amelogenesis imperfecta(AI), a structural defect of tooth enamel.[1]

Generally both the primary and permanent dentitions are involved diffusely. Various causes of amelogenesis imperfecta include febrile illness or vitamin deficiency, local infection or trauma, fluoride ingestion, congenital syphilis, birth injury, premature birth or idiopathic factors.[2]

Broadly, amelogenesis imperfecta has been categorized into four groups primarily based on phenotype—hypoplastic, hypocalcified, hypomaturation, and hypomaturation-hypoplastic with taurodontism[3].

Chief problems in amelogenesis imperfect include poor dental esthetics as there is abnormal enamel formation and abnormal color of teeth: yellow, brown or grey, reduced vertical dimension and teeth sensitivity[4],[5]

Various other dental anomalies which are associated with amelogenesis imperfecta are multiple impacted teeth, congenitally missing teeth, hypercementosis, root malformation, and taurodontism.[6],[7],[8] Anterior open bite with posterior deep bite may occur.[9]

Clinical manifestations vary in affected males as well as females. In the hypoplastic form, females show vertical ridging of the enamel, whereas, there is uniform hypoplasia in males. In the hypomaturation form,[10],[11] males present with irregular pigmented mottling whereas females present with vertical bands of mottling which is inconspicuous under normal light conditions which is known as lyonization.[12],[13],[14]

Restoration of these defects is important not only because of esthetic and functional concerns, but also because there may be a positive psychological impact for the patient.[15],[16],[17]

Treatment planning for patients with amelogenesis imperfecta is related to many factors:

Intraoral condition, the age and socioeconomic status of the patient, the type and severity of the disorder.[18],[19] Patients have been known for trying so many things to cover their teeth with pieces of paper, chewing gum or other materials in order to mimic an "ordinary" appearance. Many young people with AI request the removal of their teeth and the fitting of dentures in a society where having one's own teeth is the longed-for norm.

Also, a carefully designed and executed temporization phase is vital for overall treatment success, particularly for severe cases that require extensive rehabilitation. Since amelogenesis imperfecta is often complicated with occlusal disharmony, reduced vertical dimension and limited interocclusal clearance, so it usually requires establishment of a new occlusion.

This case report demonstrates a sequenced and logical approach to treat a patient having marked tooth damage caused by amelogenesis imperfecta.The treatment for amelogenesis imperfecta is mainly aimed on esthetic and functional rehabilitation. Moreover, careful planning with adequate follow up enabled the patient to attain satisfactory results.

## Case Report

A 32-year-old female patient presented in the O.P.D of Prosthodontics at the

Himachal institute of dental sciences, Paonta Sahib with a chief complaint of discoloured and malformed teeth including size, shape and shade of her teeth. Medical history was noncontributory. Extraoral examination did not reveal any relevant findings. No other family member had the same dental problem. Past dental history revealed that she had got composite veneering done in her upper and lower anterior teeth by some local dentist one and a half year back but since then frequent chipping of composite veneering in upper and lower anteriors has occurred so the patient was dissatisfied and disillusioned with dental treatment. Also there were multiple diastemas between maxillary teeth which were not addressed by earlier dentist. **(Fig. 1a)**

Patient also had crowding in lower teeth associated with deep bite and hypoplastic posteriors. **(Fig. 1b and Fig. 1c)**. After thorough examination, the patient was diagnosed as having a hypoplastic type of amelogenesis imperfecta.

The treatment started with complete oral prophylaxis with oral hygiene instructions. Maxillary right second molar was extracted since it was grossly decayed and mandibular left first premolar was extracted since it was out of arch.

After 15 days, maxillary and mandibular complete arch impressions were made using alginate. Diagnostic casts were poured using type III dental stone. Face-bow transfer was done **(Fig. 2a and Fig. 2b)** and interocclusal records were made to mount the casts in centric relation on a semi-adjustable articulator.

In treatment planning special attention was given to improve the aesthetics and function. Fabrication of metal-free crowns for the maxillary and mandibular anterior teeth and metal-ceramic crowns for posterior teeth was planned.

The patient was informed of the diagnosis, the treatment planned and her consent was taken before the start of the procedure. As the patient had 5 to 6 mm of interoccluslal distance, the vertical dimension was raised around 1.5-2.0 mm. An Occlusal splint was fabricated to evaluate the patient to altered VDO and patient was kept for observational phase of 6 weeks. The patient was instructed to

Fig. 1a Showing Chipping Of Composite Veneering In Upper And Lower Anteriors ; Presence Of Multiple Diastemas.

Fig. 1b Showing Lower Anterior Crowding And Hypoplastic Lower Posterior Teeth.

Fig. 1c Showing Malformed Upper Molars


Fig. 2a Showing Face-bow Transfer Using Slidematic Face Bow.

wear the splint all the time, except during teeth cleaning. She was compliant during a 6-week evaluation period. The patient tolerated increased OVD with no sign or symptoms of muscle soreness or TMJ pain. In the meantime, those teeth requiring endodontic treatment underwent root canal therapy.

The diagnostic tooth preparation and


Fig. 2b Showing Face-bow Transfer Using Slidematic Face Bow.


Fig. 3 Showing Prepared Upper Teeth With Gingival Displacement Done

diagnostic wax patterns were completed on the mounted casts at planned OVD. The diagnostic wax up models were duplicated and another set of casts were produced to form a template which was used to determine necessary tooth reductions, adequacy of tooth preparation design, and the first set of acrylic provisionals.

Tooth preparations for metal-free anterior crowns and metal-ceramic posterior crowns were completed. Gingival tissues were retracted **(Fig. 3)**. Final impressions were made with polyvinyl siloxane impression material. Provisional crowns already made from the diagnostic wax-up template tried for esthetics and phonetics requirement; checked in for margins, proximal contacts and occlusion and cemented with provisional cement. Then, we made another impression of these provisional restorations which was sent to the lab for duplication of contours in final restorations.

The maxillary cast was mounted on an articulator using face bow transfer. And mandibular cast was mounted in centric relation using inter-occclusal recording material.

The articulator was sent to the lab for the fabrication of zirconia copings for

anterior metal-free crowns and metal copings for posterior metal-ceramic crowns **(Fig. 4)**. Coping trial for zirconia copings as well as metal copings was done and a new bite registration was done using aluwax to verify earlier jaw relation record. Later metal-free crowns and metal-ceramic crowns were fabricated; tried in, margins, proximal contact and occlusion checked. Right and left Canine guided occlusion **(Fig. 5a and Fig. 5b)** and anterior guidance **(Fig. 5c)** was developed. Finally, the provisional crowns were replaced by metal-free crowns in the anterior teeth and porcelain fused to metal crowns in the posterior teeth. These crowns were cemented using dual cure resin cement. Excess cement was removed and finishing of the margins was done using finishing stones.

**Instructions to Patient**

Oral hygiene instructions were reviewed, emphasizing cleaning of the restoration margins. Additional instruction was given on the use of floss threaders and superfloss under the FPD.

**Post-treatment Therapy**

The patient was seen at 1- and 2-week follow-up appointments **(Fig. 6a and Fig. 6b)**. The patient stated that she was pleased with esthetics, function, and comfort of the prostheses. Oral hygiene was excellent. The patient was given instructions to seek 6- month prosthodontic and periodontic recall appointments.

**Prognosis**

The patient was very motivated and dedicated to restoring her oral health to optimal condition. Her positive attitude and improved oral hygiene should help to ensure a favourable prognosis. Long-term prognosis will depend on consistent and continued good oral hygiene practice.

**Conclusion**

In cases where the esthetics and function of teeth have been compromised as a result of amelogenesis imperfecta, thorough diagnosis and treatment planning are essential to achieve a satisfactory esthetic and functional result. The treatment plan for treating a case with amelogenesis imperfecta is related to many factors including age of the patient, socioeconomic status, type and severity of the disorder. This clinical report described the oral rehabilitation of a female patient affected by hypoplastic amelogenesis imperfecta.

Fig. 4 Showing Fabricated Zirconia Copings For Anterior Teeth And Metal Copings With Opaque Porcelain On Posterior Teeth.


Fig. 5a Showing Left And Right Canine Guidance


Fig. 5b Showing Left And Right Canine Guidance


Fig. 5c Showing Anterior Guidance

The treatment of choice using the metal-free crowns for anterior teeth and the porcelain fused to metal crowns for the posterior teeth was efficient for achieving esthetic and functional rehabilitation. At the end of the treatment, the patient was very pleased with the result.


Fig. 6a Postoperative View With Functionally And Esthetically Restored Teeth.


Fig. 6b Postoperative View With Functionally And Esthetically Restored Teeth.

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# Prosthetic Rehabilitation Of Pediatric Patients

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**Abstract**
Edentulism or tooth loss is considered as a major health problem that has serious emotional, social, and psychological consequences affecting a child's nutrition, esthetics, self-confidence and self-esteem. Common causes for edentulism in children are; dental caries, traumatic injury, congenital absence of teeth, congenital malformation of teeth, cleft lip and palate. Prosthodontic rehabilitation of children with pronounced edentulism helps to restore masticatory function, appearance and muscle function; to maintain and improve phonetics; prevent development of deleterious oral habits; and, to minimize possible psychological disturbances. Different treatment modalities for prosthetic rehabilitation in infants\children\adolescents are removable partial dentures, complete dentures, partial dentures fixed with orthodontic bands or Nance dentures, various kinds of crowns like stainless steel crowns, polycarbonate, composite strip crowns, resin bonded prosthesis, fiber reinforced fixed dental prosthesis etc. Prosthodontic treatment of children often requires highly intricate procedures with cooperation from patient and as well as from parents.

**Key Words**
Pediatric rehabilitation, Obturators, Implants, Speech prosthesis.

## Introduction

In-spite of scientific advancement in the area of preventive dentistry, access to use of dental services, systemic and topical fluoridation, there is a substantial prevalence of edentulism in children and adolescents[1]. Edentulism or tooth loss is considered as a major health problem that has serious emotional, social, and psychological consequences affecting a child's nutrition, esthetics, self-confidence and self-esteem.Children are often affected psychologically by the unacceptable appearance of diseased, damaged or missing teeth,one should not allowchronologic age to preclude performance of whatever treatment is necessary to provide proper function and esthetics. If teeth involved are fully erupted, have achieved complete root formation, and may be prepared without causing irreversible damage to pulp, successful prosthodontic treatment can often be provided for patient as young as 12-14 years of age. Prosthodontic treatment of children often requires highly intricate procedures with cooperation from patient and as well as from parents.

## Definition Of Age Group Terminology

According to American Academy of Pediatrics Committee on Fetus and Newborn, pediatric patients are defined as follows [2] **[Table 1]**

Table 1

| | |
|---|---|
| Neonate | A full-term newborn 0-28 days postnatal age. |
| Infant | 1 month (>28 days) to 1 year of age |
| Child/Children | 1-12 years of age |
| Adolescent | 13-18 years of age |
| Adult | >18 years of age |

## Causes And Prevalence Of Edentulism In Children

Despite significant improvements in oral health among children, tooth loss remains a dental public health problem among adults. The most important function of dental profession is to prevent tooth loss. Common causes for edentulism in children are;dental caries (rampant and nursing bottle caries ), traumatic injury, congenital absence of teeth (partial or complete anodontia) as in case of ectodermal dysplasia, congenital malformation of teeth as in case of amelogenesis and dentinogenesis imperfect and cleft lip and palate[3].

## Consequences Of Premature Tooth Loss

Premature loss of tooth can lead to loss of space in mixeddentition which in turn can lead to malalignment of teeth.Early loss of primary incisors or molars can lead to deleteriousoral habits like anterior or lateral tongue thrusting respectively. Congenital absence of anterior teeth or loss due to traumacan cause psychological trauma to children because ofunintentional, yet unkind remarks by friends or relatives. Thiscan lead to a feeling of rejection or inadequacy regarding theirpersonal appearance. Missing primary anterior teeth can leadto temporary misarticulation of consonants in speech. Apart from this, other effects of edentulism are

- Reduced masticatory efficiency
- Lack of facial support and aesthetics
- Loss of vertical dimension of occlusion
- Loss of alveolar ridge height

## Benefits Of Restoration Of Missing Teeth

Restoration of anterior teeth restores the appearance andthe self-confidence of children[4]. Many children with earlychildhood caries who had untreated carious anterior teeth will be extremely happy after full mouth rehabilitation with strip crowns or anterior stainless steel crowns. Restoration of missingposterior teeth can enhance the efficiency of mastication andanterior teeth can lead to better speech pattern. Constructionof dentures or fixed replacements of anterior teeth can preventdevelopment of deleterious oral habits. Some of the removabledentures can serve as space maintainers as well.

## Examination, Diagnosis And

**Treatment Plan:**

Prosthodontic treatment is based upon the results of a clinical examination and is ideally part of a comprehensive treatment plan. Clinical examination of the child is carried out in usual manner. Radiographic examination involves panoramic radiographs, in that one could visualize different stages of development at which the various succedaneous teeth are at that particular point of time. This information helps prosthodontist to predict approximate time and sequence of eruption of succedaneous teeth and also decide whether particular patient presents the indication for prosthesis.Treatment plan shall take into consideration[5]

1. Developmental status of the dentition;
2. Caries-risk assessment;
3. Patient's oral hygiene;
4. Anticipated parental compliance and likelihood of recall;
5. Patient's ability to cooperate for treatment.

The restorative treatment plan must be prepared in conjunction with an individually-tailored preventive program. Caries risk is greater for children, who are poor, rural, or minority or who have limited access to care. Factors for high caries risk include decayed/missing/filled surfaces greater than the child's age, numerous white spot lesions, high levels of mutans streptococci, low socioeconomic status, high caries rate in siblings/parents, diet high in sugar, and/or presence of dental appliances. Studies have reported that maxillary primary anterior caries has a direct relationship with caries in primary molars, and caries in the primary dentition is highly predictive of caries occurring in the permanent dentition.

**Rehabilitation Of Adults Vs Pediatric Patients:**

**Restoration**

Restoration of primary teeth differs from restoration of permanent teeth, due to the following factors[6].

- Differences in tooth morphology. The mesiodistal diameter of a primary molar crown is greater than the cervico-occlusal dimension. The buccal and lingual surfaces converge toward the occlusal surface.
- The enamel and dentin are thinner.
- The cervical enamel rods slope occlusally, ending abruptly at the cervix rather than being oriented gingivally and gradually becoming thinner as in permanent teeth.
- The pulp chambers of primary teeth are proportionately larger and closer to the surface.
- Primary teeth contact areas are broad and flattened rather than being a small distinct circular contact point, as in permanent teeth.
- Shorter clinical crown heights of primary teeth also affect the ability of these teeth to adequately support and retainrestorations.

Young permanent teeth also exhibit characteristics that need to be considered in restorative procedures, such as large pulp chambers and broad contact areas that are proximal to primary teeth.

**Impression Procedures:** Making impression in children is challenging owing to

- Lack of cooperation from child
- Anxiety
- Small opening of mouth
- Difficulty in tray selection
- Difficulty in controlling salivation

Children may be anxious about having impressions made and a careful explanation should be given before starting the procedure. Appropriate tray selection is important while making impressions. The amount of impression material taken on the tray should be just adequate to make an impression. Any excess material on the tray may be displaced into the pharynx and cause gagging. The posterior half of the tray may be loaded with less impression material. While placing the tray inside the mouth, it is positioned anteriorly and pressed against the teeth which will displace the excess impression material posteriorly to compensate for the less material in the posterior half of the tray. This technique works well with impression making in children. While making the impression, the operator should have a tongue mirror or tongue blade to remove the excess impression material from the posterior palatal area.

**Distraction Techniques:**

a. Asking the child to raise his or her finger or thumb as specified.For e.g. show me the right little finger or left thumb or left middle finger, etc.
b. Asking the child to lean forward and breathe through the mouth
c. A small dab of alginate is placed over the child's thumb or finger and asked to raise the hand once it sets
d. Asking the patient to breathe rapidly
e. Asking the patient to raise the legs alternatively and point the toe towards the roof
f. Asking the patient to count within himself till 30 or 50

**Different Treatment Modalities in Prosthetic Rehabilitation of Pediatric Patients:**Different treatment modalities for prosthetic rehabilitation in infants\children\adolescents are as follows.[7]

1. Removable partial dentures
2. Complete dentures
3. Partial dentures fixed with orthodontic bands or Nance dentures
4. Various kinds of crowns like stainless steel crowns, polycarbonate, composite strip crowns
5. Resin bonded prosthesis
6. Fiber reinforced fixed dental prosthesis
7. Porcelain laminate veneers
8. Feeding plates in infants
9. Palatal obturators in CLP patients.
10. Speech prosthesis for velopharyngeal deficiency or velopharyngeal incompetency.
11. Osseointegrated implants.

**Removable Partial Dentures:**

The removable partial dentures arefairly tolerated bychildren and are commonly used successfully to prevent consequencesof premature tooth loss.[8]

**Important Considerations in Design of RPD in Children:**

1. Full palatal coverage for maxillary partial dentures
2. Relatively short and contoured buccal or labial flanges
3. Clasps when used around primary canines should be removed at appropriate time to allow thecuspids to drift laterally and distally to accommodate the erupting permanent incisors
4. For mandibular RPD with lingual bar, the bar should be adapted 2mm away from the soft tissue so that it will accommodate the developmental changes in the dental archwhen succedaneous teeth starts erupting
5. When necessary the RPD should be fabricated before extraction of teeth and used as immediate partial denture as well as immediate space maintainer
6. The teeth are set with spaces and in a more vertical axis than in adult dentures.

7. As the child grows it may be necessary to remove portion of the appliance to allow for eruption of permanent successors.

**Complete Dentures:**

**Indications:**

1. Children with genetic diseases in which missing teeth are a part of the syndrome often need complete dentures to restore the primary and permanent dentition. Eg: Ectodermal dysplasia with anodontia or oligodontia. [9]

**Important Considerations in Fabrication:**

1. Children with ectodermal dysplasia continue to exhibit normal facial growth except for alveolar bone deposition. There is a need to periodically remake the prosthesis and esthetically customize denture to the child's current stage of dental and facial development.
2. Making a centric relation records is difficult in children because they do not have same musculature, TMJ functions or growth maturity as in adults. Unfortunately all prosthetic principles are directed towards adults. To overcome the problems zero degree teeth are arranged in flat occlusal plane.
3. Over denture may be fabricated using existing teeth for retention of the denture and preservation of alveolar bone.

**Resin Bonded Metal Ceramic Fdp:**

For reason of pulpal and periodontal health and conservation of tooth structure, resin boded prosthesis should be the first choice whenever possible[10]. Retention and resistance is achieved through preparation in enamel, coupled with acid etching of enamel and fixation with adhesive resin cements.

**Indications:**

1. Congenitally missing teeth.
2. Tooth lost due to trauma.
3. Adequate clinical crown height.

**Contraindications:**

1. Poor oral hygiene.
2. Large carious lesion in abutment.
3. Malpositioned teeth.

**Advantages:**

1. Conservation of teeth structure, reducing trauma to pulp.
2. Can be done without LA.
3. Excellent esthetics.
4. Failure can be easily repaired.

**Disadvantages:**

1. Cannot be given where large restoration or caries exists in abutment tooth.
2. Cannot be given in malpostioned arches, deep bite and caries prone individuals.

**Fiber Reinforced Fixed Dental Prosthesis**

There are situations in which a semi permanent fixed dental prosthesis may be desirable, particularly for patients who have completed orthodontic treatment but are too young to embark on implant therapy. Following advances in fiber reinforcement technology, fiber-reinforced composite resin (FRC) now represents a lower-cost alternative to traditional metal-ceramic for the construction of resin-bonded prostheses in case of children.

It has a number of potential advantages compared with a metal framework of traditional RBP. Improved adhesion of the resin luting agent to the framework, potential for improved esthetics, and physiologic stiffness of the framework material. The most commonly used FRCs consists of glass fibers embedded in a dimethacrylate resin matrix. An alternative system is based on the use of a multiphase polymer matrix of linear polymer with a dimethacrylate resin. A multiphase polymer matrix of FRC is proposed to improve adhesion between the veneering composite and composite luting agent to the FRC framework.

FDPs constructed from FRC may be retained using complete-coverage crowns, inlays, surface-retained wings, or a combination. The use of full-coverage retainers has been recommended; however, the preparations required for these are as extensive as those required for metal-ceramic reconstructions. In current clinical practice, FRC-FDPs are most commonly surface or inlay-retained to minimize the need for tooth preparation.

The preparations consist of removing approximately 1.0 mm of enamel on the palatal and proximal aspects of the abutment teeth. All gingival margins should be in enamel, chamfered and supragingival. The internal line angles should be round, and the gingival floor to be prepared with a butt joint.

The first step in the final cementation of the restoration is to etch enamel with 35% phosphoric acid gel for 20 seconds. The teeth are then rinsed and gently dried. Dentin bonding agent should be applied to the preparations following the manufacturer's instructions followed by gentle air thinning and light curing. The FRC-FDP restorations should be slowly seated and any gross excess of cement removed. Continuous pressure should be maintained on the restoration during initial light curing, 5 seconds for each abutment.

**Obturators**

A palatal obturator is a prosthesis that totally occludes an opening such as an oronasal/oroantralfistula. Palatal obturatorstypically are prosthesis used to close defects of the hard/soft palate that may affect speech production or cause nasal regurgitation during feeding. Following surgery, there may remain a residual oronasal opening on the palate, alveolar ridge, or labial vestibule. A palatal obturator may be used to compensate for hypernasality and to aid in speech therapy targeting correction of compensatory articulation caused by the cleft palate. Palatal obturators are indicated in individuals with cleft palate, operated cases of surgical resection of tumors and children with traumatic injuries.[11]

**Feeding plate or feeding appliance:**

Cleft lip and palate are one of the most common structural birth defects. Its consequences affect several systems and functions that include feeding, facial growth, dentition, speech as well as the social and psychological problems which have an impact on the child and parents. Neonates born with cleft lip and palate have oronasal communication which diminishes the ability to create negative pressure necessary for suckling[12]. Compressing the nipple between tongue and hard palate to squeeze out the liquid becomes difficult. Feeding appliances are often required by such patients. A feeding appliance is a device that creates a seal between the oral and nasal cavities and helps the infant to express milk. Sucking efficiency is one of the most common difficulties related to feeding in children with cleft lip and palate. In order to be successful in sucking, coordination of the intraoral muscles is important, which may be difficult in children with cleft lip and palate. Breast feeding a child

with a cleft palate can be challenging. The opening in the palate makes it impossible for the child to create suction. The baby may have difficulty in locating a place on the palate to press the breast against and to express milk. However, the amount of difficulty will vary based on the severity of the cleft. There are a variety of feeding devices that can be very useful in successfully feeding an infant with a cleft lip and palate, like a plastic squeeze bottle, soft nipple, specially designed nipple with enlarged opening and wide based nipple (useful in sealing off the cleft lip). A feeding obturator is a device that creates a seal between the oral and nasal cavities and controls the flow of milk. Feeding device is inserted over the infant's hard palate, which allows him or her to compress the nipple easier because it provides a contact point and helps the infant to express milk. It facilitates feeding, reduces nasal regurgitation and shortens the length of time required for feeding. Either heat cured acrylic resins or ethylene vinyl acetate can be used for the fabrication of feeding plate. Feeding appliance made with ethylene vinyl acetate has many advantages over acrylic feeding appliance, which are as follows:

1. Smoother surface
2. Soft in nature
3. No need of retentive wire

Palatal Plate is a kind of obturator, generally consisting of an acrylic plate and retention clasps of orthodontic wire, which covers a fistula of palate. It may be used to aid in improving articulation and feeding. The blockage of the opening helps to improve hypernasality and suckling ability for babies. In the case of a labial-oral-nasal fistula, the plate may include an anterior upward extension to fully occlude the passage running between the labial surface of the alveolus, alveolus, and nasal cavity. The plate may be constructed to include any congenitally missing teeth to improve articulation and appearance. Individuals who use palatal plates must be monitored periodically due to possible tissue irritation by the plate. Materials such as food particles, oral mucosalsecretions may cause buildup on the upper surface of the plate; therefore, it is essential to clean a palatal obturator at least twice a day to avoid tissue irritation.

**Nance Obturator**

This fixed obturator is based on the Nance appliance, which was originally used as a space maintainer in orthodontics, but has been redesigned for closing anterior palatal fistulas in patients with cleft lip and palate. The Nance obturator may be used when the surgical closure of the fistula is not feasible and a removable device is not successful.

**Speech Prosthesis**

Pharyngeal Bulb Obturator or SpeechProsthesis:This prosthesis is given in case of patients with velopharyngeal insufficiency where there is anatomic deficiency of soft palate so that it is unable to create positive seal with posterior and lateral pharyngeal wall. Pharyngeal bulb obturator has a palatal plate retained with the help of clasps and a posterior bulb replacing the deficient part of soft palate. This will provide hard and stable base against which posterior pharyngeal wall contracts to bring about velopharyngeal seal. It can be either interim speech aid prosthesis made of heatcure acrylic resin or definitive prosthesis involving cast partial denture framework.

Fabrication technique involves making of alginate impression of maxillary arch taking care to record as much posterior part of soft palate as possible. This is followed by fabrication of working cast and acrylic plate is adapted on the cast with posterior wire extension which reinforces speech bulb. Impression of pharyngeal portion of the prosthesis is done using impression compound. This is followed by functional impression of the tissues using mouth temperature waxes or tissue conditioner. These impression materials later will be replaced by heat cured acrylic resin.

**Palatal Lift Prosthesis**

Velopharyngeal incompetency is a clinical condition where soft palate is not anatomically deficient but functionally weak leading to inadequate contraction and inadequate contact with posterior pharyngeal wall. This leads to nasal resonance and reduced speech intelligibility. This condition may be due to poliomyelitis, muscular dystrophy or myotonia. Children with this condition can be rehabilitated with palatal lift prosthesis. Similar to pharyngeal bulb obturator it has two component oral and pharyngeal components. Pharyngeal part lifts the palate and approximates it close to the posterior pharyngeal wall so that positive velopharyngeal seal can be created.

**Dental Implants In Pediatric Patients**

1. Osseointegrated implants have been successfully used in dentistry for adults since the discovery of implants by Branemark in 1969. In adults, the success depends on the quality and quantity of bone and proper treatment plan, surgical technique and proper oral hygiene measures. These factors are also equally important in growing children but another critical factor that has to be considered is the ongoing growth and development in children and adolescents. Teeth loss due to trauma and congenitally missing teeth are often encountered in young children , so in such cases removable prosthesis, Maryland bridge or orthodontic movement of teeth to close space are usually the treatment modalities , because jaw growth is not completed. However, these options may lead to increased caries rate, increased residual alveolar resorption and other periodontal complications. Implants can be a good alternative because it can prevent residual alveolar resorption.
2. Other factorsthat favors early placement of implants in children would include excellent local blood supply, positive immunological resistance, uncomplicated osseous healing. When restoring the edentulous space in young children and adolescents using implants,the basic knowledge of growth and development is essential to assess the implants' response to craniofacial growth. Implants behave like ankylotic teeth and fail to move together with the surrounding structures leading to infra-occlusion of implants and difficulties with prosthesis.[13].

A basic knowledge of facial growth is critical in assessing how an implant may respond in the adolescent. An osseointegrated implant behaves like an ankylosed primary tooth because both lack a periodontal ligament. The periodontal ligament has an important function in allowing teeth to erupt and adapting for dentoalveolar and facial growth, not only vertically but also in anteroposterior and transversedimensions. Early animal studies have shown that osseointegrated implants remain fixed in their initial

position and cannot adapt for growth changes.[14]

**Growth of the Jawbones**

Growth is first completed in the transverse plane thenin sagittal plane and finally in vertical plane.[15] Thegrowth of mandible is closely associated with generalbody growth, whereas growth of the maxilla is moreassociated with the growth of the cranial structures.As a rule of thumb, which applies to both the maxillaand mandible, transverse growth is first completedbefore the pubertal growth spurt and is followed by growth in length and finally growth in height, which is completed last.[16]

**Maxillary Growth and Implants**

**Transverse Growth**

Growth in width of the median palatalsuture accelerates at puberty and is the most significantfactor in transverse growth of the maxilla. Implants placed in the central incisor region will result indiastema with the adjacent natural teeth and shift inthe midline.[17]

**Sagittal Growth**

The maxilla usually grows in a downward and forwarddirection relative to the anterior cranial base. Althoughthe initial growth is related to growth of cranialbase, the maxilla shows much greater changes fromage 4 to adulthood than does the cranial base.[18] Maxillary growth occurs as a result of both passivedisplacement and enlargement. During early childhood,passive growth is a major factor in a maxillary growthbut becomes less important as anterior sutures of thecranial base closes. After the age 7, approximatelyone-third of the maxillary growth is accounted forpassive displacement. The other two-third occurs as aresult of enlargement of maxilla itself.Resorption in anterior region will result in gradual lossof bone in the labial aspect of the implants resulting inlabial fenestration and exposure of implants.[19]

**Vertical Growth**

Vertical growth of the maxilla occurs by suturallowering i.e., passive displacement of maxilla andapposition on the tooth-borne surfaces of the maxillaryalveolus. The orbit enlarges with increasing eye size withcompensatory apposition at the floor of the orbits.[20],[21] Thenasal floor is lowered by resorption on its nasal surfaceand by deposition on the palatal and alveolar surface.Hence, as the alveolus increases in height by appositionon its occlusal aspect, it is simultaneously decreasedby resorption at the nasal floor. Approximatelyone-third of the total increase in alveolar height isaccounted by nasal resorption. Therefore, observationfrom dental casts reflects less than two-thirds of thetotal amount of vertical alveolar growth. Resorptivelowering of the nasal floor is strongly differentiatedand is usually greater anteriorly than posteriorly.[22] This differential pattern is a compensation for therotational displacement of the maxilla in whichthe posterior segments roll downwards at a greater ratethan the anterior segments. Vertical maxillary skeletalgrowth dramatically affects implants.To prevent the complication in the vertical growth dueto remodeling it is advisable to delay the placement ofimplant till 18 years or till growth is completed.

**Mandibular Growth and Implants**

The timing of mandibular growth is similar to that ofmaxilla but not identical. The differential growth ofmandible converts the convex profile of child into astraight profile in adults.[23]

**Transverse Growth**

Changes in the width of the mandible are much lessthan in the maxilla. The increase in the width of themandible occurs primarily in the posterior region ofthe mandible. As the mandible increases in length, italso increases in posterior width because of its V-shape.The width in the anterior mandible ceases due to earlyclosure of mandibular symphysis (around 1-year).Thus, mandibular anterior width stabilizes relativelyearly and increases only slightly by appositional growth,whereas mandibular posterior width increases with theincreasing length of the mandibular body.Implants can be placed in anterior mandibular regionat an early age. But implants in mandibular posteriorregion of growing children will result in lingual positiondue to bone remodeling in premolar molar region.[24]

**Sagittal Growth**

Changes in arch length in the mandible differ from thosein the maxilla. As the permanent incisors erupt, there isgenerally little or no change in mandibular arch length. Sagittal growth of mandible is due to both endochondralgrowth and remodeling of bone. The growth of thecondyle results in increase in the length of mandible.To accommodate posterior teeth, the body of themandible increases in length by resorption on anterioraspect of ramus and deposition on the posterior aspect.An implant placed in early age will result in exposureof an implant due to pattern of resorption.[25]

**Vertical Growth**

Mandibular growth increases by condylar growthand by bone apposition at dentoalveolar complex.When serial lateral cephalograms are superimposedon the cranial base, the mandible appears to growdownward and forward. Mandible does not necessarily grow downward andforward in a linear manner. Instead, the mandiblerolls forward, with apposition below the symphysisand resorption below the gonial angle. Thus, duringgrowth, the face and the mandible tend to rotate, withthe center of rotation influenced by the direction ofcondylar growth.[26]

**Conclusion**

It is not uncommon to find children with grossly carious primary teeth. In most of the cases, the only treatment possible is extraction of the decayed teeth, resulting in an increased number of children who require prosthetic rehabilitation with either partial or complete dentures.Most of the parents are negligent towards restorations and maintenance of primary teeth because of lack of knowledge about importance of primary teeth, reluctant to have prosthetic rehabilitation of their child at such an early age, economic constraints and lack of time to follow up with lengthy treatment procedure. Prosthetic rehabilitation at this stage is essential to restore masticatory function, appearance and muscle function; to maintain and improve phonetics; prevent development of deleterious oral habits; and to minimize possible psychological disturbances.

Prosthodontic rehabilitation of children with pronounced edentulismhelps to normalize the function of masticatory and perioral muscles, consequently the growth pattern of basal bones and gives psychological boost to the self – image of the child. Early rehabilitation of children will go a long way in helping them interact normally with their peers. But one must remember that any form of restoration or prosthesis should provide

dentition confirming with the age of the patient.

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# Osseointegration

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**Abstract**

Dental implants are becoming an increasingly popular alternative treatment for replacing missing teeth. Instead of using a bridge that spans between teeth, a permanent replacement tooth is attached to an implant in the mandible or maxilla. Radical changes in the practice of implant dentistry have been made possible through the evolution of a more profound understanding of the essential requirements of individual case treatment planning, improvements in surgical procedures, and the evolution of the design of the implants. However, the most fundamental process that is the basis to any implant treatment is osseointegration. A thorough knowledge of the mechanism of osseointegration and the various factors influencing it, will go a long way in optimizing the results obtained during implant therapy. This article aims at throwing light on the mechanism of osseointegration and the factors affecting it.

**Key Words**

Osseointegration, Bridge, Spans, Redical, Implant

## Introduction

Osseointegration can be defined at multiple levels: clinically, anatomically, histologically, and ultrastructurally. It is defined according to the Glossary of Prosthodontic terms as "The apparent direct attachment or connection of osseous tissue to an inert, alloplastic material without intervening connective tissue". A structurally oriented definition was put forth by Branemark and his associates in 1977. They defined osseointegration as the "Direct structural and functional connection between the ordered, living bone and the surface of load carrying implants". Alberktsson et al, defined it as direct anchorage of an implant by the formation of bone directly on the surface of an implant without any intervening layer of fibrous tissue. This definition gave a histological perspective to osseointegration. Shroeder and his colleagues termed the process as being one of 'functional ankylosis'.

The scope of osseointegration in the field of oral and maxillofacial prosthetics is immense. Prosthetic replacement of missing teeth, rehabilitation of complex maxillofacial defects, congenital defects such as cleft palate or ectodermal dysplasia and distraction osteogenesis to aid in the formation of new bone are all possible with implants having a direct connection to osseous tissue.

The concept of osseointegration was first put forth by Per-Ingvar Branemark in the year 1952. He discovered that bone can integrate with titanium implants. He termed this phenomenon osseintegration based on the Latin word 'os' which means bone and integrate which means 'to make whole'. The concept has evolved as much into a philosophy as it is a technique for rehabilitation.

It must be emphasized that rehabilitation with implants would be impossible if the connection were a fibrosseointegration rather than osseointegration. The American Academy of Implant Dentistry in 1986, defined fibrous integration as tissue to implant contact with interposition of healthy dense collagenous tissue between the implant and bone. It was assumed that collagen fibers function similar to the Sharpeys fibers in the natural dentition. However, the fact is that there are histological difference between the Sharpeys fibers and collagen fibers around the implant. Unlike the natural teeth which have oblique and horizontal fibres, those around the implant are parallel, irregular and completely encapsulate the implant. This interferes with normal load transfer drastically. The end result is an inability to transfer loads and a possibility of infection. Thus, osseointegration, as a rule, should be the goal as opposed to fibrous integration.

## Osteogenesis:

Osborn and Newsley, described the phenomenon by which bone can become juxtaposed to an implant surface. They described that this could occur via two means, either by contact osteogenesis or distance osteogenesis[1].

In distance osteogenesis, new bone is formed on the surfaces of old bone in the peri-implant site. The bone surfaces provide a population of osteogenic cells that lay down a new matrix that encroaches on the implant. The new bone is not forming on the implant, but the latter does become surrounded by bone. Thus, in these circumstances, the implant surface will always be partially obscured from bone by intervening cells.

In contrast, in contact osteogenesis, new bone forms first on the implant surface. The implant surface has to become colonized by bone cells before bone matrix formation can begin. Thus, distance osteogenesis results in bone approximating the implant surface while contact osteogenesis results in bone apposition to the implant surface.

## Factors affecting osseointegration:

Numerous factors are known to influence osseointegration, some more strongly than others. Some of these factors are listed below:

1. Implant material and its biocompatibility
2. Loading protocols
3. Patient factors
4. Surgical technique and environment
5. Implant design

**Implant material and its biocompatibility**

Various materials have been employed in the manufacture of implants to date. However, use has mostly been restricted to metals, polymers and more recently, ceramics. Among the metals, titanium and its alloys have been the mainstay for implant manufacture. Tantalum and niobium have also been used although it has been reported that they elicit an exaggerated macrophage response. The popularity of titanium has been attributed to its chemical purity and its ability to form an adherent, passivating oxide film which forms at the rate of 100 Å per minute.

Titanium alloys, mainly Ti6Al4V, have been used successfully as they are stronger than Cp Ti. But with respect to osseointegration, Cp Ti is far superior to these alloys as it exhibits stronger bony interaction. The reason for this is that the aluminium ions from the alloy compete with calcium of the bone and impede osseointegration to a certain extent.

Hydroxyapatite coated implants have been in use for sometime now. Gottlander found an increased interfacial bone formation with hydroxyapatite coated implants as compared to CpTi for a short period while this was reversed in the long run with CpTi showing about 50-70% more bone formation[2].

Zirconia based implants have recently come into the market and are becoming more popular by the day. Studies show that although the osseointegration of these implants is not superior to titanium, zirconia implants with modified surfaces result in an osseointegration which is comparable with that of titanium implants[3].

**Loading protocols**

Implant loading can be classified as progressive loading or immediate loading. Progressive loading was recommended by Misch[4] in 1980. The concept was proposed to decrease crestal bone loss and early implant failure. It necessitated two surgical appointments - the first surgery for initial implant placement and the second stage surgery was done to uncover the implant and begin prosthetic treatment. The two stages are usually separated by a span of 3 to 8 months depending on the density of bone at the intial surgery. Progressive loading calls for increasing the load on an implant retained restoration gradually. Initially no load is placed on the implant. The transitional prosthesis is then placed on the implant and contact is provided only on the implant and not on the cantilevers. Later, the final prosthesis is delivered with an implant protective occlusion scheme. Several studies indicate excellent bone formation around progressively loaded implants[5],[6],[7].

Immediate loading protocols place a transitional prosthesis on the implant at the time of implant placement itself. Various approaches have been developed by different authors to achieve the same[8],[9],[10]

Clinical trials have shown successful osseointegration (95-100% success rate-Completely edentulous patients) in recent times.

**Patient factors**

The major factors which need to be considered during implant placement with regards to health of the patient are: age, previous irradiation and history of smoking,

**Age**

Extremes in age are relative contraindications to implant placement although old age has shown no poorer results. In children, placement of implants could lead to an infrapositioning of the implant following growth and needs to be considered during implant surgery. Early placement of implants may be required in cases which use bone anchored hearing aids.

**Radiation**

Previously irradiated bone is a relative contraindication to implant placement. It has been seen that success rates are 10-15% lesser in irradiated patients as opposed to non-irradiated patients. If the patient has been irradiated before implant surgery, the higher the dose, the poorer the results. The longer the time from radiotherapy, the poorer the results[11]. Jacobsson showed an increasing implant loss over time in irradiated patients in a long term study[12]. Hyperbaric Oxygen therapy has been found to improve osseointegration in irradiated patients as it elevates the partial pressure of oxygen in the tissues.

**Smoking**

Mean failure rates are twice as high in smokers as in non-smokers[13]. History of smoking affects the healing response in osseointegration adversely. Smoking causes vasoconstriction, a reduced bone density and impaired cellular function and thereby interferes with healing following implant surgery.

Surgical technique and environment: Minimal tissue trauma provides the best environment for successful osseointegration. A violent surgical technique leads to frictional heat being produced, a wider zone of necrosis and consequently a primary failure in osseointegration. Lundskog[14] determined cellular necrosis to occur following a 30s duration at above 50°C whilst Eriksson and Albrektsson[15] demonstrated that a temperature elevation to above 47°C which is sustained for one minute has a potent osteonecrotic effect. Profuse irrigation for continuous cooling, use of well sharpened drills and use of graded series of drills, slow drill speeds (<2000rpm), proper drill geometry and intermittent drilling are recommended to achieve predictable osseointegration.

**Implant Design**

Implant design refers to the three dimensional structure of the implant. Implants may be cylindrical or screw shaped. They may be threaded or non-threaded. Bone resorption has been associated with the use of press fit or cylindrical implants primarily due to micromovements that occur during their use. This problem is more or less eliminated when screw shaped implants are used. Threaded implants have a long documentation of successful use in dentistry. The advantage of threaded implants is that they provide more functional surface area for better load distribution. Furthermore, there is lesser micromovement seen in association with these implants.

**Conclusion**

Implant osseointegration is probably one of the most critical aspects in implant therapy. It is mandatory that

osseointegration be successful in order that the implant treatment achieves its most important goal - the restoration of missing natural tissue. A thorough knowledge about the science behind this process will hold the dentist in good stead while dealing with restorative therapy involving implants.

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# Cone - Beam Computed Tomography In Dentistry – A Review

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**Abstract**
Cone-beam computed tomography (CBCT) systems have been designed for imaging hard tissues of the maxillofacial region. CBCT is capable of providing sub-millimetre resolution in images of high diagnostic quality, with short scanning times (10–70 seconds) and radiation dosages reportedly up to 15 times lower than those of conventional CT scans. Increasing availability of this technology provides the dental clinician with an imaging modality capable of providing a 3-dimensional representation of the maxillofacial skeleton with minimal distortion. This article provides an overview of currently available maxillofacial CBCT systems and reviews the specific application of various CBCT display modes to clinical dental practice.

**Key Words**
Cone, Beam, Tomography, CBCT

## Introduction

Radiology is important in the diagnostic assessment of the dental patient and guidelines for the selection of appropriate radiographic procedures for patients suspected of having dental and maxillofacial disease are available.[1] The American Academy of Oral and Maxillofacial Radiology (AAOMR) has established "parameters of care" providing rationales for image selection for diagnosis, treatment planning and follow-up of patients with conditions affecting the oral maxillofacialregion, including temporomandibular joint (TMJ) dysfunction (Parameter 2), diseases of the jaws (Parameter 3) and dental implant planning (Parameter 4).[2] Although combinations of plain x-ray transmission projections and panoramic radiography can be adequate in a number of clinical situations, radiographic assessment may sometimes be facilitated by multiplanar images including computed tomographs.For most dental practitioners, the use of advanced imaging has been limited because ofcost, availability and radiation dose considerations;however, the introduction of cone-beam computed tomography (CBCT) for the maxillofacial region provides opportunities for dental practitioners to request multiplanar imaging.Most dental practitioners are familiar with the thin-slice images produced in the axial plane by conventional helical fan-beam CT. CBCT allows the creation in "real time" of images not only in the axial plane but also 2-dimensional (2D) images in the coronal, sagittal and even oblique or curved image planes - a process referred to as multiplanar reformation (MPR). In addition,CBCT data are amenable to reformation in a volume, rather than a slice, providing 3-dimensional(3D) information. The purpose of this article is to provide an overview of the unique image display capabilities of maxillofacial CBCT systems and to illustrate specific applications in clinical practice.

## Types of CT Scanners

Computed tomography can be divided into 2 categories based on acquisition x-ray beam geometry; namely: fan beam and cone beam **(Fig 1)**. In fan-beam scanners, an x-ray source and solid-state detector are mounted on a rotating gantry. Data are acquired using a narrow fan-shaped x-ray beam transmitted through the patient. The patient is imaged slice-by slice, usually in the axial plane, and interpretation of the images is achieved by stacking the slices to obtain multiple2D representations. The linear array of detector elements used in conventional helical fan-beam CT scanners is actuallya multi-detector array. This configuration allows multidetector CT (MDCT) scanners to acquire up to 64 slices simultaneously, considerably reducing the scanning time compared with single-slice systems and allowing generation of 3D images at substantially lower doses of radiation than single detector fan-beam CT arrays.[3]

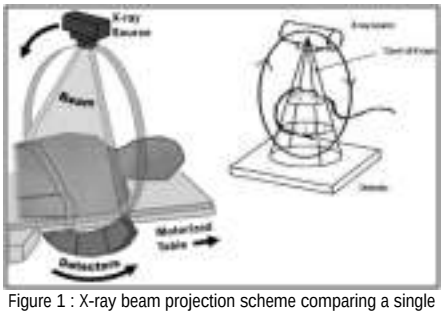


Figure 1 : X-ray beam projection scheme comparing a single detector array fan-beam CT and cone-beam CT geometry.

## Cone-Beam CT Technology

CBCT scanners are based on volumetric tomography,using a 2D extended digital array providing an area detector. This is combined with a 3D x-ray beam.The cone-beam technique involves a single 360° scan in which the x-ray source and a reciprocating area detector synchronously move around the patient's head, which is stabilized with a head holder. At certain degree intervals, single projection images, known as "basis" images, are acquired.

These are similar to lateral cephalometric radiographic images, each slightly offset from one another. This series of basis projection images is referred to as the projection data.

Software programs incorporating sophisticated algorithms including back-

filtered projection are applied to these image data to generate a 3D volumetric data set, which can be used to provide primary reconstruction images in 3orthogonal planes (axial, sagittal and coronal).Although the CBCT principle has been in use for almost 2 decades, only recently - with the development of inexpensive x-ray tubes, high-quality detector systems and powerful personal computers - have affordable systems become commercially available. Beginning with the NewTom QR DVT 9000 (Quantitative Radiology s.r.l.,Verona, Italy)[4] introduced in April 2001, other systems include CB MercuRay (Hitachi Medical Corp., Kashiwa-shi, Chiba-ken, Japan), 3D Accuitomo – XYZ Slice View Tomograph (J. Morita Mfg Corp., Kyoto, Japan) and i-CAT(Xoran Technologies, Ann Arbor, Mich., and Imaging Sciences International, Hatfield, PA).These units can be categorized according to their x-ray detection system.[5],[6] Most CBCT units for maxillofacial applications use an image intensifier tube (IIT) - chargecoupled device. Recently a system employing a flat panel imager (FPI) was released (i-CAT).[7],[8] The FPI consists of acesium iodide scintillator applied to a thin film transistor made of amorphous silicon. Images produced with an IIT generally result in more noise than images from an FPI and also need to be preprocessed to reduce geometric distortionsinherent in the detector configuration.[5],[6]

**Advantages of CBCT**

CBCT is well suited for imaging the craniofacial area. Itprovides clear images of highly contrasted structures and is extremely useful for evaluating bone.[8],[9] Although limitations currently exist in the use of this technology for softtissue imaging, efforts are being directed toward the development of techniques and software algorithms to improve signal-to-noise ratio and increase contrast.

The use of CBCT technology in clinical practice provides a number of potential advantages for maxillofacial imaging compared with conventional CT:

**X-ray beam limitation:** Reducing the size of the irradiated area by collimation of the primary x-ray beam to the area of interest minimizes the radiation dose. Most CBCT units can be adjusted to scan small regions for specific diagnostic tasks. Others are capable of scanning the entire craniofacial complex when necessary.

**Image accuracy:** The volumetric data set comprises a 3D block of smaller cuboid structures, known as voxels, each representing a specific degree of x-ray absorption. The size of these voxels determines the resolution of the image. In conventional CT, the voxels are anisotropic — rectangular cubes where the longest dimension of the voxel is the axial slice thickness and is determined by slice pitch, a function of gantry motion. Although CT voxel surfaces can be as small as 0.625 mm square, their depth is usually in the order of 1–2 mm. All CBCT units provide voxel resolutions that are isotropic — equal in all 3 dimensions. This produces sub-millimetre resolution (often exceeding the highest grade multi-slice CT) ranging from 0.4 mm to as low as 0.125 mm (Accuitomo).

**Rapid scan time:** Because CBCT acquires all basis images in a single rotation, scan time is rapid (10–70 seconds) and comparable with that of medical spiral MDCT systems. Although faster scanning time usually means fewer basis images from which to reconstruct the volumetric dataset, motion artifacts due to subject movement are reduced.

**Dose reduction:** Published reports indicate that the effective dose of radiation **(Fig 2)** (average range 36.9–50.3microsievert [μSv])[10], [11], [12], [13], [14] is significantly reduced by up to 98% compared with "conventional" fan-beam CT systems(average range for mandible 1,320–3,324 μSv; average range for maxilla 1,031–1,420 μSv).[10], [11], [15], [16], [17] This reduces the effective patient dose to approximately that of a film-based periapical survey of the dentition (13–100 μSv)[18], [19], [20] or 4–15 times that of a single panoramic radiograph(2.9–11 μSv).[14], [17], [18], [19], [20]

Display modes unique to maxillofacial imaging: Access and interaction with medical CT data are not possible as workstations are required. Although such data can be "converted" and imported into proprietary programs for use on personal computers (e.g., Sim/Plant, Materialise,Leuven, Belgium), this process is expensive and requires an intermediary stage that can extend the diagnostic phase. Reconstruction of CBCT data is performed natively by a personal computer. In addition, software can be made available to the user, not just the radiologist, either via direct purchase or innovative "per use" license from various vendors (e.g., Imaging Sciences International). This provides the clinician with the opportunity to use chair-side image display, real-time analysis and MPR modes that are task specific. Because the CBCT volumetric data set is isotropic, the entire volume can be reoriented so that the patient's anatomic features are realigned. In addition, cursor-driven measurement algorithms allow the clinician to do real-time

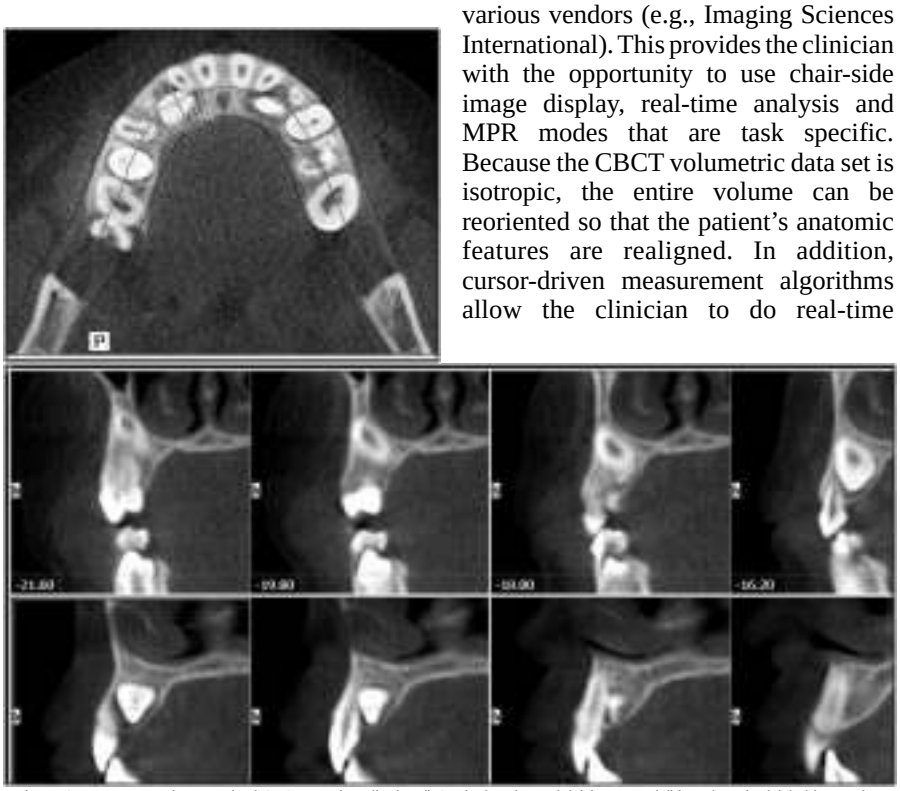

Figure 2 : Representative standard CBCT monitor display (i-CAT) showing axial (a), coronal (b) and sagittal (c) thin-section slices.

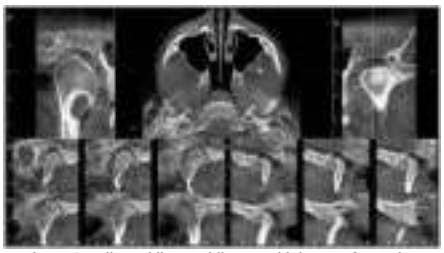

Figure 3 : Bilateral linear oblique multiplanar reformation through lateral and medial poles of the mandibular condyle on the axial image providing corrected coronal, limited field-of-view, thin-slice temporomandibular views demonstrating right condylar hyperplasia.

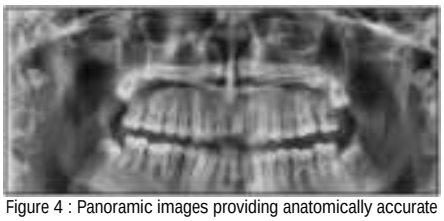

Figure 4 : Panoramic images providing anatomically accurate measurements.

Figure 6 : Right lateral cephalometric projection.

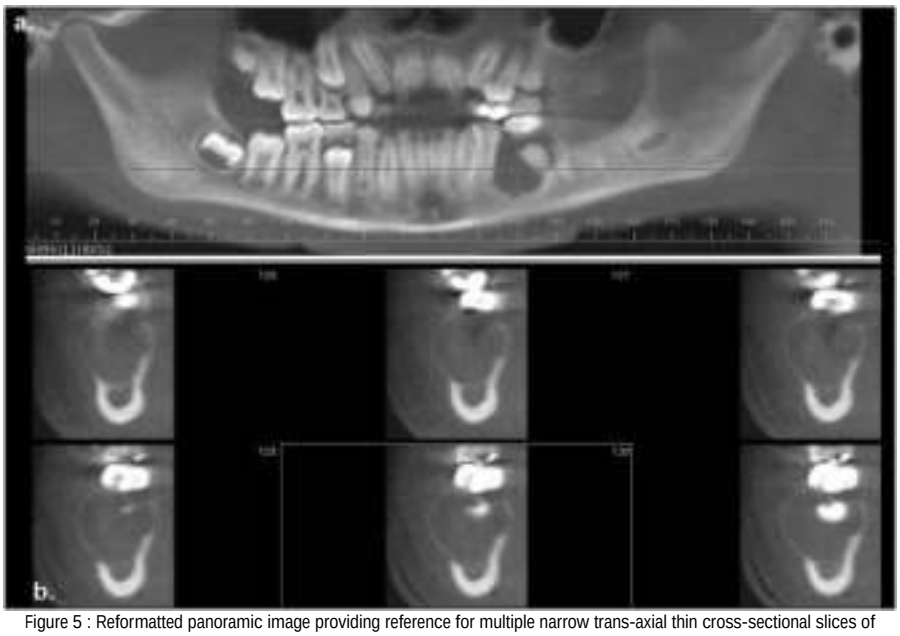

Figure 5 : Reformatted panoramic image providing reference for multiple narrow trans-axial thin cross-sectional slices of radiolucent bony pathology in the left mandible, demonstrating bucco-lingual expansion and location of the inferior alveolar canal.

dimensional assessment.

**Application of CBCT Imaging to Clinical DentalPractice**

Unlike conventional CT scanners, which are large and expensive to purchase and maintain, CBCT is suited for use in clinical dental practice where cost and dose considerations are important, space is often at a premium and scanning requirements are limited to the head.

All CBCT units initially provide correlated axial, coronal and sagittal perpendicular MPR images **(Fig. 3)**. Basic enhancements include zoom or magnification and visual adjustments to narrow the range of displayed grey-scales (window) and contrast level within this window, the capability to add annotation and cursor-driven measurement. The value of CBCT imaging in implant planning,[21],[22],[23] surgical assessment of pathology, TMJ assessment[24],[25],[26] and pre and postoperative assessment of craniofacial fractures has been reported.[8],[9],[12] In orthodontics, CBCT imaging is useful in the assessment of growth and development[8], [27], [28], [29]

Perhaps the greatest practical advantage of CBCT in maxillofacial imaging is the ability it provides to interact with the data and generate images replicating those commonly used in clinical practice. All proprietary software is capable of various real-time advanced image display techniques, easily derived from the volumetric data set. These techniques and their specific clinical applications include:

**Oblique Planar Reformation:** This technique creates nonaxial 2D images by transecting a set or "stack" of axial images. This mode is particularly useful for evaluating specific structures (e.g., TMJ, impacted third molars) as certain features may not be readily apparent on perpendicular MPR images **(Fig. 3)**.

**Curved planar reformation:** This is a type of MPR accomplished by aligning the long axis of the imaging plane with a specific anatomic structure. This mode is useful in displaying the dental arch, providing familiar panorama like thin-slice images**(Fig. 4)**. Images are undistorted so that measurements and angulations made from them have minimal error.

**Serial transplanar reformation:** This technique produces a series of stacked sequential cross-sectional images orthogonal to the oblique or curved planar reformation. Images are usually thin slices (e.g., 1 mm thick) of known separation (e.g., 1 mm apart). Resultant images are useful in the assessment of specific morphologic features such as alveolar bone height and width for implant site assessment,the inferior alveolar canal in relation to impacted mandibular molars, condylar surface and shape in the symptomatic TMJ or evaluation of pathological conditions affecting the jaws **(Fig. 5)**.

**Multiplanar volume reformations:** Any multiplanar image can be "thickened" by increasing the number of adjacent voxels included in the slice. This creates an image that represents a specific volume of the patient. The simplest technique is adding the absorption values of adjacent voxels, to produce a "ray sum" image. This mode can be used to generate simulated panoramic images by increasing the slice thickness of curved planar reformatted images along the dental arch to 25–30 mm, comparable to the infocus image layer of panoramic radiographs .Alternatively, plain projection images such as lateral cephalometric images **(Fig. 6)** can be created from full thickness (130–150 mm) perpendicular MPR images. In this case, such images can be exported and analyzed using third-party proprietary cephalometric software. Unlike

conventional radiographs, these ray sum images are without magnification and are undistorted. Another thickening technique is maximum intensity projection (MIP). MIP images are achieved by displaying only the highest voxel value within a particular thickness. This mode produces a "pseudo" 3D structure and is particularly useful in representing the surface morphology of the maxillofacial region. More complicated shaded surface displays and volume rendering algorithms can be applied to the entire thickness of the volumetric data set to provide 3D reconstruction and presentation of data that can be interactively enhanced

**Discussion**

There is little doubt that cone-beam technology will become an important tool in dental and maxillofacial imaging over the next decade or two. Clinical applications of CBCT are rapidly being applied to dental practice.However, although CBCT allows images to be displayed in a variety of formats, the interpretation of the volumetric data set, particularly when it comprises large areas, involves more than the generation of 3D representations or application of clinical protocols providing specific images. Interpretation demands an understanding of the spatial relations of bony anatomic elements and extended pathologic knowledge of various maxillofacial structures. Currently, any dental practitioner can purchase and operate a CBCT unit.

There is mounting concern among oral and maxillofacial radiologists, based on issues of quality and patient safety,that interpretation of extended field of view diagnostic imaging studies using CBCT should not be performed by dentists with inadequate training and experience. The AAOMR has indicated that, to use CT in implant imaging,the interpreting practitioner should either be a boardcertified oral and maxillofacial radiologist or a dentist with adequate training and experience.[2] Perhaps, as has occurred in medical imaging where the use and costs of imaging have increased at double-digit rates, third-party payers and federal policymakers will also become involved in setting standards for providers who bill the government for obtaining and interpreting diagnostic images.[30] Nonradiologist dentists should not be excluded from performing CBCT imaging provided they have appropriate and documented training and experience. Given that a single CBCT scan uses ionizing radiation at levels exceeding any current dental imaging protocol series, it is timely to recommend the development of rigorous training standards in maxillofacial CBCT imaging in the interests of our patients who deserve to have imaging performed by competent clinicians.

**Conclusions**

The development and rapid commercialization of CBCT technology dedicated to imaging the maxillofacial region will undoubtedly increase dental practitioner access to 3D radiographic assessments in clinical dental practice. CBCT imaging provides clinicians with sub-millimetre spatial resolution images of high diagnostic quality with relatively short scanning times (10–70 seconds) and a reported radiation dose equivalent to that needed for 4 to15 panoramic radiographs.

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# Behaviour Management Strategies In Treating Children With Dental Fear

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**Abstract**
Anxiety and fear remain the primary emotion of a child entering a dental office. It is natural to have a fear of the unknown and this fear can show itself as misbehavior in the dental office. Successful dentistry depends not only on the dentist's technical skills, but also on his ability to acquire and maintain a child's cooperation. One's goal is to have the child be comfortable during dental treatment. Another is to provide the optimum in dental treatment safely and easily for the patient. Still another is to encourage the child to continue regular dental visits in the future.[1] It is more important to focus on a positive interaction between dentist and child rather than the completion of the dental procedure .This paper describes the various behavior management techniques like the tell-show-do, reinforcements, voice control, and hand over mouth exercise that, from a behavioral science perspective, offer promise for dentists managing disruptive children also it presents an overview of behavioural management techniques in the dental situation, and to prepare guidelines for the treatment of dentally fearful children, focusing on the behavioural management approach.

**Key Words**
Behavior management , Anxiety, Fear, Needle phobia

## Introduction

It has been said that the major difference between adult and pediatric dental patients is that the latter did not request the treatment and frequently they do not even understand why they are at the dentist's office! Essentially, from many children's perspective, a dentist has little to offer to them except short-term pain and long-term gain, the latter being a difficult concept for many a young mind to grasp. Children frequently display behaviors that make traditional dental care delivery a challenge. It becomes the job of the dental practitioner, therefore, to understand the unique issues at stake and to make these patients and often their parents too, feel at ease. Behavior management is as fundamental to the successful treatment of children as are handpiece skills and knowledge of dental materials.[2] Disruptive behavior can interfere significantly with providing quality dental care, resulting in increased delivery time and risk of injury to the child.[3] These difficulties have lead to the development of a well established child behavior management armamentarium for dentists.

**Is it necessary to let patient cry throughout the treatment…? Or post the patient to general anesthesia….?!!**

Children have relatively limited communication skills and are less able to express their fears and anxieties. Their behaviour is essentially a reflection of their inability to cope with their anxiety. When children cannot cope, they attempt to escape the impending event. The subsequent change in behaviour seen is often a manifestation of anxiety or discomfort in a child who has no other way to cope or of informing you of their difficulty. Children often have anxiety when they experience something new.

Behaviour management aims to give children appropriate coping strategies. The goals of behavior management in dentistry are to establish effective communication, to alleviate patient fear and anxiety and build a trusting relationship with the child that will ultimately allow the dentist to deliver quality dental care and promote in the child a positive attitude towards dental care and oral health. If they had a bad experience or are very nervous, our goal is to help them overcome this and help them realize that they can do it ! so start with "baby steps" until you gain the trust of the child.

- Often the first potential source of conflict to be encountered is whether to allow the parents to accompany a child into the dental operatory. There is currently no real consensus regarding parental presence in the operatory, however it is agreed that it may sometimes be effective in gaining cooperation for treatment.[4] Children vary in their response to their parents presence or absence ranging from very positive to highly detrimental. Occasionally the presence of a parent has a negative effect on the necessary communication between the child and the dentist. It is difficult to manage the combination of a 'demanding child and an anxious parent without separation. The separation should take place as comfortably as possible. Therefore, it needs to be explained in a professional manner to the parent prior to the treatment and the parent must willingly agree to it.
- Another important detterent to seeking dental care is "needle phobia ".Why are children scared of injections ? Often, parents threaten a child by saying something like" because you don't brush your teeth properly or because you eat too many chocolates, doctor will give you an injection."Commonly stated fears reported by children regarding the

dental experience can be either - Real - such as those based on a previous negative experience; acquired fears such as needle (pain); Potential fear responses- include those that may be induced by the emotional state of dentist or assistant, or Protective fears - such as fear of the unknown, fear of bodily harm, of a stranger or of separation from the parent.[4] While treating children, we must realize that we are behavior therapists and not merely dentists. We must believe that if we use child management methods properly, 85-90% children can cooperate for all dental procedures (many of them enjoy them, too !

**Basic Behavior Guidance Techniques**

Behavior shaping means providing the child with cues and reinforcements that direct them toward more desirable behaviors.

**Creating a positive first impression**

The manner in which a child is welcomed into the dental office may influence his/her future behaviour during treatment. Communication starts before a word is said and the first few minutes of an encounter are vital as it is difficult to alter a first impression. Smile, eye contact are key factors in it.

Traditional behavior shaping strategies effective in the dental office include:

**Tell-Show-So (TSD)**

Tell-show-do is the first technique learned by many dental professionals in dental school. An advantage of this method is that, with appropriate use of language and technical terminology, it can be used with children of all ages and comprehension abilities.[4] The dentist explains to the child what is to be done using simple terminology and repetition and then shows the child what is to be done by demonstrating with instruments on a model or the child's or dentist's finger. Then the procedure is performed exactly as described. Praise is used to reinforce cooperative behavior.[5] As the name suggests, it involves:

**1. Tell:** the dentist explaining to you what they'd like to do. i.e.clean the soft part of the tooth away" (not "drill the tooth")."whistle" (not drill), "make your tooth sleepy" (not give a needle, shot, or injection).

**2. Show:** showing you what is involved (e. g. showing the equipment and demonstrating it on a finger)

**3. Do:** performing the procedure

**Modeling**

Children are great copycats. An extension of Tell-show-do is behavior modeling, using the ability of the child to imitate others modeling the desired behaviors.[3] The modeling technique pairs a timid child in dental treatment with a cooperative child, sometimes a sibling. They quickly learn that what the other child is doing is easy! Permitting children to observe other children adaptively undergoing dental treatment is an effective way of preparing them to accept treatment and to demonstrate what is expected of them.[6] Simply being observed by peers during dental procedures was sufficient to decrease levels of disruptive behavior. The researchers felt that these children were more cooperative because being observed by the next patient placed them in the role of a coping model. An important advantage of live modeling is that no additional equipment, personnel, or alterations in the dental routine are required.[7]

**Distraction**

Distraction is a powerful tool when it comes to dealing with phobias. It involves diverting the patient's attention from what would be perceived as an unpleasant dental procedure in order to avert or delay negative or avoidance behavior. e.g. listen to music via earphones. Distraction is thought to gain control over an aspect of the patient's capability to respond (i.e.,paying attention) that is incompatible with disruptive behavior.[8]

Reduction in anxiety can be attributed to two reasons. First, a child listening to music will tend to close his eyes to concentrate on audio presentation thereby screening out the sight of dental treatment[9]. Second the sound of music will eliminate unpleasant dental sound like sound of handpiece . and these two advantages coupled with the effect of music will provide relaxation and allow the dentist to effectively manage the anxious patient.[10]

**Voice Control**

The modification of the intensity or pitch one's voice dominates the interaction between the pediatric dentist and the child. The tone of voice can change from gentle to firm. To show the child that this is a serious matter.

**Contingent Escape**

Dentists have long recognized that giving children a sense of trust and control is an important strategy in coping with dental procedures. Using nonverbal communication techniques (e.g., raising a hand) to allow child to stop treatment when they experience discomfort is one way that dentists have allowed children to gain that trust and instill a sense of control.[11]

A key component of all of these behavior guidance techniques is immediate positive reinforcement, both verbal (praise - e. g. "You're doing great", "That's good") and non-verbal (smiles, nods, appropriate physical demonstrations of affection) where the child is given positive feedback when they are exhibiting appropriate behaviors. It is very important that even with the extremely anxious, disruptive and uncooperative child, that any positive behavior is immediately rewarded. Two factors are considered very important in use of this technique:

1. The reward is most effective when it comes directly from dental professional and
2. Use of a reward may provoke additional anxiety in some patients (i.e. patient concludes the reward must follow an unpleasant activity!)

**Advanced Behavior Management**

Not all undesirable behaviors in children can be so easily modified however. For these more extreme patients, advanced behavior management techniques may be required to bring about compliant behaviors. Only if the child is uncooperative after above mentioned methods have been attempted, the need for advanced behavior arises.

These advanced methodologies can be divided into the following areas:

1. Physical Management
2. Aversive Management
3. Pharmacological Management

Techniques that fall within the first two areas require training and practice to be used safely and to maximum effect while most that fall under "Pharmacological management" should only be practiced after appropriate advanced instruction and in accordance with relevant state licensure practices.[3]

**1.Physical Management**

It might sound crazy or overboard, but some children require physical restraint to ensure that the dentist can carry out their jobs safely and effectively. This is the last resort used for handling uncooperative children or handicapped children. It involves the restriction of movement of the child's head, hands, feet or body.

The physical restraining force may be of human origin (so-called "active" restraint where the hands of a parent or dental assistant are used to restrain the child) or provided by mechanical adjuncts ("passive" restraint such as the use of a Papoose board, Pedi-Wrap or a combination thereof. Before any use of active or passive restraint, it is vital to obtain and document in the patient's record the informed consent of a parent.[4]

**2. Aversive Techniques in Behavior Management**

This area includes the use of both voice control and time-out, but it is probably most clearly represented by the "Hand-over-mouth" (HOM) technique. The purpose of the Home technique is to gain the attention of a child so that communication can be achieve . If the child continues the physical resistance, screaming or crying little communication is taking place. The dentist then places the hand over the child's mouth to stifle the noise .At the same time, in close proximity to the patient the dentist says calmly but firmly. Once the patient discontinues resistance, the dentist should remove the hand and reinforced the improved behavior[12]. Hand-over-mouth-excercise (HOME): The disruptive child is told that a hand is to be placed over the child's mouth. When the hand is in place, the dentist speaks directly into the child's ear and tells the child that if the noise stops the hand will be removed. When the noise stops the hand is removed and the child is praised for cooperating. If the noise resumes the hand again is placed on the mouth and the exercise repeated.[5]

INDICATIONS - 3 TO 6 YRS OLD, Healthy child who can understand but who exhibits defiance and hysterical behavior during treatment, a child who can understand simple verbal communication, Children displaying uncontrollable behavior.

Behavior management strategies for pediatric dental patients have evolved greatly over the past two decades, with adverse techniques such as hand-over-mouth exercise and hand-over-mouth with airway restriction having lost considerable popularity.[13]

**3. Pharmacological Management**

Although most of children can be managed with routine behavioral techniques but few require aggressive (restraint) or pharmacological support. This may include the use of anxiolytic medications, conscious or deep sedation or general anesthesia. Behavioural management and prevention, coupled with local anaesthesia when required, form the foundation of the delivery of pain-free dentistry to children. Although behavioural management may need to be augmented with conscious sedation for some anxious children, pharmacological agents are not substitutes for effective communication and the persuasive ability of the operator. There is certainly no place for invasive and high-risk sedative techniques such as deep sedation or polypharmacy in the dental management of anxious children within paediatric dental care .Indeed, even in parts of the world where deep sedation techniques are more common, their use is often limited to hospitals.[14]

The most commonly used anxiolytic agent for conscious sedation in pediatric dentistry is nitrous oxide (NO) - Rapid onset of action and recovery (5/10mins), easy titration and patient acceptability (more than enteral/parenteral forms of conscious sedation), however it displays only minimal analgesia (so patients will require local anesthesia for painful dental procedures). Nitrous oxide is administrated in a mixture with oxygen (30% or more) to safeguard the patient's oxygen supply.[4]

**Behavioral Strategies for the child management and to relieve anxiety in the dental environment**

The child must be made comfortable in dental set-up.It should be prime focus of dentist in first few visits of child simple procedures such as consultation and treatment planings. Radiographs fluoride application small restorations etc. can be carried out prior to treatment. A child sitting comfortably is less likely to resist treatment. Following approach will be helpful in smooth completion of treatment , getting adequate patient cooperation and effectively reducing time required in dealing with pediatric patient:

1 Preparation of parent prior to treatment

- A discussion with parents prior to any procedure should help them prepare themselves better for child's dental care.
- Dentists should encourage parents to bring their children to the dentist by age two, or earlier if there is noticeable discoloration of the baby teeth or if the child is signaling pain. The sooner the child is seen, the less likely the child will have extensive dental problems.
- Educate and explain the parent that in initial visits, dental team needs time to assess child cooperation and modify the child behavior so do not insist on completing the treatment in first visit itself .
- Never voice their own fears about dentistry (pain, injections, extraction, blood etc.) in front of child.
- Ask the parents not to feed the child immedietly before bringing him to dentist otherwise child tends to gag.
- Do not promise anything about the nature of treatment and time required for it, just tell them to say that they don't know.
- Report the doctor any past negative experience.

2. Never deny a child's fear. Conduct the first session in a non-dental setting.[15] Use age appropriate behavior modification techniques.
3. Explain the procedure in brief, firm yet friendly manner e.g. local anesthesia as to put the medicine to put the tooth to sleep and tell him it may hurt you as an ant bite for only few seconds.
4. Express concern. Ask the child how she is feeling or whether she is comfortable.
5. Do not ask about past negative experience
6. Praise all cooperative behaviors. Compliment a child who is sitting still and cooperating.
7. Give specific directions. Use direct and specific requests (e.g., "please open your mouth now," "turn this way").
8. Use positive suggestions. Positive suggestions (e.g., "Today we are going to clean your teeth with a magic toothbrush") have been shown to decrease resistant behaviors.
9. Keep cool. Do not show anger in response to a child who is upset.
10. Always use a topical anesthesia prior to injecting local anesthetic.

11. Use the thinnest gauge needle (27-30G for infiltration, 26-27G for blocks.)
12. Do not show the child the syringe while being loaded. If the child sees the needles do not panic, just demonstrate how it works by injecting a few drops on hand.
13. Have an assistant on left side to avoid any sudden unwanted movements during the procedure.
14. Distract the child by continuously talking with him/her during the injection.
15. Once pain control is achieved with adequate anesthesia, it is advisable to carry out maximum work; single visit endodontics etc.
16. Establish a signal which permits the patient to temporarily interrupt the procedure when their anxiety or pain has increased.[15]
17. Remember that all children can be treated using appropriate modality.

Last but not the least, with adult patients waiting outside and having a child in the chair , refusing to open his mouth for treatment, time seems to be more valuable than ever". Child management and time management go hand in hand in dentistry. However, the importance of time management while handling pediatric patient need not to be stressed.[16] Few things can be kept in mind:

- If possible, keep a separate session of pediatric patients in a week for treatment procedure in a busy dental clinic
- Preferably schedule a new child just after a conditioned child and let him observe the cooperative child.
- Use material which takes less time such a resin modified GIC for fillings and prefilled syringes of calcium hydroxide and iodoform for pulpectomy.

**Conclusion**

One of the most challenging aspects of dental practice is working with the "difficult," challenging, or uncooperative patient. It is during these times that the dentist's clinical and patient management skills are most thoroughly tested. Success requires a personal knowledge of the patient and an understanding of human behavior, development.[2] Proper assessment of children's behavior helps the dentist to plan appointments and render effective and efficient dental treatment. Appropriate use of management techniques can improve the child's behavior in subsequent dental visits. Finally, the most effective communication always reflects the personality of the dental professionals themselves. Use of the management strategies described in this article will increase the likelihood that dental appointments will go smoothly and will ultimately be completed. In dealing with a child with dental anxiety, it is extremely important to complete the treatment. Treatment completion not only has implications for the patient's heath, but will also allow the child to realize that the procedure was not nearly as aversive as had been expected. This sense of mastery will likely enable the child to confront future dental appointments with less anxiety. Given the prevalence of dental anxiety, as well as its implications, it is important to consider a broad range of management strategies that can easily be implemented in the dental setting.[17]

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# Treatment Parameters For Aggressive Periodontitis

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**Abstract**
Generalized aggressive periodontitis results in rapid destruction of the periodontium and can lead to early tooth loss in the affected individuals if not diagnosed early and treated appropriately. General dentists frequently encounter patients with aggressive periodontal disease and should be able to diagnose and manage this disease properly. It is important for the general dentist to diagnose, inform, and treat the periodontal patient accurately, using referral and nonsurgical, surgical, and antimicrobial/ antibiotic therapy. With the exponential rate of developments in periodontal research, regenerative therapy, tissue engineering, and genetic technologies, the future seems promising in regard to options at managing the disease. This article attempts to describe the current treatment options along with a suggested protocol for comprehensive management of generalized aggressive periodontitis patients.

**Key Words**
Aggressive periodontitis, treatment modalities.

## Introduction

Aggressive periodontitis, as the name implies is a type of periodontitis where there is rapid destruction of periodontal ligament and alveolar bone which occurs in otherwise systemically healthy individuals generally of a younger age group but patients may be older. It tends to have a familial aggregation.[1],[2],[3] Aggressive periodontitis is an autosomal dominant triad with reduced penetrance. Parents, offspring and siblings of patients affected with aggressive periodontitis have a 50% risk of this disease.

## Classification

At the International Workshop for Classification of Periodontal diseases and conditions in 1999, the classification of periodontal diseases was revised (Armitage 1999). Aggressive periodontitis now replaces the term "juvenile or early onset periodontitis". Aggressive periodontitis can be further classified into localized and generalized categories based on the specific features of the disease process.

The localized form of aggressive periodontal disease has a circumpubertal onset. Intraoral/radiographic examination reveals that the disease process is limited to the first molars and incisors with interproximal attachment loss on at least two permanent teeth, one of which is a permanent molar, and involving no more than two teeth other than the first molars and incisors.Several species of bacteria are detected in the localized form; however, Actinobacillus actinomycetemcomitans produces several virulence factors that help it evade the host's defense mechanisms. Following the initial assault, the host's defense mechanism produces a robust serum antibody response to the infecting agents, overcoming the neutrophil function abnormalities and localizing the disease process as a result.[4]

The generalized form of aggressive periodontal disease usually affects men and women over the age of 30, although patients may be older.Generalized aggressive periodontitis has a poor serum antibody response to the initial assault[4]. This response, along with the periodontal pathogen virulence factors, produces a disease process in which intraoral/radiographic examination reveals that the disease process has generalized interproximal bone loss affecting at least three permanent teeth other than the first molars and incisors.This attachment loss is episodic in nature and has periods of quiescence of variable lengths.This form of the disease frequently is associated primarily with Actinobacillus actinomycetemcomitans and Porphyromonas gingivalis and neutrophil function abnormalities . Other bacteria involved in the etiology of aggressive periodontitis are Eikenella corrodens and Capnocytophaga species.[5] It is important to note that not all of the features of Aggressive periodontitis need to be present or will be present in all cases.

## Clinical Features

With regard to clinical and paraclinical aspects Aggressive periodontitis can be distinguished from chronic periodontitis. It is defined by following characteristics (Land et al . 1999 ) [6]

1) Except for the presence of periodontitis patients are clinically healthy.
2) Rapid attachment loss and bone destruction.
3) Familial aggregation.

**Non constant characteristics of the disease -**

1) Amounts of microbial deposits are inconsistent with severity of periodontal tissue destruction.
2) Elevated proportions of Actinobacillus actinomycetemcomitans and in some populations Porphyromonas gingivalis may be elevated.
3) Phagocyte abnormalities.
4) Hyper – responsive macrophage

Virulence Factors Of Actinobacillus Actinomycetemcomitans [7],[4]

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|---|
| Factors that promote colonization and persistence in the oral cavity - Adhesions, Invasions, Bacteriocins, Antibiotic resistance |
| Factors that interfere with the host's defenses - Leukotoxin, Chemotactic inhibitors, Immunosuppressive proteins , Fc-binding proteins |
| Factors that destroy host tissues - Cytotoxins, Collagenase, Bone resorption agents , Stimulators of inflammatory mediators |
| Factors that inhibit host repair of tissues - Inhibitors of fibroblast proliferation , Inhibitors of bone formation |

phenotype including elevated levels of PGE2 and IL – 1 N38;.

5) Progression to the attachment loss and bone loss may be self arresting.

Actinobacillus actinomy cetemcomit anshas an arsenal of virulence factors that attack the host and compromise the periodontium. Because this periodontal pathogen has a high virulence and destructive nature, the dental practitioner needs to employ systemic antibiotics in addition to surgical and/or nonsurgical therapy.

The American Academy of Periodontology has developed the following parameter on treatment of Aggressive periodontitis. Patients should be informed of the disease process, therapeutic alternatives, potential complications, expected results, and their responsibility in treatment. Consequences of no treatment should be explained. Failure to treat aggressive periodontitis appropriately can result in progressive and often lead to rapid loss of periodontal supporting tissues. This has an adverse effect on prognosis and could result in tooth loss.

**Therapeautic Goals -**

The goals of periodontal therapy are to alter or eliminate the microbial etiology and contributing risk factors for periodontitis, thereby arresting the progression of disease and preserving the dentition in comfort , function , and appropriate esthetics and to prevent the recurrence of disease. In addition , regeneration of periodontal attachment apparatus, where indicated may be attempted. Due to complexity of aggressive periodontal diseases with regard to systemic factors , immune defects, and the microbial flora , control of diseases may not be possible in all instances. In such cases , a reasonable treatment objective is to slow the progression of the disease.

**Trearment Modalities – (Considerations)**

Once aggressive periodontal disease has been diagnosed, a comprehensive periodontal treatment plan must be developed. The treatment of periodontal diseases may be divided into four phases: systemic, hygienic, corrective, and maintenance / supportive therapy. Pihlstrom described the systemic phase as the appropriate consideration of systemic diseases and their impact on the etiology or treatment of the disease. The focus of therapy in the hygienic phase is to eliminate as many of the local factors of periodontal disease (bacterial plaque and calculus) as possible.[8] The corrective phase focuses on procedures designed to correct the effects of periodontal disease.[9] In the maintenance/supportive phase, recall and therapy outcomes are assessed. Systemic antibiotics are employed in the hygienic and/or corrective phases. As treatment progresses through the four phases, the dentist uses both surgical and nonsurgical therapy to remove biofilm created by the bacterial pathogens; this procedure is in agreement with good medical practice because the bacterial load should be reduced as much as possible prior to the use of antibiotics. Systemic antibiotics are considered only for those who exhibit continued loss of periodontal attachment despite conventional mechanical periodontal therapy.

In addition to the parameter for chronic periodontitis , the following should be considered for patients who have aggressive periodontitis:

1) A general medical evaluation may determine if systemic disease is present in children and young adults who exhibit severe periodontitis , particularly if aggressive periodontitis appears to be resistant to therapy. Consultation with the patient's physician may be indicated. Modification of environmental risk factors should be considered.
2) Initial periodontal therapy alone is often ineffective. However , in the early stages of disease, lesions may be treated with adjunctive antimicrobial therapy combined with scaling and root planning with or without surgical therapy.[3]
3) The long-term outcome may depend upon patient compliance and delivery of periodontal maintenance at appropriate intervals, as determined by the clinician . If primary teeth are affected, eruption of permanent teeth should be monitored to detect possible attachment loss.
4) Due to the potential familial nature of aggressive diseases, evaluation and counselling of family members may be indicated.

**Systemic Versus Topical Antibiotic Use:**

There are several advantages to using systemic antibiotics instead of topical ones. Systemic antibiotics reach the periodontal pathogens via serum at the base of deep pockets, in furcation areas, and within gingival epithelial and connective tissues. The antibiotic's diffusion into the connective tissue and epithelium is important because Aactinobacillus actinomycetemcomitans invades those areas where topical agents are less effective at achieving high concentrations, however, topical agents can achieve higher gingival crevicular fluid concentration than systemic agents.[10] Systemic antibiotics also inhibit periodontal pathogens from colonizing other periodontal sites. Disadvantages include adverse drug reactions and uncertain patient compliance in following the prescribed antibiotic regimen.

**Antibiotic Selection:**

Once a patient has been diagnosed with periodontitis, treated and evaluated appropriately, and has not responded favourably to conventional therapy , the adjunctive use of an antibiotic[11] may be indicated.

Most periodontal investigators and many practitioners believe that to obtain the best results in the treatment of Actinobacillus actinomycetamcomitans associated aggressive periodontitis, whether localized or generalized , the use of an adjunctive antibiotic along with mechanical therapy is necessary. A likely reason for this may be ability of Actinobacillus actinomycetamcomitans to penetrate the epithelial surface of the pocket. Widespread disease may necessiciate the need to incorporate systemic antibiotics into the treatment plan. Culture and sensitivity testing are strongly recommended to select the antibiotic regimen that will be the most efficacious . when culture and sensitivity testing are not feasible , the practitioner has to make the choice of antibiotic based

Suggested Oral Antibiotic Dosages ( Walker C< Karpinia K 2002)[12]:

| Generic Name | Usual Adult Dosage | Length Of Treatment | Maximum Child Dosage | Dosage Suggestions |
|---|---|---|---|---|
| Amoxicillin / clavulanic acid | 250 or 500 mg . tid | 10 days | Weight < 20kg : 20 -40 mg / kg in divided doses , tid | Given without regard to meals (given with food helps eliminate some of the stomach distress ) |
| Amoxicillin plus metronidazole | 375 mg amoxicillin , tid, plus 250 gm metronidazole , tid | 7 days | Not recommended for children under 16 years of age | Given without regard to meals |
| Clindamycin hydrochloride | 1560- 300 mg. qid | 10 days | 8 – 12 mg / kg in 3 – 4 equally divided doses | Give without regard to meals (given with food helps eliminate some of the stomach distress ) |
| Doxycycline hyclate | 100 mg bid first day followed | 10 – 14 days | Age > 8 years : 4 mg / kg divided | Given 1 hour before or 2 hours |
| | by 100 mg a day either as single dose or 50 mg , bid | | into equal dose , bid , on 1st day ; followed by 2 mg/kg as single dose or divided into equal doses , bid | after meal |
| Metronidazole | 250 mg . tid or qid | 10 days | Not recommended for children under 16 years of age | Given without regard to meals |
| Minocycline hydrochloride | 200 mg bid first day followed by 100 mg. bid | 10- 14 days | Age > 8 years : 4 mg/ kg divided into equal doses bid on first day : followed by 2 mg/ kg , bid | Given 1 hour before or 2 hours after meal |
| Tetracycline hydrochloride | 250 mg . qid | 14 – 21 days | Age > 8 years : 25 – 50 mg / kg in equal doses, bid | Given hour before or 2 hours after meal |

on patient presentation and history.[12]

In case of classical Actinobacillus actinomycetamcomitans associated aggressive periodontitis , the practitioner might choose tetracycline HCL , or one of its derivatives (doxycycline hyclate or minocycline hydrochloride), in conjunction with conventional therapy. If a favourable response is not obtained with tetracycline or if the disease appears to be particularly aggressive the combination of amoxicillin and metronidazole would be suggested.

Very good results have been reported in treatment of aggressive periodontitis cases using the combination of metronidazole plus amoxicillin. Van Winkelhoff et al.[13] have reported that use of metronidazole (250 mg, tid) and amoxicillin (375 mg , tid) , simultaneously administered for a period of 10 days following periodontal scaling and root planning, eliminated Aactinobacillus actinomycetamcomitans in 97 % or more of the patients and resulted in improved clinical status. The oral dosages, treatment regimens, and absorption suggestions for the administration for the administration of systemic antibiotics are summarized in the following table :

The decision to incorporate adjunctive therapy into the treatment protocol for aggressive periodontitis should be based on accurate scientific knowledge and sound clinical judgement. The need for an adjunctive antibiotic should be firmly established in the clinician's mind as well as the expected outcome of the therapy.[12].

**Out Come Assessment:**

The desired outcome of periodontal therapy is:

1) Significant reduction of clinical signs of gingival inflammation;
2) Reduction of probing depths;
3) Stabilization or gain of clinical attachment;
4) Radiographic evidence of resolution of osseous lesions;
5) Progress toward occlusal stability ;
6) Progress toward the reduction of clinically detectable plaque to a level compatible with periodontal health.

**Recent Treatment Advancements For Aggressive Periodontitis:**

It is generally accepted that mechanical removal of contaminants and adjunctive use of antibiotics and disinfectants make up the conventional treatment for aggressive periodontitis. Furthermore, the clinician is informed that biofilm structure of dental plaque confers remarkable resistance to species within the biofilm. Also there is an increased concern regarding the development of antibiotic resistance. Because of variability in design of existing studies it has not yet been concluded which antimicrobial agent, dose , and duration provide the optimal clinical and microbiologic effect in this group of patients. For these reasons alternatives that might offer the possibility of efficient removal of bacteria from hard tissue surfaces are being sought.

Laser irradiation of subgingival sites to eradicate periodontopathic microorganisms is also being considered in the nonsurgical therapy of periodontitis patients. Diode laser treatment has shown a superior clinical and microbiological effect when used along with SRP, compared to SRP alone or laser therapy alone in aggressive periodontitis patients [1],[14].

PDT is based on the principle that a photo-activable substance, the photosensitizer, binds to the target cell and can be activated by light of a suitable wavelength.[15] During this process, free radicals of singlet oxygen are formed, which produce an effect that is toxic to the cell. This so-called ''photodynamic action'' was described as a process in which light, after being absorbed by dyes, sensitizes organisms for visible light-inducing cell damage. Although PDT is more widely known for its application in the treatment of neoplasms, there is also an interest in antimicrobial photodynamic therapy because a large number of microorganisms (including oral species) have been reported to be killed in vitro by this approach. Potential of some key virulence factors (lipopolysaccharide and proteases) have also been shown to be reduced by photosensitization. The bactericidal efficacy of PDT against periodontal pathogens has been shown in a study using a rat model, and the results show that toluidine blue–mediated lethal photosensitization of Porphyromonas gingivalis is possible in vivo and that this results in decreased bone loss Sigush et al[16] showed that PDT using a photosensitizer and a 662-nm laser light source are advantageous in reducing the periodontal signs of redness and bleeding on probing (BOP) in dogs. Histologic examination of the periodontal tissues of the rats after PDT showed no adverse effects , even with highest light doses and toluidine blue concentration used[17]. Development of resistance to PDT seems to be unlikely because its bactericidal activity is caused by singlet oxygen and other reactive species such as hydroxyl

radicals, which affect a range of cellular targets. Photosensitization may be important in dealing with aggressive periodontitis because the photosensitizer is capable of penetrating through the epithelium and connective tissues. Considering that PDT is not truly a mechanical therapy , residual presence of calculus , residual calculus is expected to occur. Because of the lower presence of calculus , aggressive forms of disease and patients are more likely to benefit from the antimicrobial effect.

Another new remedy for treatment of aggressive periodontitis being tried is use of ozonized solutions (Sorokina and Zaslavskaja, 1997). The effect of ozonized water on oral microorganisms and dental plaque was studied by Nagayoshi et al. They found that ozonized water should be useful in reducing the infections caused by oral microorganisms in dental plaque. Ozone was found to have a potent antibacterial effect explained by the fact that it causes disruption of the envelope integrity through peroxidation of phospholipids. Nagayoshi et al. found that ozonized water should be useful in reducing the infections caused by oral microorganisms in dental plaque. Concerning the results obtained by Agapov et al. ozone can cause stimulation of body's own defenses which is in a good agreement with the present results of this study and in good conformity with the results obtained by Lukinykh and Kosiuga who studied the efficacy of hygienic treatment of the oral cavity in combination with ozone therapy. They proved that this combination mechanically removed soft dental deposits and also decreased bacterial contamination[5].

Surgical Therapyessentially consists of open flap debridement either alone or as a combination with regenerative procedures. The main aim of a flap procedure is to get access and visibility to root and furcation areas so that a thorough instrumentation and debridement can be performed. Flap techniques like modified Widman flap[18], modified flap operation/Kirkland flap (sulcular incision flap)[19], [1] achieve this aim without eliminating the pockets.

A sulcular incision flap or papilla preservation flap will be the ideal technique to minimize recession in the anterior regions due to esthetic reasons, and Modified Widman flap or conventional/sulcular incision flap will be the technique of choice in the posterior regions when opting for bone grafting and another regenerative therapy. A papilla preservation flap is preferred for bone grafting when there is spacing between the teeth to obtain maximum coverage of the graft material at the interdental region and to prevent shrinkage of papilla on healing.

Biomodification of the root surface (Root conditioning) with citric acid, tetracycline, or fibronectin is preferable when performing bone grafting or GTR for better clinical results[20].

Use of biologic mediators like growth factors (insulin-like growth factor (ILGF), platelet-derived growth factor (PDGF)) use of platelet-rich plasma which contains PDGF, extracellular matrix proteins like emdogain, etc. are of promising results. Application of enamel matrix proteins alone[1] or in combination with bone grafts including bioactive glass has shown to result in the successful treatment of intrabony defects in aggressive periodontitis .

The importance of supportive periodontal therapy has to be stressed in management of aggressive periodontitis. Regular SPT was found to be effective in maintaining clinical and microbiological improvements attained after active periodontal therapy in early onset periodontitis. The maintenance therapy starts soon after the phase I therapy or nonsurgical therapy and should be continued throughout the lifetime of the patient.

Cosmetic concerns in young aggressive periodontitis patients will be high since the disease can result in flaring, protrusion, pathologic migration, and even extrusion of the anterior teeth. Malocclusion, pathologic migration and potential occlusal traumatism which can cause secondary trauma from occlusion can be corrected by orthodontic therapy in generalized aggressive periodontitis patients already stabilized by periodontal therapy. Orthodontic treatment can be commenced once attachment gain and bone stability is achieved after periodontal therapy but is generally advised to postpone till 3 months to 1 year after active periodontal therapy.

Psychotherapy has to be started immediately following the first appointment and should be continued concomitantly for total rehabilitation of the patient for a variable duration depending upon the psychologic status of the individual patient. A recent study reported that psychotherapy offered at 3 levels (individual, group, and conjoint family psychotherapy) to Generalized aggressive periodontitis patients gave positive psychologic effects that restored their ability to socialize in their environment contributing to their positive experience in life.

Host modulation therapy with systemically and locally administered agents is under research for therapy in aggressive periodontitis. Adjunctive use of locally administered alendronate gel with SRP for host modulation has shown promising results in aggressive periodontitis.

With further understanding of the genetic risk factors, a futuristic application of genetic screening tests will be in identifying the susceptible individuals and instituting the preventive measures to keep the gene expression and thus the disease under control[1].

**Conclusion:**

Management of aggressive periodontitis is more challenging because of its strong genetic predisposition as an unmodifiable risk factor. The key to successful management at present lies in early diagnosis of the disease and rigorous treatment employing the different treatment modalities mentioned along with systemic antibiotic therapy followed by meticulous lifelong maintenance therapy. With the current treatment modalities, successful long-term maintenance of the dentition in a healthy and functional state can be achieved. A comprehensive periodontal treatment consisting of mechanical/surgical and systemic antimicrobial therapy is found to be an appropriate treatment regimen for long-term stabilization of periodontal health with arrest of periodontal disease progression in 95% of the initially compromised lesions. Further understanding of the etiology, risk factors, pathogenesis, and host immune response in aggressive periodontitis along with advances in regenerative concepts, tissue engineering, and gene

therapy is needed for formulating better management protocols in the treatment of generalized aggressive periodontitis.

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# Nanostructured Implant Materials And Their Surface Interactions

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**Abstract**
The interactions between solid surfaces and cells are crucial to many biological phenomena for all biomaterials. A material is said to be biocompatible, only when no or minimal adverse reactions ensue at the blood/tissue - material interface, and high resistance to biodegeneration.Nanoscale modification of the implant surface can alter the chemistry and/or topography. Different methods have been described to modify or to embellish titanium substrates with nanoscale features. Such changes alter the implant surface interaction with ions, biomolecules and cells. These interactions can favorably influence molecular and cellular activities and alter the process of osseointegration. Here we present a review of these surface interactions and its applicability in practice.

**Key Words**
Nanotechnology, Implant Materials, Nanostructured Implant surfaces

## Introduction

The biocompatibility of an artificial material in the body is complicated. The artificial implants, once implanted in vivo, induce a cascade of reactions in the biological micro-environment through interaction of the biomaterial with body fluid, proteins, and various cells [1], [2], [3], [4]. The sequence of local events often leads to the classic foreign body response and the formation of a fibrous tissue capsule around an implant. It is clear that a major factor influencing this unfavorable reaction of the body is the biomaterial surface. Both the chemical composition of the surface and the surface topography are believed to be important in bone contacting implants[5].

Primary stability is the first step of the osseointegration of implants. This is related to the implant design, mechanical anchorage and bone structure. The primary stability gives way to secondary anchorage with time, which is characterized by a biological bonding at the bone-implant interface. Thus, the nature of the initial bone-implant interface determines the ultimate success or failure of implant. Tissue compatibility is also an issue of prime importance issue while determining the implant success.

The interactions between solid surfaces and cells are crucial to many biological phenomena for all biomaterials. A material is said to be biocompatible, only when no or minimal adverse reactions ensue at the blood/tissue - material interface, and high resistance to biodegeneration. To be deemed biocompatible, implant materials don't destroy or sensitize the cellular elements of blood, cause adverse immune responses or cause any teratological effects or produce toxic and allergic responses or be affected by sterilization. Till date, no material has been able to satisfy these criteria, so inevitable reaction occurs.

Surface characteristics of dental implants
Biocompatibility is multifactorial as simultaneous stimuli from implant materials properties i.e. morphological, chemical, or electrical surface qualities can elicit reactionary responses from the surrounding biological environment that can affect the host response.

The quality of titanium surfaces has been described in terms of surface chemistry, which refers to the critical surface tension (CST) or surface energy[6]. CST is related to the contact angle of a liquid drop on the surface and, thus, provides an indicator of the potential of cell adhesion or surface wettability[7]. It has been observed that chemically activated and hydrophilic sandblasted and acid-etched (SLA) surfaces resulted in a greater percentage of bone-implant contact in the first weeks of osseointegration[8].

The surface properties of the implants can be changed by different methods of cleaning, sterilization, and storage [2], [9], [10]. For example, it has been observed that discs with an active SLA surface sterilized by gamma irradiation and continuously submersed in isotonic NaCl presented less contamination with hydrocarbons and carbonates from the atmosphere, producing a chemically clean and reactive surface [11].

The chemical composition and surface microstructure can regulate the adsorption of components present in extracellular fluid as a result of alterations in the surface energy. In vitro studies showed that rough and chemically activated surface provides the ideal conditions for direct protein adsorption and alter the adsorption of fibronectin and albumin due to modifications in their ionic state [12].

Titanium is found to be well tolerated and nearly an inert material in the human body environment. Under optimal situations, titanium is capable of osseointegration with bone[1]. Moreover,

titanium forms a highly stable passive layer of TiO2 on its outer surface and provides superior biocompatibility. Even if this passive layer gets damaged, TiO2 is immediately rebuilt. The oxide film protects the metal substrate from corrosion and is of particular importance due to its physicochemical properties such as crystallinity, impurity segregation etc, have been found to be quite relevant.

**Advances in surface modification**

Various advances have been introduced in the field of surface modification of implants. Few of these are:

1. **Physical approaches**
   a. Compacting nanosized particles of Titanium dioxide onto the metal core.
   b. Ion beam deposition
2. **Chemical approaches**
   a. Acid etching
   b. Sol – gel deposition (colloidal particle adsorption) of calcium phosphate, aluminium, zirconia, titanium and other materials
3. **Lithography and other optical methods.**
   a. Peroxidation
   b. Discrete crystalline depositions which superimposes a nano-topography
4. **Biomimetics**
   a. Alkali treatment
   b. Anodization- Acid etching and exposure to hydrogen peroxide increases the adsorption of RGD and mineralization. Leads to the formation of a titanium gel layer. Sodium titanate is formed allowing the deposition of hydroxyapatite.
   c. Plasmanitriding: Titanium implants are exposed to a gas atmosphere containing a mixture of nitrogen and hydrogen in the ratio of 20:80 at low pressure and ionized by a continuous current, leading to deposition of nitride onto the metallic surface. It has the advantage of reduced treatment time, lower treatment temperature, reduced cost and increased environmental cleanliness.This produces surfaces with increased wettability and hydrophilic characteristics and cell adhesion apart from modifying chemical characteristics and surface topography.

Laser lock technology has introduced implant with a 2 mm wide collar with the uppermost 0.5 mm is smooth and lower 0.7 mm of the implant surface has grooves of 5-8 µ to prevent epithelial downgrowth. The lowermost 0.8 mm of the collar having grooves of 10- 12µ helps in developing a strong bone-implant interface and retains crestal bone.

Studies have demonstrated that calcium phosphate coatings provide osteoconductive surface to the titanium implants[13].The dissolution of calcium phosphate coatings in the peri-implant region increases ionic strength and saturation of blood leading to the precipitation of biological apatite nanocrystals onto the implant surface. This biological apatite layer incorporated proteins and promoted the adhesion of osteoprogenitor cells that producedosteoid. Also, it was shown that osteoclasts were able to degrade the calcium phosphate coatings through enzymatic degradation and created resorption pits on the implant surface[14].

Hybrid implants i.e. titanium implants with zirconia collars demonstrates lower level of crestal bone loss as compared to implants with titanium collars as it enhances the fibroblast and osteoblast adhesion and proliferation.

Flouride modified titanium implants are those that undergo additional cleaning procedure in hydrofluoric acid after the process of blasting. This leads to the formation of fluoridated hydroxyapatite and fluoroapatitein the calcified tissues further leading to increase in bone implant contact.

**Nanostructured Biomaterials**

Using nanotechnology for regenerative therapy becomes obvious when examining nature[15]. Bone is a nano scaled composite that consists of collagen, non-collagenous proteins (laminin, fibronectin, vitronectin), and water) and hard inorganic components (hydroxyapatite), HA, $Ca_{10}(PO_4)_6(OH)_2$ [16],[17]. 70% of the bone matrix is composed of nanocrystalline HA[18].

Nanostructured biomaterials possess unique surface and mechanical properties similar to the bone and hence are considered to be the future generation biomaterials [22],[23],[24]. Owing to very high number of atoms on the surface, nanograined materials possess large surface energy. Thus, they exhibit entirely different behavior compared to the micron-sized grains. The bone-forming cells generally attach themselves to the surface whose roughness is of nanometer range.

Nano-materials exhibit unique surface properties such as surface chemistry, wettability, and energy, due to their increased surface area and roughness as compared to thetraditional or microstructuredimplant materials. Material surface properties mediate specific proteins (such as fibronectin, vitronectin, and laminin) adsorption and bioactivity, thus regulating the cell behavior and dictating tissue regeneration[16]. Increased alkaline phosphatase levels, increased collagen matrix,increased primary retention of the implant, and greater shear strength is some of the factors that have popularized these materials recently.

On metal surfaces, enhanced cell metabolic activity has been observed, such as the upregulation of bone sialoprotein and osteopontin[19], as well as a threefold increase in osteoblastic cell adhesion as compared with the surfaces without nanostructure. Furthermore, enhancement of calcium and phosphorus deposition has been observed on nanostructured titanium alloys and on CoCrMo surfaces but it was not observed on pure titanium [20],[21].

The nano roughness arises because of the fact that human bones consist of inorganic minerals of grain size varying from 20 to 80 nm long and 2 to 3 nm in diameter[25]. The variation in the surface energy due to the nanosurface roughness leads to desirable cellular responses on nanostructured titanium and other materials resulting in high osseointegration [26],[27],[28],[29],[30],[31]. The cell adhesion behavior on submicron, nanometer structured titanium surface was investigated and the obtained results were compared with a flat smooth titanium surface[26]. The study demonstrated that both nanometer and submicron surfaces have very high surface energy and adhesion of bone cells was very high. Additionally, nanograined alloys made of Cp Ti, Ti–6Al, 4V, and

CoCr as well as nanoceramic biomaterials such as alumina, titania, and hydroxyapatite also exhibit increased cell adhesion [32],[33]. When the grain size was decreased from 167 to 24 nm, 51% increased osteoblast adhesion and fibroblast adhesion responsible for encapsulation was reduced by 235%.

Though different types of cells were utilized for cell culture studies on the alloys and ceramics, the cell density was observed to be relatively higher for the nanomaterials when compared to conventional counterparts.

Apart from the roughness, the pore size on the surface also has an influence on the protein adhesion. The protein, victronectin, is generally adsorbed on pores of smaller sizes on the other hand, the protein that decreases cell adhesion such as laminin, generally adsorbs to bigger pore size[34]. Increased osteoblast adhesion was also observed on nano HA coated Titanium alloy and further bone ingrowth toward implant was noted indicating ceramic surface coatings leading to high osseointegration[35].

**Nanostructured Biointerfaces**

In vivo, the cell interactions with its surroundings are mediated at the both molecular and macromolecular level. Specific interactions with, for example extracellular matrix components and soluble factors, or macromolecules in the outer membranes of adjacent cells provide necessary signaling and communication routes. Such interfaces have both topographic nanostructure and chemical/ biospecific interaction sites distributed at the nanoscale.

Studies have focused on the effect of surface nanotopography on cell functions such as adhesion, motility, morphology, cytokine release, gene expression, and differentiation[36]. The ability to define interfaces on a length scale that match those of the mediating macromolecules in cell membranes and extracellular matrixes, has the potential to create artificial biointerfaces that are capable of signaling/communicating with the adherent cells. Such artificial biointerfaces are of immediate interest for application in areas such as biomaterials, tissue engineering, scaffolds for cell therapies, and cell-based sensors/electronics.

The role of surface parameters (both bulk chemistry and topography) requires consideration of molecular (ionic and biomolecular) interactions with the surface, cell adhesion phenomenon, and local biomechanical features of the established interface. It is clear that nanoscalemodification affects the chemical reactivity of an endosseous implant surface and alter the ionic and biomolecular interactions with the surface. Proposed changes include enhanced wettability, altered protein adsorption, and potential mineralization phenomenon[37]. Changes in wettability and altered protein adsorption lead to altered cell adhesion, likely involving both integrin and non-integrin receptors. The potential for mineralization and epitaxic crystal growth in support of early bone bonding could dramatically alter the biomechanical environment of the healing implant in favor of stability.

Recently, a set of unique structures ranging from mesoporousnanoscaffolds, nanoflowers, nanoneedles, nanorods, and octahedral pyramids were fabricated by tuning the hydrothermal conditions such as reaction medium composition, concentration, temperature, and time duration systematically[38]. The cytotoxicity of surface modified Ti was assessed using human primary osteoblastic cells, and more than 90% of the cells were found to be viable after 24 h of incubation. Various studies on protein adsorption have revealed that the nano-modified surface structures on titanium adsorbed more proteins, suggesting that these promote cell adhesion/attachment.

**Interaction of surfaces and blood**

Blood interactions with implant material leads to protein adsorption this being dependent on the surface properties of the implantable material. This occurs through a complex series of steps of adsorption and displacement, more commonly known as the Vroman effect [39] A hydrophilic surface is better than a hydrophobic surfacefor blood coagulation. Consequently, dental implants manufacturers have developed high hydrophilic and rough implant surfaces that in turn exhibited better osseointegration than conventional ones[40]. Adsorption of proteins such as fibronectin, vitronectin on the surface of dental implants has been shown to promote cell adhesion by cell-binding RGD domain[41]. After proteins absorption, the osseointegration is characterized by platelet adhesion and fibrin clots formation at the injured blood vessels site. Previous studies have shown that implants in contact with platelet-rich plasma (PRP) having a platelet concentration of approximately 106 protein/μL have a positive effect on peri implant bone regeneration and osseointegration. At lower concentrations of platelet rich plasma, the effect was not optimal, while higher concentrations resulted in a paradoxically inhibitory effect on peri implant bone regeneration. Few studies that were not in agreement with effect of PRP on the osseointegration of dental implants, have also been documented[42].

**Interactions between surfaces and Mesenchymal stem cells**

Following clotting around the implants, several cells interact with implant surfaces for healing. Mesenchymal stem cells (MSCs) are attracted to the injured site by chemotactic action of implant with neighboring bone and gingival tissue factors have a determinant role in peri implant tissue healing.

The integration of implant with neighboring bone and gingival tissue depends on successful crosstalk between old tissue and implant surface. The challenge in dental implant research is the capability of the surface to guide cells colonization and differentiation. Cell migration, adhesion, and proliferation on implant surfaces are a prerequisite to initiate the tissue regeneration. Authors have shown that some factors present in tissues and secreted during the inflammatory phase are able to attract MSCs to the injured site [43],[44].

In the microenvironment, MSCs are stimulated by some specific factors to differentiate into the adequate cell line. Under the influence of these factors, MSCs switch to osteoblastic cells in contact to bone tissue while they differentiate into fibroblastic lineage in the gingival tissue region. These two differentiation pathways are in concurrence around dental implants. In some cases, implants are encapsulated by fibrous tissue due to the proliferation and differentiation of MSCs into fibroblastic cells. In response to cytokine, fibroblasts migrate and generate a capsule of collagen, the first step in generation of gingival tissue or rejection on contact to

bone. This fibrous capsule prevents bonding between implant surface and juxtaposed bone and causes a failure of the implant[45]. On the other hand, both the differentiation of MSCs into fibroblastic lineage and the fibroblastic adhesion are desired in the gingival upper part of dental implants. Fibroblasts adhesion has been shown to be lower on nanoscale surface compared to conventional surfaces[46]. Moreover, nanometer size features have been shown to decrease fibroblast adhesion and proliferation [47],[48]. The micro- and nanoscale surface properties of the implant i.e. surface chemistry, surface roughness, and wettability, could affect bone formation [49]. Research has specifically demonstrated that nanorough Ti [50] and nanostructured Ti can enhance osteoblast adhesion and differentiation compared to their nanosmooth control[51]. Furthermore, surfaces with micro- and nanopores have shown to enhance greatly osseointegration[52],[53]. Surface properties may control the steps of adhesion, proliferation, and differentiation of MSCs and, thus, condition tissue integration.

**Tissue Integration**

Branemark et al. described the osseointegration as a direct structural and functional bone to implant contact under load. The challenge in developing new implant surface consists in increasing the clinical success rate as well as decreasing the tissue healing time for immediate loading of implants, particularly in aesthetic situations. Implant surface with various roughnesses have been used to increase the total area available for osteoapposition. Kubo et al.[54] observed a substantial increase by 3.1 times in bone-titanium interfacial strength by Ti nanotube (300 nm) at 2 weeks of implantation in femur rats. These results suggest the establishment of nanostructured surfaces for improved osteoconductivity. Moreover, Ogawa et al.[55] have prepared titanium nanostructure by physical vapor deposition and tested their osseointegration in the femur of rats. They found an increased surface area by up to 40% and a greater strength of osseointegration for the nanostructured compared to an acid-etched surface [55].

In particular, Le Guehennec et al.[56] studied the osseointegration of 4 implant surfaces in the femoral epiphyses of rabbits after 2 & 8 weeks of healing. In this study, the bone-implant contact and bone growth inside the chambers were compared for four different implant surfaces and shown that biomimetic coating method may enhance the bone apposition onto titanium. In order to prevent coating delamination and implant loosening, the Calcium phosphate coating should dissolve or degrade under osteoclastic activity at a similar rate than bone apposition. The preferred result should be a direct bone-implant coating without the presence of fibrous tissue. Another advantage of these calcium phosphate coatings is related to their preparation by biomimetic methods at physiological temperature and pH from simulated body fluids. Calcium phosphate crystals have characteristics that resemble bone mineral in terms of size and composition. Furthermore, it is possible to incorporate biologically active drugs such as antibiotics or growth factors during the precipitation of calcium phosphate coatings on titanium implants[57]. These molecules could be locally and gradually released in the peri-implant bone region for either preventing bacterial infections or stimulating bone growth.

**Effects of nanotopography on osseointegration**

Depiction of broad range of nanoscale topography effects observed in cellular protein adsorption is altered by nanoscale modification of bulk material. It is believed that, the changes in initial protein–surface interaction control osteoblast adhesion [58]. When implants come into contact with a biological environment, protein adsorption (e.g. plasma fibronectin) that occurs immediately will mediate subsequent cell attachment and proliferation. Altering the surface energy or wettability of a material is a classical approach to changing cell interactions with the surface. Nanotopography specific effects on cellular behavior have been demonstrated using a wide range of different cell types including epithelial cells, fibroblasts, myocytes, and osteoblasts.

Interestingly, osteoblasts were observed to adhere specifically at particle boundaries. Since nanophase metals have higher percentages of particle boundaries at the surface, this may explain the greater numbers of osteoblasts on nanophase compared to conventional metals.

Both cell specificity and extent of cell adhesion are altered, too. Depending on the nano-architecture of the cell, spreading may be affected. Lim[56] more directly related protein adsorption, cell adhesion and the active process of attachment by measurement of increased focal adhesion kinase (FAK) activity. Surface roughness at the nanoscale is an important determinant of protein interactions that ultimately direct cell activity in control of tissue formation at implant surfaces [59].

Nanotopographicalfeatures of a surface affect both cell adhesion and motility. On comparison of cell morphology and cytokine production on deep grooves and hemispherical nanopillars, the cells appeared partially aligned to the grooves and had a cytokine release similar to that found from cells on flat surfaces. Osteoprogenitor cell adhesion was enhanced on poly-L-lactide (PLLA) and polystyrene (PS) surface with nanoscale and micron-scale roughness compared to smooth surfaces.

Cell proliferation and osteoblast differentiation appears to be enhanced by nanoscale topography, too. Webster [29],[32] observed increased osteoblast proliferation on the nanoscale materials. Several investigators have demonstrated the relative diminution of fibroblast adhesion compared to osteoblast adhesion when nano- and micron-structured surfaces were evaluated [61],[60]. For example, on nano-sized materials, the affinity ratio between osteoblasts and fibroblasts was 3 to 1 compared to conventional materials, the ratio was 1:1 [62]. Bacterial adhesion and proliferation is also diminished on nanophase materials [63]. Decreased bacterial colonization on nanostructured titanium oxide and zinc oxidehas been observed even though these surfaces promote osteoblast differentiation and adhesion.

The topographical and chemical properties of the implant surface strongly influence the properties of the layer. Since cells and proteins range in size from nano- to micrometer, these are relevant length scales for the problem. Equally importantis theability of cells to communicate through the extracellular

matrix by signal molecules. These bioactive signal molecules control the regeneration during tissue healing and some proteins stimulate healing near the implant.

**Biocompatibility of Ti-BioceramicNanocomposites**

The application of Ti-bioceramicnanocomposites has focused attention on the biocompatibility of synthesized bulk materials. For Dental Implants, hybrid Ti-x vol% 45S5 Bioglass, Ti-x vol% SiO2, and Ti-x vol% HA bionanocomposites (0 = x = 20) were produced by the combination of mechanical alloying (MA) and powder metallurgical process [64],[65],[66],[67],[68],[69].

It has been demonstrated that metal (Ti, Ti6Al4V, and CoCrMo) surfaces utilizing submicron to nanometer particles, due to higher amounts of particle boundaries at their surfaces, promoted the adhesion of osteoblasts as compared to metals composed of respective micron particles [31].

Cytotoxicity tests of the extracts of studied Ti-45S5 Bioglass materials under wear conditions are shown. The relative viability of the cells (RVC) decreases when fraction increases. It is important to note that the RVC of nanoscale Ti-45S5 Bioglass is higher in comparison with microcrystalline titanium. The wear and fretting accelerates the corrosion of the studied samples in a biological environment such as cell culture medium. Two factors may influence cell growth on the disks: adsorbing protein onto the disks and released metal ions from the disks.

A quantification study provided evidence of significant differences in the amount of calcium and phosphorus deposition by osteoblasts as well as their precipitation from culture media between common orthopedic (Ti6Al4V, CoCrMo) alloys due to nanometer particle sizes [31]. Also chromium was detected at the concentration of 4.4 ± 0.7 and 4.1 ± 0.6 mg/L, respectively. Chromium is one of the essential elements for human, so slight amount of this element may contribute to cell proliferation, and resulting in higher cell growth.

**Conclusion**

Nanoscale surface modification have shown to alter the chemistry and/or topography of the implantable material surface. Various methods have been described to modify titanium substrates with nanoscale features. Such changes have been shown to alter the implant surface interaction with host bio-environment. These interactions have been shown to favorably influence molecular and cellular activities and alter the process of osseointegration.

As the disciplines of immunology continue to understand the process of wound healing, development of biomaterials plays a complementary role as an interdisciplinary approach to developing implant surfaces, which mimic and promote accelerated wound healing processes. At this moment, both a hydrofluoric acid modified titanium endosseous implant with nanoscale features and calcium phosphate nanofeature-modified titanium implants are available for clinical use. The potential risks and benefits of manipulating biomaterial interfaces at the nanoscale will be defined by long-term clinical evaluation of such endosseous devices.

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# Endodontics Or Implants: A Review Of Decisive Criteria And Guidelines For Endodontic And Dental Implant Therapy

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**Abstract**
A complex problem faced in contemporary dental practice is the decision between treating a tooth endodontically or extracting and replacing it with an implant. When considering this issue, there are many factors to be taken into account. The aim of this review is to evaluate these factors allowing the clinician to make decisions on the basis of best available evidence. The authors examined publications (research, literature reviews and systematic reviews) related to the factors affecting decision making in such cases. The factors included patient-related factors, oral conditions, site-specific aspects, the restorative prognosis of the endodontically-treated tooth and operator skill. It can be concluded that endodontic treatment represents an economical and practical method to preserve teeth and that implants are a good alternative in cases where the prognosis is compromised.

**Key Words**
Endodontics, extraction, implants, preservation, RCT

## Introduction

A fundamental principle in traditional dental practice has been the preservation and rehabilitation of natural teeth. Endodontic treatment procedures have played a key role in this context in the retention and restoration to function of teeth affected by pulpal and periapical pathosis. The extraction of teeth has generally been considered undesirable and as a treatment of last resort due to the limitations of alternative prosthodontic replacements such as bridges and removable prostheses. In recent years however, this paradigm has been challenged by emerging trends in implant dentistry, with implant replacements being touted as equal to or even superior to the preservation of natural teeth[1], [2], [3], [4], [5].

A MEDLINE search (PubMed) was conducted using different keyword combinations including the terms 'root canal therapy', 'dental implants', 'decision making', 'treatment planning', and 'outcome'. In addition, bibliographies of all relevant papers and previous review articles were handsearched. Titles were excluded, if no abstract was available, single case reports or conference reports were presented, or the topic was not related to the subject of the current review.

This review will discuss the major factors that can affect the decision regarding whether a tooth receives endodontic treatment or is extracted and replaced by an implant.

## Indications of Endodontic Treatment and Implant Therapy

An analysis of the causative factors of root canal treatment performed indicated that approximately 60% of root canal treatments were necessitated by caries, 19% by restorative failures, 13% by post-treatment apical periodontitis, and six percent by dental trauma [6].

When dental implants were first introduced by Branemark in 1977 [7], they were envisioned as a replacement for missing teeth and indicated for patients who might otherwise have received removable prosthesis. As more research on dental implants was conducted, the potential range of applications was expanded to encompass a larger population of teeth that otherwise would have been referred for restorative procedures including endodontics. An analysis of single-tooth implant studies indicates that endodontic complications, trauma, and caries are commonly cited as the leading causes of tooth extraction and replacement with single-tooth implants. Contrary to the preponderance of evidence, the presence of apical periodontitis is increasingly being used to recommend tooth extraction and immediate implant placement [6], [8], [9].

## General Endodontic and Implant Contraindications

There are virtually no medical contraindications to endodontic treatment except for uncontrolled diabetes and possibly a recent coronary event. However, certain factors may affect the outcome of endodontic treatment in adverse ways. They are as follows:

- Patients with high caries activity.
- Patients with diabetes, particularly in cases with preoperative periradicular lesions.
- Impaired integrity of the patient's nonspecific immune system.

Other patient-related factors such as age and smoking had no impact on the healing rate [10], [11].

When implant treatment was introduced in the 1970s, several restrictions were defined in order to minimize the risk of implant failure or complications. Hence, implant therapy was not recommended in

patients with xerostomia, osteoporosis, aggressive forms of periodontitis and heavy smokers. Today, it is evident that the peri-implant tissues are not affected by hyposalivation and/or the symptoms of xerostomia. Further, a reduced bone mineral density in osteoporotic patients entails a reduced bone-to-implant contact, but does not appear to inhibit osseointegration. Implant indications have been extended to patients with a history of periodontitis and also to smokers accepting an increased risk for complications and failures.

Presently, there are few absolute and permanent implant contraindications, but several temporary restrictions [12], [13], [14] such as

- Incomplete cranial growth
- An implant may be precluded if the site impinges on vital anatomic structures,
- Insufficient mouth opening
- Patients who are unlikely to maintain a high level of oral hygiene should not be considered for an implant.
- Patients under intravenous bisphosphonate medication for more than two years.
- Certain medications such as antiosteoporosis drugs.
- Smoking is a significant risk factor for implant treatment and augmentation procedures accompanying implant therapies.
- A history of alcoholism, immune disorders, and other conditions that impair healing.
- Implants in patients with diabetes can be successful, at least in the short term. Medium to long-term follow-ups are lacking.

**Case Selection & Factors Influencing Prognosis of Endodontic and Implant Treatments**

Appropriate case selection plays an important role in the outcome of any dental treatment. However, patient selection remains a difficult and controversial area when comparing implant and endodontic studies. All patient-related, oral and site specific factors should be evaluated systematically, the strategic value of the tooth determined and a risk analysis performed before any definitive decision is taken. The patient's expectations, medical contraindications and his/her financial position are further aspects taken into account during treatment planning.

**A. Patient-Related Factors**

**1. Systemic risk factors**

A number of systemic risk factors have been evaluated for their impact on the survival rates of endodontically treated teeth or dental implants. In general, diabetes seems to have a deleterious effect on the prognosis of both implant and root canal treatment. A negative effect of smoking on apical periodontitis has been reported in endodontic literature. A recent systematic review has reported that smoking also reduces implant survival rates. Therefore, factors that alter the host response to inflammation, such as smoking, might also indirectly influence the risk of infection in both implants and root canal treatment groups[15].

**2. Physical Pain of Procedure**

The incidence of postoperative pain is one of the major concerns when evaluating endodontic treatment alternatives. It has been reported that the public's perception of endodontic treatment is negative because of the association of endodontic treatment with pain. In contrast, the results of one study have demonstrated that pain was not the major cause of dissatisfaction with endodontic treatment. Moreover, even placebo treated patients report that root canal treatment substantially reduces pain compared with preoperative levels. In another study, implant placement was found to be a mild to moderately painful and anxiety provoking procedure. Taken together, these results indicate that the pain experienced after root canal treatment and implant surgery fall within the guidelines for adequate control of perioperative pain [6].

**3. Length of Treatment**

In general, endodontic therapy takes fewer visits and a shorter time for completion than implants. Implants are placed in either single or two stages. In the two-stage protocol, a four-to-six week period may be recommended to allow for soft tissue healing over the extraction site before the implant is placed. Once the implant is placed, a four-to-six month period for the mandible and maxilla, respectively, is allowed before the implant can be restored. In practice, this may need to be extended to six and eight months.

Time can be saved if the single-stage protocol is followed. Single-stage placement has been associated with an increased risk of failure protocol. However, other studies show that single-stage placement with immediate loading has a predictable outcome [6].

**4. Financial Implications**

A cost–benefit analysis comparison between endodontic treatment and a single-tooth implant concluded that endodontics and a crown is less expensive, entails fewer office visits and is completed more quickly then the implant. The analysis did not take into account the possible adjunctive procedures before implant placement such as sinus lift and bone grafts, which would increase the cost of an implant [6],[16].

**5. Patient satisfaction**

Gibbard and Zarb reported that only 80% of patients were somewhat satisfied or extremely satisfied with single-tooth implants, while another study, which assessed quality of life after endodontic treatment, clearly demonstrated that endodontic treatment significantly improved quality of life for all measures investigated. As far as quality of life assessments are considered, both endodontic and single-tooth implant studies are quite comparable to each other [6], [17].

**B. Oral Conditions**

**1. General oral situation**

The situation of the remaining dentition and the full-mouth treatment planning decides, at least in part, whether or not to maintain a questionable tooth. Hence, a tooth with a relatively good prognosis, but requiring tremendous pre-treatment efforts may be intended for extraction, as treatment requirements in the adjacent tooth positions (either tooth- or implant supported) overrule the decision made for the single tooth [15], [18].

**2. Occlusion**

Occlusal overloading and parafunction can play a significant role in failure of endodontically treated teeth due to crown and root fracture. On the other hand, occlusal trauma may cause a more rapid destruction of the bone supporting an implant compared with similar forces on a natural tooth. When planning either implants or endodontic therapy in such patients, the underlying factors should be

recognized and resolved for a successful outcome [5].

**3. Periodontal factors**

In endodontics, periodontal disease is a negative factor, but it rarely precludes treatment. Conversely, the periodontal health of the peri-implant tissue is critical in determining the outcomes of implant placement. Hence, the elimination of periodontal disease is mandatory in prospective implant patients [15].

**C. Site-Specific Aspects**

**1. Bone characteristics and Regional anatomy**

Not much information is available in the endodontic literature regarding survival of root canal–treated teeth according to the quality of bone or the anatomic zone. The quality and quantity of bone for implant placement must be sufficient. Patients with both low density and quantity of bone are at the greatest risk of implant loss. In addition, anatomical limitations are a principal reason for not performing implants [6], [15].

**2. Esthetics**

The natural tooth restoration should be strongly considered when esthetic demands are of paramount significance.

The most frequent problem with implants is esthetics in the anterior maxilla. In patients with high aesthetic demands and a thin mucosal biotype, greater efforts should be made to save a questionable anterior tooth in order to ensure preservation of the soft tissue architecture. Posterior teeth with questionable prognosis, however, are replaced by an implant with less restraint, than in the aesthetic zone [5], [6].

**D. Restorative Prognosis Of The Endodontically-Treated Tooth**

Contemporary literature supports the direct relationship between a coronal restoration and the positive outcome of endodontic treatment. Iqbal et al. identified poor crown margins as one factor significantly associated with the presence of post-treatment periapical lesions. Poor fitting crowns may allow bacterial leakage and reinfection of the root canal system, and in vitro studies identify leakage as a possible cause of a negative outcome following root canal treatment. These observations indicate that, provided endodontic treatment is performed with good case selection and sound restorative procedures, long-term survival rates are comparable to implant survival rates. Dawson and Cardaci noted that the restorative prognosis of a tooth being planned for endodontic treatment or retreatment is likely to be the most important factor in deciding whether to retain or replace. The patient's own preferences are also likely to play a key role in this decision-making process [6], [18], [19].

**E. Operator Skill**

It is conceivable that a significant predictor of both implant and endodontic treatment may be the expertise of the clinician and the technical quality of the treatment. This may be a problem in endodontics with training in new technology. Initially, most implants were placed by specialists, but it is expected that over time most implants will be placed and restored by general dentists. Pure training courses as opposed to formal education and academically-based experiences may be only of a few days' duration and the practitioner may lack the necessary diagnostic, surgical and prosthetic skills [5], [20].

The most important factor promoting a successful result is the technical quality of the surgery, reflecting the skill of the operator. Referral to a more experienced colleague is in the best interest of the patient and should be actively encouraged when appropriate.

**Endodontics and Implants: Success vs. Survival**

Treatment outcome or 'success' in endodontics is usually measured by an absence of clinical symptoms and specific radiographic criteria. The concept of 'survival' is applied to implant studies. Implant survival has been defined as 'a retained non-mobile implant capable of supporting a crown'. However, some of these implants may have associated bone loss and periodontal defects. Such a broad definition makes a comparison with the strict criteria for a positive endodontic outcome not possible [18].

**Further Treatment Modalities In Case Of Failure**

Fortunately, a negative outcome following nonsurgical root canal treatment can be managed with more flexibility, and in stages. Non-surgical retreatment, periapical surgery, periradicular surgery (hemisection and tooth sectioning), intentional replantation, or transplantation can prolong the life of the tooth. Restorations are retained and function is unaltered [18].

The failure of an implant is always clinically significant because extraction is the only alternative. The extraction may require surgery. Restorations must be removed, leading to altered function and possibly appearance. The bony defect must heal before further treatment can be undertaken. Further reimplantation may then entail additional bone augmentation in a staged approach [18].

**Implant vs. The endodontically-treated tooth**

In general terms, the arguments favoring tooth retention focus on the advances in endodontic treatment which allow the provision of a greater range of treatment options with greater predictability. This treatment option has also been proposed to be more conservative, less invasive and less costly than implant placement. The effects of "failure" are also seen to be more significant with implant therapy as compared to endodontic treatment (i.e., loss of fixture in implant therapy vs. non-healing after endodontic treatment which may still be managed and result in tooth retention).

Arguments favoring implant placement focus on the perceived poor outcomes of endodontic treatment when compared to implant "success" rates of over 90 per cent and concerns over the structural durability of a weakened endodontically treated tooth to support a coronal restoration. An implant fixture is seen as a better foundation for restorative dentistry than an endodontically-treated tooth. The implant has also been seen as a restorative option that requires little follow-up when compared to endodontic-prosthodontic rehabilitations, which is seen to be at a greater risk of further problems due to caries, periodontal disease and structural deficiencies [5], [9].

**Conclusions**

Factors such as patient expectations, dental and medical health status, regional anatomy and bone characteristics, risk associated with treatment, treatment time, costs, prognosis and consequences of a negative outcome need to be individually assessed for a specific

clinical situation. As discussed previously, comparisons of prognosis are difficult when comparing endodontic treatment and implant therapy due to differences in treatment procedures, outcome measures and complications. If the available data are based on survival, it is apparent that endodontic treatment outcome in general practice is comparable to implant therapy in prospective studies. In conclusion, restorability and periodontal stability should be the major factors in determining whether to replace or rehabilitate.

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# Finite Element Analysis - An Insight

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**Abstract**
Finite Element Modeling can provide insights when dealing with complex structures. The application of the FEM in dental investigation began in seventies by using two and three-dimensional models. This method provides us with useful findings to analyze forces, moments, stresses etc. Finite element analysis has been applied to the description of form changes in biological structures particularly in the area of growth and development and in restorative dentistry. With FEA technique one can model actual continous structure with descrete element mathematical representation which can then be used to calculate the stresses, strains and displacement in tooth and supporting structures and materials used.

**Key Words**
Biomechanics, Finite element Analysis, Stress and Strain

## Introduction

BIOMECHANICS is defined as the application of mechanical forces to the living organisms and the integration of forces and the body or system which includes forces that arise from within and outside the body (Tabers Encyclopedia Medical Dictionary).

Simply, it is application of mechanics (motion of bodies) to biologic systems.

### Stress Analysis

Theoretical : Experimental
Mathematical Analysis : Strain Gauge
Finite Element Analysis : Holography Photoelasticity

The Finite Element Method (FEM) is a computerized numerical iteration technique used to determine the stress and displacements through a predetermined model.

The Finite Element Method is a numerical analysis technique used by engineers, scientists, and mathematicians to obtain solutions to the differential equations that describe, or approximately describe a wide variety of physical (and non-physical) problems. Physical problems range in diversity from solid, fluid and soil mechanics, to electromagnetism or dynamics. Hence FEA is being considered a part of the design process spanning across industries or domains, be it automotive, aerospace, medical, civil, and electrical etc.

The method was introduced in late sixties in the aerospace industry and was applied in dentistry in the early seventies.

With age, human teeth are weakened by caries, abrasion, malocclusion and fracture. Cavity preparation procedures and other treatments, due to reduction of tooth structure and loss of nutrients from dental pulp, exaggerate the fracture potential of the remaining tooth structure. Inappropriate treatments, such as unnecessarily wide cavity preparation increase the potential of further trauma and possible fracture of remaining tooth structures. Fracture potential may be directly related to the stresses exerted upon the tooth during masticatory function. An understanding of this relationship between the stresses in a tooth and its fracture potential should assist clinicians in eliminating or reducing the factors contributing to tooth fracture, thus maintaining the remaining tooth structure without fracture.[1] In an attempt to better understand the stresses in the tooth, a variety of methods have been used to predict tissue response to load.[2] These include theoretical mathematical techniques[3], photoelastic systems[4] and laser holographic interferometry[5]. However, these techniques have the disadvantage of only examining surface stress, whilst having the added problem of usually being supported by poor validation systems as judged by the current standards.[6] The finite element method can be applicable to the problem of the stress strain levels induced in internal structures. This method also has the potential for equivalent mathematical modeling of a real object of complicated shape and different materials.

## FEM - Concept

Stress-Strain Relations (Hooke's Law): A specimen of a specific diameter is subjected to a tensile or pulling force. The stress is calculated as force per unit area. The change in the gauge length is measured and the strain is evaluated as change in length per unit length. Stress and strain are linearly related up to the proportional limit. Hooke's Law states that the stress is proportional to strain. The constant of proportionality is called the Young's modulus or modulus of elasticity. The diameter of the specimen reduces as the specimen is pulled. The ratio of lateral strain to the axial strain is called the Poisson's ratio.[7]

Finite analysis solves a complex problem by redefining it as the summation of the solution by a series of interrelated simpler problems. FE stress analysis technique models actual continuous structure with discrete element mathematical representation. This approach transforms the problem into one of matrix algebra which may be solved with the aid of digital computer. To create the model of tooth CT scan of the sections is combined to create a tree dimensional model. **Figure 1** Is the ct

Figure 1 A Ct Scan Image Of Maxillary Central Incisor

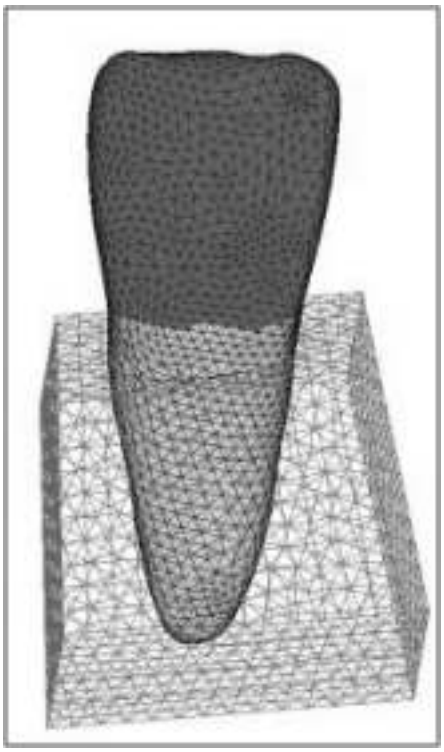

Figure 2 Finite Element Model Of Maxillary Central Incisor With Supporting Structures

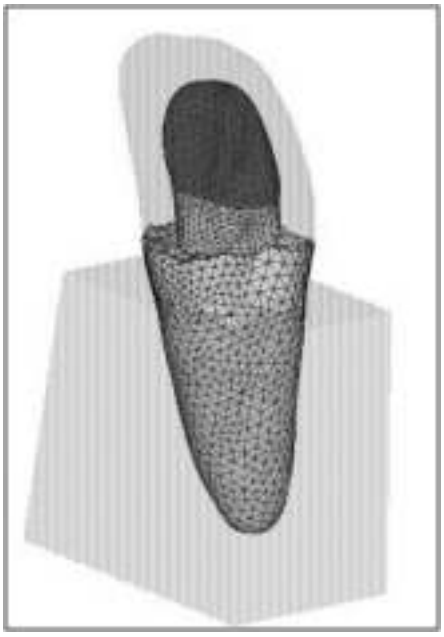

Figure 3 Fem Model Of Tooth With The Post And Core Assembly

scan image of central incisor. The first step is to subdivide (i.e. discretize) the complex geometry into a suitable set of smaller "elements" of "finite" dimensions when combined from the "mesh" model of the investigated structures. Each element can adapt a specific geometric shape (i.e. triangle, square, tetrahedron etc) with a specific internal strain function. **Figure 2 and 3** is the Mesh model of the investigating structures.

Using these functions and the actual geometry of the element, the equilibrium equations between the external forces acting on the element and the displacements occurring on its nodes can be determined.

**Information required for the software used in the computer is as follows.**

1) Coordinates the nodal points.
2) Number of nodes for each element.
3) Young's modulus and Poisson's ratio of the material modeled by different elements.
4) The initial and boundary conditions.
5) External forces applied on the structure.

The boundary condition of these models is defined so that all the movements at the base of the model are restrained. This manner of restraining prevents the model from any rigid body motion while the load is acting.[8]

**Figure 4** boundary conditions are applied

It Includes:

- Discretization of given problem
- Developing element properties
- Imposition of boundary conditions
- Solution of assembled equation
- Post processing of the results.

**Mathematically:**

F = Kx

Where,

F --- Force

K -------- Proportional constant

X -------- Distance of stretching

**FEA is needed to:**

1. Reduce the amount of prototype testing.
2. Computer simulation allows multiple "what if" scenarios to be tested quickly and effectively.
3. Simulate design that is not suitable for prototype testing (e.g. surgical implants as an artificial knee).
4. Cost saving

Figure 4 3d Model Of Maxillary Central Incisor With Post And Core Assembly And Applied Boundary Conditions.

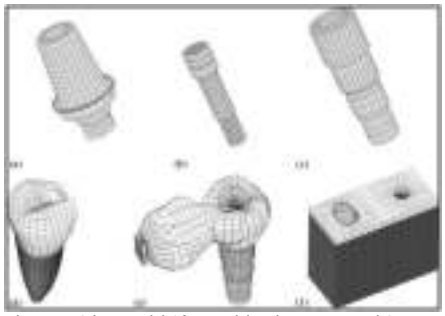

Figure 5a 3d Fe Model Of A Tooth/Implant-supported System Constructed For Analysis

5. Time saving reduce time to market.
6. Creates more reliable, better quality designs.

**Dental Applications**

1) Finite element analysis has been applied to the description of form changes in biological structures (morphometrics), particularly in the area of growth and development.
2) Finite element analysis as well as other related morphometric techniques such as the macro-element and the boundary integral equation method (BIE) is useful for the assessment of complex shape changes.
3) The knowledge of physiological values of alveolar stresses is important for the understanding of stress related bone remodeling and also provides a guideline reference for the design of dental implants. **Figure 5** 3D FE model of a tooth/implant-supported system constructed for analysis.
4) Finite element method is also useful for structures with inherent material

homogeneity and potentially complicated shapes such as dental implants, restorative pins, post and core.

5) Analysis of stresses produced in the periodontal ligament when subjected to orthodontic forces.
6) To study stress distribution in tooth in relation to different designs.
7) To optimize the design of dental restorations.
8) To investigate stress distribution in tooth with cavity preparation.
9) The type of predictive computer model described may be used to study the biomechanics of tooth movement, whilst accurately assessing the effect of new appliance systems and materials without the need to go to animal or other less representative models.
10) To find out stresses induced with in the tooth, periodontal ligament and alveolar bone due to normal occlusal forces which may be a cause for non carious cervical lesion i.e. Abfraction. **Figure 6** finite element model showing constraints and applied load [9].
11) To study effect of adhesive layer properties on stress distribution in composite restorations and stresses induced by different techniques used for restoration.
12) To investigate the effect of thermal and mechanical loading on the resorted teeth.

**Advantages Of Fem:**

1. It is a non destructive method which employs simulation of conditions with greater accuracy.
2. The actual physical properties of the materials involved can be simulated. Thus this method is nearest one that could possibly get to simulate the oral environment in-vitro.
3. Can be applied to bodies composed of several materials.
4. The actual stress experienced at any given point can be measured.
5. Reproducibility does not affect the physical properties of the involved material and the study can be repeated as many times, as the operator wants.
6. Irregularly shaped boundaries can be approximated.
7. Mixed boundary conditions can be easily handled.
8. Analyzes complex geometry and it can determine stresses and strain through out a 3 dimensional

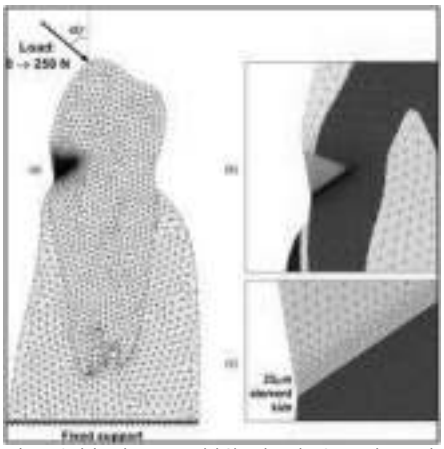

Figure 6 Finite Element Model Showing The Constraints And The Applied Load

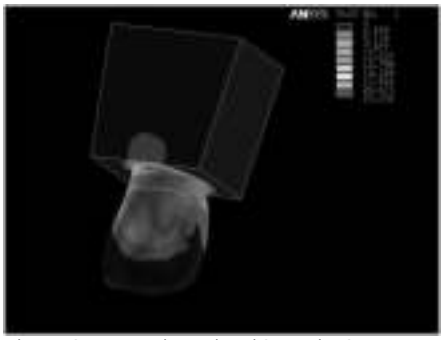
Figure 7 Stresses In The Tooth And Supporting Structures In 3d Model Of Custom Cast Post

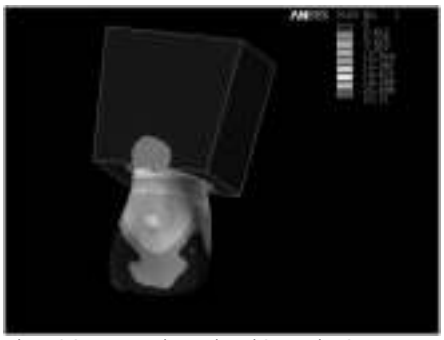
Figure 8 Stresses In The Tooth And Supporting Structures In 3d Model Of Light Transmitting Post

component.

9. The ability to obtain accurately the stresses through out the structure under consideration.
10. Inclusion of any type of anisotropy (directional characteristics) and inhomogeneity is conceptually possible by inserting the appropriate distribution of material properties at the nodes of the elements.
11. FEM an engineering method of calculating stresses and strain in all materials including living tissue has made it possible to adequately model the tooth and periodontal structures for scientific checking and validating the clinical assumptions.
12. The finite element method offers an ideal method for accurate modeling of the tooth – periodontium system with its complicated three dimensional geometry. Abnormal stress levels may allow the clinician to estimate the tissue damage and implement therapeutic modalities sooner.[10]
13. The type of predictive computer model described may be used to study the biomechanics of tooth movement, whilst accurately assessing the effect of new appliance systems and materials without the need to go to animal or other less representative models.[11]

Using the finite element program ANSYS a study was conducted in the Department of conservative dentistry and endodontics, Bangalore, using a three dimensional finite element model of maxillary central incisor treated with root canal and post core to find out the difference in the stresses induced within the tooth,periodontal ligament and alveolar bone due to normal occlusal force directed in a palato-labial direction with cast post and core and with light transmitting post.The results of the study concluded that Stress transfer was more with in the post and core unit for the Custom cast post compared to the Light transmitting post, which had low stresses distribution with in post and core unit.Also the transfer of stresses to the tooth and supporting structure was more for the Custom cast post when compared to the Light transmitting post.

Maximum stresses were observed in the cervical region for both the posts systems, but at different locations. Finite Element Analysis for the Light transmitting post showed that the maximum stress concentration was at the post-core junction and all the fractures were at core level in Fracture Strength Test indicating a definite correlation between the level of maximum stress and mode of failure.[12]

**Figure 7** Stresses in the tooth and supporting structures in 3D model of Custom cast post **Figure 8** Stresses in the tooth and supporting structures in 3D model of Light transmitting post

**Disadvantages Of FEM:**

Finite Element Analysis is an approximation method to represent both the deformation and the 3D-stress distribution in bodies that are exposed to

stress. In addition to the FEM advantages, it has some disadvantages. For example, the mechanical properties of the materials are complicated, and it might not be possible to include the ideal properties into the model. For this reason some assumptions are accepted, and the FEM is based on them to simplify the real situation. Some errors are added to the solution of the problem due to assumptions. But the error percentage in the solution can be omitted. The first idealization is about material, and the materials are assumed to be linearly elastic, homogeneous, and isotropic. However, the material is not really linearly elastic, and the material properties and the geometry of the model change from one person to another. This makes the problem even more complex. On the other hand, forces or stresses that can cause plastic deformations in bone or teeth do not occur in the real situation.

**A Final Word:**

The finite element method is extremely powerful. Finite element analysis finds its wide application in the numerical solution of many problems in engineering and technology. The problems include design of shafts, trusses, bridges, aeroplane structures, buildings, heating and ventilation, fluid flow, electric and magnetic fields, and so on. The main advantage of using finite element analysis is that many alternative designs can be tried out for their validity, safety, and integrity using the computer, even before the first prototype is built. Finite element analysis uses the idea of dividing a large body into small parts called elements, connected at predefined points called nodes. Element behavior is approximated in terms of the nodal variables called degrees of freedom. Elements are assembled with due consideration of loading and boundary conditions. This results in a finite number of equations. Solution of these equations represents the approximate behavior of the problem.

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