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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

Guest Editorial

A little learning is a dangerous thing.
- Euripides.

The process of learning never comes to an end even after post-graduation for dental practitioners all over the world. A dental journal becomes the modem for constant education. It provides a platform where there is exchange of knowledge between the contributors and the dental clinicians so it can be put to significant use in day to day practice. The aim of this journal is to meet this yardstick. The interest of students, research scholars and clinicians in contributing their quality work to this journal is amazing.

Great care is taken on our behalf to ensure the authenticity of the scientific content of the articles. We aspire to keep on improving the range of articles with every issue. Focus of the journal remains on evidence based original research and solutions to clinical problems encountered in our dental practice. Lot of effort is done in providing a variety of relevant original research articles, case reports of clinical importance and quality reviews so as to provide interesting reading. The published articles in this issue are based on dental research relative to the changes consistently occurring in our dental profession.

Dr. Vikas Jindal
Editor in Chief
Indian Journal of Dental Sciences

There is nothing more gratifying than the generation of enthusiastic response from the readers for the publishers. I am greatly humbled by the enormous contributions of the dental professionals and research scholars to this journal. Your quality work is of paramount importance as a source of inspiration and interest to the dental fraternity. Our commitment to raise the standard of IJDS to global standards remains undaunted with every issue.

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Original Article

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A Comparative Evaluation Of Flexural And Impact Strength Of Flexible And Other Denture Base Materials – An In Vitro Study

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Abstract
The material most commonly used in the construction of dentures is poly methylmethacrylate. This material is used because of its favorable working characteristics, processing ease, better accuracy, stability etc. Despite of these excellent properties, this material is not without limitations, particularly in terms of flexural and impact strength. The fracture of denture is rather a common problem & resistance to fracture of acrylic resin denture depends on the flexural and impact strength. The ongoing research, to improve their physical and mechanical properties has led to the introduction of high impact resins and flexible denture base resins. This study comparatively evaluates clinically significant properties of fracture resistance viz. flexural and impact strengths of a flexible denture base material with conventional denture base material and high impact denture base material that would help the clinician in solving the day to day problems of denture fracture and durability.

Key Words
Denture base materials, flexible denture base resins, flexural and impact strength.

Introduction

The fracture of denture causes inconvenience to the patient & embarrassment to the dentist. Denture fracture may occur either inside the mouth during function, primarily because of deflective occlusal forces or resin fatigue or outside the mouth through impact if the denture is dropped[1]. Hence there is a need for improvement in the fracture resistance of polymethylmethacrylate. Denture base materials have always been a matter of research in the field of dental materials. Various previous studies[2],[3],[4] were done on mechanical as well as physical properties of denture base materials. In recent times, many approaches have been used to strengthen the polymethylmetha crylate denture base resin, among these one approach is reinforcement with different types of fibers. A major difficulity with these fibers is bonding with denture base resin is difficult[5]. A search for alternative material has led to the introduction of nylon based denture base material. To date, no research has assessed the lately developed nylon based flexible resin system for denture base construction. Lucitone FRS is a flexible and monomer-free thermoplastic dental polymer[6].

Flexural failure of denture base materials is considered the primary mode of clinical study[7]. Zappini et al[8] stated that to evaluate the resistance of denture base resins against fracture, fracture toughness tests as well as impact strength should be performed.

Due to increased concern for quality control and to obtain assures results repeatedly, the evaluation of such newly introduced and currently available products is imperative[1]. This study is one such effort to evaluate and compare the properties related to the fracture resistance i.e. flexural and impact strength of a nylon denture base material to other polymethylmethacrylate denture base material.

Materials & Methods

Three different denture base materials were used in this study (i.e. co-polyamide nylon denture base resin Lucitone FRS Dentsply Pvt. Ltd., high impact polymethylmethacrylate denture base resin Trevalon HI Dentsply Pvt. Ltd. and conventional polymethylmethacrylate-DPI Heat Cure Dental Product of India Pvt. Ltd.) for evaluation and comparison of flexural strength and impact strength. The methodology has been described as:

Preparation Of Metal Strips

Stainless steel metal strips for flexural strength of dimensions 65 x 10 x 3 mm **(Fig.1 a)** and for impact strength samples dimensions 80 x 12.7 x 3.17 mm **(Fig.1 b)** were fabricated from a private engineering works according to ADA specification no. 12[9] and ASTM D-256[10] respectively. These metal strips were used to prepare the samples from each of the three materials.

Preparation Of Samples

Total of 60 resin samples were made from three different materials selected for this study i.e. Lucitone FRS **(Fig.2,3,4,5)** (Group A), Trevalon HI (Group B) and DPI Heat Cure (Group C) **(Fig.6,7)**. 20 samples were made from each group, which were further divided into 2 subgroups each , 10 samples for flexural strength(f) and 10 for impact strength(i). Sample size is chosen using a target for the power of a statistical test to be applied

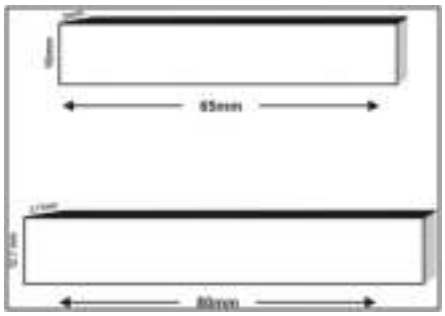


Fig.1 : A Dimensions Of Metal Strip (Ada Specification No.12) B Dimensions Of Metal Strip (Astm D-256)

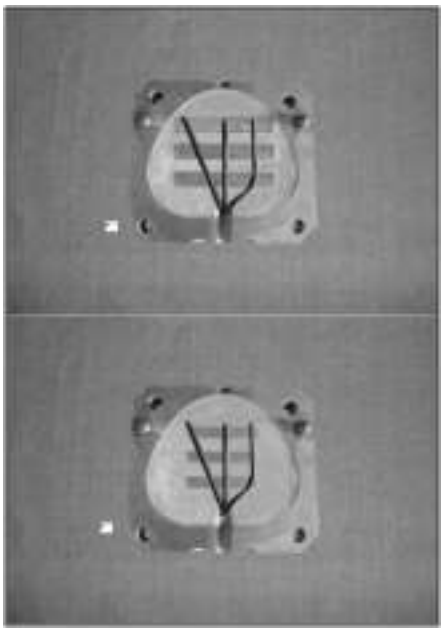


Fig.2 : Fabrication Of Lucitone Frs Samples: (A)Impact Strength (B) Flexural Strength

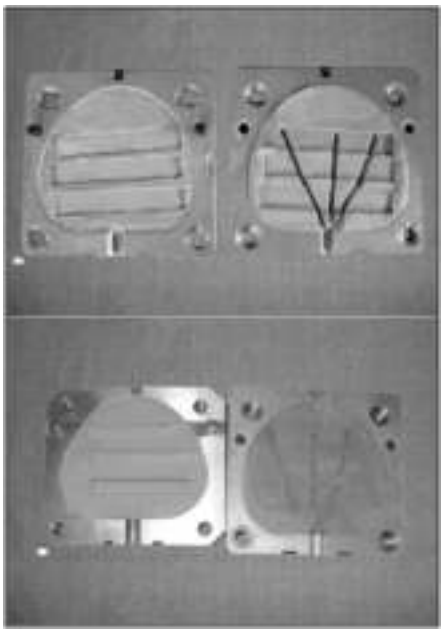


Fig.3 : After Dewaxing : (A)Impact Strength & (B) Flexural Strength

once the sample is collected. So, all the groups and subgroups were represented as Af, Ai, Bf, Bi, Cf, Ci .All the samples were immersed in distilled water in three different jars at 37°C in an incubator for 1 week before testing[1]. This was done to simulate the oral conditions.

- Testing of samples
- Testing of samples for flexural strength
- Testing of samples for impact strength
- Testing of samples for flexural strength- Flexural strength is measured in terms of stress. Flexural strength of samples was tested on

Fig.4 : Cartridge Sleeve Preheated In Success Cartridge Furnance.

Fig.5 : Cartridge Containing Molten Lucitone Frs Placed On To The Success Injection Unit

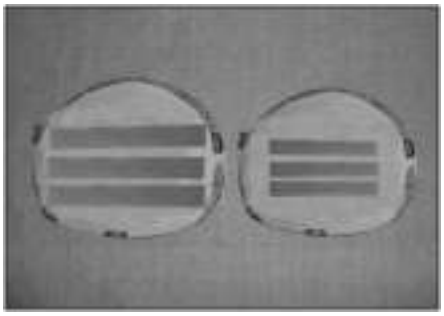


Fig.6 : Flasking Of Metal Strips For Fabrication Of Samples: Impact Strength (Left Side) And Flexural Strength (Right Side)

Instron universal testing machine (model LR 100 K, LLOYDS, UK) at a cross head speed of 2 mm/min and span length of 50 mm[11]. The load was applied centrally on the bar sample until fracture occurred. The load and corresponding deflection were recorded for each sample. Load deflection curve (stress-strain curve) was observed for each sample, showing the amount of stress applied on the material which led to strain

Flexural strength for each sample was calculated using the formula - Flexural strength (Mpa) = Where, P=peak load, l =span length, b=sample width, d=sample thickness.

All the polymethyl methacrylate samples fractured. **(Fig.8,9)**. For nylon samples it was decided to record the maximum load (P) once the load deflection curve became constant. This was done because it was observed from pilot study that the

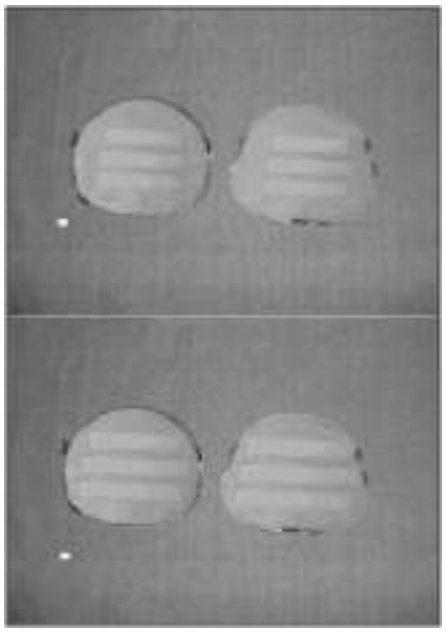


Fig.7 : After Dewaxing (A) Flexural Strength And (B) Impact Strength

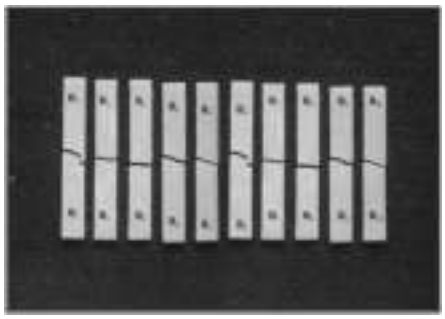


Fig.8 : Fractured Samples After Testing For Flexural Strength: (Trevalonhi)

nylon samples (Lucitone FRS) did not fracture but deflected beyond the capacity of the machine **(Fig.10)**. For materials that deformed significantly but did not break, flexural yield strength was calculated[6]. Flexural yield strength is the stress at which material strain changes from elastic deformation to plastic deformation, causing it to deform permanently.

Testing of samples for impact strength – Impact strength of samples were tested on Izod Digital Impact Tester (ATS Faar Italy) with accuracy of 0.01 J. For Impact strength a 'V' shaped notch to a depth of 2.5 mm (according to ASTM standard D618)[10] was made in the centre on a lateral margin across the long axis of the samples for impact strength. The notching of samples were done with the help of NOTCH VIS (CEAST) Machine. Before notching the width of sample was 12.7 mm but after making a notch the width remained 10.2 mm for each sample. The notch prepared in samples

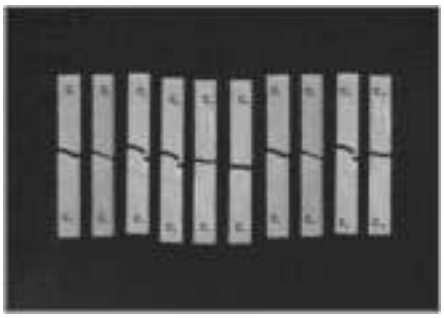
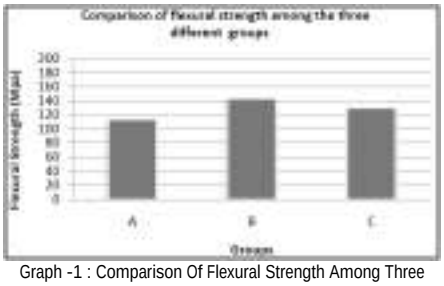
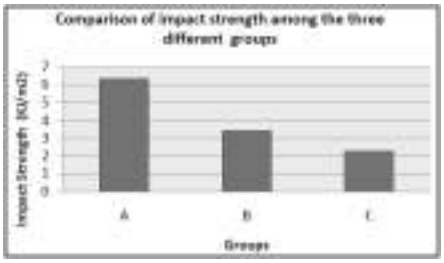


Fig.9 : Fractured Samples After Testing For Flexural Strength: (Dpi Heat Cure)

Fig.10 : Deflected Lucitone Frs Samples



Graph -1 : Comparison Of Flexural Strength Among Three Different Groups



Graph -2 : Comparison Of Impact Strength Among Three Different Groups

simulated the notches present in denture base in frenal areas. The notches and scratches are stress concentrated areas which may reduce the strength of denture. The presence of a notch also ensured that the test specimens break at the same point during testing[12].

The samples were clamped vertically at one end in such a way that half of the length remained outse with a notch. The pendulum of 2J was released towards the side of the notch of the sample[13]. It was observed that the sample was broken and the absorbed energy by the each sample was noted.

The impact strength was calculated using

Table I : Analysis Of Difference In Flexural Strengths Of Different Subgroups Using One-way Analysis Of Variance (Anova) Test

Descriptives							
		N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Flexural Strength (Mpa)	A	10	114.1500	3.23805	1.02396	110.50	119.00
	B	10	143.6100	4.32857	1.36882	138.90	149.30
	C	10	130.1500	2.84185	.89867	125.90	133.90
	Total	30	129.3033	12.71151	2.32079	110.50	149.30
Value Of P (N)	A	10	136.9800	3.83806	1.21370	132.60	143.00
	B	10	173.4300	3.53461	1.11774	168.90	179.10
	C	10	156.1700	3.40491	1.07673	151.10	160.70
	Total	30	155.5267	15.53481	2.83626	132.60	179.10

Anova		
	F	Sig
Flexural Strength (Mpa)	174.952	< .0001**
Value Of P (N)	256.941	< .0001**

Table II : Bonferroni Post Hoc Test Of Significance For Flexural Strength Differences Among The Means Of Different Groups

Multiple Comparisons Bonferroni					
Dependent Variable	(I) Group	(J) Group	Mean Difference (I-j)	Std. Error	Sig.
Flexural Strength (Mpa)	A	B	-29.46000(*)	1.57687	< .0001**
		C	-16.00000(*)	1.57687	< .0001**
	B	A	29.46000(*)	1.57687	< .0001**
		C	13.46000(*)	1.57687	< .0001**
	C	A	16.00000(*)	1.57687	< .0001**
		B	-13.46000(*)	1.57687	< .0001**
Value Of P (N)	A	B	-36.45000(*)	1.60868	< .0001**
		C	-19.19000(*)	1.60868	< .0001**
	B	A	36.45000(*)	1.60868	< .0001**
		C	17.26000(*)	1.60868	< .0001**
	C	A	19.19000(*)	1.60868	< .0001**
		B	-17.26000(*)	1.60868	< .0001**

* The Mean Difference Is Significant At The .05 Level.
** Value Of Significance < 0.0001 Is Considered Highly Significant.

the formula- Impact Strength (KJ/m2) = Where, E = energy absorbed by the sample ; b = sample width ; d = sample thickness

Result

Sub group Af (Lucitone FRS) samples did not fracture during the flexural strength test and deflected beyond the capacity of testing machine. Hence for sub group Af samples, the load (i.e. value of P) at which the load deflection curve reached the maximum and became constant were recorded and were considered as flexural yield strength[6]. For sub group Bf (Trevalon HI), and sub group Cf (DPI Heat Cure) samples flexural strength was calculated. An analysis of difference in flexural strengths of different groups was carried out using one-way analysis of variance (ANOVA) test. **(Table - I)**Then, Bonferroni Post Hoc test of significance for flexural strength differences among the means of different groups was carried out. This revealed that all the 3 groups were highly significantly different from each other **(Table - II)**. The software used for statistical analysis was SPSS Processor version 15.

Trevalon HI (Group B) showed the maximum mean value of flexural strength 143.61 Mpa. It showed the maximum peak load value of 17.67 Kg. i.e. maximum stress required to break the samples. DPI Heat Cure (Group C) showed the second highest mean value of flexural strength 130.15 Mpa with peak load value of 15.91 Kg whereas the mean value of flexural yield strength of Lucitone FRS was 114.15 Mpa with peak load value of 13.96 Kg **(Graph-1)**. The low flexural strength exhibited by Lucitone FRS (Group A) means that it is less rigid than conventional polymethylmethacrylate resins. Lucitone FRS samples did not break because they reached above their proportional limit.

An analysis of difference in impact strengths of different subgroups (Ai, Bi, Ci) was carried out using one-way analysis of variance (ANOVA) test **(Table - III)**. Then, Bonferroni Post Hoc test of significance for impact strength differences among the means of different groups was carried out. This revealed that all the 3 groups were highly significantly different from each other **(Table - IV)**.

Lucitone FRS (Group A) showed the highest impact strength of 6.36 KJ/m2. The flexibility of Lucitone FRS coupled with its strength (impact) enables it to resist all normal attempts at fracture. The samples of Lucitone FRS showed the maximum energy absorbed i.e. 0.196 J to break the samples. Trevalon HI (Group

Table III : Analysis Of Difference In Impact Strengths Of Different Subgroups Using One-way Analysis Of Variance (Anova) Test

Descriptives							
		N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Value Of E (J)	A	10	.1966	.01066	.00337	.18	.21
	B	10	.1063	.01396	.00441	.09	.12
	C	10	.0700	.00930	.00294	.06	.08
	Total	30	.1243	.05526	.01009	.06	.21
Impact Strength Kj/M2	A	10	6.3600	.35963	.11372	5.90	6.90
	B	10	3.4300	.44981	.14224	2.90	4.00
	C	10	2.2600	.29889	.09452	1.90	2.70
	Total	30	4.0167	1.79080	.32695	1.90	6.90

Anova		
	F	Sig.
Value Of E (J)	322.822	< .0001**
Impact Strength Kj/M2	317.860	< .0001**

Table IV : Bonferroni Post Hoc Test Of Significance For Impact Strength Differences Among The Means Of Different Groups

Multiple Comparisons Bonferroni					
Dependent Variable	(I) Group	(J) Group	Mean Difference (I-j)	Std. Error	Sig.
Value Of E (J)	A	B	.09030(*)	.00513	< .0001**
		C	.12660(*)	.00513	< .0001**
	B	A	-.09030(*)	.00513	< .0001**
		C	.03630(*)	.00513	< .0001**
	C	A	-.12660(*)	.00513	< .0001**
		B	-.03630(*)	.00513	< .0001**
Impact Strength Kj/M2	A	B	2.93000(*)	.16753	< .0001**
		C	4.10000(*)	.16753	< .0001**
	B	A	-2.93000(*)	.16753	< .0001**
		C	1.17000(*)	.16753	< .0001**
	C	A	-4.10000(*)	.16753	< .0001**
		B	-1.17000(*)	.16753	< .0001**

* The Mean Difference Is Significant At The .05 Level
**value Of Significance < 0.0001 Is Considered Highly Significant

B) showed the second highest impact strength of 3.43KJ/m2 as less energy was absorbed i.e. 0.106 J in breaking these samples as compared to Lucitone FRS. Whereas DPI Heat Cure (Group C) on application of a sudden force showed impact strength of 2.26 KJ/m2 with least energy absorbed i.e 0.070 J. **(Graph-2)**.

Discussion

Problems encountered when fabricating a partial denture prosthesis using polymethylmethacrylate resin are that as the material is rigid, the undercuts present around the teeth and the tissues have to be blocked out so that insertion and removal of the prosthesis can be done without interferences and damage to the tissues. This block out of the undercuts has undesirable effects like presence of dead space, poor esthetics, food entrapment and soft tissue proliferation. Further, in these prosthesis the use of wrought wire metal clasps to enhance retention becomes vital thus compromising esthetics. Hence attempts to overcome the limitations of polymethylmetha crylate have taken researchers through many avenues. Radford; Radford & Braden[14] did the chemical modification of polymethyl methacrylate resin through the incorporation of rubber in the form of butadiene styrene in improving the impact strength but with limited success

Jagger DC., Harrison A , Jandt K.D.[15] studied the reinforcements of denture base material and gave different reviews of attempts to improve the mechanical properties of polymethyl methacrylate denture base. It showed that rubber modified acrylic-polymer had high impact strength.

High impact denture base resin (Trevalon HI) is fiber reinforced resin. Trevalon HI is a micro-dispersed rubber - phase polymer, in which methyl methacrylate and butadiene styrene are co-polymerized in an emulsion with a second coating of methyl methacrylate being added to cover the bead. These beads are mixed with monomer to form the dough that is packed into the dental flask[16]. These high impact resins are well suited for the patients with heavy masticatory forces and also for complete/partial conventional dentures. Impact strength may be defined as the energy required for fracturing a material under an impact force. The term impact is used to describe the reaction of a stationary object to a collision with a moving object.

Flexible denture base material eg. Lucitone FRS is thermoplastic co-polyamide nylon polymer. Nylon is a generic name of certain type of thermoplastic polymers belonging to the class known as polyamides. Polyamide molecules contain the amide group CONH, spaced at intervals in a carbon chain. Nylon is a crystalline polymer whereas polymethylmethacrylate is amorphous. Thus in solid nylon there is more or less ordered parallel packing of the long chain molecules which is due to the strong attractive forces between the chains. This crystallinity accounts for lack of solubility in solvents, high heat resistance and high strength coupled with ductility[17]. This difference in internal molecular structure contributes to the outstanding features of toughness, low density, abrasion resistance, high melting point and resistance to chemical attack. They are well suited in certain type of partially edentulous conditions i.e. tooth and tissue supported prosthesis (long bounded saddle) as the tissue-borne saddles will move relative to the tooth-borne ones during mastication[18]. This flexibility of nylon makes it possible to use simpler designs of the prosthesis and can be the material of choice in anterior teeth replacement because the need to block out the undercuts are not required and hence deliver a prosthesis that is esthetically superior[19].

Flexural strength is defined as a material's ability to resist deformation under load. The flexural strength represents the highest stress experienced within the material at its modulus of rupture. The low flexural strength exhibited by Lucitone FRS (Group A) means that it is less rigid than conventional polymethylmethacrylate resins. Lucitone FRS samples did not break because the Lucitone FRS reached above to its proportional limit. That is why it is indicated in repeated denture fracture cases and in certain clinical situations, which allows it to engage certain degree of undercuts for retention without these undercuts being blocked.

Conclusion

Within the limitations of this study, it was concluded that Lucitone FRS is more flexible than other two materials as Lucitone FRS samples did not break during testing of flexural strength. They flexed beyond the capacity of the machine and slipped from the supporting wedges of the machine. Whereas for impact strength testing, this material showed highest value as maximum energy was required in breaking this

material than the other two materials. So, Lucitone FRS material exhibits flexibility, high impact strength and excellent retention. It can be used in removable partial dentures where undercuts are present and also in situations where repeated denture fractures have occurred. Another advantage of this material is that it is esthetically acceptable as this material merges itself with the oral tissues and is virtually invisible as there is no need of metal clasps in the denture. This material has certain limitations that it stains easily and show high water sorption. The manufacturers recommend a design that does not incorporate rests to provide vertical support since the inherent flexibility of the nylon material may fail to effectively transfer the forces from the prosthesis to the abutment. This is an inherent disadvantage of Lucitone FRS prosthesis as the prosthesis derives only retention from the abutment tooth but no support from it. Other problems faced with this material are that repair or relining is infeasible, high cost and expensive equipments.

Trevalon HI showed the maximum flexural strength. It means that this material can bear heavy masticatory load easily and leading to better chewing efficiency. This material is also recommended in V-shaped palate and broad arches. DPI heat cure showed least flexural and impact strength values. So, strength wise DPI heat cure stands at third place than rest of the two materials. This material can be used in conventional conditions and is cost effective than rest of the two materials. Though Lucitone FRS is gaining attention but Trevalon HI is an acceptable material for both partial and complete dentures as this material can bear the heavy masticatory forces. Secondly, its colour stability is better than the other two materials.

The mechanical behavior of a denture depends not only on the strength of the material but also on the design, construction and conditions of loading. Factors like different powder/liquid ratio, homogenous co polymer beads, differences in water uptake may also affect the mechanical properties. Therefore, the resin should possess adequate strength and resilience as well as resistance to biting or chewing forces, impact forces that occur in the oral cavity. The laboratory test results for any resin are not necessarily equivalent to clinical findings, even though efforts are made to simulate the clinical conditions in laboratory experiments. The data obtained in this study for flexural strength and impact strength pertain to the conditions in which they are tested but with any changes in the materials and methodology of testing, the strength values obtained are subject to change.

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A Comparative, In-vitro Evaluation Of The Antimicrobial Efficacy Of Different Concentrations Of Chlorhexidine Gel And Propolis Against Specific Endodontic Pathogens

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Abstract

The aim of the present in vitro study was to compare the antimicrobial efficacy of different concentrations of chlorhexidine gel and propolis against pure cultures of Enterococcus faecalis, Staphylococcus aureus and Candida albicans, commonly found in infected cases of root canal using the Agar-diffusion test. Inoculae of these organisms were used to make lawn cultures on Mueller-Hinton agar. Wells were prepared with these lawn cultures and filled with 1% chlorhexidine gel, 2% chlorhexidine gel, extract of propolis and propylene glycol. The Agar plates were kept overnight for incubation at 37I0;C and the zone of inhibition was recorded after 24 hrs, 72 hrs and 7 days. The results suggest that 2% chlorhexidine gel is more effective than 1% chlorhexidine gel and propolis for all test time periods and against all test microbes. Propolis did not show any antimicrobial activity against E. faecalis and C. albicans at 24 hrs, however, at 72 hrs a distinct zone was seen for C. albicans. E. faecalis showed smallest zones of inhibition and staphylococcus aureus the largest for all medicaments tested. 2% chlorhexidine gel may be amore effective intracanal medicament as compared to 1% chlorhexidine gel or propolis against S. aureus, C. albicans and E. faecalis.

Key Words

Agar-diffusion Test, Chlorhexidine, Propolis, Enterococcus Faecalis, Staphylococcus Aureus, Candida Albicans.

Introduction

Bacteria have been implicated in the pathogenesis and progression of pulpal and periapical disease. The primary aim of endodontic treatment is to remove as many bacteria as possible from the root canal system and then to create an environment in which any remaining organism cannot survive. This can only be achieved through the use of a combination of aseptic treatment techniques, bio-mechanical preparation of root canal, antimicrobial irrigating solutions and Intracanal medicaments.

Common pathogens which have been implicated in teeth with necrotic pulp and periapical lesions are gram-negative anaerobic bacteria. These gram-negative bacteria are more susceptible to eradication by bio-mechanical procedures than gram-positive, facultative organisms such as Enterococcus faecalis and Staphylococcus spp., which are considered by many researchers to be the most resistant species in the oral cavity and a plausible cause of root canal failure.[1]

Candida albicansis not routinely isolated in primary root canal infections but Waltimo et al, in 1997, reported the presence of Candida albicans in pure cultures in therapy resistant apical periodontitis establishing it as a plausible cause of root canal failure.[2]

These bacteria can exist within the root canal itself or within other related regions such as the dentinal tubules, accessory canals, canal ramifications, apical deltas, fins and transverse anastamoses. Since there is no entirely predictable way to ensure complete elimination of root canal bacteria, an effective antimicrobial agent is required to eradicate or destroy any remaining bacteria.

The need for Intracanal medicament is greater in those cases where bacteria are resistant to routine treatment and where therapy cannot be successfully completed due to presence of pain or continuing exudates.[3] Ideally an Intracanal medicament should also reduce periapical inflammation and consequently reduce pain and induce a cure by formation of hard tissue, control persistent exudation, inhibit osteoclastic activity and prevent or at least delay re-infection of root canal system between sessions. None of the intracanal medicaments used presently, present all these properties which justifies research for newer agents that together with consistent antimicrobial activity are less toxic.

Calcium hydroxide is the most widely used intracanal medicament but its limited activity against Enterococcus faecalis and Candida albicans has put its use as a universal intracanal medicament to question.[3],[4]

Various studies have proved the efficacy of chlorhexidine as an irrigating material, its potential as an Intracanal medicament has also been sought in a gel form in various concentrations.[5],[6],[7]

Chlorhexidine has an added advantage of substantivity, but concern has been expressed regarding the formation of a precipitate containing para-chloroanaline which occludes the dentinal tubules when chlorhexidine combines with sodium hypochlorite which is used as an irrigant. Para-chloroanaline has been shown to be

carcinogenic in animals.[8]

Natural products have been used in dental practice for thousands of years and have become even popular today. Propolis is one such product that has attracted increased interest due to its antimicrobial activity against wide range of pathogenic microorganisms. Propolis is a resinous hive product that is collected from various plant sources by bees and the nature of its chemical composition is very complex. The composition of propolis depends upon the vegetation of the area from where it is collected and can vary. Oncag O et al, in an in vitro study found that propolis had good activity against Enterococcus faecalis and suggested its use as an Intracanal medicament.[9] The use of agar diffusion test has been widely used for testing antimicrobial activities of endodontic medicaments.[10],[11] It allows direct comparison of intracanal medicaments against test microorganisms, indicating which medicament has potential to eliminate bacteria from the root canal system.[10]

Thus the purpose of this study was to compare in vitro, the antimicrobial efficacy of 1% & 2% chlorhexidine gel and extract of propolis against pure cultures of Enterococcus faecalis, Candida albicans and Staphylococcus aureus using the agar–well diffusion test.

Materials And Methods

The present investigation was performed against pure lyophilized cultures of Staphylococcus aureus, ATCC6538P, Enterococcus faecalis, ATCC35550 (facultative anaerobes) and Candida albicans ATCC10231 (yeast), as obtained from IMTEC, Ind. The reconstitution of these lyophilized cultures was done on Malt yeast agar for C. albicans and Nutrient agar for E. faecalis and S. aureus. Since the organisms used in this study are not strict anaerobes, they were incubated under aerobic conditions. Mueller-Hinton agar and Mueller-Hinton agar fortified with 2% glucose was used as culture media to test for the antimicrobial efficacy. These agar plates were prepared in sterile glass petri dishes, 90mm in diameter and kept overnight for sterility at 37I0;C.After ensuring sterility, the inoculae of the strains, previously sub-cultured, were prepared with peptone water and the turbidity was compared using the McFarland's turbidity standard tube No. 0.5. The inoculae were used to make lawn culture of the organisms using sterile cotton swabs on M-H agar, for E. faecalis and S. aureus and on M-H agar with 2% glucose for C. albicans. After making the lawn culture, wells with 6mm diameter and 5mm depth were made in agar plates with sterile Pasteur pipette attached to a vacuum suction. Four wells were made in each agar plate, equidistant from each other and from the rim of the agar plate. The wells were numbered from 1-4 and 1% chlorhexidine gel (ICPA health Ltd, Ind) was added to well no 1, propolis (Apiario Silvestre Green Propolis, Royal Natural Poducts Co., Brasil) was added to well no 2, 2% chlorhexidine gel, (ICPA health Ltd, India) was placed in well no 3 and negative control, propylene glycol (s.d. fine- chem. Limited, Mumbai), which was the vehicle used in all the three test medicaments, was added to well no 4. Ten such agar plates were used for each organism. The plates were incubated overnight at 37I0;C.The specimens were examined after 24 hrs, 72 hrs and 7 days and the zones of inhibition for each chemical used against a particular isolate were recorded with a dial caliper (FORBES, Ltd), calibrated to the least count of 0.02mm. The results were statistically analysed using the one-way ANOVA and post Hoc Turkey HSD.

Table 1 : Mean Zone Diameters with standard deviation for Enterococcus faecalis (EF), Staphylococcus aureus (SA) and Candida albicans (CA) after 7 days, for 1% Chlorhexidine gel (CHX1), 2% Chlorhexidine gel (CHX2) and Propolis (PROP) Also showing, Minimum and Maximum diameters at 95% and 99% confidence intervals (CI 95% and CI 99%)

		Mean	SD	MIN	MAX	Coefficient of variation %	SE Mean	CI 95%		Ci99%	
EF	CHX1%	19.70	0.71	18.64	20.40	3.61	0.22	19.26	20.14	19.12	20.28
	CHX2%	21.84	0.55	21.10	22.68	2.52	0.17	21.50	22.18	21.39	22.29
	PROP	0.00	0.00	0.00	0.00	--	--	--	--	--	--
SA	CHX1%	25.09	0.79	24.00	26.56	3.16	0.25	24.60	25.58	24.45	25.74
	CHX2%	29.54	0.83	28.28	30.58	2.81	0.26	29.02	30.05	28.86	30.21
	PROP	12.82	0.62	12.00	13.62	4.85	0.20	12.43	13.20	12.31	13.32
CA	CHX1%	23.72	0.36	23.10	24.36	1.52	0.11	23.49	23.94	23.42	24.01
	CHX2%	27.12	0.51	26.22	27.70	1.86	0.16	26.80	27.43	26.70	27.53
	PROP	11.75	0.52	11.12	12.72	4.46	0.17	11.43	12.08	11.33	12.18

Results

Statistical analysis of the differences between the mean inhibitory zones for S. aureus, C. albicans and E. faecalis are shown in **Table 1**.

For S. aureus, at 24 hrs, efficacy of all three test medications was statistically different ($p<0.001$). 2% chlorhexidine gel showed the maximum inhibitory zone (29.54mm), 1% chlorhexidine gel showed intermediate inhibitory zone (25.09mm) and Propolis showed minimum inhibitory zone (12.82mm). For propylene glycol (control), no inhibition zone was seen. The zones of inhibition remained the same at 24hrs, 72 hrs and 7 days, for all the test medicaments and the control **(Table 2)**.

Table 2 : One-way ANOVA for the comparison of mean zone of inhibition (in mm), for Propylene glycol, Control (C), 1% Chlorhexidine gel (CHX1), 2% Chlorhexidine gel (CHX2) and Propolis (P) for Staphylococcus aureus at 24 hrs, 72 hrs and 7 days.

	N	Mean Value	Std. Deviation	F-value	P-value
C	10	0.00	0.00	4133.54	< 0.001
Chx1	10	25.09	0.79		
Chx2	10	29.54	0.83		
P	10	12.82	0.62		

Table 3 : One-way ANOVA for the comparison of mean zone of inhibition (in mm) for Propylene glycol, Control ©, 1% Chlorhexidine gel (CHX1), 2% Chlorhexidine gel (CHX2) and Propolis (P), for Enterococcus faecalis at 24 hours, 72 hours and 7 days

	N	Mean value	Std. deviation	F-value	P-value
C	10	0.00	0.00	7162.78	< 0.001
CHX1	10	19.70	0.71		
CHX2	10	21.84	0.55		
P	10	0.00	0.00		

For E. faecalis, at 24 hrs, efficacy of all the three test medications, was statistically different ($p<0.001$) with 2% chlorhexidine showing the maximum inhibitory zone(21.84mm) and 1% chlorhexidine showed smaller inhibitory zone(19.70mm). Propolis and the negative control, propylene glycol, showed no zone of inhibition. The zones once obtained remained the same for all test time periods for E. faecalis **(Table 3)**.

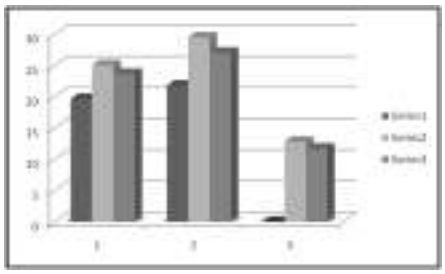
For C. albicans at 24 hrs, all the three test medications showed statistically different efficacy ($p<0.001$). 2% chlorhexidine showed maximum zone of inhibition (27.12mm), 1% chlorhexidine showed smaller zone of inhibition (23.72mm), while propolis and negative control showed no zone of inhibition. However, at 72 hrs, propolis showed a distinct zone of inhibition (11.75mm), which remained the same at 7 days. The zones of inhibition obtained for 1% and 2% chlorhexidine gels remained the same

Table 4 : One-way ANOVA for the comparison of mean zone of inhibition (in mm), for Propylene glycol, Control (C), 1% Chlorhexidine gel (CHX1), 2% Chlorhexidine gel (CHX2) and Propolis (P) for Candida albicans at 24 hours

	N	Mean value	Std. Deviation	F-value	P-value
C	10	0.00	0.00	22536.64	<0.001
CHX1	10	23.72	0.36		
CHX2	10	27.12	0.51		
P	10	0.00	0.00		

Table 5 : One-way ANOVA for the comparison of mean zone of inhibition (in mm), for Propylene glycol, Control (C), 1% Chlorhexidine gel (CHX1), 2% Chlorhexidine gel (CHX2) and Propolis (P) for Candida albicans at 72 hrs and 7 days.

	N	Mean value	Std. Deviation	F-value	P-value
C	10	0.00	0.00	9225.27	<0.001
CHX1	10	23.72	0.36		
CHX2	10	27.12	0.51		
P	10	11.75	0.52		



Graph 1
1- Comparative zones of inhibition formed by Chlorhexidine 1%
2- Comparative zones of inhibition formed by Chlorhexidine 2%
3- Comparative zones of inhibition formed by Propolis
Series 1- Enterococcus faecalis
Series 2- Staphylococcus aureus
Series 3-Candida albicans

for all test time periods.**(Table 4, 5)**.
E. faecalis was the most resistant organism showing the smallest zones of inhibition, followed by C. albicans, while, S. aureus was the most susceptible with largest zones of inhibition for all test medications at all test time periods. This difference was statistically highly significant ($p<0.001$) **(Graph 1)**.

Discussion

The present study investigated the antimicrobial efficacy of 1% and 2% chlorhexidine gels and propolis against E. faecalis, S. aureus and C. albicans. In a study by Lin et al[12] (2003) it was stated that chlorhexidine should remain within the root canal for 7 days in order to reach a distance of 500 microns within the tubules to achieve adequate disinfection, as E. faecalis can reach the tubules up to a depth of 300-400 microns after a 3-week incubation period[13] and a depth of 500-700 microns after 60 days of incubation.[14] It is also not always possible to complete the root canal treatment in a single sitting, so an inter-appointment dressing is needed to keep the canal free of the bacteria within appointments.

Therefore, the short term and long term effect of the medicaments was evaluated for 24 hrs, 72 hrs and 7 days.

Mueller-Hinton agar was used for testing the efficacy of the medicaments as it has a neutral pH (7.2-7.4), and does not affect the efficacy of the medicament due to a difference in pH of the medium. 2% glucose was added to Mueller-Hinton agar for inoculation of C. albicans, since C. albicans is a slow growing organism and an enriched media is required to obtain its growth in subculture. The inoculum was standardized to 0.5 McFarland scale using a barium sulphate standard, so that each time a fixed number of microorganisms were seeded onto the agar plates. There is no universal agreement on the size of the wells made in agar, but the usual antibiotic discs used in antibiotic sensitivity testing have a fixed diameter of 6mm, therefore, the well size was standardized to 6mm diameter and 5mm depth of the agar medium and fixed amount of medicament, i.e. 50 micro-litres was added to each well made in agar, in order to reduce the chances of error owing to difference in the amount of medication or size of sample.[15]

Chlorhexidine was used as it has multiple benefits, one of the main benefit being its substantivity which is conferred to the root dentin for a period of 12 weeks according to Rosenthal et al (2004).[16] Unlike the conventional medicaments, the positively charged molecules of chlorhexidine can adsorb onto dentin and prevent microbial colonization due to its substantive property. It can also be used in cases where the root formation is incomplete due to its marked bio-compatibility.

Chlorhexidine is a cationic bisguanide that seems to act by adsorbing onto the cell wall of the microorganisms and causing leakage of intracellular components. The miminum inhibitory concentration (MIC) of chlorhexidine has been reported to be up to 256 microgram/ml for aerobic and facultative anaerobic microorganisms.[17]

At lower concentration, small molecule weight substances leak out, resulting in a bacteriostatic effect. At higher concentration, it has a bactericidal effect due to the precipitation and/or coagulation of the cytoplasm, probably caused by protein cross-linking. Thus, the effect of chlorhexidine is proportional to its concentration, as greater numbers of chlorhexidine molecules are available by using higher concentrations.[18]

In the present study, chlorhexidine concentration of 1% and 2% is much higher than the minimum inhibitory concentration for facultative anaerobic and aerobic microorganisms. So, the effect of 1% chlorhexidine gel and 2% chlorhexidine gel seen in the present study is essentially bactericidal in nature with 2% chlorhexidine gel showing better efficacy. The concentration of chlorhexidine upto 2% is considered to be biologically safe.[1]

Propolis showed inhibition against S. aureus at all test time periods.Takaisi-Kikuni and Schilcher observed the mode of action of propolis on Streptococcus agalactiae, by electron microscopic and micro-calorimetric modes. They observed that propolis inhibited bacterial growth by preventing cell division. In addition, propolis disorganized the cytoplasm, cytoplasmic membrane and the cell wall, caused a partial bacteriolysis and inhibited protein synthesis.[19]

There was no activity of propolis seen at 24 hrs for Candida albicans. Faint growth of the yeast was seen at 24 hrs within the halo formed by diffusion of propolis. While at 72 hrs, thick Candidal growth was observed on the agar plates except a well demarcated zone around propolis in which faint growth that was seen at 24 hrs persisted. This zone remained unchanged at 7 days, with no growth of the yeast cells within the halo. A possible explanation for this may be that propolis exerted a fungistatic activity against Candida albicans and the effect of the medicament did not appear for several generation times, so faint growth was seen at 24 hrs which was soon halted by the action of propolis, as checked at 72 hrs and till the 7 day time period.[20]

The possible mechanism of the antifungal action was studied by Mello et al. It was suggested that the effect of propolis on fungi was attributed to its interaction with cellular sulphydryl compounds, thus having a deleterious effect on the integrity of the cell wall.[21]

Propolis as a medicament showed no zone of inhibition for Enterococcus faecalis at all time periods. A study by Kosalec et al (2005), in which the flavonoid content and the antimicrobial activity was evaluated for ten commercially available ethanolic

solutions of propolis, on six bacteria and one yeast showed that, the largest zones of inhibition were obtained for Staphylococcus aureus and the smallest for Enterococcus faecalis with some extracts showing no activity on Enterococcus faecalis. It was concluded that this was due to a low concentration of bactericidal flavonoids in the product.[22]

In the present study as well, the lower content of flavonoids in the propolis sample used, or their reduced solubility in propylene glycol used as a solvent, or diffusibility through the agar medium may have been responsible for the lack of effectivity against Enterococcus faecalis.

In-vitro studies have their limitations. Endodontic infections are primarily polymicrobial. The medicament that is effective against a single microbe in vitro, may not necessarily be effective against the same microbe in vivo since the root canal system has multiple microorganisms in a well organized bio-film. Also, the buffering capacity of dentin, the presence of exudates, all has a bearing on the effectivity of the medication.

Agar diffusion test is a simple and inexpensive test for the comparison of the drugs having a similar diffusion gradient. The present study wherein propylene glycol was the vehicle for all test medicaments, justifies the direct comparison of the efficacy of the medicaments by use of the agar diffusion test.

But the results of the agar diffusion method, depend upon the molecular size, solubility and diffusion of the materials through the aqueous agar medium, the sensitivity of the drug, the bacterial source (wild strain or collection sample), the number of bacteria inoculated, the pH of the substrates in plates, agar viscosity, storage conditions of agar plates, incubation time and metabolic activity of the microorganisms.[11]

Thus the results of the agar-diffusion test cannot be directly extrapolated to the clinical conditions.In the agar diffusion test, the size of the microbial inhibition zone depends upon the solubility and diffusibility of the test substance and, therefore, may not express the medicament's full effective potential. The direct exposure test is correlated to substance effectiveness and has direct contact with the microorganisms, it seems to be independent of the other variables and appears to be a practical laboratory test as well. Clinical trails using propolis as an intracanal medicament on failed endodontic cases or persistent non-healing lesions would give a better understanding on the effectiveness of propolis.

Also, before accepting or abandoning propolis as an intracanal medicament, it becomes imperative to understand that the flavonoid composition of propolis is both quantitatively and qualitatively different, depending on the region from where it is collected. Thus, the activity of propolis may also vary. Therefore, it would be important to set guidelines of standardization and quality control of crude form of propolis, which is used to manufacture dental products.

Conclusion

The present study suggests that 2% chlorhexidine gel as intracanal medicament has a significant antimicrobial effect against E. faecalis, C. albicans and S. aureus. It is more effective than 1% chlorhexidine gel and Propolis for 7 days.

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Examination And Correlation Of Facial Midline And Skeletal Midline To Dental Midline By Photographic And Radiographic Anaylsis Respectively.

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Abstract

Aims

The aim of the present study is to examine and evaluate the amount of facial midline deviation to the dental midline through photographs, amount of skeletal midline deviation to the dental midline through radiographs, the amount and sidedness of deviation in overlapping facial and skeletal images.

Materials and Methodology

The following materials are used for the study SLR camera, tripod stand, x-ray viewer, frontal cephalograms, panoramic x ray unit, manual set-up simulating the parallelism of the ala-tragus line of the subject to the floor, adobe Photoshop CS2 Version, paintshop Pro version. The methodology includes the obtaining the smiling photographs with standard head positions of the sample and also PA radiographs are obtained and using the Adobe photoshop and Paint pro software the facial midline, skeletal midline and dental midlines are cephalometrically traced and the amount of deviation is noted.

Results

The amounts of deviations thus obtained are statistically analyzed using paired T-test and Pearson Chi-square test of the total sample size. The results showed statistically significance values in the overlapping images of the sample with significance value ^5; = 0.01 (P<0.01).

Conclusion

The male subjects showed the greater percentage in the amount the facial midline deviation and skeletal midline deviation than the females, whereas the coincidence of facial and skeletal midlines in males and females are similar in percentage. No significant correlation exist between the amount of facial midline deviation and skeletal midline deviation to dental midline but when the both the facial and skeletal images are overlapped the results obtained are statistically significant in determining the sidedness of deviation in females and males proper.

Key Words

Skeletal midline, Dental midline, Facial midline, Interpupillary line, Esthetic smile

Introduction

Aesthetically, the midline is the most important crucial spot in a smile. Esthetics in dentistry has become a major concern for patients and often serves as a predominant reason for seeking dental care. Although perfect bilateral symmetry will not exist in living organisms, it is one of the most important factors in defining the attractiveness of a smile. A properly placed midline contributes to the desirable effect of balance and harmony of the dental composition[1].

Towards the end of 19th century, several attempts have been made to find and correlate quantitatively the facial midline(FM) and skeletal midline(SM), with the help of landmarks which fall in the middle of the facial and skeletal images and correlating these midline landmarks with the dental midline(DM) to find the amount of deviation through both the photographic and radiographic forms respectively

Lundstrom(1961) in his study on the asymmetries in the dental arches and face, explained that asymmetric can be genetic or non genetic in origin and is usually a combination of both[2]. Golub (1988) reported that the DM perpendicular to the interpupillary line offers one of the most striking contrasts serving to anchor the smile of the face[3].

Avinash Bindra et al in the year 2009 has conducted a study on the relationship of the facial anatomic landmarks with the midline of the face and mouth, stated the hierarchy of anatomic landmarks closest to the midline of the face are i) Midline of the commissure, ii) DM iii) Tip of the philtrum iv) Nasion and v) Tip of the nose[4].

DM is the imaginary line that will separate the two maxillary central incisors. Dental authors who have addressed themselves to this matter revealed a division of thought: One school of thought recommends that the midline of the anterior teeth to be placed precisely in the facial median line or the middle of the mouth using such landmarks as the incisive papilla and the labial frenum to establish it. Members of another school believe that the DM should almost never be established in the precise middle of the mouth because to do so contributes to an artificial appearance[5].

Aims & Objectives

The present clinical study has been conducted to evaluate the following criteria.

1. Examining and evaluating the amount of FM deviation to the DM through photographs.
2. Examining and evaluating the amount of SM deviation to the DM through radiographs.
3. Examining and evaluating both the FM and SM deviations simultaneously by Adobe Photoshop software.

Materials & Methods

Following list of materials were used for the study

1. List of materials used for examination of the subjects.
   a) Mouth mirror
   b) Explorer
   c) Periodontal probe [Graduated]
2. List of materials used for taking photographs of the sample
   a) Nikon D3000 SLR camera.
   b) Tripod tron tpt-30.
   c) Surgical Spirit.
   d) X ray viewer.
   e) Frontal cephalogram of skull radiographs of the sample.
   f) Panoramic x ray unit
   g) Manual set-up simulating the parallelism of the ala-tragus line of the subject to the floor.
3. Materials used for editing the photographs
   a) Laptop – Acer 4720Z
   b) Adobe Photoshop CS2 Version 9
   c) Paint shop Pro version.

For the present study the sample size of fifty (50) has been taken of which the male and female subject are proportional in quantity

Study Was Carried Out In The Following Manner

1. Selection of subjects was done.
2. Frontal cephalograms of subjects were taken.
3. Photographs of frontal cephalograms of the skull were taken.
4. Photograph of the subjects were taken.
5. Amount of midline deviation of the facial photographs of the sample were noted.
6. Amount of midline deviation of the frontal cephalogram of the skull of the same sample were noted.
7. With the help of digital photographic software, the digital images of the frontal cephalograms and the respective facial images were overlapped and the sides of the deviations were determined.

Criteria For Selection Of Subjects

Exclusion Criteria

1. Subjects having gross facial asymmetry due to trauma or congenital conditions.
2. Subjects with history of trauma to the head and neck.
3. Subjects underwent orthodontic, endodontic, periodontic and prosthodontic treatment.
4. Subjects having attrition, erosion and abrasions of the anterior teeth.
5. Subjects with crowding, overlapping, tipping, spacing(including diastemas), retained deciduous teeth and rotations of anterior teeth.
6. Subjects with congenital defects of lips or anterior maxillae or who had corrective oral surgery of the region.
7. Images with rotations of head around the vertical axis, ophthalmic asymmetries, inaccurate clinical markings and images without a good resolution.

Inclusion Criteria

1. The randomized sample obtained from the people who have hailed from different places of this state to Government Dental College & Hospital, Hyderabad.
2. The sample had permanent teeth with no history of extraction for orthodontic treatment or any other reason.
3. All the teeth were morphologically normal.
4. No gingival inflammation or hypertrophy present.
5. Subjects with average smile line revealing 75-100% of the maxillary anterior teeth

Methodology

Determination Of Sample Size

As an initial step, a pilot study was conducted to calculate the sample size. For this purpose, five photographs of the frontal view of the face and frontal view of the skull were analyzed and based on the measurement obtained the calculations were established. With the help of the software "Adobe Photoshop CS2 Version 9" and with statistical significance of 95% and power 90%, the sample size indicator formula is applied and the sample size (N) of fifty (50) is established. The randomized samples of both the genders of equal quantity (Male=25: Female=25) participated in the study with age ranged from 18 years to 30 years with a mean age of 24years.

The study was carried out in three parts, first part includes the determination of SM deviation to the DM, the second part includes the determination of FM deviation to the DM and the third part includes the amount of facial and SM deviation in the overlapped images of photograph and the cephalogram.

Sm Of The Skull

The horizontal reference line was defined as the line connecting the right and left latero-orbitales[6]. The line perpendicular to the horizontal reference line passing through the crista galli and the anterior nasal spine was considered as vertical reference line. This vertical reference line should bisect the nasal septum, anterior nasal spine, glabella, maxillary and mandibular midlines and the menton[7].

Soft-tissue(Facial) Midline Of The Face

The FM is defined as the perpendicular bisector of the line between the centers of the left and right pupils[8],[9],[10].

Obtaining The Extra Oral Radiograph

The frontal cephalogram of the skull(PA view) has been taken using the panoramic X ray machine (PLANMECA, PLANMECA EC PANAROMIC x ray unit, Version 12 software PK 15, Helsinki, Finland). Frontal cephalograms were taken with 70Kv, 12mA and 1.2seconds in postero-anterior (PA) projections with a distance of 180cm between the x ray focus and the film[11]. The postero-anterior cephalograms were printed on a film at 1.08 magnifications on 8X10 inch films. A frontal cephalogram (PA) was obtained with each subject in centric occlusion. The subjects head position is standardized by positioning cones so that the ends of the ear posts are level with the external auditory meatus. Position the subject between the two ear posts. Adjust the tilt of the patients so that the Frankfurt plane is parallel to the floor (tragus to the infra orbital margin)[12].

The frontal cephalogram of the skull of the sample has been taken. The frontal cephalogram of the skull shows distinguishable midline landmarks which are symmetrical and stable. The landmarks are glabella, anterior nasal spine, menton and the base of the crista galli[13]. The other landmarks which are readily identifiable are lateral borders of the orbits, the point gonion, the anterior cranial base and the lesser wing of sphenoid.

Obtaining The Photograph Of Subjects

Full face images of the subjects were made in a frontal view with all subjects in smiling position. A specially designed device resembling a face bow mounted on a stand **(Fig.1)** was used to standardize the photographic conditions. Each subject was seated in a dental chair with the natural head position and the occlusal plane of the maxillary teeth parallel to the floor[14]. The stabilizer was adjusted to the

Figure : 1

subject by fitting the ear pieces into the external auditory canals. In addition, a third point of reference has been taken at the infraorbital margin, parallel to the floor. The photographs were made with a constant focal distance and under a standard light source using the Nikon D3000 SLR digital camera (10.1megapixels, 10X optical zoom: Nikon USA, Melville, NY). The height of the lens of the camera was adjusted on the tripod to match the eye level of the subject when seated upright with shoulders and head held straight and facing forward[15]. As the subject looked straight ahead at the lens of the camera on a tripod, the natural head position was standardized along both horizontal and vertical axes. The photographs thus obtained are stored in the JPEG format in the computer.

Amount Of Fm Deviation-photometric Evaluation

After obtaining the standardized full face photographs of the subjects. With the help of Adobe Photoshop CS2 version, tracing of the photographs are done. The center of the pupils of both eyes is joined and the line thus obtained is referred as horizontal reference line. The center of philtrum is taken as another reliable midline landmark and used to draw a line perpendicular to the horizontal reference line. This perpendicular line is referred as midsagittal reference line. Another perpendicular line is drawn taking the middle of both the maxillary central incisors to the horizontal reference line[9]. This line is referred to as DM and is in parallel to the midsagittal reference line. The amount of deviation (mm) is noted from the mid-sagittal reference line to the DM **(Fig.2)**.

Amount Of Sm Deviation-radiographic Evaluation

After obtaining the standardized frontal cephalograms of the skull photographs of the subjects, maintaining the same focal length distance as that taken for the facial

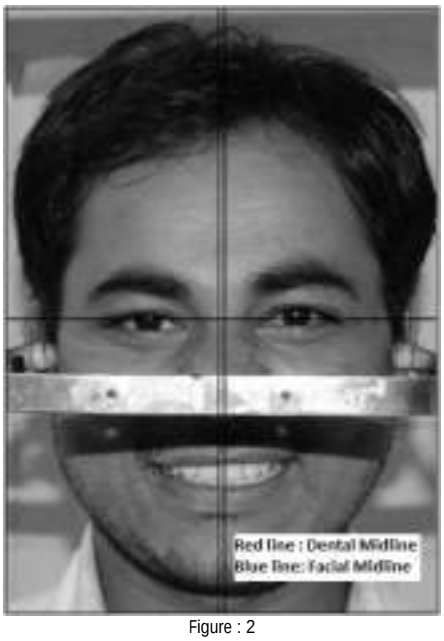

Figure : 2

photographs. Tracings of the photographs are done using the Adobe Photoshop CS2 software. The superior lateral orbits of both the contralateral sides are reliable landmarks and the horizontal line passing through both these points are referred as horizontal reference line[6]. The base of the crista galli and the anterior nasal spine are two midline landmarks through which the vertical line passes is referred as vertical reference line[7], which bisects the horizontal line. This vertical reference line is the SM of the skull. Another vertical line drawn parallel to the SM which bisects the median line of both central incisors and is also perpendicular to the horizontal reference line. With the help of the ruler in the Adobe Photoshop(CS2 version), the amount of deviation in mm is noted **(Fig.3)**. The data thus obtained are recorded for all the subjects.

Assessment Of Deviation Side Of Overlapped Photographic Images Of Face And Related Radiograph.

With the help of the Adobe Photoshop CS2 version, the digital images of both the face form and the radiograph are taken and are overlapped. The overlapping of the images is done in such a way that the DM of both images of the same subject is coincided. The overlapped images are made LIFE-LIKE size while maintaining the fixed aspect ratio **(Fig.4)**. Thus, the side of deviation of the subjects is recorded, whether the deviation side is on the same side or on the contralateral side of the DM is established.

Figure : 3

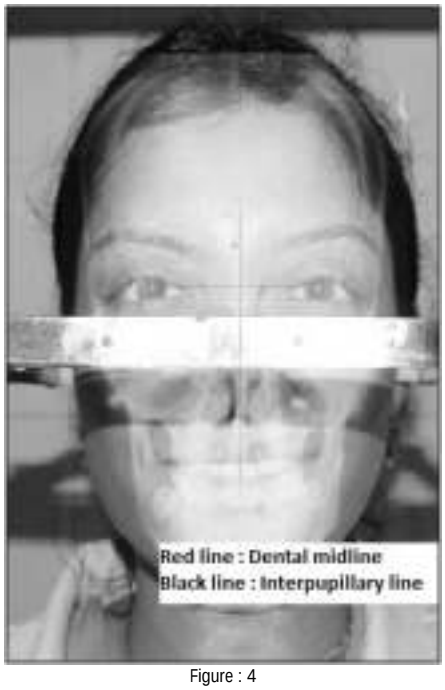

Figure : 4

Results & Discussion

The present study was aimed to examine and correlate the amount of FM deviation and SM deviation to the DM by photometric and radiographic analysis in both male and female samples. The FM, SM and the DM were taken as the basic criteria for the present study. Accordingly the subjects were selected and their photographs with smiling face forms and also the photographs of the frontal view of the skull radiographs were evaluated digitally.

Results thus obtained were tabulated and statistically compared by Paired T-Test

Table 1 : Amount Of Skeletal Midline Deviation In X-ray

Deviation In mm	Frequency In Sample	Percentage %
0.00	3	6.0
0.50	10	20.0
1.00	13	26.0
1.20	3	6.0
1.40	1	2.0
1.50	5	10.0
1.60	2	4.0
2.00	5	10.0
2.50	6	12.0
3.00	1	2.0
3.50	1	2.0
Total	50	100.0

Table 2 : Amount Of Facial Midline Deviation In Photograph.

Deviation in mm	Frequency In Sample	Percentage %
0.00	18	36.0
0.20	1	2.0
0.50	18	36.0
1.00	10	20.0
1.50	2	4.0
2.00	1	2.0
Total	50	100.0

Table 3 : Side Of Deviation In Overlapping Images.

Side Of Deviation	Frequency In Sample	Percentage %
Both (Same Side)	13	26.0
Coiniciding	2	4.0
Left	7	14.0
Right	28	56.0
Total	50	100

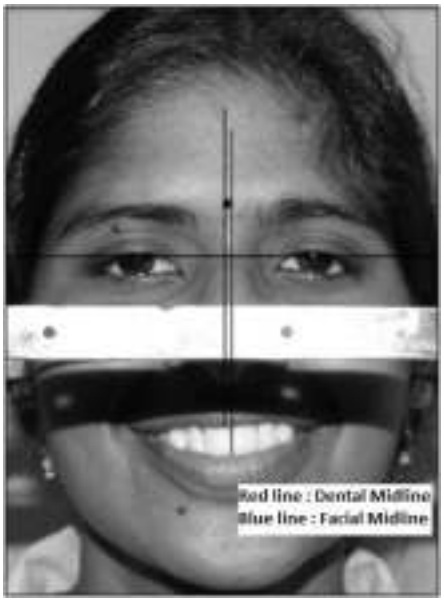

Figure : 5

and also by Chi- Square Test.

Table 1 : The amount of deviation in x rays ranges from 0mm to 3.5mm, with maximum of 26% of sample showed deviation of 1mm followed by 20% of the sample showing 0.5mm deviation and

Figure : 6

Figure : 7

with minimum of 3.5mm and 3.0mm of deviation is shown by 2% of the sample size.

Table 2 : The amount of deviation in photograph ranges from 0-2mm (in the sample), with maximum of 36% of sample showing deviation of 0.5mm followed by 1mm of deviation in 20% sample and with minimum sample size of 2% showing 2mm of deviation.

Table 3 : The images show right side deviation **(Fig.5)** in 56% of the sample size followed by deviation on both sides in 26% of sample size followed by left side deviation **(Fig.6)** in 14% of sample size and coincidence of both SM and FM to the DM in 4% sample **(Fig.7)**.

Table 4 : The statistical T-test with equal variance shows the skeletal deviation in X-ray has t=2.18 and for the deviation in photograph t=0.08. The ratio of mean values in skeletal deviation for females:males is 1.54:1.06 and ratio of mean values for females : males is 0.42 : 0.54.

Table 5 : The Pearson Chi- Square test in overlapping images show that the right side deviation is more(56% sample) followed by deviation both sides(26% sample) followed by left side deviation(14% sample) and shows a statistical significance value of 0.099.

Table 6 : Results showed that the Paired T test of the sample with mean of the amount of deviation in x rays shows 1.30 and that of the amount of deviation in photograph shows mean of 0.48. The paired samples test of both the amount of deviation in x ray and photographs shows mean of 0.82 and t value of 6.89 with degree of freedom of 49 shows statistical significant value of 0.01.

Conclusion

From the above study it can be concluded that no significant correlation exist between the amount of FM deviation to DM and the amount of SM deviation to DM but when the both the facial and

Table 4 : T-test For Determining The Amount Of Deviation In X-ray And Photograph Of Sample Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Amount Of Deviation In X Ray(mm)	Female	25	1.54	0.83	0.16
	Male	25	1.06	0.71	0.14
Amount Of Deviation In Photographs(mm)	Females	25	0.42	0.41	0.08
	Males	25	0.54	0.53	0.10

Independent Samples Test

		T-test for equality of means		
		T	Degree of freedom	Significance
Amount of deviation on x-ray(mm)	Equal variance assumed	2.18	48	0.034
Amount of deviation in photographs(mm)		0.82	48	0.41

Table 5 : Pearson Chi Square Test For Determining The Side Of Deviation Of Both Genders

			Side Of Deviation In Overlapping Images				Total
			Both	Coinciding	Left	Right	
Sex	Females	Count	5	0	2	18	25
		% within sex	20%	0	8%	72%	100%
	Males	Count	8	2	5	10	25
		% within sex	32%	8%	20%	40%	100%
Total		Count	13	2	7	28	50
		% within sex	26%	4%	14%	56%	100%

Pearson Chi-square Tests

	Value	Degree Of Freedom	Significance
Pearson Chi-square	6.26	3	0.099

Table 6 : Paired T-test For Determining The Amount Of Deviation In X-ray And The Photograph Of The Sample Paired Sample Statistics

Deviation	Mean	N	Std. Deviation	Std. Error Mean
Amount Of Deviation In X-ray(mm)	1.30	50	0.80	0.11
Amount Of Deviation In Photograph	0.48	50	0.48	0.06

Paired Sample Test

	Mean	T	Df	Significance
Amount of Deviation In Overlapping Images	0.82	6.89	49	0.001

Figure : 8

Figure : 9

skeletal images are overlapped the results obtained are statistically significant in determining the sidedness of deviation in females and males proper.

Among female and male subjects, males showed the greater percentage in the amount the FM deviation and SM deviation than the females, whereas the coincidence of FMs and SMs in males and females are similar in percentage.

Figure : 10

Based on the above results, the dentist can clinically arrive at certain conclusions. Although this method involves high technology, it may improve the accuracy of determining FM and its correlation in placing the DM in edentulous and partially edentulous patients. Other factors should also be evaluated along with face form, selection of teeth in order to achieve aesthetically pleasing result. As no universally accepted method for determining the DM is established, dentist must seek guidance from a variety of techniques using their clinical experience and esthetic sense to attain what is hoped will be an acceptable result.

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Study To Evaluate Prevalence, Severity And Extension Of Gingival Recession In Local Adult Population Of Sunam, Punjab.

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Abstract
Background And Aim
The aim of the present study was to evaluate the prevalence, extension and severity of the gingival recession in patients aged above 18 years, who sought dental treatment in a dental institution.
Materials And Method
The study was performed on 200 patients. All measurements of recession depth and width were done with a UNC-15 periodontal probe. Recessions were further scored following the criteria suggested by P.D Miller in 1985.
Results
Gingival recession was present in 59% of the total study sample and mean number of teeth with gingival recession was 8.20. The prevalence of gingival recession was 32%, 60%, 66% and 78% in age groups of 18-29 years, 30-39 years, 40-49 years and X05; 50 years respectively. In younger age groups Class I gingival recession was more prevalent whereas Class III and Class IV gingival recession was more prevalent in older age groups. Mandibular anteriors were the teeth most frequently affected by gingival recession.
Conclusion
High prevalence of gingival recession in adult subjects provides information about the importance of diagnosis, studying factors and clinical symptoms and the treatment management.
Key Words
Gingival Recession, Chronic Periodontitis, UNC-15 Probe

Introduction

Gingival recession is the most common and undesirable condition of the gingiva and its prevalence increases with age. It is characterized by displacement of gingival margin apically from cemento-enamel junction (CEJ) and exposure of root surface to the oral environment[1]. Gingival recession is defined as location of marginal periodontal tissues apical to cemento-enamel junction[2]. It can be localized or generalized and often is associated with one or more surfaces[1]. Gingival recession, often a source of anxiety to patients and perplexity to those treating them, is an intriguing and complex phenomenon[4]. Although many dental conditions pass by patients unnoticed, gingival recession can often be a visible dental change that is noted by patients and which may cause them to seek advice of a dentist. The prevalence of this condition is high, but in some patients, recession may be sign of periodontal disease. Therefore, prevention and control of gingival recession is based on an accurate survey of the prevalence of the condition in relation to the risk factors that contribute to its development[5]. Recession may exist in the presence of normal sulci and undiseased interdental crestal bone levels or may occur as the part of the pathogenesis of the periodontal disease where alveolar bone is lost[6]. The etiology of gingival recession is multifactorial. Several factors may play a role in recession development, such as excessive or inadequate tooth brushing, destructive periodontal disease, tooth malpositioning, alveolar bone dehiscence, thin marginal tissue covering a non-vascularized root surface, high muscle attachment, frenal pull and occlusal trauma. Other causative factors that have been reported are iatrogenic factors related to reconstructive, conservative, periodontologic, orthodontic or prosthetics treatment[7]. Despite common observation in adults; the prevalence, extension and degree of severity of gingival recession present considerable differences among various study populations. Prevalence indicates number of cases or occurrences of gingival recession; extension corresponds to the number of teeth affected by gingival recession; and severity signifies the total root surface exposed by the gingival recession, i.e. the linear apico-coronal height of the gingival recession[8]. The concern on these alterations is based on the potential consequences they may bring about, which affect not only oral health but also the general health. Following gingival recession, several complications like pain, tooth loss, loss of esthetic appearance, plaque retention, root caries and tooth abrasion may occur[9]. In addition to all clinical implications associated with the presence of gingival recession, such alterations have been regarded as the clinical manifestation of the periodontal attachment loss and may be an important aspect in the diagnosis of susceptibility to periodontal disease. Thus, perception of the occurrence of gingival recession in a given population is a basic need for their prevention and control and allows the proper planning of health centers based on information on the prevalence and severity of these lesions, in order to establish proper and

effective preventive programs that may control the onset and/or progression of gingival recession, as well as to avoid the complex local disturbances that may develop[10]. Several epidemiological studies on prevalence and severity of gingival recession have been conducted in Western population. Therefore, the present study was carried out to evaluate prevalence, severity and extension of gingival recession in local adult population sample of Sunam, Punjab.

Materials And Methods

The study population of the present study comprised of 200 patients aged above 18 years who sought dental treatment at Guru Nanak Dev Dental College and Research Institute, Sunam, Punjab. All participants were informed about the evaluation to which they would be submitted. The subjects of both genders were divided in 4 groups according to the age range: Group I : 18 to 29 years: 50 patients; Group II : 30 to 39 years: 50 patients; Group III : 40 to 49 years: 50 patients; Group IV : >50 years: 50 patients. The selection criteria comprised a mean number of 20 natural teeth, since large numbers of missing teeth might interfere with the results of this study. The participants of the present study were evaluated by a single examiner, who was not submitted to any previous calibration.

Exclusion Criteria

Third molars were excluded from the study. Patients with systemic disease and smokers were also excluded.

Method

A millimetered periodontal probe marked up to 15 mm, UNC-15, Hu-Friedy, was employed for evaluation of the teeth of each subject by a single examiner, concerning the presence of gingival recession, which was recorded whenever there was more than 1 mm of root surface exposed. Two surfaces were evaluated in each tooth: buccal and lingual, and linear measurements were obtained from the cementoenamel junction up to the gingival margin in the teeth presenting with gingival recession, in order to evaluate the vertical (apicocoronal) width of the recession.

Vertical Component

Linear measurements were obtained from the cementoenamel junction upto the gingival margin in the teeth presenting with gingival recession. In cases where the cementoenamel junction was covered by calculus, hidden by a restoration or lost due to caries or wear lesions, the location of such junction was estimated on the basis of the adjacent teeth, similar to a previously used methodology. Three categories were established according to apico-occlusal dimension of the root surface exposed by gingival recession; mild recessions: less than 3 mm of root surface exposed; moderate recessions: 3 to 4 mm of root surface exposed; advanced recessions: more than 4 mm of root surface exposed to the oral environment. Gingival recession was recorded according to P.D Miller's classification of marginal tissue recession[11].

Horizontal Component

Measurement was taken as proportion of root exposed at the level of cementoenamel junction. The criteria for scoring of horizontal component was as follows:

- Score 0 : no clinical evidence of root exposure
- Score 1 : exposure upto 10%
- Score 2 : exposure >10% but not exceeding 25%
- Score 3 : exposure > 25% but not exceeding 50%
- Score 4 : exposure > 50% but not exceeding 75%
- Score 5 : exposure > 75% upto 100%

Statistical Analysis

The recorded data was compiled and subjected to statistical analysis using Chi-Square test. Normality of quantitative data was checked by measures of Kolmogorov Smirnov tests of normality. A p- value of < 0.0001 was considered to indicate statistical significance. All calculations were performed using SPSS® version 17 (Statistical Packages for the Social Sciences, Chicago, IL).

Results

The study revealed gingival recession in 118 subjects out of 200, which is 59% of the total sample examined. Among 5123 teeth of the 200 subjects examined; 1640 teeth displayed gingival recession corresponding to 32.01% of the total teeth examined. Among all the subjects, mean number of teeth with gingival recession was 8.20 and gingival recession was observed in 2359 sites with the mean number of sites of gingival recession per subject as 11.79 **(Table I)**. Results show that the prevalence of gingival recession increased significantly with age. Among the study sample, the prevalence of gingival recession increased from 32% in age group of 18-29 years to 60% in 30-39 years, 66% in 40-49 years and 78% in age group > 50 years. Increase in age also led to increase in the mean number of teeth with gingival recession. Similarly the extension of gingival recession was also found to be increased with age. The mean number of teeth with gingival recession per subject at 18-29 years age group (2.90) was significantly less than at the age groups above 50 years (12.9) **(Table I)**. The results also show that there was a significant difference in distribution of Miller classes and the age groups. In age groups 18-29 and 30-39 years, Class I gingival recession was more prevalent i.e 86.89% and 67.25% respectively whereas Class III and Class IV gingival recessions were more prevalent in older age groups **(Table II)**. Only 2.75% of subjects of age groups 18-29 years had Class IV gingival recession as compared to 42.48% at the age groups above 50 years; at the older age groups more than 50 years; Class III and Class IV gingival recessions were 36.12% and 42.48% respectively, whereas only 19.69% subjects had Class II gingival recession and 1.70% subjects had Class I gingival recession **(Table II)**. Mandibular anterior teeth i.e central incisors, lateral incisors

Table I: Prevalence And Extension Of Gingival Recession According To Age Group

		Prevalence			Extension		
Age (years)	Number of subjects	Total number of teeth	% subjects	Number of teeth with GR	Mean number of teeth with GR/subjects	Number of sites with GR	Mean number of sites of GR/subjects
18-29	50	1400	32	145(10.35%)	2.90	170	3.40
30-39	50	1260	60	284(22.53%)	5.68	364	7.28
40-49	50	1249	66	566(45.31%)	11.32	804	16.08
> 50	50	1214	78	645(33.97%)	12.9	1021	20.42
Total	200	5123	59	1640(32.01%)	8.20	2359	11.79

Table II: Scoring Of Severity Of Gingival Recession According To P.D. Miller Criteria 1985

Gingival Recession									
Age Groups (Years)	Class I		Class Ii		Class Iii		Class Iv		Total
	No	%	No	%	No	%	No	%	
18-29	126	86.89	10	6.89	5	3.44	4	2.75	145
30-39	191	67.25	65	22.8	18	6.33	10	3.52	284
40-49	186	32.86	152	26.85	188	33.21	40	7.06	566
> 50	11	1.70	127	19.69	233	36.12	274	42.48	645
Total	514	31.34	354	21.58	444	27.07	328	20	1640

Chi Sq. = 836.74; P-val. = <.0001 Highly Significant

Table III: Intraoral Distribution Of Gingival Recession

%	0.13	1.00	0.31	0.38	1.14	1.22	1.51	1.40	1.10	1.22	0.37	0.28	0.81	0.19
Teeth	17	16	15	14	13	12	11	21	22	23	24	25	26	27
	47	46	45	44	43	42	41	31	32	33	34	35	36	37
%	0.09	0.71	0.45	0.78	9.72	8.83	8.83	10.8	7.42	6.86	0.59	0.43	0.68	0.10

Table IV: Percentage Severity Of Gingival Recession According To Age Groups (Vertical Dimension)

Age Group	Gingival	Gingival	Gingival
(Years)	Recession < 3mm	Recession 3-4mm	Recession >4mm
18-29	79.53	17.03	3.44
30-39	59.15	31.33	9.52
40-49	13.42	56.25	30.33
> 50	9.69	58.13	32.18

Chi Sq. = ; 520.52 P-val. = <.0001 Highly Significant

Table V: Percentage Severity Of Gingival Recession According To Age Groups (Horizontal Dimension)

Age Group	Score 1	Score 2	Score 3	Score 4	Score 5
(Years)	< 10%	10-25%	25-50%	50-75%	75-100%
18-29	6.2	43.4	39.3	10.3	0.69
30-39	2.8	28.1	48.2	13.02	7.7
40-49	0.5	8.3	66.6	19.4	5.1
> 50	0.3	7.4	66.6	17.3	8.21

Chi Sq. = 242.02; P-val. = <.0001 Highly Significant

and canines revealed more gingival recession as compared to rest of the teeth **(Table III)**. It was noted that the gingival recession (based on apico-coronal height of recession) increased with age. Only 3.44% of teeth were affected by severe form of gingival recession (> 4 mm) at the age group of 18-29 years as compared to 32.18% at the age groups above 50 years **(Table IV)**. 43.4% of teeth at age group of 18-29 years showed horizontal recession extending from 10-25% whereas with increasing age i.e in age group of 40- 49 years and above 50 years, horizontal recession of 25-50% was seen in 66.6% teeth **(Table V)**. All these results clearly indicate that the prevalence, extension and severity of gingival recession increased with increasing age.

Discussion

Several epidemiological studies reveal important information on prevalence and severity of gingival recession and can be used to predict the disease pattern, progression and treatment needs etc. In the present study, the overall prevalence of gingival recession was found to be 59%. Significant association was found between gingival recession and age. It was observed that severity of gingival recession increased with age. Least prevalence was seen in Group I with age 18-29 years (32%) and highest prevalence was seen in Group IV with age > 50 years (78%). The reason could be related to poor oral hygiene among the participants; population being rural. This negligence of oral hygiene thus tends to increase the pocket depth and loss of attachment. Gorman WG (1967) and Murray JJ (1973) also reported similar findings[12],[13]. The relationship between increased prevalence of gingival recession and age may probably be because of the longer period of exposure to agents that cause gingival recession, associated to intrinsic changes in the organism, both local and systemic, besides the cumulative effects of the lesion itself[10]. Gingival recession in young patients is usually localized, which seems to be the result of isolated etiological factors. As the age increases, gingival recession becomes more generalized in distribution (prevalence, extension and severity increases) which may be due to cumulative effect of local factors. The main precipitating factors of gingival recession are bacterial plaque, mechanical trauma related to the employment of hard-bristled toothbrushes, brushing technique and frequency of toothbrushing, orthodontic therapy and chemical trauma, primarily related to smoking. Other factors that favour the occurrence of gingival recession are functionally unsatisfactory quantity and quality of attached gingiva, bone dehiscence, buccal tipping, high frenum attachment and traumatic occlusion[10]. In the present study, gingival recession was found to be more prevalent in the mandibular anterior teeth. Similar results were seen in the studies performed by Vehkalathi M et al 1989, Guimaraes MG and Aguiar EG 2012, Humagain M and Kafle D 2013 and Anarthe R et al 2013[14],[15],[8],[1].

Maxillary teeth were found to be less frequently affected by gingival recession (1.5%) which may be related to the characteristics of keratinized mucosa, which is wider and thicker in maxilla than in the mandible[8]. Areas with deficient keratinized mucosa, especially as regards thickness, have been demonstrated to be more susceptible to gingival recession, especially due to smaller amount of connective tissue available in the area, that leads to localized inflammatory reactions triggered by different processes to be able to affect the entire extension of the tissue, ultimately leading to gingival recession[10]. However, studies by Gorman WJ et al in 1967 and Chrysanthakopoulos NA in 2010 showed a higher prevalence of recession in maxillary teeth which maybe due to faulty toothbrushing or due to thin or absent bone plates[12],[16]. Checchi L et al in 1999 found that in the age group of 19-25 years old, canines of both jaws were the teeth most frequently affected by gingival recession[17]. Murray JJ in 2006 showed that the most frequently affected teeth were mandibular incisors followed by first maxillary molars, first mandibular molars, premolars of both jaws, second maxillary molars, second mandibular molars and canines of the mandible[13]. As regards the teeth most frequently affected by gingival recession, no agreement is observed in literature. Watson PJC in 1984 indicated the maxillary canines and premolars to be most affected as they have a prominent position in jaw[18]. No significant differences were observed in the occurrence of gingival recession at the right and left sides which is in agreement with the findings of Vehkalathi M (2011) and Anarthe R et al (2013)[14],[1]. In our study, Miller's Class I recession was the most prevalent in Group I (86.89%) whereas Class III and Class IV recessions were more prevalent in Group IV (36.12% and 42.48%). In agreement to the findings of other epidemiological studies, the present study also yields the finding that the prevalence, extension and severity of gingival recession

increases with age.

Conclusion

Gingival recession is most commonly occurring periodontal condition. It mainly occurs due to faulty oral hygiene practices by the patients, it causes alarming conditions like tooth sensitivity, food lodgment, plaque retention and esthetic problems. The prevalence of gingival recession was found out to be 59% in the local population of Sunam, Punjab. In subjects below 40 years of the age class I and class II gingival recessions were more prevalent whereas in those above 40 years, class III and class IV gingival recessions were more prevalent. The mandibular anterior teeth were the most affected teeth with gingival recession. There is necessity to do the longitudinal studies for exact assessment of prevalence, extension and severity gingival recession. Present study is conducted to assess gingival recession in the rural population so that dental practitioners and dental hygienist should take more efforts to educate the patients regarding oral hygiene practices for the prevention of such conditions in periodontium and if the condition has started, it should be treated immediately to avoid the further complications.

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Comparative Evaluation Of Antimicrobial Activity Of Different Herbal Extracts And 2% Chlorhexidine Gluconate Against E. Faecalis & C. Albicans: An In Vitro Study.

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Abstract
AIM
To compare anti-microbial efficacy of herbal extracts with that of 2 % Chlorhexidine against Enterococcus faecalis and Candida albicans.
Material and Methods
The antimicrobial activity was determined using agar diffusion test. Samples were divided into 4 groups : Group A 2% Chlorhexidine Gluconate (positive control), Group B – 5% garlic extract, Group C- 5% turmeric extract Group and Group D– Distilled water (negative control). The zones of inhibition of growth were recorded.
Statistical Analysis Used
Statistical analysis was performed using One way Anova with post-Hoc Turkey's HSD and was statistically significant ($P < 0.05$).
Result
Maximum inhibitory effect against Enterococcus faecalis was shown by Chlorhexidine followed by turmeric and then garlic. Maximum antimicrobial activity against Candida albicans was shown by garlic followed by Chlorhexidine and then turmeric. Conclusion Herbal extracts showed significant inhibitory effects against Enterococcus faecalis and Candida albicans which are comparable with 2% Chlorhexidine.

Key Words
Herbal Extracts, Candida Albicans, Enterococcus Faecalis, Chlorhexidine

Introduction

The role of microorganisms and their byproducts in the initiation and perpetuation of pulpal and periapical pathology has been well established. The main objective of endodontic treatment is the elimination of infected pulp tissue and microorganisms from the root canal system and prevention of subsequent re-infection to achieve complete peri-radicular healing.[1]

It is generally believed that the major cause of post-treatment disease after root canal treatment is the persistence of microorganisms in the apical part of the root canal of root filled teeth.[2] Enterococcus faecalis and Candida albicans are the most commonly isolated species in persistent root canal infections.[3]

Enterococcus faecalisaccounts for up to 22 to 77% of therapeutic failures because of its inherent ability to tolerate starvation and extreme pH (upto11.5), salt concentration, bio-film formation, dentin tubular invasion and emergence of antibiotic resistance.[4]

Candida albicanshas been isolated in persistent root canal infections is 2.9 to 22.2 % of cases. Its ability to form biofilm by adhering to the dental tissues utilizing its hyphae to penetrate into the dentinal tubule as well as secretion of proteases and hydrolytic enzymes add to its pathogenicity.[5]

Complete debridement and adequate elimination of microbial irritants is a fundamental prerequisite for successful endodontic therapy. Among the procedures involved in the control of endodontic infection, irrigation is an important step in eliminating micro-organisms from the root canal system. An ideal root canal irrigant should have potent anti-microbial activity, ability to dissolve remaining pulp tissues as well as should be non-toxic and non-carcinogenic. It should be relatively inexpensive, easily available and convenient to apply.[6]

Chlorhexidine Gluconate, a cationic bis-guanide is a broad spectrum antimicrobial agent and is effective bactericidal and fungicidal agent. It has been used as an irrigant and intracanal medicament in endodontics in concentration of 2 %.[7] A major advantage of Chlorhexidine is its substantively, which allows prolonged residual antimicrobial effect.

2% Chlorhexidine solution is irritating to the skin and have toxic effect on host tissue if expressed beyond the confines of root canal. In addition, its cytotoxic effects on human osteoblasts might indicate its ability to impair the regenerative potential of the periapical tissues and can thus impairs healing.[8]

The constant increase in antibiotic resistant strains and side effects caused by synthetic drugs has prompted researchers to look for herbal alternatives. The importance of this problem has been emphasized in WHO World Health Day theme for the year 2011 "COMBAT ANTIBIOTIC RESITANCE".[9]

With time plant extracts have been understood to encompass the attributes accounted not only for their fragrance and flavor but also for their antimicrobial nature. Various natural plant extracts

have known antimicrobial and therapeutic effects suggesting their potential to be used as an endodontic irrigant. Phytochemical extracts such as Curcuma longa (turmeric) and Allium sativum (garlic) consists of active ingredients like Curcumin and Allicin respectively which have anti microbial, anti inflammatory and anti-oxidant properties.[10],[11]

The efficacy of these herbal extracts has been evaluated in the present study for their antimicrobial activity against Enterococcus faecalis and Candida albicans (the most resistant endodontic pathogens) to assess their possible future use as root canal irrigant/medicament.

Materials and Methods

In the present study, the aqueous extracts of Garlic and turmeric were taken as the experimental groups for their antimicrobial effect, whereas 2% Chlorhexidine Gluconate was taken as positive control and distilled water as negative control. Enterococcus faecalis (MTCC 439) and Candida albicans (MTCC 854) strains were used in this study to check antimicrobial activity.

Groups were divided as under:

Group A- 2% Chlorhexidine Gluconate (Positive control)

Group B – 5% Garlic extract (Experimental group)

Group C- 5% Turmeric extract (Experimental group)

Group D- Distilled water (negative control)

Preparation of extracts: Whole plants of garlic and turmeric were procured from botanical Gardens of Himachal Institute of Dental Sciences (HIDS), Paonta Sahib (H.P) and were cleaned using distilled water. Fresh peeled cloves of garlic and rhizomes of turmeric were shade dried and powdered in a mechanical grinder. 5 grams each of air-dried garlic and turmeric powder were macerated with 100 ml of distilled water. The homogenate of garlic and turmeric powder was filtered using Whatman's filter paper no. 1. These extracts of garlic and turmeric were heated over water bath for 5-6 hrs till they become viscous. The anti- microbial tests was started on the same after preparation of extracts.

Preparation of cultures: Pure strains of Enterococcus faecalis (MTCC 439) and Candida albicans (MTCC 854) were obtained from the Department of Microbiology, HIDS, Paonta sahib (H.P). Pure culture of E.faecalis and C.albicans was added to two test tubes containing 10 ml peptone water and Sabouraud Dextrose Broth respectively. The test tubes were incubated at 370C for 24 hrs. Cultures were adjusted to a 0.5% turbidity reading on McFarland scale.

Agar diffusion method: Hundred Micro-liters each of E.faecalis and C.albicans suspensions were taken from prepared cultures and inoculated in 130 mm culture plates with previously set layers of Mueller Hinton and Sabouraud Dextrose Agar respectively (Hi Media Labs). Inoculations were performed by using sterile spreader across media. Uniform wells of 7 mm diameter and about 2 centimeter apart from each other were made in each culture plate with the help of sterile cork-borer **(Fig 1)**. About 100 µl of herbal extracts (garlic and turmeric) were added using sterilized micropipette into the prepared wells. 100 µl each of 2% Chlorhexidine Gluconate (positive control) and distilled water (negative control) were also added into other wells for control. The plates were incubated at 37°C for 24 hours for Enterococcus faecalis and 37°C for 48 hours for Candida albicans. All the procedures were done under strict aseptic conditions using laminar air flow chamber. The diameters of bacterial inhibition zones were recorded in millimeters around each well.

Results

The mean values of growth inhibition in mm recorded for 2% Chlorhexidine, Turmeric (5%) and Garlic (5%) against E.faecalis are given in **Table 1 and Graph-1** and the culture plates showing zones of inhibition are shown in **Figure 1**

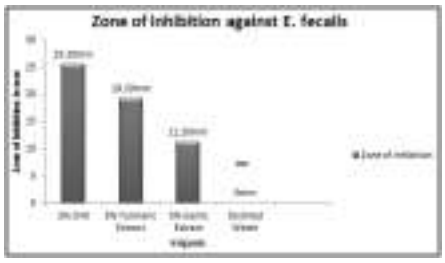
The Graph1 depicts that mean zone of inhibition was highest for Chlorhexidine (25.3) > Turmeric (19.2) > Garlic (11.2) > Distilled water (00). From the results of One Way ANOVA, the mean zone of inhibition of five groups were statistically significant from each other at F=1549.279, P=<.001.

The mean values of growth inhibition produced by 2% Chlorhexidine, Turmeric (5%), Garlic (5%) against C.albicans are given in **Table 2 and Graph 2** and the culture plates showing zones of inhibition are shown in **Figure 2**.

The **Graph 2** depicts that mean zone of

Sr. No	Group Name (Extract)	N	Mean	Std Dev	Standard error
A	2% Chlorhexidine	10	25.3	1.159	.366
B	5% Garlic	10	11.2	1.033	.326
C	5% Turmeric	10	19.2	1.316	.416
D	Distilled water	10	00	000	000

Table 1 (Mean Zone Of Inhibition – Enterococcus Faecalis)



Graph 1

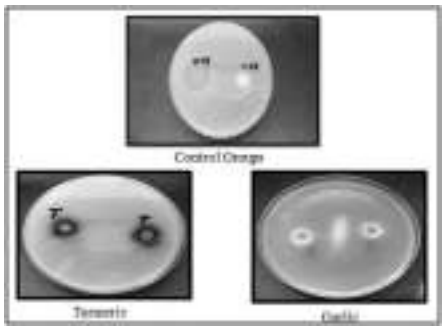
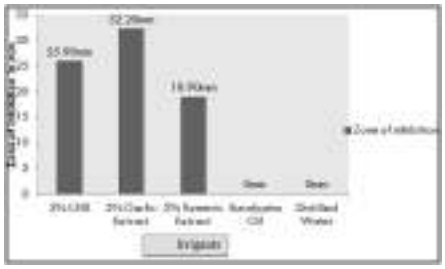


Fig 1 - Culture Plates Showing Zones Of Inhibition Against Enterococcus Faecalis

Sr. No	Group Name	N	Mean	Std Dev	Standard error
A	2% Chlorhexidine	10	22.9	.876	.276
B	5% Garlic	10	12.2	1.229	.389
C	5% Turmeric	10	16.9	.954	.314
D	Distilled water	10	00	000	000

Table 2 (Mean Zone Of Inhibition – Candida Albicans)



Graph 2

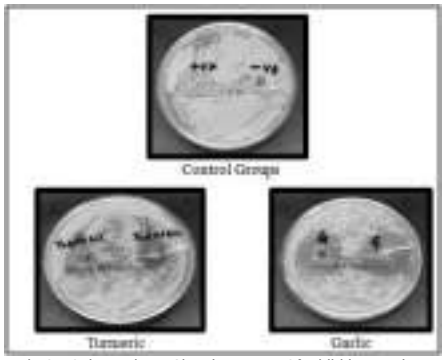


Fig 2 - Culture Plates Showing Zones Of Inhibition Against Candida Albicans

inhibition was highest for Garlic (32.2) > Chlorhexidine > Turmeric (18.9) > Distilled water (00). From the results of One Way ANOVA, the mean zone of inhibition of five groups were statistically significant from each other at F= 3363.750 P= <.001.

Discussion

The main objective of root canal therapy is the elimination of microorganisms from the root canal system and the prevention of recontamination after treatment. The complex anatomy of the root canal system limits the mechanical action of endodontic instruments. Chemical debridement by endodontic irrigant solutions are used to facilitate the debridement and disinfection of the root canal space. Thus, mechanical enlargement of canals must be accompanied by copious irrigation in order to facilitate maximum removal of micro-organisms.[12]

Despite the antimicrobial properties of the irrigants, elimination of microorganisms may not be uniform because of the varying vulnerabilities of the involved organisms. Primary endodontic infections are polymicrobial, typically dominated by obligatory anaerobic bacteria. The most frequently isolated microorganisms before root canal treatment include Gram-negative anaerobic rods, Gram-positive anaerobic cocci, Gram-positive anaerobic and facultative rods, Lactobacillus species, and Gram positive Streptococcus species. The obligate anaerobes are rather easily eradicated during root canal treatment. On the other hand, facultative bacteria such as Staphylococcus, Enterococci, once established, are more likely to survive chemo-mechanical instrumentation and root canal medication.[13]

In particular Enterococcus faecalis has gained attention in the endodontic literature, as it can frequently be isolated from root canals in cases of failed root canal treatments. In addition, yeasts may also be found in root canals associated with therapy resistant apical cases and chronic apical periodontitis as they are more resistant to antimicrobial agents usually used in endodontics.[12]

Chlorhexidine gluconate (CHX) is widely used in disinfection because of its excellent antimicrobial activity. It has potent and substantive antimicrobial activity against some resistant bacteria such as Enterococcus faecalis and fungi Candida albicans.[14]

In our study, the zone of inhibition with 2% CHX was bigger than herbal extracts (5% Turmeric and 5% Garlic) for E.faecalis. Its efficacy is because of the interaction of the positive charge of the molecule with the negatively charged phosphate groups on microbial cell walls which alters the cells osmotic equilibrium. This increases the permeability of the cell wall, allowing the CHX molecule to penetrate into the bacteria. Damage to this delicate membrane is followed by leakage of intracellular constituents, particularly phosphate entities such as adenosine triphosphate and nucleic acids.

This finding is in agreement with a study carried out by Kandaswamy, Eswar et al where 2% CHX showed the maximum efficacy against E.faecalis as compared to garlic and calcium hydroxide.[15]

This is not in agreement with another study by Hemanshi Kumar, where 20% turmeric (Curcuma longa) showed larger zone of microbial inhibition than CHX gel 1%.[16] The difference may be due to more concentration of turmeric and lesser concentration of CHX used in the present study.

In the present study, 5 % garlic (Allium sativum) extract showed maximum antifungal efficacy whereas activity against E.faecalis was mild as compared to CHX and turmeric. Garlic contains at least 33 sulphur compounds, several enzymes, 17 amino acids, and minerals such as selenium. It contains a higher concentration of sulphur compounds than any other Allium species. The sulphur compounds are responsible both for garlic's pungent odour and many of its medicinal effects. Dried, powdered garlic contains approximately 1% Allicin (S-allyl cysteine sulfoxide). One of the most biologically active compounds, allinin (diallyl thiosulfinate or diallyl disulfide) does not exist in garlic until it is crushed or cut; injury to the garlic bulb activates the enzyme allinase, which metabolizes allilin to allicin. Allicin is further metabolized to vinyldithines.

Allicin was assumed to be the main component responsible for the inhibition of fungal growth. A concentrated garlic extract containing 34% allicin, 44% total thiosulfinates, and 20% vinyldithiins possessed potent in vitro fungistatic and fungicidal activity. Allicin inhibits both germination of spores and growth of hyphae. The main antimicrobial effect of allicin is due to its chemical reaction with thiol groups of various enzymes such as e.g. alcohol dehydrogenase, thioredoxin reductase, and RNA polymerase. This could be the possible reason for the antifungal efficacy of garlic extract.[17]

This finding is in agreement with a study carried out by Heon-J in Leea and Hani A. Masaadeh et al according to which garlic extract has maximum efficacy against C.albicans and mild activity against E.faecalis[18],[19]

Turmeric (Curcuma longa) used extensively in foods for both its flavor and color, as well as having a long tradition of use in the Chinese and Ayurvedic systems of medicine, particularly as an anti-inflammatory and for the treatment of flatulence, jaundice, hematuria, hemorrhage, and colic. Turmeric can also be applied topically in poultices to relieve pain and inflammation. Curcumin (diferuloylmethane) the main yellow bioactive component of turmeric has been shown to have a wide spectrum of biological actions, including anti microbial, anti – inflammatory and anti-oxidant activities, anti bacterial and has immune regulatory functions.[10]

In this study, the turmeric has shown good antimicrobial efficacy against E.faecalis and mild activity against C.albicans. This finding is in synchrony with a study done by Thilla S Vinoth Kumar according to which turmeric showed good inhibitory activity against E.faecalis and C.albicans.[13]

A study by Vibha Hegde et al has concluded that turmeric has shown good antimicrobial efficacy only against C.albicans which is contradictory to the results of this study.[20]

Conclusion:

The present in-vitro study explored the potential clinical application of herbal extracts in the root canal by finding the antimicrobial activity against the most resistant microorganisms in persistent root canal infections compared with that of Chlorhexidine.

On the basis of the results obtained in present study, the following can be concluded:

- Garlic extract showed the superior anti fungal action against Candida albicans as compared with Chlorhexidine and mild activity against Enterococcus faecalis
- Turmeric showed the comparable activity against Enterococcus faecalis and Candida albicans as compared to

CHX.

However, further ex-vivo studies followed by clinical studies are recommended to determine the potential use of garlic and turmeric extracts as intracanal irrigant as well as intracanal medicaments during root canal treatment.

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Role Of Alkalinization In Enhancing Efficacy Of The Local Anesthetic – A Clinical Study

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Abstract

Local anesthetics are the safest and most effective drugs employed for analgesia and pain management.Ways to improve the clinical efficacy of local anesthetics, particularly lignocaine, is a subject of extensive research and debate. Raising the pH of the lignocaine solution prior to its use has been a popular choice and has received considerable attention where soft-tissue surgery is performed. Hence, an attempt is made in this study to compare in vivo and ex vivo alkalinization and evaluate the efficacy of sodium bicarbonate in creating a favorable environment for lignocaine to act around the inflamed and infected pulpal and periapical tissues of the mandibular teeth for painless exodontia.

Key Words

Local Anesthesia, Sodium Bicarbonate, Lignocaine, Buffered La, Alkalinization

Introduction

Local anesthetics are the safest and most effective drugs employed for analgesia and pain management. Local anesthetic salts are water soluble and stable, existing simultaneously as cationic or charged (RNH+) molecules and deionized or uncharged (RN) molecules. The deionized free-base is referred to as the active form of the local anesthetic.[1] The active form of the local anesthetic is 4,000 times more lipid soluble than the cationic form, allowing easy penetration of the former into the nerve membrane.[2]

The pH of the solution determines the initial availability of the active form in the injection. The body's mechanism for raising the pH of an acidic solution depends upon the bicarbonate present in the tissues at the injection site. The rate at which this buffering occurs depends upon the patient's physiology and the condition of the tissues in the area of injection. At a physiologic pH of 7.4, the ratio of the active form to the cationic form is greatly improved to approximately one RN molecule for every three RNH+ molecules. The relative proportion of ionic forms also depends upon the dissociation constant (pKa) of the local anesthetic. Usually the infected tissues may have a pH as low as 5.0, which explains why infected teeth are more difficult or even impossible to numb.[1]

The pH of a solution is also a strong determinant of the latency or 'onset time'. Raising the pH using sodium bicarbonate (NaHCO3) solution is an alternative to depending upon the body in accomplishing an equivalent pH change after the injection of local anesthesia. The ex vivo process (buffered LA) uses the same chemical mechanism and molecule (bicarbonate) as the body will use to buffer the anesthetic after the injection in vivo (inside the body), but the ex vivo process is an innovative way to accomplish the pH change instantaneously and more dependably.[1] The latency varies widely from patient to patient. Eliminating this variability and increasing predictability of onset, is a paramount feature of buffering anesthetic solutions outside the body.

The presentstudy compares in vivo and ex vivo alkalinization and evaluates the efficacy of sodium bicarbonate in creating a favorable environment for lignocaine to act around the inflamed and infected pulpal and periapical tissues of the mandibular teeth for painless exodontia.

Methodology

The study was conducted on patients reporting to the out-patient department of Oral & Maxillofacial Surgery, HIDS Paonta Sahib (HP), for the purpose of exodontia. 80 consenting patients aged between 15-72 years, who were divided into 2 groups of a sample size of 40 each. Group A received sodium bicarbonate infiltration for in vivo alkalinization and group B received buffered LA for ex vivo alkalinization. The study was independent of sex and weight of the patients and was conducted only upon the mandibular teeth. Teeth that were clinically tender on percussion were radiographically checked for the assessment of the periapical tissues.

In 'group A', the pain felt by the patient was scored using the visual analogue pain scale (VAS) with a 0-10 numeric pain rating scale.[2] The patients in group A underwent in vivo alkalinization with sodium bicarbonate infiltration. A standard 'inferior alveolar nerve block', along with 'lingual nerve block' was administered using a regular solution of lignocaine with adrenaline. A 'long buccal nerve block' was also given when the case involved the molar teeth. Approximately 2ml of local anesthetic solution was administered that contained 2% lignocaine with 1: 200,000 adrenaline. The 'latency' or the onset time of this regular LA containing adrenaline is noted. The subjective and objective signs and symptoms of local anesthesia were checked. A maximum of 10 minutes was allowed for the local anesthetic to take effect.

A chronically infected tooth that remained tender on percussion with anesthesia in the surrounding tissue, was made inclusive in this study group. In these cases of inadequate anesthesia, local infiltrations consisting of 0.5 ml 7.5% sodium bicarbonate solution were given in the buccal and lingual cortex at the position of the root apices of the tooth. The bone resorption caused due to chronic infection helped the bicarbonate solution to diffuse into the inflamed periapical tissues. We allowed a time of 3 minutes for this in vivo alkalinization to occur, which was the same as the maximum time taken by an infiltration of lignocaine with adrenaline to produce an analgesic effect. It raised the pH of the acidic tissues and created a favorable environment for the local anesthetic to work.

Local infiltrations each of 0.5 ml 2% lignocaine with adrenaline were then given buccally and lingually in the same areas. A solution was created in this region which contained both sodium bicarbonate and lignocaine with adrenaline in a 50-50 dilution. This led to the production of carbon dioxide which had its own independent anesthetic effect and acted as a catalyst to increase the potency of lignocaine.[1],[3] Pain was scored after 3 minutes using VAS. A reading of 3 or less on the scale was adequate for extraction.

In 'group B', the pain felt by the patient was scored using the VAS. The patients in group B underwent ex vivo alkalinization. 2 ml of 'buffered LA' is prepared with sodium bicarbonate and LA containing adrenaline used in a dilution of 1: 10.[4],[5] To every 10cc of 2% lignocaine with 1: 200,000 adrenaline, 1mEq of 7.5% sodium bicarbonate was added (i.e., 1.12 cc of 7.5%) to make a chair-side buffered LA solution in the syringe for injection. The latency of this buffered LA was noted. The pain was scored after the injection using VAS. A reading of 3 or less on the scale was adequate for extraction.

Teeth were extracted only after a score of 3 or less on the visual analogue pain scale. In case the VAS score was more than 3, the procedure was aborted and the extraction was done after 48 hours under oral antibiotic cover. Post-extraction instructions were verbally explained to all the patients.

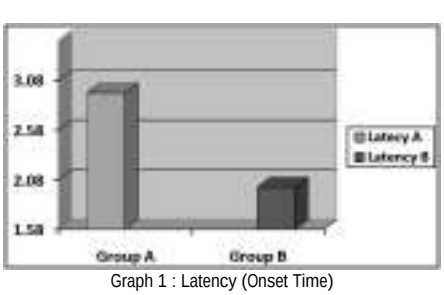
Results And Discussion

Lignocaine is a weak base with a pKa of 7.9 at room temperature.[1],[6] Lignocaine with adrenaline is marketed at an acidic pH between 3.3 and 5.5 since its aqueous solubility is higher at this range of pH than at a more physiological pH of around 7.4.[1] Alkalinization of the local anesthetic with sodium bicarbonate reduces the 'sting' felt during the injection and hastens the onset time of the anesthetic.[3] It decreases the tissue-injury caused due to the acidic pH of the local anesthetic solution, thus reducing the post-injection soreness. Sodium bicarbonate is clinically applauded because it is easier to work with than carbon dioxide.[6]

The first clinical report of improved onset time of local anesthesia following alkalinization was that of Gros in 1910.[1] Malamed SF[1],[3],[6] has stated that adding sodium bicarbonate to the local anesthetic solution results in a number of clinical advantages. Momota and associates[7] studied the tissue damage by lidocaine and alkalinized lidocaine using a three-dimensional cultured human skin model. The study concluded that alkalinization of lidocaine (pH 7.85, pH 7.9) may have a possibility of decreasing cell viability.

The present study had a similar age distribution in both groups. This is identical to the studies by Gormley[8] and Capogna.[9] The respective mean in our study was 37.45 years and 33.45 years in group A and B. The p value was 0.199 and was found to be non-significant ($p > 0.05$).

The latency was faster in group B. The mean was 2.0025 minutes in the group B as compared to 2.9505 minutes in group A, which calculated the latency of regular lignocaine with adrenalinesolution. The p value was found to be <0.001 which was highly significant ($p < 0.01$). Our findings are in line with the observations of Al-Sultan and associates[10] who noticed a more rapid onset of action in the buffered group. The findings of our study are also similar to the study by Kashyap and associates[5] who reported a faster onset of anesthesia in the group receiving lignocaine buffered with sodium bicarbonate. Our findings also correlate with Bromage and Gertel[11] who observedthe latency being quicker in carbonated lignocaine **Graph 1**.



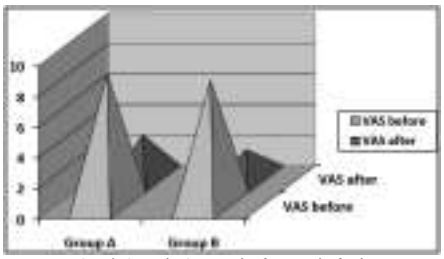
Graph 1 : Latency (Onset Time)

The findings of the present study go in line with Eppley and Sadove[4] who stated that by increasing the pH (which places it closer to the anesthetic solution pKa) more unionized form is available, that enhances the uptake and makes the onset of anesthesia instantaneous. In our study, the improved latency in group B is probably due to the reason that we used 2% lignocaine with 1: 200,000 adrenaline. Gormley[8] used 1.5% lignocaine with 1: 200,000 adrenaline, while Capogna[9] used 2% plain lignocaine. Our study also supports the findings of Koppal and associates[12] who concluded that alkalinization of lignocaine offers an earlier onset with good intensity and adequate depth of the regional block. Similar increase in onset of alkalinized lignocaine was reported by Mehta and associates[13] in brachial plexus block and Gupta and Kapoor[14] in peribulbar anesthesia.

Sinnot and associates[15] studied the effect of adding sodium bicarbonate to lidocaine with and without epinephrine versus equivalent alkalinization by sodium hydroxide (NaOH) on onset, degree and duration of peripheral nerve block in the rat. They concluded that with 1% commercial lidocaine without epinephrine, sodium bicarbonate decreases the degree and duration of block. However, in solutions with epinephrine, sodium bicarbonate hastens onset, without effecting degree or duration. Our study is in accordance with this finding.

The results of the present study differ from the study by Whitcomb and associates[16] who concluded that buffering 2% lidocaine with 1: 100,000 epinephrine with sodium bicarbonate did not statistically increase anesthetic success, provide faster onset, or result in less pain of injection when compared with unbuffered 2% lidocaine with 1: 100,000 epinephrine for an inferior alveolar nerve block. Our findings also differ from the study by Chow and associates[17], who demonstrated that alkalinization does not hasten the onset of brachial plexus block.

The choice of local anaesthetic will influence the degree to which the pH can be altered without the occurrence of



Graph 2 : Pain On Vas (Before And After)

precipitation. Precipitation and pH adjustment study by Peterfreund and associates[18] suggests that lidocaine is particularly suited for alkalinization. This is because it can be alkalinized to a pH close to its dissociation constant without the occurrence of precipitation. DiFazio and associates[19] suggested that improvement in latency is directly related to the degree of change in pH.Gormley and associates[8] had a change of pH from 4.2 in control group to 7.2 in alkalinized group. The study by Capogna and associates[9] had a pH change from 5.85 to 7.12.

In our study the change in pH was from 4.55 to 7.2 in group B, in accordance with Malamed SF.[6] This change in pH after addition of sodium bicarbonate was large enough to achieve the benefits of alkalinization, thereby explaining the earlier onset of anesthesia in Group B. The onset was delayed in group A because it received a solution containing lignocaine with adrenaline without the addition of sodium bicarbonate.

Pain, in the present study, was defined as pain described by the patient on the visual analogue pain scale (VAS) with a 0-10 numeric pain rating scale.[2] Pain was scored before the injection of local anesthesia and after the procedure of alkalinization and anesthesia. The mean VAS before the injection was 8.60 in group A and 8.18 in group B. The VAS before the injection was greater in group A and the p value was 0.197, which was not significant (p> 0.05). The mean VAS after the injection in group A was 2.88 and in group B was 1.93. The VAS after the injection was lesser in group B and the p value was 0.011, which was found to be statistically significant (p< 0.05) **Graph 2**.

The final VAS after the injection was obtained by alkalinization of the inflamed pulpal and periapical tissues of the tender tooth. The difference in VAS before and after the injection was highly significant (p <0.01) in both group A and group B with a p value of < 0.001 in each group. The mean change in VAS score in group A was 5.7250 and in group B was 6.2500. The p value was 0.140 (on comparing the changed VAS of the two groups) and was found to be non-significant (p > 0.05). Thus, it can be assumed that both in vivo and ex vivo techniques of alkalinization are equally effective in reducing the pain felt by the patient during the extraction of a tender tooth.

Raymond and associates[20] reported that analgesia upon administration of buffered lidocaine was twice as potent as that of plain lidocaine due to the presence of free CO2 in the alkalinized solution. The present study showed that alkalinization significantly decreased the pain felt during the extraction of infected teeth, a finding that is supported by the study of Al-Sultan and associates[10] who concluded that the pH adjusted solutions enhanced anesthetic efficiency and reduced pain on injection as well as during surgery. Our study upholds the findings of Lem LC[21] who showed that alkalinization of lidocaine decreases the total volume of local anesthetic required and pain of extraction.

The present study used oral antibiotics for the extraction of teeth that remained tender even after alkalinization in both the groups. Out of 40 patients in each group, 10 patients (25%) in group A and 5 patients (12.5%) in group B were prescribed oral antibiotics three times a day and recalled after 2 days for the extraction of the symptomatic tooth. The use of pre-operative antibiotics for the extraction of infected teeth within the two groups individually or in comparison was found to be non-significant (p > 0.05). However, after the tooth extraction, oral antibiotics were prescribed for a period of 5 days along with analgesics (NSAIDs) for the suppression of pain.

The decreased usage of antibiotics before the extraction of tender teeth may suggest a greater quality of anesthesia. It may be seen as a useful alternative to the indiscriminate use of antibiotics prior to the extraction of chronically infected teeth for making the LA solution effective at the site of inflammation. The results of our study support the findings of Gormley[8] and Capogna[9] who showed that the quality was better in pH adjusted group along with an improved latency.

Conclusion

This study concludes that alkalinized local anesthetics produce a more rapid onset of anesthesia than regular local anesthetic solutions and both in vivo and ex vivo techniques of alkalinization are effective in reducing the pain felt by the patient during the extraction of teeth that are tender on percussion. Alkalinization may be used as an adjunct to the pre-operative antibiotic cover prescribed in order to make the local anesthetic effective. Stress-free anesthetic techniques are need of the hour and alkalinization with sodium bicarbonate has a definite role in enhancing patient comfort and clinical performance of the regular local anesthetic solution.

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Relationship Of Socioeconomic Status And Oral Hygiene Practices On Dmft Score Of Pregnant Females In North India

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Abstract

Background

Thorough knowledge about good hygiene practices is important for pregnant females so that transmission of cariogenic factors can be avoided to the next generation.

Aim

To determine the association between socio-economic status and oral hygiene practices on DMFT scores of pregnant women.

Subjects & methods: This prospective study was performed by Paedodontist from MMCDSR, Mullana, team of research fellows & investigators from Deptt of Paedodontics & Preventive Dentistry of Maharishi Markandeshwar College of Dental Sciences & Research Mullana, Ambala at Medical College & Hospital, Mullana & surrounding Primary Health Centres. The study included 238 pregnant women. Informed consent of all of them was taken. Mother's demographic data was collected using a questionnaire & their DMFT score was recorded according to WHO oral health assessment form 2004 by trained observer. Statistical analysis was performed using SPSS 11.0 for windows for 't-test' & 'chi-square' analysis. Relationship of oral health status and socio-economic factors (according to K.S scale) were studied in pregnant ladies.

Results

Significantly higher DMFT was observed in lower middle class than upper class and it was higher in urban females than those of rural ones.

Conclusion

Oral health status indicator i.e DMFT was found higher in lower socio-economic classes than in upper & middle class.

Key Words

Pregnant females, oral hygiene, DMFT, socio-economic status

Introduction

Health is defined as a state of physical, mental, social and emotional well being in which the body functions with comfort, confidence, creativity and contentment eventually leading an economically productive life. In essence, health is fundamental to human progress[1].

Pregnancy is a delicate condition involving complex physical and physiological changes.[2] Hormonal effects cause changes to almost every organ system, including the oral cavity. Prevention and health promotion interventions could enhance her own health or that of her infant. Gingival and periodontal changes during pregnancy have been well-documented[3] and research has shown that a great number of pregnant women do not undergo dental visits during the prenatal period and there is also high incidence of dental caries.[4]

Pregnancy and early childhood are particularly important times to access oral health care because the consequences of poor oral health can have .a lifelong impact.[4] Evidence suggests that most young children acquire caries-causing bacteria from mothers.[3] Cariogenic or decay-causing bacteria are typically transmitted from mother - or caregiver to child by behaviour that directly pass saliva, such as sharing a spoon when tasting baby food. The earlier those cariogenic bacteria occupy ecological niches in the child's mouth, the greater percentage of the child's plaque will contain these bacteria. Mothers who themselves have experienced extensive past or current caries have particularly a strong need for counseling on how .to avoid early transmission of cariogenic bacteria to their offspring.[4]

Pregnancy-related changes are most frequent and severe on gingival tissue.[5] Some of the periodontal conditions are considered specific to pregnancy, such as pregnancy gingivitis and epulis gravidarum.[6] Periodontal disease, including gingivitis and periodontitis, are infections that if left untreated, can lead to tooth loss.[7]

Pregnancy is a "teachable moment" when women are motivated to change behaviour. Untreated oral infection may become a systemic problem during pregnancy and may contribute to preterm and/or low birth weight deliveries.

Emerging science indicates that women with periodontal disease may be at the greater risk of delivering preterm, low birth weight babies. For this the American association of periodontology recommends that women who are pregnant or planning pregnancy should undergo periodontal examination.[8]

Reports have documented a high prevalence of gingivitis among pregnant women. Physiologic changes such as pregnancy alter women's body response to external stimuli. In the mouth, the greatest effect of pregnancy is seen in the gums. The higher concentration of oestrogen and progesterone during

pregnancy especially in the presence of plaque have been implicated in the patho-physiology of pregnancy gingivitis.[9]

Though there is voluminous literature regarding the oral health status of pregnant women,[10] scanty data is available from Indian subcontinent and no study assessedthe influence of various socioeconomic factors on the oral hygiene status. Adler et al.[12] have described a model suggesting, that socio-economic position affects general health through health care, psycho-social factors and health related behaviors. In the present study we have also tried to find a relation of socio-economic status with DMFT scores in pregnant women.

The purpose of the study was 1) To evaluate the effect of socio economic status on DMFT scores of pregnant women. 2) To evaluate the DMFT of pregnant women with proper oral attitude. 3) To correlate socio-economic status and attitude with DMFI' of pregnant females in North India.

Methodology

The study included 238 pregnant females visiting the gynaecology out patient department of the M.M. College of medical sciences, Mullana, Ambala and surrounding primary health centers within a period of 6 months. Ethical clearance was taken for conducting the study. All the patients entered the study voluntarily, following an explanation of its purpose and objectives. A written consent was taken from each patient after explaining the purpose and objectives of the study.

Before the assessment of the oral health status, the patients were asked from a self-rectified questionnaire for the socio-economic and cultural background according to Kuppuswamy scale and demographic data which included the subject's age, month of pregnancy, order of pregnancy, qualification, occupation, status and locality they reside in. Patients were also asked about the frequency of their dental appointments.

After inquiring about the socio cultural status of the subject, oral hygiene of the patient was assessed by asking the subjects about their oral hygiene practices which included habit of brushing, rinsing after meals, duration and frequency of brushing, type of brush used, method used for brushing, use of toothpaste and brush or not, visit to a dentist and regular dental checkups.

After acquiring all the information, the subject was examined for the oral health status by determining the DMFT score, according to WHO oral health assessment form (2004). All the Patients were examined by a well trained observer accounting for the DMFT of the individual.

KUPPUSWAMY'S SOCIO-ECONOMIC STATUS SCALE was used for the socio economic assessment of the subjects in consideration. The professional categories for education were defined as 1) Illiterate 2) Primary school certificate 3) Middle school certificate 4) High school. certificate 5) Post high school diploma 6) Graduate 7) Post graduate

On the basis of occupation 1) unemployed 2)Un-skilled worker 3) Semi skilled worker 4) Skilled worker 5) Clerical, Shop owner, Farmer 6) Semi – Professional 7) Professional.

On the basis of family income scale is classified as 1) less than Rs.1093 2) 1093-3248 3) 3249- 5414 4) 5415- 8121 6) 8122- 10829 10) 10830 – 21659 12) more than Rs. 21660.

Oral Health Assessment

All the patients were examined by a previously trained observer. Number and type of teeth were recorded. The DMFT score of each patient was assessed to check the oral health status of the patient using WHO oral health assessment form (2004). DMFT was assessed as 0- sound, 1- decayed, 2- filled and decayed, 3- filled without decay, 4- missing due to caries, 5- missing for any reason other than caries, 6- sealent or varnish, 7- bridge abutment, 8- unerupted tooth, 9- excluded tooth, T-trauma or fracture.

The data was transferred to the computer, corrected for logical errors. The statistical analysis was performed using the Statistical Program for Social Sciences (SPSS 11.0 for Windows), using Kruskal Wallis test and Fisher's Exact test.

Results & Analysis

Table 1 Shows demographic distribution of the population including 238 pregnant females between the ages of 18 to 30 years. Most of the subjects were under the age of 25 years (63.9%). More than half were conceiving for the first time (60.9%).

A total of 238 pregnant women were considered in the study. Mean age of the subjects were 23.97. 63.9% of the subjects were among the age group of 21 – 25yrs.

Table 2: As the data for DMFT is non parametric KRUSKAL WALLIS test was applied to compare the mean DMFT values with 3 socioeconomic groups ie; upper, middle and lower 73.5% of the subjects were residing in rural areas & 26.5% were residing in urban areas, as is reflected in Table no. 2 . Lower half of table 2 shows distribution of study subjects according to socioeconomic status and locality. More than half of the subjects were from lower middle class ie; 62.2%. However lower upper class were 39 ie; 16.4% And upper middle class were represented by 48 pregnant females

Table.1 Demographic Description Of The Study Population (N = 238)

Age (Years)	Frequency	Percent
< 20	24	10.1
21 – 25	152	63.9
26 – 30	62	26.1
Total	238	100.0
Pregnancy Order	Frequency	Percent
1	145	60.9
2	93	39.1
Total	238	100.0

Table 2. Shows Distribution Of Study Subjects According To Socio-economic Status And Locality

Socioeconomic Status			
		Frequency	Percentage
1	Lower Class	00	0
2	Lower Upper Class	39	16.4
3	Lower Middle	148	62.2
4	Upper Middle	48	20.2
5	Upper Class	3	1.2
Locality			
1	Urban	63	26.5
2	Rural	175	73.5
	Total	238	100

Table 3. A) And B) Comparison Of Mean Dmft Between Different Socio-economic Classes Using Kruskal Wallis Test And Post Hoc Analysis

Table 3. A)

	DMFT
Chi-Square	6.325
Df	2
Asymp. Sig.	.042*

Table 3. B)

	Socioeconomic Classes	Mean	Std. Deviation	P-value
Dmft	Lower Class	3.63	2.382	0.021*
	Middle Class	2.72	2.195	
Dmft	Middle Class	2.72	2.195	0.409
	Upper Class	1.67	2.082	
Dmft	Lower Class	3.63	2.382	0.175
	Upper Class	1.67	2.082	
Dmft Total		2.86	2.247	

Table 4. Association Of Oral Hygiene Aids And Socio-economic Status *p Value < 0.05

	Lower Class	Middle Class	Upper class	Total	Fisher's Exact p value
Mouth rinse after snacking					
Yes	30	161	2	193	
No	10	34	1	45	0.292
Matelrials used to clean teeth					
Brushing	38	193	3	234	
Datun	2	2	0	4	0.178
Type of toothbrush					
Hard	5	26	0	31	
Soft	36	168	3	207	0.123
Frequency of tooth brushing					
Once	32	130	3	165	
Twice	9	64	0	73	0.105
Method of tooth brushing					
Vertical	13	70	1	84	
Horizontal	12	71	1	84	
Cicular	4	36	1	41	0.004
Horizontal + Vertical	11	17	0	28	
Time to change toothbrush					
0-3 months	5	29	1	35	
3-6 months	27	140	2	169	0.561
> 6 months	8	26	0	34	
Visit to dentist in the past					
Yes	8	59	0	67	
No	32	136	3	171	0.335

ie; 20.2% And only 3 subjects ie; 12% were from upper class.

Table 3. a) and b) Comparison of mean DMFT between different socio-economic classes using Kruskal wallis test and post hoc analysis:

Shows comparison of mean dmft between different socioeconomic classes using kruskal wallis test and post hoc analysis.

In Table 3(a) p value less than 0.05 shows some significant difference in the DMFT between three socioeconomic classes there.

Table 3(b) shows significant difference between lower class and middle class as mean values are 3.62 and 2.72

However, there is no significant difference between upper and middle class as mean values in these two classes are 2.72 and 1.67 saying that DMFT of these two classes is almost same.

Similarly in lower and upper class, mean DMFT was 1.67 and 3.63. Thus the difference is insignificant.

Table no. 4. Association of oral hygiene aids and socio-economic status *p value < 0.05

Table 4 Shows that there was not much difference between lower, middle and upper class as regards the habit of mouth rinsing after snacking.

Secondly, there was no significant difference between the material used for cleaning by various groups ie; whether datun or tooth brush, neither was there any difference between the frequency of tooth brushing and time in changing the tooth brush.

However, method of tooth brushing was significantly different between 3 socioeconomic groups.

Rest all other oral hygiene habits were almost similar.

Discussion

Pregnancy involves complex changes in the body. Every system in even healthy women is altered to some degree during pregnancy including saliva and oral cavity. The monitoring and care of oral cavities in pregnant women are amongst important public oral health activities in India, as healthy oral cavity in pregnancies is directly related to a decrease in DMFT and leads to improvement inchild oral health indicators and in quality of life for women.

A number of features inherent in this study deserve some clarification for convenience; although the present study aimed to estimate the oral hygiene of pregnant females in North India & to explore the association of various sociodemographic factors on oral hygiene status of pregnant women, the study was conducted in a limited area and socio-demographic data collected was based on subjective information. It is recognized that the external validity of this study is limited, and therefore, the results cannot be generalized to all of the pregnant women, which is one of the limitations of the study.

The results of the present study support earlier reports, confirming that DMFT is increased in pregnant females.[11],[12] Al–Nuaimy K et al conducted a study on 200 females to assess Decayed, Missing and Filled Teeth Index (DMFTI) among other parameters during pregnancy. The result of this study during pregnancy showed increased DMFT Index as compared with the controls.[11] Results of our study also showed that DMFT index is high in pregnant females.

Majority of the pregnant females were under 25 years of age. Results of study revealed that pregnant women in younger age group i.e. up to 25 years had good oral hygiene practices as compared to women in comparatively older age group i.e. 26 years to 30 years. The implication of this observation is that the women who are pregnant in older age groups need to be observedmore diligently and their oral health practices are required to be improved. This is possible witha concerted effort on the part of oral healthpractitioners to educate these women about oral health to improve the quality of their life and oral health of their offspring.

Educated women possess a better oral hygiene as compared to illiterate women as they are more concerned about their oral health. Oral health education to all pregnantwomen should be mandatory at the health centres.

Wandera M[12] in a study on socio demographic factors related to periodontal diseases and tooth loss of pregnant females concluded that rural, nulliparous and those who never visited a dentist were less likely, whereas women from larger households were more likely, to have lost at least one tooth. Similar results were found in our study where DMFT score was more in urban pregnant females as compared to pregnant females from rural areas.

Acharya S[13] conducted a study on pregnant females and concluded that those women with previous history of pregnancies had more severe levels of

gingivitis than those who were pregnant for the first time. Machua G[6] in their study also showed that women in 2nd and 3rd trimester reported some inflammatory changes evident during these stages of pregnancy. Several hormonal factors have been associated with these periodontal changes, particularly rising serum progesterone levels.[15] Similar to the periodontal changes, in our study, the DMFT score was more pronounced in 3rd and 2nd trimester of pregnancy as compared to 1st trimester.

The data from the study can have some implications on the oral health of the offspring these pregnant women will deliver. As the previous studies[16] have shown that oral health of the mother is indicative of the oral health of the offspring, the data from this study can also be correlated with the oral health of the children of these women & measures can be taken for prevention of oral diseases. Various studies documented that oral health care of pregnant women as an "early preventive strategy" for her child's oral health which may improve the oral & systemic health of children. Dentistry can be vital in improving prenatal outcome and maternal or fetal dental health through screening, referral and education of pregnant women. These methods can be applied on a larger scale in the community for the better oral health of the mothers and children.

Conclusion

According to the results obtained, it can be concluded that the pregnant women evaluated in this study had unfavorable oral health as regards DMFT, and there was significant difference between the impact of socioeconomic status on DMFT of study samples. Significant difference was seen in the method of tooth brushing amongst three socioeconomic classes and DMFT was higher in lower socio- economic classes as compared to upper and middle class.

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Comparative Evaluation Of Flexural Loading Of Provisional Restorations Fabricated Using Different Materials : An In - Vitro Study

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Abstract

Purpose of the study

The objectives of the study were to determine flexural strength of autopolymerising acrylic resin, protemp-4 and heat cure acrylic resin and their comparative evaluation. The recommendation of material for clinical applications is based on results of this study.

Method

A total of 90 samples were fabricated and divided into three groups. Each group consisted of 30 samples divided according to type of materials: Group A: Autopolymerising resin, Group B: Pro temp 4, Group C: Heat cure resin. The samples were subjected to three point bending test under Universal Testing Machine (Instron) and the results were subjected to statistical analysis by applying one – way ANOVA (Analysis of Variance) and Post Hoc Tukey HSD tests (for multiple comparisons).

Result

The mean value of flexural strength was highest for Group C (Heat cure resin) i.e. 563.1137, followed by Group B (Pro temp 4) i.e. 523.7173 and Group A (Autopolymerising resin) i.e. 323.2993.

Conclusion

In posterior long span fixed partial denture and in full mouth rehabilitation cases, the material of choice should be heat polymerizing PMMA or protemp 4 because of increased demand on strength of material to tolerate functional stresses.

Key Words

Flexural strength, Provisional Restoration, Heat cure resin, Pro temp 4, Autopolymerising resin

Introduction

The word provisional means pending a permanent one. Fixed prosthodontic treatment, whether involving complete or partial coverage and natural tooth or dental implant abutments, commonly relies on indirect fabrication of definitive prosthesis in the dental laboratory[1]. Provisional restorations should be the same as definitive restorations in all aspects, except for the material from which they are fabricated[2]. Biologically acceptable fixed prosthodontic treatment demands that prepared teeth be protected and stabilized with provisional restorations that resemble the form and function of the planned definitive treatment[3].

Different materials and techniques have been employed in the fabrication of provisional restoration. The materials may range from acrylic to metals. An ideal material should be easy to handle, have high strength and good tissue compatibility[4].

This study aimed to evaluate the flexural strength of three different provisional restorative materials under conditions that simulate the stresses acting on them to those acting on a fixed partial denture and determine clinical application of the results.

Materials And Methodology

This study was conducted at Department of Prosthodontics and Crown & Bridge, Genesis Institute of Dental Sciences and Research, Ferozepur and Central Institute of plastic and Engineering Technology, Murthal to evaluate flexural strength of provisional restoration fabricated using different materials. The materials used for testing were Heat cure Polymethylmethacrylate resin (Dental Products of India, Mumbai), Autopolymerising Polymethyl metacrylate resin (Dental Products of India, Mumbai) and Protemp-4, Bisphenol-A-glycidil Methacrylate-4 (3M ESPE Deutschland, Germany).

A total of 90 samples were fabricated and divided into three groups. Each group consisted of 30 samples divided according to type of materials:

Group A: Autopolymerising resin
Group B: Pro temp 4
Group C: Heat cure resin

The method used in the study was divided into the following steps -

1. Fabrication of precision die:

Two abutments second premolar and second molar on the left lower quadrant of typodont set were selected, simulating as lower left quadrant of patient with missing first molar. The trough that was created after removing the first molar was filled by modelling wax to represent a residual edentulous space. Ideal tooth preparation was done with a chamfer finish line and uniform taper of 60 (approximately). After tooth preparation perforated sectional metal stock tray was selected for making the impression. Tray adhesive was applied and polyvinyl siloxane putty and light body impression material (3M ESPE AG, Seefeld Germany) was used for making impression. Impression was scraped for creating space for light body. After setting of material sectional tray was removed and impression was inspected. Molten blue inlay wax was poured into the impression for fabrication of wax pattern. After solidification of wax pattern it was retrieved, sprues were

attached at an angle of 450 (approximately) on the non functional cusp. Cobalt chromium alloy was used for casting. All procedures of investing, casting, finishing and polishing were done to get a precision die. The exposed root portion of both the abutment and residual edentulous space was covered by autopolymerising resin block **(Figure 1a)**.

2. Fabrication of all metal fixed partial denture:

Wax pattern for three unit fixed partial denture using second premolar and second molar as abutment was fabricated on precision die. A bar sanitary pontic design was selected for the fabrication of wax pattern by using inlay wax. After making of wax pattern, it was checked for any defect. Sprues were attached at an angle of 450 (approximately)on the non functional cusp. Cobalt chromium alloy was used for casting the F.P.D in metal. Elective induction and standard procedure was used to obtain error free casting. Three unit F.P.D was checked that it should seat properly over the precision die without any rocking and had self retention with good marginal fit **(Figure 1b)**.

3. Construction of custom tray:

An index of precision die along with all metal fixed partial denture was made using Polyvinyl siloxane putty and light body impression material (3M ESPE AG, Seefeld Germany). The index was poured with dental stone, two sheets of modelling wax were adapted and sealed over the stone model. All standard procedures of flasking, dewaxing, packing and curing with heat cure acrylic resin (Dental Products of India, Mumbai) were carried out according to manufacturer instruction. A handle was prepared using self cure resin (Dental Products of India, Mumbai). Sufficient Perforations in tray were made with number 8 round bur.

4. Making of master impression :

Block out of dead space below the three unit F.P.D on precision die was done with putty. Tray adhesive was applied to custom tray, Polyvinyl siloxane putty and light body impression material (3M ESPE AG, Seefeld Germany) was used to yield a master impression which was used for construction of interim prosthesis samples **(Figure 2)**.

5. Fabrication of autopolymerising resin samples (Group A) :

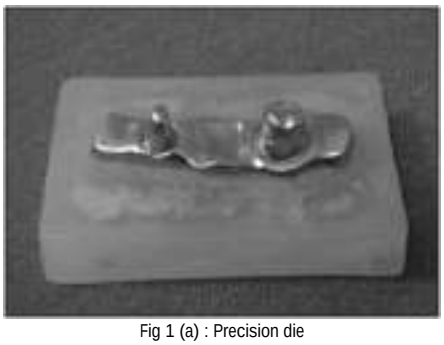


Fig 1 (a) : Precision die

Fig 1 (b) : All metal F.P.D

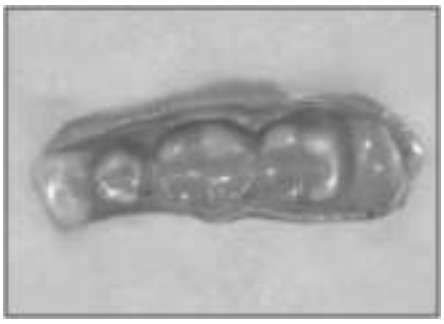


Fig 2 : Master Impression

Tooth coloured polymethyl methacrylate (PMMA) acrylic resin (DPI Dental Products of India Ltd, Mumbai, India) was used to make the interim prosthesis samples. The samples were fabricated with the polymer to monomer ratio as per manufacturers recommended ratio of 3:1 by volume. Resin mixture was poured into the master impression which was then placed on the metal die. The sample was retrieved from the master impression and the excess was trimmed and sample was finished and polished. Ten such samples were prepared in one impression. Though there were negligible chances of distortion, but to rule out any change in the samples three impressions were made for accuracy and safety. Thirty such samples were prepared and were subjected to three point bending test using universal testing machine.

6. Fabrication of Protemp-4 samples (Group B):

Protemp 4 is a composite materials for fabrication of provisional restoration. Material was loaded in master impression, using a new mixing tip each time. A small amount of material was extruded from mixing tip on to mixing pad and discarded then the material was injected into the master impression and then placed over the metal die. According to manufacturer instructions material attained a hard elastic consistency within 1 min 40 sec. The master impression was removed from the metal die within 2 min 50 sec. Sample was retrieved. The oxygen inhibitor layer was removed using alcohol. Sample was then finished using fine carbide burs. Thirty such samples were prepared and were subjected to three point bending test using universal testing machine.

7. Fabrication of Heat cure resin samples (Group C):

Polymethylmetacrylate heat cure resin (Dental Products of India, Mumbai) was used for the fabrication of provisional restoration. First of all impression with Polyvinyl siloxane putty and light body impression (3M ESPE AG, Seefeld Germany) was made of metal die and poured in dental stone. Molten wax was poured into the master impression and placed over the metal die for fabricating wax pattern. After solidification of wax, pattern was retrieved and sealed over stone model of metal die. Flasking, dewaxing and processing was done following according the standard protocol and manufacturer instructions for this material. Samples were finished and polished Thirty such samples were prepared and were subjected to three point bending test using universal testing machine.

8. Measurement of flexural strength of samples:

Metal die was fitted within the jaws of fixture. Each sample fitted snugly on the die **(Figure 3)**. The test samples were loaded with a 1.5 mm diameter of stainless steel pin placed in the specifically demarcated region of the sample, i.e. the central fossa of the pontic with a crosshead speed of 5 mm/min till the fracture occurred **(Figure 4)**. The load resulting in fracture of the sample was recorded using the software attached to universal testing machine.

Flexural strength was automatically calculated by the equipment software (the reading displayed on the system) using the formula: FS = 3 W L/2 b d2, where

FS = flexural strength (MPa or MN/m2),

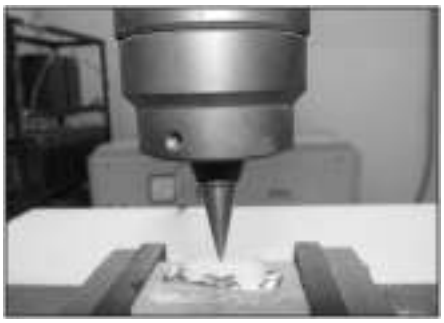


Fig 3 : Precision die with sample fitted in fixture and load application on central fossa of pontic

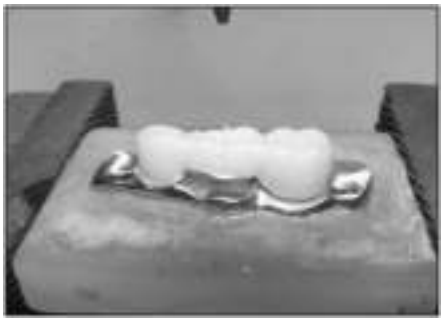


Fig 4 : Fractured sample

Table 1 : Flexural Strength (Mean ± Sd) Values

Group	N	Range	Mean	± Sd	Sem
A	30	52.88-696.16	323.2993	168.31028	30.72911
B	30	127.44-1074.19	523.7173	221.91110	40.51524
C	30	70.78-982.69	563.1137	228.94849	41.80008

N: Number of samples
SD: Standard Deviation
Sem: Standard Error of Mean

Table 2 : One Way Anova (Analysis Of Variance)

Source Of Variance	Sum Of Squares	Df	Mean Square	F	P Value
Between Groups	992303.60	2	496151.80	11.451	<0.001*
Within Groups	3769718.65	87	43330.10		
Total	4762022.26	89			

* P < 0.001; Highly Significant

W = maximum load before fracture (N), L = distance between the supports (mm), b = width of the samples (mm) and d = thickness of the samples (mm). All the collected data was subjected to statistical analysis.

Results

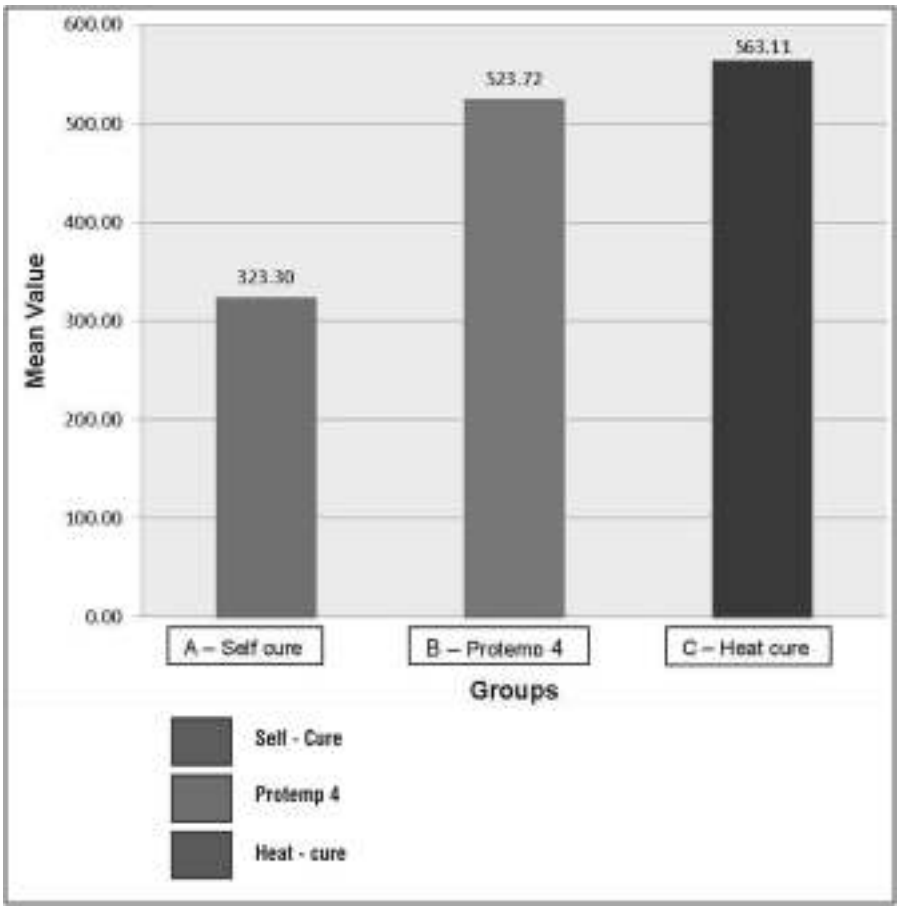
The samples were subjected to three point bending test under Universal Testing Machine (Instron) and the values were obtained. The results were subjected to statistical analysis by applying one – way ANOVA (Analysis of Variance) and Post Hoc Tukey HSD tests (for multiple comparisons) and graphs were plotted.

The mean value of flexural strength was highest for Group C (Heat cure resin) i.e. 563.1137, followed by Group B (Pro temp 4) i.e. 523.7173 and Group A (Autopolymerising resin) i.e. 323.2993 **(Table 1 and Graph 1)**.

By applying Oneway Analysis of Variance, a statistically significant difference in flexural load was seen within groups and between groups i.e. p < 0.001 **(Table 2)**.

Post Hoc Tukey HSD tests were applied to make multiple comparisons between different groups. At 0.05 level, statistically significant mean difference values were seen between the following groups – A & B, A & C and B & C. p value < 0.05 was obtained between Groups A & B which is statistically significant. p value < 0.001 was obtained between Groups A & C which is statistically highly significant. p value > 0.05 was obtained between Groups B & C which is statistically not significant.

The provisional restorations fabricated using heat cure resin showed the highest mean flexural load of 563.1137 N followed by Protemp 4 (523.7173 N) and self cure resin (323.2993N).



Graph 1 : Mean Flexural Strength In Different Groups

Discussion

Interim restorations are an essential part of fixed prosthodontic treatment. Patients must be provided with an interim restoration from initial tooth preparation until the definitive prosthesis is placed.

Unsatisfactory strength of self cure resin results in failure or partial breakage of provisional FPDs over time. Traditional PMMA resin provisional FPDs typically fracture owing to heavy occlusal stress. This results in clinical inconvenience due to the need to rehabilitate or replace the FPDs, which is much more difficult for the dentist. The frequent mechanical failures of provisional fixed prostheses usually cause inconvenience, loss of time, and embarrassment for both dental clinicians and patients and also loss of confidence for dental clinicians before definitive restoration.

For patients with bruxism or those whose treatment plans require long term use of provisional restorations, when periodontally involved teeth to be retained during osseointegration of an implant, provisional restoration with improved physical properties are required. Temporomandibular joint observations demands prolonged use of provisional fixed partial denture. Therefore it is imperative to fabricate provisional fixed partial denture in sufficiently strong materials to avoid frustrating moments for clinician and patient.

Flexural Strengthis the stress that is necessary to cause fracture or a specified amount of plastic deformation. One

method to evaluate the ability to withstand the functional loads is to evaluate the material's flexural strength, also known as transverse strength, which is the strength of a material under a static load. This measurement is a combination of tensile and compressive strength tests with elements of proportional limit and elastic measurements[5]. According to the International Organization for Standardization (ISO 4049) and the American National Standards Institute (ANSI) / American Dental Association (ADA) Specifications # 27, an interim fixed prosthesis material must have a minimum strength of 50 Mega Pascals (MPa) when a bar of the material undergoes a 3-point bend test.

Interim fixed dental prosthesis are subjected to flexure under function and the fracture can occur under occlusal load resulting in failure of the restoration. Therefore, the interim restorations should have adequate flexural strength to withstand the masticatory forces. Although, restorations should be properly designed to avoid it, they may nevertheless fail leading to discomfort and time loss. The flexural strength of interim restoration materials is one of the important factors and should be considered prior to selecting a provisional restorative material for the clinical success.

Studies have been carried out to modify the chain structure for enhancing the flexural strength of materials. Protemp 4 is a Bis acrylic resin composite material, in which the manufacturer modified the chain structure of Bis acrylic resin composite materials to increase the flexural strength. Bis acrylic resin composite materials are difunctional and capable of cross linking with another monomer chain. This cross-linking imparts strength and toughness to the material. Protemp 4 is based on these modifications in which instead of rigid intermediate chain characteristics of some Bis-acrylic homologues, it also has flexible chain in comparison to other synthetic resin.

S. Dagar et al. 2005conducted a study on direct and indirect provisional materials and found that Protemp 2 has lesser flexural strength as compared to heat cure polymethyl methacrylate but more than self cure poly methyl methacrylate[4]. Singhal Romil et al 2012 conducted a study for flexural strength of four different provisional restorative materials. It was concluded that highest mean flexural strength was Heat cured acrylic resin followed by auto polymerized composite resin (Protemp-3), auto polymerized cold cured acrylic resin and light cured composite resin[6].

In the present study, three chemically different, commercially available crown and bridge provisional restorative materials were chosen to test and compare the flexural strength. Group (A) Autopolymerising resin, Polymethyl metacrylate (Dental Products of India, Mumbai), Group (B) Protemp-4, Bisphenol-A-glycidil Methacrylate-4 (3M ESPE Deutschland, Germany), Group (C) Heat cure resin, Polymethylmethacrylate(Dental Products of India, Mumbai). The materials we have chosen were based on their popular use, chemical composition differences and recent advances. Various advantages of PMMA are ease of availability, cost effective, easy to finish and polish and can be repaired easily.

In the study mean flexural strength was highest for Heat cured acrylic (563.11 N) followed by Protemp 4 (523.72 N) and least for Self cured acrylic (323.30 N). PMMA resins are relatively inexpensive, with good color stability, excellent polishability, and good marginal adaptation. Though materials have some draw backs like exothermic reaction, polymerisation shrinkage, low strength and pulpal irritation associated with excess free monomer but their ease of fabrication, cost effectiveness and good marginal adaptability outweigh their draw backs.

Visible light-cured urethane dimetha crylates have controllable working time, good wear resistance, low temperature changes, and good color stability. Their disadvantages include poor marginal fit, brittle nature, and high cost. Selection of a material should be based upon consideration of all the properties of the material in addition to its flexural strength and hardness. In spite of following a standard protocol for preparing, curing, and finishing of the test specimens, the homogeneity of mix, presence of internal porosity, pressure, and the release of stresses during finishing and polishing procedures was not controlled.

In the oral cavity, the provisional restoration is exposed to forces of varying magnitudes acting in different directions, and there are also temperature variations. The same situation was not simulated in this in vitro study. No correlation between effects of varying span length and different types of food solvents on the mechanical properties of the provisional restorations was done. Therefore further investigations are required under more closely simulated clinical conditions.

Conclusion

Based on the observation of present study it is recommended that in posterior long span fixed partial denture and in full mouth rehabilitation cases, the material of choice should be heat polymerizing PMMA or protemp 4 because of increased demand on strength of material to tolerate functional stresses. In anterior region Protemp 4 is recommended to be used because magnitude of functional stresses is comparatively less than posterior region. In certain surgical cases where an immediate provisional restoration is required Protemp 4 is material of choice because of ease of manipulation of direct fabrication. In addition it has advantage of no exothermic reaction and compatibility with eugenol temporary cement. Self cure acrylic resin may be put in to limited use of single provisional crown.

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Effect Of Various Plaque Disclosing Agents On Color Stability Of Esthetic Restorative Materials An Invitro Study

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Quick Response Code

Abstract
Background and objectives
The purpose of the present invitro study was to compare the effects of various plaque disclosing agents namely Erythrosine based, Bismarck brown based, Basic fuchsin based, Two-Tone and Iodine based disclosing agents, whereas Deionized water was used as control, on color stability of compomer (Dyract), RMGIC (Vitremer), Composite resin (Filtek Z350) and GIC (Ketac Fil Plus).
Methodology
Thirty six spherical shaped specimens of each material were prepared and were divided into six subgroups (I-VI), each subgroup containing (n=6) six specimens. The baseline color measurements were performed and the six subgroups of each group were exposed to the respective disclosing agents for 60 seconds. Then the final color evaluation was made using spectrophotometer.
Results
The result showed that the compomer and composite showed significant color change with all the disclosing agents except for control i.e. Deionized water, where as RMGIC showed insignificant color change in Deionized water (control), Erythrosine and Iodine disclosing agent subgroups and rest all subgroups showed statistically significant color change and GIC showed statistically insignificant color change in Deionized water subgroup, Two-tone and Iodine based disclosing agent subgroups, where as the remaining subgroups showed statistically significant color change.
Interpretations and Conclusions
Compomer was least color stable material followed by Composite, RMGIC and GIC. Erythrosine based disclosing agent produced least color change among different restorative materials and Bismarck brown based disclosing agents caused maximum discoloration in all the restorative materials.

Key Words
Color stability; Staining; Plaque disclosing agents; Esthetic restorative materials.

Introduction

Amalgam was taught for decades as the material of choice for restoration in primary molars. Patient demand for better esthetics and parents scare of potential adverse effect of mercury on health and pollution of the environment, motivated manufactures of dental products to develop alternatives for amalgam.[1] With increasing acceptance of adhesive dentistry and the public demand for more esthetics in dentistry, there has been an ever increasing demand by the lay public for tooth-colored restoration, instead of silver or metallic fillings.[2] Aesthetic restorative materials are marketed in various types with different physical characteristics and colors. For direct aesthetic restorations, four types of materials are widely used: composites, compomers, RMGICs and GICs. In pediatric dentistry these esthetically pleasing materials have tremendously changed the concept of today's practice. These tooth-colored materials are not only used for restoration of decay areas, but are also used for cosmetic improvement of smile by changing the color of teeth and reshaping disfigured teeth.[3] Discoloration is the major esthetic failure of direct tooth-colored restorations. It results from surface staining, marginal staining due to microleakage, changes in surface morphology by wear, and internal material discoloration.

Children with high index of caries usually need a great number of restorations. After the restorative treatment, bacterial plaque control is an important step to prevent secondary caries and pigmentation around margin areas of restoration.[4] Motivation of child patient is a valuable aspect to improve oral hygiene. Dental biofilm is nearly colorless unless stained, so plaque disclosing agents are used to stain the deposits that can be seen distinctly and provide a valuable visual aid in patient instruction.[5] Due to the wide use of tooth-colored restorative materials, it is important to determine which ones are susceptible to color change as the effect of these plaque disclosing agents on the colour stability of restorative materials remains unclear.

Since there is a paucity of information available and in view of limited work done on this aspect, this invitro study was undertaken to compare and evaluate the effect of various plaque disclosing agents on colour stability of various esthetic restorative materials.

Methodology

Thirty six spherical shaped specimens of (compomer (Dyract), Resin- modified glass ionomer cement (Vitremer), Composite resin (Filtek Z350) and Conventional glass ionomer cement (Ketac Fil Plus) each material of dimension of 12 mm in diameter and 1.5 mm in thickness were prepared using brass moulds and the samples were polished with Sof-Lex™ superfine polishing disks. After polishing, the samples were rinsed, dried with paper tissue, and the baseline color measurements were performed. Each

Group is then divided into six subgroups (I-VI), each subgroup containing (n=6) six specimens. The six subgroups of each group were exposed to Deionized water (control), Erythrosine based, Bismarck brown based, Basic fuchsin based, Two-Tone and Iodine based disclosing agents respectively for 60 seconds. Then the specimens were rinsed and dried, and final color evaluation was made using spectrophotometer.

Statistical Analysis

The color stability was evaluated by the determination of color change (ΔE*) between the final (F) and the baseline (O) color evaluations, using CIE L*a*b measuring system. The mean values (ΔE*) were calculated for each subgroup pre and post exposure to disclosing agents and analyzed using Students Paired-t-test and inter-comparison between disclosing agents and materials was done using One-Way-Anova with Scheff Multiple comparison test procedure.

The level of significance for all the tests was chosen as $p < 0.05$.

Results

The result showed that the Compomer (Dyract) and Composite (Filtek Z350), showed significant color change with all the disclosing agents except for control i.e. Deionized water, where as RMGIC showed insignificant color change in Deionized water, Erythrosine and Iodine disclosing agent subgroups and rest all subgroups showed ($p<0.05$) statistically significant color change and GIC showed statistically insignificant color change in Deionized water subgroup, Two-tone and Iodine based disclosing agent subgroups, where as the remaining subgroups showed ($p<0.05$) statistically significant color change.

Discussion

Today it is well established that dental plaque is harmful to both teeth and periodontium. Since self cleaning does not occur in modern diet and the use of antiseptic or antibiotics, because of their limitations, have not been introduced in routine plaque control, dental plaque must be removed by other methods, if inflammatory periodontal disease and caries are to be prevented. Effective plaque control must also be the most important part of any dental treatment plan and maintenance care program. Mechanical cleansing procedures are still considered to be the most reliable means of controlling plaque that is not readily visible to the necked eye. As recognition of the (in situ) plaque is considered to be a key factor in patient motivation, the need for disclosing agent arose, and as early as 1914 Skinner introduced the first disclosing agent in the dental literature.During the last twenty years, many investigatorshave suggested that the use of disclosing agents at home is important in patient motivation.[6] Despite the quality improvement of restorative materials, pediatric dentistry treatment reaches a better prognosis when the dental plaque control is done. The oral hygiene motivation should be made several times during the treatment. The plaque disclosing agents improve the motivation of the children. Several plaque disclosing agents have been used: Iodine solution, Mercurochrome solutions, Erythrosine, Basic Fuchsin and organic dye solutions.[4]

Tooth-colored restorative materials provide better esthetic results. Nevertheless, the color stability of tooth-color materials remains a major problem. The color changes can be related to intrinsic changes, such as changes in filler, matrix or silane coating, or extrinsic factors, such as adsorption or absorption of soft drinks, juices, coffee, tea or the products used in dentist's office. The extent of discoloration in the oral cavity may be associated with dietary habits.[7] Thus one of the side effect of the plaque disclosing agents could be the color change of the tooth-colored restorations. Color changes in esthetic restorative materials have been attributed to a wide variety of possible causes. Many color changes were described as the result of physical adsorption or physico-chemical reactions of the ingredients of the composite material during exposure to the oral environment. Wear or chemical degradation can increase the susceptibility of the material to extrinsic staining. Discoloration of polymeric materials could be due to an oxidation of the un-reacted carbon-carbon double bonds, producing colored peroxide compounds. Other causative factors that may contribute to the change in color of esthetic restorative materials include stain accumulation, dehydration, water sorption, leakage, poor bonding and surface roughness.[8]

In assessing chromatic differences, generally two color systems are utilized, Munsell Color System and Standard Commission International de L'Eclairage (CIELab). In the present study CIE Lab color system was used to evaluate color stability because this color system can transform spectrophotometer data to an approximately uniform color space. In the color space L* indicates lightness, a* indicates (red-green) and b* indicates (yellow-blue) are the chromatically coordinates which indicate color directions.[9] This study investigated the effect of some of the plaque disclosing agents on the surface staining of a range of esthetic restorative materials. Among resin based composite materials (viz compomer, composite and RMGIC), all disclosing agents stained these esthetic restorative materials. Compomer (Dyract) showed highest ΔE values with Basic Fuchsin, and higher ΔE values with Bismarck Brown and Iodine based disclosing agents and was more susceptible to staining than RMGIC (Vitremer) and composite (Filtek Z350).

In the present study compomer (Dyract) showed maximum discoloration when exposed to disclosing agents used in the study **(Table-I)**. There may be number of factors involved in the staining process of compomers, the main reason may be the material may absorb the liquid in the way that it absorbs water,surface reactivity and incomplete polymerization also may have contributed to the color instability of compomers.[7] Compomer absorbs water faster than composite; their hygroscopic expansion is high.[7] Water sorption occurs mainly as direct absorption in the resin matrix. The glass filler particles will not absorb water into the bulk of the material, but can absorb water on to the surface. Thus the amount of water sorption is dependent on the

TABLE I : Comparison Of Pre And Post Color Stability Scores Of Compomer With Different Disclosing Agents.

Groups	Treatment	Mean	Std.Dv.	p-value	Significance
Compomer And Water	Pre	34.4433	0.8057	0.1622	NS
	Post	34.0433	0.5277		
Compomer With Erythrosine	Pre	34.4383	0.3091	0.0485	S
	Post	35.6967	1.3494		
Compomer And Bismarck Brown	Pre	34.3600	0.4976	0.0000	S
	Post	44.4100	1.4699		
Compomer And Basic Fuchsin	Pre	34.4933	0.2391	0.0000	S
	Post	60.4550	3.4385		
Compomer And Two-tone	Pre	34.8450	0.4358	0.0034	S
	Post	36.7517	0.8212		
Compomer And Iodine Agent	Pre	34.8450	0.4351	0.0000	S
	Post	45.9267	1.5562		

The level of significance was $p < 0.05$.

TABLE II : Comparison Of Pre And Post Color Stability Scores Of Rmgic With Different Disclosing Agents.

GROUPS	Treatment	Mean	Std.Dv.	p-value	Significance
RMGIC and Water	Pre	31.7567	1.0137	0.4670	NS
	Post	31.7917	1.0215		
RMGIC with Erythrosine	Pre	32.5050	1.1407	0.1143	NS
	Post	33.3000	1.7067		
RMGIC and Bismarck Brown	Pre	30.7350	0.8326	0.0006	S
	Post	38.1250	3.0607		
RMGIC and Basic Fuchsin	Pre	30.9683	1.7294	0.0000	S
	Post	43.3633	1.3315		
RMGIC and Two-Tone	Pre	30.9333	1.4301	0.0127	S
	Post	34.5117	1.9482		
RMGIC and Iodine agent	Pre	30.2100	1.8512	0.0667	NS
	Post	31.4900	1.4557		

The level of significance was $p < 0.05$.

TABLE III : Comparison Of Pre And Post Color Stability Scores Of Composite With Different Disclosing Agents.

GROUPS	Treatment	Mean	Std.Dv.	p-value	Significance
Composite and Water	Pre	32.3933	1.0379	0.3018	NS
	Post	31.9700	1.4774		
Composite with Erythrosine	Pre	33.4167	1.6423	0.0012	S
	Post	33.7133	1.6481		
Composite and Bismarck Brown	Pre	34.0950	0.6921	0.0001	S
	Post	49.2250	2.7430		
Composite and Basic Fuchsin	Pre	33.4933	0.7855	0.0010	S
	Post	43.3950	2.8476		
Composite and Two-Tone	Pre	33.2617	0.4849	0.0168	S
	Post	33.7183	0.5441		
Composite and Iodine agent	Pre	34.0433	1.2093	0.0180	S
	Post	35.3633	1.1312		

The level of significance was $p < 0.05$.

TABLE IV : Comparison Of Pre And Post Color Stability Scores Of Gic With Different Disclosing Agents.

GROUPS	Treatment	Mean	Std.Dv.	p-value	Significance
GIC and Water	Pre	26.5383	1.4101	0.5611	NS
	Post	26.6283	1.2015		
GIC with Erythrosine	Pre	26.7600	1.3399	0.0011	S
	Post	26.9583	1.3479		
GIC and Bismarck Brown	Pre	27.3267	1.9670	0.0180	S
	Post	30.9550	0.8853		
GIC and Basic Fuchsin	Pre	27.6683	2.0568	0.0307	S
	Post	31.5100	2.6916		
GIC and Two-Tone	Pre	26.4200	1.2097	0.0821	NS
	Post	26.8600	1.0309		
GIC and Iodine agent	Pre	28.1433	0.8753	0.1196	NS
	Post	28.5700	0.5942		

The level of significance was $p < 0.05$.

resin content of the material and the quality of the bond between the resin and the filler. Extra water sorption may decrease the life of resin composites by expanding and plasticizing the resin component, hydrolyzing the silane and causing micro-cracks or the interfacial gaps at the interface between filler and matrix allowing stain penetration and discoloration.[10]

The composite (Filtek Z350) showed highest ΔE values **(Table-III)** after exposing to Bismarck Brown based disclosing agent followed by Basic Fuchsin based disclosing agents and also showed significant color change with all the other agents except for the Deionized water (control). Three types of composite material discolorations are generally described (Vermeersch and Vreven 1989); 1) external discolorations due to the accumulation of plaque and surface stains; 2) surface and sub-surface color alterations implying a superficial degradation or a slight penetration and reaction of staining agents within the superficial layer of resin composites (adsorption); or 3) body or intrinsic discolorations due to physico-chemical reactions in the deeper portions of the restorations.[11] Staining susceptibility of resin composites might be attributed to their degree of water sorption and hydrophilicity of the matrix resin. If the resin composite can absorb water, then it is also able to absorb other fluids, which result in discoloration. In the present study all the resin based materials namely composite (Filtek Z350), compomer (Dyract) and RMGIC (Vitremer) showed significant color change with Bismarck Brown based disclosing agent which contains the ethanol and it may be correlated to the higher resin content in these three materials. The color change seen in glass ionomers was minimum, but it was statistically significant.[9]

Bismarck Brown based disclosing agent contained ethanol which may contribute to deterioration of esthetic restorative materials, including some effect on the color stability. Dental polymers have been shown to be susceptible to softening by organic acids produced in plaque as well as ethanol solutions. Since the softening phenomenon is associated with a loosening of polymer structure, an increased propensity to surface staining might be another result of softening. There are many reports[12] in the literature stating that the alcohol in mouth rinses may soften resin based composites restorations, but the mechanism of breakdown is not fully understood. Alcohol is thought to produce stress crazing and cause corrosive effects on the surface of polymeric materials.[9] The color of composite resins may change after exposure to various energy sources and immersion in water for long period.[7]

Although glass-ionomers and poly acid modified resin based composites (Compomers) have a beneficial effects of fluoride release on human dentition, these poly-acid based restorative materials should be used judiciously as substitute esthetic materials for resin based composites in clinical applications.[9] The glass-ionomers produced maximum discoloration with Basic Fuchsin and Bismarck Brown disclosing agents but the extent of discoloration was not very high when compared to the other materials, possible reason may be the glass filler particles will not absorb water into the bulk of the material, but discoloration can be caused by absorption of disclosing solution on to the surface as it absorbs water on to its surface.[10] It has been found that color change of chemically cured materials is associated with the type and quantity of amine involved in the polymerization. Further, the inhibitor has been found to play the role. Besides amine and inhibitor, it has been conjectured that the monomer content and the peroxide may influence internal discoloration.

Since GICs and RMGICs have different compositions, they will not be equally susceptible to surface staining. The results of this study indicated that RMGIC (Vitremer) was more susceptible to staining **(Table-II)** than Conventional GIC (Ketac Fil Plus) **(Table-IV)**. Previous studieshave shown that the water sorption of Resin-modified glass-ionomers is higher than that of conventional glass-ionomer cements because of the rapid water sorption by HEMA, a significant resin component and accelerated acid-base reaction, but discoloration decreases with time. Fruits et al proposed that Resin-modified glass-ionomers may be chemically stable after sufficient maturation has taken place.[9] Knobloch et al, stated that all Resin-modified glass-ionomer cements showed high water sorption due to their hydrophilic nature. The results of present study confirmed previous findings. Another reason could be related to GICs water content, which is higher in conventional GICs than in RMGICs, such that the former absorbs less water and therefore less susceptible to staining. Glass-ionomers and poly acid modified resin based composites (compomers) may be more adequate for children than adults because in children the materials are less likely to be subjected to long term exposure to organic acids, ethanol, or bleaching agents.

Erythrosine is one of the eleven kinds of

synthetic dyestuffs permitted to be used in Japan, and it has the largest adsorption index among other dyes. In disclosing agent containing erythrosine showed lesser discoloration of restorative materials, possible reason may be sorption of water might have taken place faster than staining.[13] In the present study, the plaque disclosing agent was applied only one time on the samples. During the treatment, the child can be subjected to several contacts with the disclosing agents. Moreover, there is the action of other kind of products (soft drinks, tea and juices) that could increase the color changes of the restorations.[4] Combinations of staining solution, immersion time and absence of sufficient cleaning or brushing the specimens during the study are significant factors affecting susceptibility to staining of the materials. However, actual staining in the oral cavity would very likely require longer period of time, because of intermittent nature of stain exposure, because saliva and other fluids will dilute staining media and because restorations will be polished by tooth brushing.

This encouraging invitro data suggests the need for a well controlled clinical trial to evaluate further clinical effectiveness. The verdict of the cumulative experience is awaited.

What This Paper Adds...?

- With increasing acceptance of adhesive dentistry and the public demand for more esthetics in Pediatric Dentistry, there has been an ever increasing demand by the lay public for tooth-colored restoration and it is important to know most color stable material of wide variety of tooth colored materials available in market.
- GIC (Ketac Fil Plus) was the most color stable material which is one of the most widely used cement in Pediatric Dentistry followed by RMGIC (Vitremer), composite (Filtek Z350) and Compomer (Dyract) was the least color stable.
- Erythrosine based disclosing agent (Plaksee) produced least color change among different materials. Bismarck brown based disclosing agent caused maximum discoloration in all tooth colored materials.

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Comparison Of Different Impression Techniques For Post Space: An In Vitro Study

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Abstract

AIM

To compare different dowel–space impression techniques so as to determine the method that produces minimum voids in post space impressions.

MATERIALS AND METHOD

Anterior teeth were endodontically treated and prepared for dowel and core. These were divided into five groups and impressions were made with various techniques to observe voids.

RESULT

The number of impressions without voids made by each of the technique was in decreasing order: technique I > technique II > technique IV > technique III >technique V.

CONCLUSION

Impression made using 24 gauge anesthetic needle which acted as a vent at the apex during injecting light body polyvinyl siloxane impression material followed by removal of the needle and placement of orthodontic wire to the depth of preparation resulted in maximum number of void free impressions.

Key Words

vent, dowel, impression technique, voids

Quick Response Code

Introduction

Endodontic therapy enables several advantages including maintenance of a natural tooth, restoration of esthetics and function. But teeth treated by endodontic therapy are often mutilated by caries fracture or previous restoration. Historically, many methods have been attempted in the search for an ideal foundation or build-up design for endodontically treated teeth.

Post and core has been found to be the most appropriate method for reinforcing these teeth. Post is the portion embedded into the prepared root canal. Post can be either prefabricated or custom made. Custom made post can be fabricated either by direct or indirect technique. In indirect technique, impression taken should exactly replicate the parameters such as design, length, surface configuration and diameter. The major problem associated with making the impression of post space is incorporation of voids in the radicular portion and inability to produce accurate impression in all dimensionswhichaffects the cast post fabricated. With the indirect technique, less chair time is used when multiple cast dowel-cores are fabricated for the same patient. In addition, when radicular attachments are incorporated into partial denture designs, the indirect technique is invaluable to accurately align on the cast, the attachment system's path of insertion with the prosthesis path of insertion.

Regardless of the selected technique, the impression must accurately reproduce the full length of the dowel space, as greater dowel length can contribute to more predictable retention of the core.

Materials And Method

To standardize the procedure standard instruments and equipments were used to make post-space. The extracted maxillary central incisors weresterilized for 48 hours in/ glutaraldehyde solution and stored in normal saline solution. The central incisor was prepared for complete porcelain fused to metal (PFM) crown. The facial and proximal reduction of 1.5 mm with a shoulder finish line and 0.5 mm lingual with a chamfer was given. An incisal reduction of 2 mm was done. A further incisal reduction of 4 mm was done on a flat plane for a core restoration. Access to root canal was made and pulp was extirpated. Biomechanical preparation was done upto K-file no. 80 using Schilder method and obturation was done with gutta percha usinglateral condensation technique.Post space was prepared with a No. 3 Paeso reamer (Dentsply Caulk, Milford, DE)leaving 4 mm of gutta percha at the apex and enlarged to No.5 Paeso reamer.Five such teeth were prepared.

Custom trays (SR Ivoclar Custom Tray Material; Ivoclar, Liechtenstein) were made to carry heavy body impression material to make an impression with 2 mm wax relief **(Figure I)**. Five different techniques were used to obtain the impression of post space by using light body addition polyvinyl silicone impression materialand fiveimpressions were made with each technique **(Figure 2)**. Impression tray adhesive (VPS impression tray adhesive; Kerr Manufacturing Co, Romulus, MI) was applied to the inner surface of the tray 15

Figure 1: Materials Used For Custom Tray Fabrication

Figure 2: Equipment Used For Making Impression

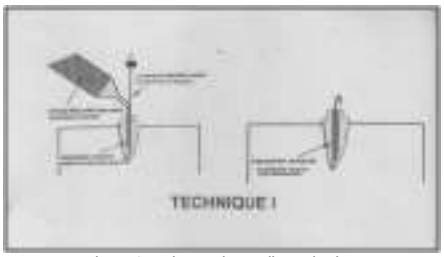

Figure 3: Using Both Needle And Wire.

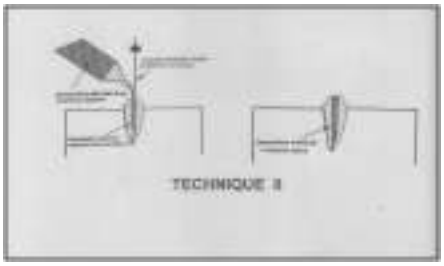

Figure 4: Using Needle Only.

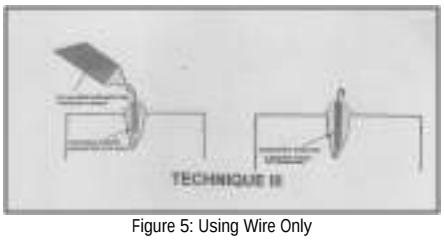

Figure 5: Using Wire Only

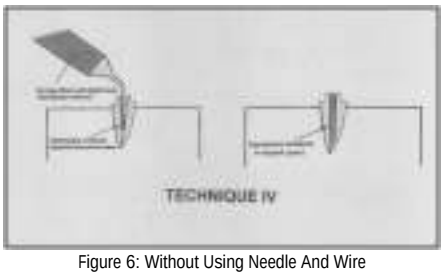

Figure 6: Without Using Needle And Wire

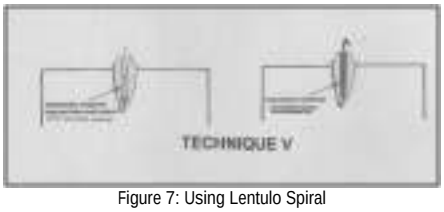

Figure 7: Using Lentulo Spiral

minutes before each dowel space impression procedure. Tests were conducted at a room temperature of 23°C and a relative humidity of approximately 70%.

Technique I

In this technique a 24 gauge needle was used as a vent. It was inserted and held in the post-space with the help of tweezer and the light body addition silicone impression material was injected into the post space using disposable tip. Anesthetic needle was then removed and a half inch 24 gauze orthodontic wire bent slightly at tip was inserted into the light body impression material in the post-space. Then the custom tray filled with heavy body addition silicone impression material was used to pick up post impression and to record the prepared tooth.

The basic procedure for the post space impression was kept the same as in technique 1. Following alteration was done as mentioned in respective techniques. **(Figure 3)**.

Technique II

In this technique, 24 No. anesthetic needle was used as a vent.But no orthodontic wire was used. **(Figure 4)**.

Technique III

In this technique, onlyorthodontic wire was inserted to recover the impression. **(Figure 5)**.

Technique IV

In this technique, neither needle nor wire was used. **(Figure 6)**.

Technique V

In this technique, the light body addition silicone impression material was placed in the post space with the help of lentulo spiral with slow speed contra angle hand piece. Then orthodontic wire was inserted into the impression material. The impression was then made as in technique I and was recovered. **(Figure 7)**.

A total of 125 samples obtained were evaluated for their accuracy using magnifying lenses of 3.5X. The clinical pictures of post space impression with and without voids are shown in Figure 8 and 9 respectively.

Observations And Results

Impression technique directly influenced the proportion of impressions without voids. The maximum number of impressions without voids were in technique I where 24 out of 25 samples were void free. The number of impressions without voids made by each of the techniquewere in decreasing order of technique I > technique II > technique IV >technique III > technique V. **(Table I, Figure 10)**.

Figure 8: Showing Post Space Impression With Voids

Figure 9 : Showing Post Space Impression Without Voids

Further themean value of impression without voids using different techniques was found to be highest for technique I i.e. 4.80 and lowest for technique V i.e. 1.00. **(Table II, Figure 11)**.

It was also found that maximum length covered by impression material was in technique I and minimum length was covered by technique IVas the root canals were prepared till the length of 8mm. **(Table III, Figure 12)**.

Discussion

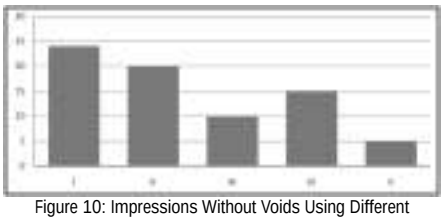

Figure 10: Impressions Without Voids Using Different Techniques

Table I : Showing Number Of Samples Without Voids

	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5
Technique I	5	5	4	5	5
Technique II	5	5	3	4	3
Technique III	2	3	3	1	2
Technique IV	3	2	2	3	5
Technique V	2	1	0	0	2

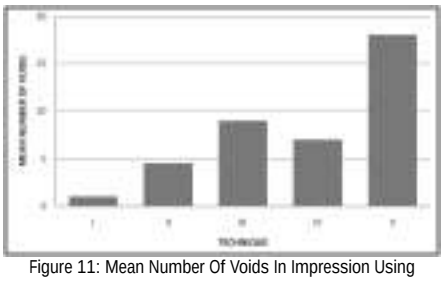

Figure 11: Mean Number Of Voids In Impression Using Different Techniques

Table II : Showing Mean (± SD) Of Impressions Without Voids Using Different Techniques

	Technique I	Technique II	Technique III	Technique IV	Technique V
Number Of Specimens	25	25	25	25	25
Mean Value	4.80	4.00	2.00	3.00	1.00
Standard Deviation	0.4472	1.000	0.7072	1.2247	1.00

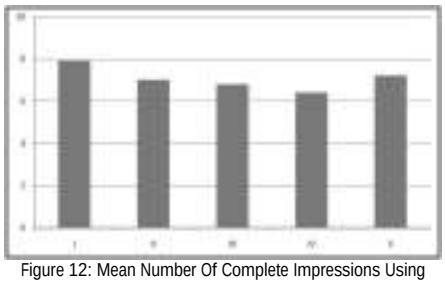

Figure 12: Mean Number Of Complete Impressions Using Different Techniques

Table III : Showing completeness of impression in each of the technique (Total length of prepared post-space-8 mm)

	Specimen I	Specimen II	Specimen III	Specimen IV	Specimen V
Technique I	8	8	7	8	8
Technique II	7	7	6.5	8	7.3
Technique III	6	7	7.5	7.3	7
Technique IV	6	6	7	6.5	7
Technique V	8	7	7	7	8

Endodontically treated teeth generally require post core system to develop a tooth preparation necessary to provide retention and adequate resistance form for the success of the definitive crown. Custom cast post-core is the method of choice to restore such teeth. There are two methods by which impression of post space core can be made - direct and indirect techniques. Out of these, indirect method is preferred as it takes lesser chair side time especially for multiple restorations.

In indirect technique, an impression of the prepared post space is made to form a working cast upon which the post-core pattern is then fabricated. Regardless of the technique employed, the impression for the post must record accurately the surface details along the entire length of the post space.While the impression is being made, due to insufficient escapement for air, voids commonly get incorporated in the radicular portion of the post impression leading to inaccurate fit of cast post.

This study was conducted to compare different post space impression techniques using polyvinyl siloxane impression material to determine which technique produced the most accurate impression of the post space.

Venting the dowel space with a needle while injecting impression material into the canal is an easy technique to predictably make void-free dowel space impressions. The use of local anesthetic needle allowed for air escape, leading to complete impressions of the apical portions of the dowel space. Voids on the lateral aspect of the intra radicular part of the impressions were found on the apical third of the dowel space with many impressions using Techniques II through V, and the voids largely resulted from air entrapment while the impression material was expressed into the canal.

When Technique I is used clinically, the local anesthetic needle should be secured with dental floss to prevent accidental swallowing or aspiration by the patient. Although use of vents with dowel space impression has not been previously reported, the use of vents to improve other aspects of fixed prosthodontics therapy has been described. For example, occlusal vents can be used to reduce hydraulic pressure during crown luting, thereby reducing vertical seating discrepancy and improving definitive restoration marginal adaptation.[10],[11] In this situation, the vent is an escape for excess luting agent during final restoration cementation. Likewise, the needle vent during a dowel space impression allows for air escape in the dowel space during impression material injection.

Summary And Conclusions

Based on the observation made, the following salient features can be deciphered:

1. In technique I, impression made using 24 gauge anesthetic needle which acted as a vent at the apex during injecting light body polyvinyl siloxane impression material followed by removal of the needle and placement of orthodontic wire to the depth of preparation resulted in maximum number of void free impressions.
2. In technique V, on the contrast when a lentulo spiral and orthodontic wire was used, the number of voids was maximum.
3. The void free impression with various techniques showed statistically significant difference.
4. In technique I, completeness of impression was maximum where as in technique IV the completeness of impression was minimum.
5. Completeness of impression with various techniques showed statistically significant difference.
6. When compared for the surface irregularity on the impression, the surface irregularity was maximum in apical third and minimum in cervical third in all the technique.

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Comparative Evaluation Of Retention Of Conventional Resin Bonded Fixed Partial Denture And Its Modified Designs: An In Vitro Study

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Abstract

Background and Objective

Over the years, RBFPDs have gone through substantial development and refinement. Several studies examined the biomechanics of tooth preparation and framework design in relation to the success rate of RBFPDs and considered retention and resistance form essential for increasing the clinical retention. However, these criteria required preparations to be more invasive which violates not only the original intentions of the RBFPD but may also have an adverse effect on retention due to loss of enamel. The purpose of this in vitro study was to evaluate retention of the two modified designs of RBFPDs and to compare them with that of conventional RBFPDs.

Method

Ninety extracted human teeth were randomly divided into three groups (n=15). Specimens in group 1 (conventional RBFPDs) were prepared with proximal grooves, occlusal rest seats, and lingual wings. Specimens in group 2(modified RBFPDs) were prepared with proximal slots, occlusal rest seats and lingual wings. Specimens in group 3(modified RBFPDs) were prepared with Class II inlay cavities. Castings were made and cemented with self-adhesive resin cement. The specimens were then subjected to tensile pull out test using universal testing machine. The force required to dislodge each RBFPD from the teeth was recorded. The data were analyzed using ANOVA and Bonferroni test.

Result

The mean tensile bond strength of group 2 was significantly higher than groups 1 and 3. Though the mean tensile bond strength for group 3 was higher than group 1, it was not statistically significant.

Conclusion

The modified RBFPDs of group 2 had better potential for retention. Increased resistance to dislodgment of the RBFPDs was related to the surface area available for bonding. The positive findings of this study warrant a long term clinical trial of the modified RBFPDs.

Key Words

Resin bonded fixed partial denture; Maryland Bridge; Retention; Tensile strength.

Introduction

Rochette in 1973 proposed adhesively bonded splints with macromechanical retention through perforated retainers.[1] Later, Howe and Denehy[2] used this technique for an anterior fixed partial denture, and Livaditis[3] described this technique for posterior tooth replacement.

The main advantages of the RBFPDs are reduced pulpal morbidity caused by minimal tooth preparation, as well as less gingival inflammation resulting from supragingival placement of the margins.[4] In addition, chairside time and laboratory costs are reduced compared to conventional prostheses.[5]

Introducing a minimally invasive preparation design with large surface areas for bonding and vertical grooves improved the survival rates of RBFPDs.[5],[6] In addition, several retentive systems for bonding composite resin to metal were developed. However, clinical results showed unsatisfactory retention rates for RBFPDs. Several studies evaluated the biomechanics of tooth preparation and framework design in relation to the success rate of RBFPDs and considered retention and resistance form essential for increasing the clinical retention of RBFPDs.[7],[8] Consequently, the original design of RBFPDs which involved no tooth preparation gradually went through a number of changes such as preparation of proximal grooves, occlusal rest seats, and lingual wings.[7] Other modifications like incorporation of pins (pin-retained RBFPDs)[9], retentive slots and inlay preparations[10] were also proved to be effective.

These new modified designs, however, are less conservative than the designs that have been previously used. Therefore, prior to prescribing these designs for the replacement of the posterior teeth in the partially edentulous patients, it is prudent to evaluate their retention in an in vitro study. The purpose of this in vitro study was, therefore, to compare the retention of the two modified designs of the RBFPDs with that of the conventional RBFPDs and to assess their suitability for use as an alternative to partial or full coverage retainers, wherever, indicated.

Material and Method

Ninety freshly extracted human teeth (forty five 2nd premolars and 2nd molars) were employed in the study. Each selected tooth received two grooves on the mesial and distal surfaces of its root prior to being embedded in the resin. The grooves were placed in the roots in order to secure them in place in the resin base

[self-cure acrylic resin (DPI-RR Cold cure, DPI, Mumbai, India)] during the tensile test. Specimens were then prepared by mounting one premolar and one molar with a space equivalent to 1st molar tooth between them in the resin base, with the long axis of the tooth perpendicular to the horizontal plane, at dough stage. All the specimens were preserved in distilled water until further use.

The specimens were then assigned at random to three different preparation designs, consisting of 15 specimens each. The division was made in such a way that there was a similar distribution of teeth (small, medium, large) and type (maxillary and mandibular) in each group.

Group 1- Specimens in group 1 were prepared with proximal grooves, occlusal rest seats, and lingual wings to receive conventional RBFPDs. **(Figure 1)**.

Group 2- Specimens in group 2 were prepared with proximal slots, occlusal rest seats and lingual wings to receive modified RBFPDs. **(Figure 2)**.

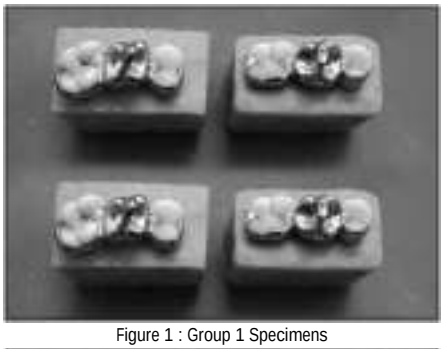

Figure 1 : Group 1 Specimens

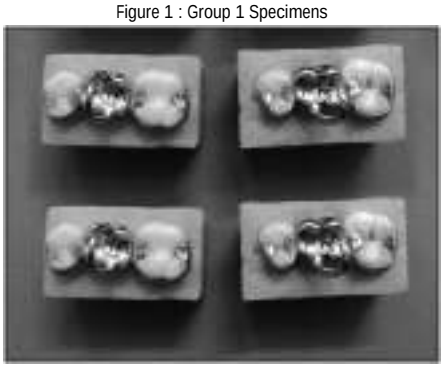

Figure 2 : Group 2 Specimens

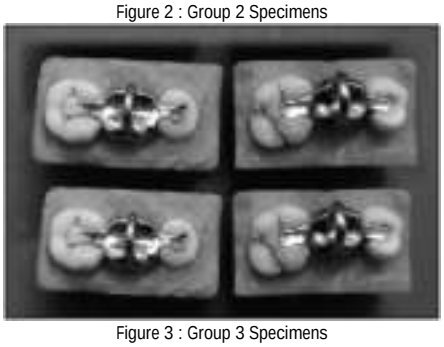

Figure 3 : Group 3 Specimens

Group 3- Specimens in group 3 were prepared with Class II inlay cavities to receive modified RBFPDs. **(Figure 3)**.

Tooth preparation

Putty index was made using addition silicone impression material (3M ESPE, ExpressTM STD, vinyl polysiloxane impression material, Germany, Lot no. 153490) for each specimen before starting the preparation.

Group 1 specimens consisted ofproximal grooves, lingual wings and occlusal rest seats on the abutment teeth. The lingual reduction was done using micromotor handpiece attached to the Jelenko surveyor. The margins were placed 1mm above the cemento-enamel junction with a wing preparation of 0.6mm depth. The lingual reduction was extended further onto the other proximal surface to ensure a total circumferential coverage of more than 1800. The proximal grooves were placed in the center of the mesial surface of the premolar and in the center of the distal surface of the molar, 0.5mm above the finish line. Occlusal rest seats were prepared in the distal fossa of the premolar and in the mesial fossa of the molar. Occlusal rest seat was roughly rounded triangular in shape with apex towards the center of the occlusal surface. The depth of the rest seat was 1.5mm in the central fossa and 0.5mm at the marginal ridge with buccolingual width of 1/3rd the intercuspal distance and mesiodistal width 1/3rd the mesiodistal width of the concerned tooth.

Group 2 specimens consisted of proximal slots, lingual wings and occlusal rest seats on the abutment teeth. Occlusal rest seats were prepared in the mesial fossa of the premolar and the distal fossa of the molar. The preparation of occlusal rest and lingual wing preparation was done in the same way as it was done for specimens in group 1. The proximal slots, 3mm deep, 2mm wide bucco-lingually and 1.5mm wide mesio-distally, were prepared on the disto-occlusal surface of the premolar and the mesio-occlusal surface of the molar.

Group 3 specimensconsisted of class II inlay cavity on the distal side of the premolar and mesial side of the molar. Inlays were 2mm deep occlusally extending till the central fossa with an occlusal dovetail (0.5mm) and buccolingual width of 1/3rd the intercuspal distance; proximal box was made 3mm deep with straight parallel walls, beveled axio-pulpal line angle, flat pulpal and gingival floors.

Putty index was used to verify the amount of lingual reduction. William's graduated periodontal probe was used to measure the depth, width and height of the proximal slots and class II inlay preparations. All the preparations were done by single set of burs for the particular group to standardize the preparations.

The putty wash impression technique was employed for making the impression of all the specimens using addition silicone- putty (3M ESPE, Express TM STD, vinyl polysiloxane impression material, Germany, Lot no. 153490) and light body (3M ESPE, vinyl polysiloxane impression material, Germany, Lot no. 128670) material. Impressions were poured using type IV die stone (Gyprock, Rajkot (Gujarat), India).

Wax patterns were fabricated using casting wax. A round sprue wax (Bilkim Polywax, Duron, Turkey) was shaped as a loop and attached to the center of the occlusal surface of the pontic buccolingually, parallel to the long axis of the tooth to allow tensile testing. Castings were made using Ni-Cr alloy, trimmed and polished.

Castings were cemented using self-adhesive resin cement (Smart cemTM2, Dentsply Caulk, USA, Lot no. 1105181). The specimens were then subjected to tensile pull out test using universal testing machine (Llyod LR 50K, FIE, India) after 24h of water storage **(Figure 4)**. The force required to dislodge each RBFPD from teeth was recorded. The data were analyzed using one-way ANOVA and Bonferroni test.

Figure 4 : RBFPD Dislodged From The Mounted Specimen

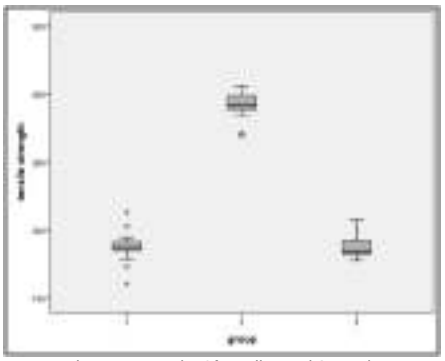

Figure 5 : Box Plot Of Tensile Bond Strength

Results

Mean values and standard deviations were calculated for each group. The highest mean tensile bond strength was obtained for group 2 (382.30 N) and the lowest was obtained for group 1 **(Figure 5)**. One way Analysis of Variance (ANOVA) was done using Statistical Package for Social Scientist (SPSS) at a level of significance of 0.05 and at a confidence interval of 95%. From the results of the analysis it was found that there was a highly significant difference between the three groups with respect to the mean load ($F = 512.870$, $p < 0.01$).

In order to find out among which groups there exists a significant difference, multiple comparisons using Bonferroni test was done. (**Table I)** shows the pair wise comparisons of groups. There was significant difference in the mean load of group 1 when compared with group 2 ($p < 0.01$). However, the difference in mean load between groups 1 and 3 was not statistically significant ($p > 0.05$). There was statistically significant difference between the mean loads of group 2 when compared to both groups 1 and 3 ($p < 0.01$). The difference in mean load between group 3 & group 2 was found to be statistically significant ($p < 0.01$). No statistically significant difference was observed between groups 3 and 1 with respect to the mean load ($p > 0.05$).

Discussion

Teeth extracted for orthodontic treatment and periodontal treatment were chosen for the study as this would increase the chances of finding tooth with intact clinical crown and root. Human teeth were used for the study in an effort to simulate clinical conditions so that the results would be comparable and applicable in clinical situations.

An RBFPD is subjected to repeated tension, compression and torquing forces in the mouth. Until now, it has not been possible to simulate these forces in vitro. Although the tensile test does not directly reflect the intraoral dislodging forces, it does estimate the retentive properties of the RBFPDs. Hence, in the present study tensile force test was used as it is a widely accepted estimate for retention of RBFPDs.

Table I : Pair-wise Comparisons: Bonferroni Test

(I) Group	(J) Group	Mean Difference (I-j)	P -value	95% Ci For Mean Difference	
				Lower Bound	Upper Bound
Group 1	Group 2	-207.007	< 0.001*	-225.597	-188.417
	Group 3	-0.470	1.000	-19.060	18.120
Group 2	Group 1	207.007	< 0.001*	188.417	225.597
	Group 3	206.537	< 0.001*	187.947	225.127
Group 3	Group 1	0.470	1.000	-18.120	19.060
	Group 2	-206.537	< 0.001*	-225.127	-187.947

In the present study, group 2 showed highest mean tensile bond strength and the difference was statistically significant as compared to the other two groups. The results were consistent with the study done by El-Mowafy O and Rubo MH.[10] They concluded that the addition of the slot cavities resulted in an increase in the preparation area, thereby increasing the surface area for bonding. Lankford and Christensen stated that modifications in teeth, such as grooves or slots, were required to provide adequate resistance form.[16] Eshelman JR et al stated that an increase in the resistance form can be obtained by incorporation of proximal slots which would interfere with the rotational movement of the prosthesis.[17] Crispin BJ from his longitudinal study concluded that the proximal segments act as connectors for the pontic and contribute to the buccolingual bracing of the abutments, while the lingual segments increase the surface area available for bonding and add to dissipation of laterally directed forces.[18]

Group 3 showed higher tensile bond strength than group 1 but the difference was not statistically significant. The results were consistent with the study done by Cotert SH and Ozturk B, where after 3 years follow up no significant difference in survival rate was found between the inlay design and the conventional design. They concluded that a layer of enamel should be retained on the pulpal walls and floor to maintain the enamel-resin-metal bond.[19] Isidor F and Stockholm R conducted a 4 year longitudinal study that used inlay preparation on abutments with twenty three RBFPDs reported no failures.[20] Kiremitci A et al also found in their in vitro study that self-adhesive resin cement showed higher bond strength to enamel than dentin.[21] In this study group 3 preparation was in dentin so this might be a reason for less bond strength as compared to group 2.

Maximizing the contact area for bonding the retainer to the enamel is one of basic concepts, which can be achieved by extension of the preparation around 1800 of the axial surface.[22],[23],[24] As the group 3 preparations lacked this feature, this might be another reason for less retention as compared to group 2.

Visual inspection of the surface of the prostheses (71.33%) after dislodgement from the teeth showed that there were no remnants of the luting agent on their surfaces. This implies an adhesive failure at the interface between the cement and the prosthesis. 26.67% prostheses after dislodgement from the teeth showed that cement was retained on their surfaces, but there were areas free of cements, implying that the mode of failure was a combination of adhesive and cohesive failures. Only 2% of prostheses showed cohesive failure.

Most of the adhesive failures in this study occurred at the metal-cement interface indicating that this was the weakest link in the system. This observation was in agreement with the several clinical studies done by Hansson and Moberg[25], Rammelsberg et al[26], Boening[27], Hansson and Bergstrom.[28]

The extrapolation of the results from work of a purely in vitro nature must always be made with caution. In the oral environment, failure of RBFPDs takes place under conditions of repeated compressive and lateral forces of mastication, under the influence of thermal changes, and under changing pH of the salivary fluids, not under a continuous tensile load similar to that used in this study. This study assessed the tensile bond strengths of RBFPDs after 24 h of water storage. It is possible that a longer storage time and/or thermal cycling and cyclic (fatigue) loading would give different results.

Another crucial factor is the ability of an RBFPD to distribute stress under

function. Hence a photoelastic stress analysis study may be useful in this regard.

Conclusion

Within the limitations of the study, the following conclusions were made:

1. The mean tensile bond strength of modified RBFPDs with proximal slots, occlusal rest seats and lingual wings was significantly higher than that of conventional RBFPDs and modified RBFPDs with class II inlays.
2. Modified RBFPDs with class II inlays had higher mean tensile bond strength than that of conventional RBFPDs, the difference was not statistically significant.
3. The tensile bond strengths were significantly affected by the surface area covered i.e., area available for bonding. Incorporation of slots, 1800 wraparound and occlusal rest seats increase the surface area thereby increasing the retention of the RBFPDs.
4. The positive findings of this study warrant a long term clinical trial of the modified RBFPDs.

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Oral Microbiopsies: An Alternative Tool To Incisional Biopsies For Diagnosis Of Oral Potentially Malignant Lesions: A Pilot Study

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Abstract
Background : Small tissue fragments obtained from more than one site by scraping the whole surface of the lesion with a dermatological curette could be used as 'micro' biopsies in diagnosis of oral dysplasias/carcinomas. This study was undertaken to assess the accuracy of micro-biopsies in the diagnosis of oral potentially malignant lesions.
Methods : A prospective study was done out on 40 patients with potentially malignant lesions. The microbiopsies were carried out from more than one site, of a particular lesion which is followed by routine scalpel biopsy procedure. The confirmatory diagnosis obtained by scalpel biopsy was used for evaluating accuracy of micro-biopsy procedure.
Results : Out of 40 microbiopsy samples, 3 were inadequate for the diagnosis. For two cases, result of scalpel biopsy was unavailable for comparison as patient refused for the procedure. An accuracy of 88.57% was obtained for microbiopsy technique as 31 out of remaining 35 cases were showing results in accordance with the scalpel biopsy diagnosis.
Conclusions : Oral microbiopsy proved to be a simple, practicable and minimally invasive technique for early detection of oral potentially malignant lesions (especially in follow ups and multiple lesions) which leads to prevention and better treatment outcome. However, further research, with more number of study sample is required to establish this technique as routine diagnostic aid.

Key Words
Curette, Microbiopsy, Oral

Introduction

The World Health Organization (WHO) reported oral cancer as having one of the highest mortality ratios amongst all malignancies,[1] as often its diagnosis is made only in advanced stages. The global increase in frequency and mortality of oral cancer has intensified current research efforts in the field of early detection and prevention.

Oral premalignant/precancerous lesions are defined as altered epithelium with an increased likelihood for progression to squamous cell carcinoma (SCC)[2]. The principal oral premalignant lesions which may be precursor to Oral squamous cell carcinoma are white patches (leukoplakia) and red patches (erythroplasia/erythroplakia) or mixed red and white lesions. In WHO(2005) workshop, the term potentially malignant was preferred above 'premalignant' or 'precancerous' as it conveys that not all lesions and conditions described under this term may transform to cancer, rather that there is a family of morphological alterations amongst which some may have an increased potential for malignant transformation. Furthermore, it was recommended to abandon the traditional distinction between potentially malignant lesions and potentially malignant conditions and to use the term "potentially malignant disorders" instead[3],[4]. Histologically these disorders may show varying grades of dysplasia that can be ascertained by histopathological examination using various criteria the most commonly followed being those given by Banoczy and Csiba[5] and WHO(2005)[3]. Although scalpel biopsy is the gold standard in confirmation of diagnosis, it is a technique with surgical and psychological implication for some patients.

Certain factors make scalpel biopsy a problematic procedure. As it is an invasive technique, patient often refuses to repeat the procedure during follow up period. Since scalpel biopsy is taken from one site or limited number of sites, it represents only small areas, which may not be sufficient in larger lesions. When multiple lesions are present, the one with malignant transformation would be overlooked. Thus, there is need for a more accurate, less invasive diagnostic tool that can detect early lesions and represent larger areas.

A technique of microbiopsies employing the use of a dermatological ring curette for scraping the mucosal surface of the lesion has been used in early detection of cervical cancer. A study by Mravunac M et al in 1998 on microbiopsies in non cervical smears concluded that the application of the microbiopsy technique in routine cytology smears containing microbiopsies is helpful, particularly in those cases in which the diagnosis is not clear on the basis of the cytology smear[6]. Another study by Mravunac M et al in 2000 on interpreting microbiopsies in cervical smears concluded that the processing of microbiopsies in smears with an inconclusive cytologic diagnosis or a diagnosis of atypical squamous cells of undetermined significance (ASCUS) allowed correct diagnosis in 50% of cases in this study[7].

To overcome the drawbacks of scalpel biopsies, attempts have been made to use Microbiopsies in early detection of Oral potentially malignant lesions (OPMLs) and oral squamous cell carcinoma. Thus, this study was undertaken to assess the accuracy of oral microbiopsies in the diagnosis of oral potentially malignant lesions.

Materials and Methods

The study was performed in the Department of Oral and Maxillofacial Pathology, MMCDSR, Mullana (Haryana, India). Forty patients with clinical diagnoses of OPMLs were selected for the study.

The micro-biopsies were carried out from more than one site, by scraping the surface of lesion using dermatological ring curette **(Figure 1)**. Care was taken to cause slight bleeding so as to ensure that basal layer of epithelium had been sampled **(Figure 2)**. The microbiopsied small tissue fragments were placed in alcoholic formalin. The curette sampling was immediately followed by scalpel biopsy. Both the curettage specimens and scalpel biopsy specimens were processed routinely and sections stained with hematoxylin and eosin. The slides were coded to prevent any bias during histopathological examination. The microbiopsies with only superficial layers of epithelium were considered inadequate.

Dysplasia was recorded as either positive or negative using Banoczy and Csibacriteria[5] **(Table 1)**. Grading of epithelial dysplasia was graded as positive when 2 or more of the listed histological changes were present and as negative when 0 or less than 2 changes were present. Diagnoses other than dysplasias were specified. The histological diagnoses obtained by microbiopsies were compared to confirmatory diagnosis by scalpel biopsy **(Figure 3)** for evaluating the accuracy of diagnosis by microbiopsy procedure. The same were also statistically analysed for specificity and sensitivity.

Results

Out of the forty cases taken, the curette samples were inadequate for microbiopsy assessment in three cases, which were excluded from the study. For two cases, no result of scalpel biopsy was available for comparison as patient refused the procedure. Thus a total of 35 cases with adequate microbiopsy specimen were available for comparison. Dysplasia was accurately diagnosed in all 21 cases of dysplasia diagnosed by scalpel biopsy. Three cases that were diagnosed as oral submucous fibrosis **(Figure 4)** and seven as hyperkeratotic lesion **(Figure 5)** by microbiopsy were also in agreement with the diagnoses obtained by scalpel biopsy. Four cases were diagnosed positive for dysplasia with micro-biopsy but did not show any dysplasia in the scalpel biopsy **(Table 2)**. Accuracy of diagnosis by microbiopsy was calculated in percentage as follows:-

Figure 1. Photograph Showing Sampling The Surface Of Lesion Using Dermatological Ring Curette

Figure 2. Photograph Showing Bleeding Points Obtained During Scraping Procedure Which Ensured The Inclusion Of Basal Layer Of Epithelium

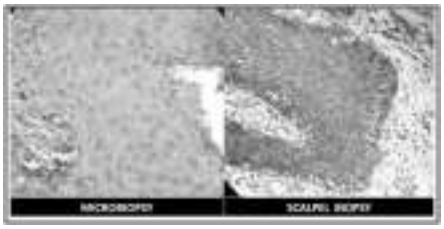

Figure 3. Photomicrograph Showing Epithelial Dysplasia Diagnosed By Two Procedures (H & E, 40 X)

Figure 4. Photomicrograph Showing Oral Submucous Fibrosis Diagnosed By Two Procedures (H & E, 40 X)

Figure 5. Photomicrograph Showing Hyperkeratotic Lesion Diagnosed By Two Procedures

Accuracy (%) = Number of cases in agreement with scalpel biopsy X 100

Total number of cases available for comparison

Table 1: Criteria for diagnosis of epithelial dysplasia[5]

	Histopathological Change
1	Irregular Epithelial Stratification
2	Increased Density Of The Basal Cell Layer Or Prickle Cell Layer Or Both
3	Increased Number Of Mitotic Figs (A New Abnormal Mitoses May Be Present)
4	Increased Nuclear Cytoplasmic Ratio
5	Loss Of Polarity Of Cells
6	Nuclear Pleomorphism
7	Hyperchromatism
8	Keratinization Of Single Cells Or Cell Groups In The Prickle Cell Layer
9	Loss Of Intercellular Adherence

Positive – Presence of 2 or more of the above listed histological changes
Negative – Presence of 0 or less than 2 of the above listed histological changes.

Table 2: Distribution Of 40 Cases Diagnosed By Microbiopsy And/Or Scalpel Biopsy

	No Of Cases (40)	Microbiopsy	Scalpel Biopsies
True Positive (24)	21	Dysplasia	Dysplasia
	3	Osmf	Osmf
False Positive (4)	4	Dysplasia	No Dysplasia
True Negative (7)	7	Hyperkeratosis	Hyperkeratosis
False Negative (0)	0	-	-
Cases Excluded (5)	3	Inadequates Sample	Dysplasia
	2	Dysplasia (1)	Biopsy Unavailable
		No Dysplasia(1)	

Table 3: Table Showing Statistical Analysis Of 35 Adequate Samples

Statistical Test	Percentage	95% Confidence Interval
Sensitivity	100 %	85.62 - 100%
Specificity	63.64 %	30.88 - 88.85%
Positive Predictive Value	85.71 %	67.32 - 95.88%
Negative Predictive Value	100 %	58.93 - 100%

31 out of 35 cases were found to be in agreement with the diagnoses by scalpel biopsy, giving an accuracy of 88.57%. Percentage of Inadequate sample was calculated as follows:-

Inadequate Samples(%) = Number of inadequate samples X 100

Total number of cases sampled

In the present study, three out of forty cases were inadequate for evaluation (7.5 %). The sensitivity of microbiopsy procedure was 100% and specificity was 63.64% **(Table 3)**.

Discussion

The histopathological diagnosis of OPMLs by biopsied material (incisional biopsy) is the classical and the most accepted diagnostic method. While conventional oral examination may be useful in the diagnosis of some oral lesions, it does not identify all OPMLs.

Furthermore, microscopic investigation of the progressive cancer is often conducted too late for successful intervention.[8] Although brush biopsy and other cytology techniques have proven to be an adjunct in histopathological diagnosis of oral lesions, many studies have also suggested that they produce conflicting results. This further confirms the need for a universally accepted early diagnostic tool aid for oral oncologists.

A dermatological ring curette was used to obtain small tissue fragments from the oral lesions in the same manner as it is used in dermatology for skin and mucosal lesions.[9] The sharp edges of curette help in easy scraping from the whole surface of the lesion without applying much pressure and minimal trauma.

As in our research work, curette sampling is more acceptable than scalpel biopsy procedure thus reducing patient stress. Two out of forty subjects refused a scalpel biopsy while they had no qualms about a curettage procedure. This further allows the diagnostic procedure to be carried out from larger surface of lesion. Also, the samples can be obtained from multiple sites, including also those with low index of suspicion. This is also of major importance in follow up of OPMLs and in lesions involving multiple areas, such as oral lichen planus or proliferative verrucous leukoplakia, as these lesions require repeated evaluation to check for any malignant transformation.

The criteria for grading of epithelial dysplasia give by Banoczy and Csiba was used in this study as this is a simple and efficient method for grading dysplasia and could be easily used on curetted tissues.[5]

The oral microbiopsy technique used in the present study gave promising results as obtained by the standard scalpel biopsy procedure with an accuracy of 88.57%. Navone Ret al in 2007, in a similar study regardingimpact of liquid-based oral cytology on the diagnosis of oral squamous dysplasia and carcinomas using a dermatological curette to allow for the collection of 'accidental' tissue fragments, utilized as microbiopsies, found that there were 8.8% of inadequate specimens in the liquid-based cytology group; sensitivity was 95.1% and specificity was 99.0%.[10] Comparable results were seen in the present study with a sensitivity of 100% and a positive predictive value of 85.71%. The specificity of 63.64% with a negative predictive value of 100% was seen.

In a study done by Poilehero et al (2003) an under diagnosis of dysplasia / carcinoma cases ranging from 28.3% to 4.4 % has been reported by scalpel biopsy procedure,[11] which could be attributed to limited sample area or non-representative site. In our study, out of forty cases, four showed the presence of dysplasia in microbiopsy but was negative in scalpel biopsy, which could be due to the scalpel biopsy not being from the representative area.

Another favorable point is that microbiopsy sampling involved a limited loss of tissue and did not interfere with evaluation by scalpel biopsy procedure. But at the same time, it may yield inadequate samples, so no diagnosis can be made. In the present study, 4 cases were inadequate for evaluation (7.5%). Thus, the reduced thickness of tissue and lack of proper orientation may become the limitations of this procedure.

Conclusions

Based on above facts we conclude that microbiopsy may prove to be a practicable first level diagnostic aid for OPMLs. Microbiopsies can help in screening of oral lesions to identify representative areas for further procedures and also early detection of dysplastic/ carcinomatous changes. Oral microbiopsy being a simple, minimally invasive procedure can also be used for examining multiple lesions in individuals and also screening of large populations with great accuracy. It can be used in follow up of cases of OPMLs with less psychological distress to patients. However, further investigations with more number of study samples will be needed to establish this technique as a routine diagnostic aid.

Thus microbiopsies could help in overall improvement in sensitivity for diagnosing of oral dysplasias/carcinomas of oral cavity.

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Upper Lip Soft Tissue Changes And Gingival Display On Smiling: A Study Of Vertical Dimension

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Abstract

Introduction

Smile is a voluntary facial expression indicating happiness. An excessive gingival display during smiling is called as gummy smile which is often considered unsightly by the individual and for which correction is sought. Various treatment modalities have been suggested for the same. The objectives of this study were to evaluate and quantify upper lip changes in vertical dimension at both rest and smiling and to examine the correlation between upper labial vestibular attachment height and maxillary gingival exposure on smiling.

Materials and Methods

The study was performed on 54 subjects (27 males, 27 females). A total of nine parameters were performed at rest and when in maximum social smile.

Results

Data from this study indicate sexual dimorphism in upper lip length, maxillary incisal display and upper labial insertion.

Conclusions

High lip line is more common in females; and in subjects with this feature, short upper lip length, low smiling/resting upper lip length ratio and inferior attachment of upper labial vestibule are found.

Key Words

Upper Lip, Tissue Changesm Gingival, Maxillary

Introduction

Esthetics have become increasingly important in the practice of modern dentistry and are synonymous with a natural, harmonious appearance. The term 'esthetics' is derived from a greek word meaning perception. It can be divided into two dimensions: objective (admirable) and subjective (enjoyable). Contemporary technique in orthodontics should lend objective esthetics to entire orofacial complex involving form, structure, balance, function and display of dentition[2]. The subject of smile and facial animation as it relates to communication and expression of emotions is of special interest to orthodontists.[3] According to Graber and Salama,[4] an esthetic smile involves relationship between 3 components: teeth, lip framework, and gingival scaffold.

An excessive display of gingiva on smiling, referred to as "gummy smile, "high lip line," or "high smile line," is often considered aesthetically displeasing and undesirable.[4],[5],[6],[7],[8],[9] Various etiologic factors including skeletal, gingival, and muscular factors can contribute alone or in combination to this feature.[5],[10],[11] This has led to development of several different modalities for treatment of excessive gingival exposure on smiling that include: surgical crown lengthening/gingivectomy in patients with clinically short anterior tooth crowns,[4] injecting botulinum toxin A to lip elevator muscles in patients with suspected muscular hyperactivity,[11],[12],[13] intrusion with microimplants or orthognathic surgery in patients with vertical maxillary excess.[4],[14]

The purpose of this study was to appraise the upper lip soft-tissue changes in the vertical dimension at both rest and maximum smile, and investigate the correlation between upper labial vestibular attachment height and maxillary gingival exposure on smiling.

Materials And Methods

A total of 54 subjects consisting of 27 males and 27 females volunteered for this study. Exclusion criteria- subjects who had history of: a) Previous orthodontic treatment, b) Maxillofacial surgery, c) Anterior maxillary tooth prosthodontic rehabilitation.

Upper lip position and maxillary incisor crown height at rest and in maximum social smiling were recorded using 9 measurements for each subject. The measurements and the methods used to obtain these variables were as follows:

A) The measurements performed both at rest and maximum smiling :(a) external upper lip length, the vertical measurement from subnasale to stomion

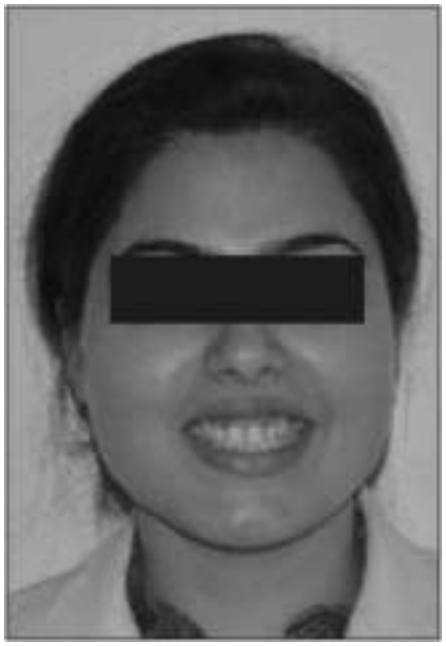

Fig 1 : Sample Photograph Showing Excessive Ginigival Display

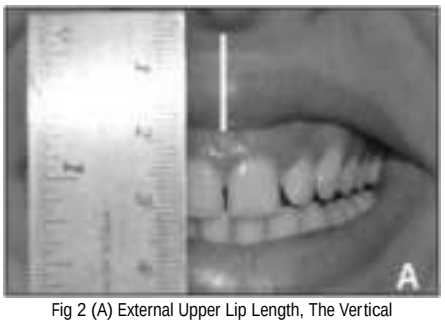

Fig 2 (A) External Upper Lip Length, The Vertical Measurement From Subnasale To Stomion Superioris;

Fig 2 (B) Vermilion Height, The Vertical Measurement From Cupid's Bow To The Stomion Superioris

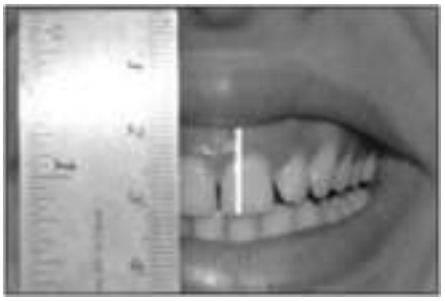

Fig 3 (A) Maxillary Central Incisor Display, The Vertical Measurement From The Stomion Superioris To The Incisal Edge Of Upper Left Central Incisor

Fig 3 (B) Gingival Display In Maximum Smiling

Fig 4: Maxillary Central Incisor Height; The Vertical Measurement Of The Clinical Crown Height Of The Maxillary Left Central Incisor

superioris **(Fig 2-A);(b)** vermilion height, the vertical measurement from cupid's bow to the stomion superioris **(Fig 2-B);(c)** maxillary central incisor display, the vertical measurement from the stomion superioris to the incisal edge of upper left central incisor **(Fig 3-A)**.

B) The measurements performed once at rest position: (a) internal upper lip length; the vertical measurement, from the labial vestibule apical to the central incisors to the inferior border of the upper lip;(b) maxillary central incisor height, the vertical measurement of the clinical crown height of the maxillary left central incisor **(Fig 4)**.

C) The measurements performed once in maximum smiling when applicable: gingival display in the maximum smiling, the vertical measurement from the inferior border of upper lip to gingival zenith of maxillary central incisor, recorded in patients whose gingival display was noticed in the maximum smile.

All measurements were recorded to the nearest millimetre directly on the face using a simple, small metal ruler. Smile pattern was classified according to the 3 categories described by Tjan et al,[8] relating to the anterior maxillary tooth crown exposure at maximum smile: A) "Low smile" displaying less than 75% of the clinical crown height of the maxillary anterior teeth, B) "Average smile" revealing 75% to 100% of the maxillary anterior crown height, C) "High smile" exposing the whole anterior maxillary crown height and a band of contiguous maxillary gingiva.

Statistical Analysis

Independent Student 't' tests were performed to assess differences between the sexes, and between subjects with and without gingival exposure in maximum smiles. Pearson's correlation analysis was used to find the relationship between the 2 variables. One-way 'ANOVA' was used to assess the differences between smile pattern groups.

Results

Table 1 shows the differences in the measured parameters between females and males. The mean age for the whole study population was 21.85 years with the age range from 19 years to 25 years. The mean age for females was 0.63 years younger than the mean, and the mean age for men was 0.29 years older than the mean. Most of the measured variables showed a statistically significant sexual dimorphism. Relaxed external upper lip length was 2 mm shorter in the women than in the males (P<0.01). The mean maxillary central incisor display at rest was 0.37 mm greater in the females than in males (P<0.005). The upper vermilion comprised 33% of the external upper lip length (34.5% in females and 33.7% in males). Central incisor clinical crown height was 0.28 mm shorter in the females compared with the males (P<.005). External upper lip length became shorter by about 23.6% at maximum smiling in both sexes on an average. High smiles, with exposure of the entire maxillary incisors and a band of gingiva, were noticed in 38.8% of the study population and were 2.9 times more prevalent in females (55.6%) than in males (22.2%). Low smiles, noticed in 51.8% of the subjects, were 2 times more common in males (66.1%) than in females (33.3%). A positive, statistically significant correlation was found between smile patterns and the following: resting external upper lip length, resting maxillary central incisor display, smiling/resting external upper lip length ratio.

Table 2 shows the comparative evaluation of lip measurements in different smile patterns. The mean external upper lip length in subjects with a low smile pattern was 2.47 mm greater than in subjects with a high smile (P <0.05). The mean maxillary central incisor display at rest in subjects with a low smile pattern was 0.86 mm, whereas, in those with a high smile pattern, the mean maxillary central incisor display was 1.66 mm (P<0.05). In the low smile group, external upper lip length in maximum smiling was only 24% shorter than resting external upper lip length; in the average smile group, the external upper lip was shortened by 26%, and in

Table 1: Sex Differences Of Study Parameters

Parameter	Female	N = 27	Male	N = 27	Significance
	Mean	Sd	Mean	Sd	*-significant At P < .05, ** At P < .01
Age(Y)	21.22	1.050	22.1481	1.53682	Ns
Resting Upper Lip Length (Mm)	18.8148	1.73287	20.8704	2.14204	-0.7875*
Resting Vermillion Length (Mm)	6.5148	1.50709	6.6296	1.66752	Ns
Resting Maxillary C.I Display (Mm)	1.1667	2.16617	0.7963	1.17881	-0.03704**
Smiling Upper Lip Length (Mm)	14.0370	2.12098	16.2407	2.56968	-0.08636
Smiling Vermillion Length (Mm)	5.1481	1.9948	5.3519	1.23113	Ns
Smiling Maxillary C.I Display (Mm)	7.8519	2.65596	5.7037	3.39473	-0.05923*
Gingival Exposure (Mm)	1.1667	1.27852	0.4074	0.84395	0.07593**
Maxillary C.I Height (Mm)	10.510	2.05100	10.790	1.05003	0.2733**
Resting Internal Upper Lip Length (Mm)	17.4444	1.60128	19.7778	1.46978	0.02531*

Table 2: Lip Measurements By Smile Pattern

Parameter	Low Smile		Average Smile		High Smile		Anova	High-low Student T Test	High-average Student T Test
	N = 28		N = 5		N = 21				
	Mean	Sd	Mean	Sd	Mean	Sd			
Resting Upper Lip Length	22	1	19.95	2.14	19.53	2.22	P < .05	P < .05	Ns
Resting Maxillary C.I Display	.08621	1.89	1.04	1.38	1.66	2.88	P < .05	P < .05	P < .05
Smiling/Resting Upper Lip Length	0.761	1.29	0.742	3.78	0.51	1.06	P < .05	P < .01	P < .01
Resting Internal Upper Lip Length /Resting External Upper Lip Length	0.947	0.334	0.92	0.33	0.90	0.31	P < .05	Ns	Ns

the high group by 50% (P<0.05). Statistically significant differences were found predominantly between between the high and the low smile groups. The findings of this study give more weight to the assumption that patients with a gummy smile have hyper-function of the upper lip.

Although statistically not significant, the resting internal upper lip length/external upper lip length ratio demonstrated a positive correlation between labial vestibule location and smile pattern. In the low smile group, the internal upper lip length was 94.6% of resting external upper lip length; in the average and high smile groups, the internal upper lip lengths were 92% and 90% of the resting external upper lip lengths, respectively.

Discussion

Excessive gingival exposure during smiling is considered to be unattractive and is often a challenging issue to many physicians, especially those dealing with smile esthetics.

Data from this study, in concordance with other studies, indicates sexual dimorphism in lip and tooth measurements. These differences reflect simple biologic scaling: male subjects are uniformly larger than equivalent female subjects. Peck et al,[15] who recorded vertical measurements in young orthodontic patients (mean age, 15 years), observed that the difference in upper lip length between the sexes was only 2.2 mm, and that tooth exposure at rest was 5.3 mm in the girls and 4.7 mm in the boys. Hagai Miron et al[16] conducted another study in older orthodontic patients (mean age, 30.5 years) and found a difference in upper lip length of 3.03 mm between the two sexes, but the age-related lip changes reported in the literature do not explain the differences in lengths between the two studies.

In the present study, the upper lip length at rest was found to be 2 mm shorter in the females than in the males. The clinical central incisor crown was 0.28 mm shorter in the females than in the males. The internal upper lip length comprised 92.5% of the external upper lip in females and 94.7% in males. The upper lip length was 25.6% shorter in maximum smiling relative to the resting position in females and 22.2% in males. The findings suggest that a high smile pattern can be considered a female norm, since more than half of the women in this study exposed their gums while smiling, and a low smile pattern can be considered a male norm. Similar results and female/male ratios were observed by others.[8],[13],[15],[16] Ratio of gingival exposure between female and male subjects, was found to be 2.9:1. Although other authors have found a 2:1 ratio of gingival exposure between female and male subjects,[8],[13],[15],[16] in the present study, a slightly higher ratio of 2.9:1 was found between females and males in exposure of gingiva when smiling.

Short upper lip and hyperactivity of the lip elevator muscles are two distinctive features observed in subjects with high smile patterns. In this study subjects with a high smile line had an upper lip on average 2.47 mm shorter than subjects with a low smile pattern.

According to Peck et al,[10] subjects with a gummy smile pattern (more than 2 mm of gingival exposure in maximum smiling) had 20% more muscular capacity to raise the upper lip than did subjects without a gummy smile.

Conclusion

Data from this study indicate sexual dimorphisms in upper lip length, maxillary incisor display, and upper labial vestibule insertion. Higher smile patterns are more common among female patients, and lower smile patterns are more common among male patients. The following findings were observed in subjects with a high smile pattern compared with those with a low smile pattern.

- Short upper lip length.
- Low smiling/resting upper lip length ratio (indicates greater upper lip shortening and might suggest hyperactivity of the lip elevator muscles).
- Low (inferior) attachment of the upper labial vestibule.

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Original Article

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Sphenoid Sinus As A Mandibular Growth Prediction - Is It Valid ?

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Abstract

Introduction

Downward and forward enlargement of sphenoid sinus at sphenoccipital suture/synchondrosis may influence the growth of maxillo-mandibular complex.

Aim

This cross-sectional study correlates the growth of sphenoid sinus with mandibular growth.

Material And Methods

A random selection of 40 cephalograms of adult subjects with skeletal class I and class III pattern were analysed. Pearson correlation coefficient was used to assess the association between sphenoid sinus Height and Width with maxillo-mandibular growth parameter.

Results

The result indicate that there is a significant correlation between maxillary length,mandibular length,symphysis width, condylar length and sphenoid sinus height and width on a lateral cephalogram.

Conclusion

The sphenoid sinus can possibly be used as an additional indicator when one is predicting mandibular growth.

Key Words

Sphenoid Sinus, Mandible and Growth Status.

Introduction

Growth of the craniofacial region is a complex process. It shows variation in rate and direction from infancy to adulthood before leading morphology. Growth prediction has been a controversial topic ever since it was advocated by Ricketts[1]. Prediction would involve forecasting a change in direction or growth rates on the basis of some prior knowledge, such as a cephalometric measurement[2].

Various lateral cephalometric methods have been used to predict the craniofacial growth such as frontal sinus as an indicator of mandibular growth prediction[3], Craniocervical posture, CVMI as a maturity indicator and antegonial notch as a predictor of vertical mandibular growth[4]. The sphenoid sinus is a part of paranasal sinuses and starts developing at 4 months post-conception by constriction of posterosuperior portion of the sphenoethmoid recess and thus passing primary pneumatization. The recess lies in between the sphenoid conchae and the sphenoid body. Secondary pneumatization of the sphenoid sinus occurs at 6 to 7 years in to the sphenoid and basisphenoid bone. Later, the sinus continues to grow up till early adulthood and may invade the wing and rarely the pterygoid plate of the sphenoid bone. Also the sphenoid sinus grows in a downward and forward direction, due to the growth at sphenoccipital suture/synchondrosis.

Therefore, it is hypothesized that the growth of sphenoid sinus may influence the growth of maxillo-mandibular complex. However there is no study correlating the growth of sphenoid sinus with the growth of mandible.

Aim

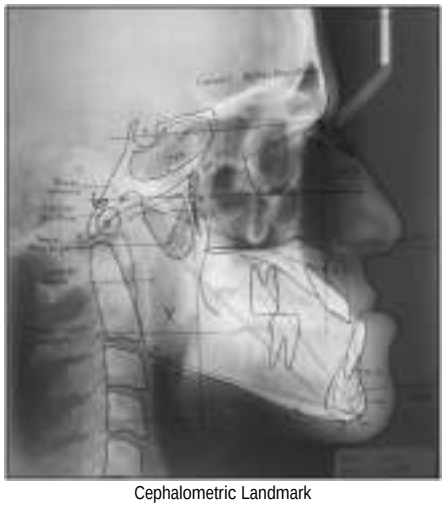
The aim of the present cross-sectional study is to correlate (using lateral cephalogram) the growth of sphenoid sinus with the mandibular growth.

Material And Methodology

A random selection of 40 cephalograms of adult subjects with skeletal Class I (N=25) or skeletal Class III (N=15) pattern were analysed. The six measurements described by Ricketts were used to determine the presence of abnormal mandibular growth[5]. These were-1.Mandibular length(CO-Gn) 2.Porion location 3.Ramus position 4.Condylar length 5.Symphysis width 6. Cranial Deflection angle.

The size of Sphenoid sinus as expressed in height and width were measured from maximum vertical and horizontal dimension of the sphenoid sinus. The ANB angle was used to ensure that the subjects conformed to skeletal growth difference. The facial axis angle and SN-MP angle were measured to give an indicator of growth direction. Maxillary and mandibular length were measured to give an indicator of the size of bone **(Image 1)**.

Using SPSS 17.0 software, Pearson Correlation Coefficient was used to



Cephalometric Landmark

Table 1

	N	Mean	Std. Deviation	Min.	Max.
Sphenoid sinus height(mm)	40	17.68	2.45	13	25
Sphenoid sinus width(mm)	40	35.43	3.59	27	41
Maxillary length(mm	40	90.65	7.65	72	106
Mandibular length(mm)	40	120.80	10.40	102	142
SN-MP angle	40	32.08	6.53	17	46
Facial axis angle	40	89.53	5.48	75	103
ANB angle	40	0.65	3.66	-8	4
Porion location(mm)	40	44.45	5.22	33	55
Ramus Position angle	40	70.08	5.99	59	85
Condylar length(mm)	40	32.28	5.06	20	41
Symphysis width(mm)	40	13.93	2.44	9	19
Cranial deflection angle	40	24.20	4.21	17	32

Table 2

		Sphenoid sinus width (mm) {N = 40}	Sphenoid sinus Height (mm) {N = 40}
Maxillary length (mm)	Pearson Correlation	0.547(**)	0.424(**)
	Sig. (p-value)	0.000	0.006
Mandibular length (mm)	Pearson Correlation	0.507(**)	0.440(**)
	Sig. (p-value)	0.001	0.005
SN-MP angle	Pearson Correlation	-0.082	0.066
	Sig. (p-value)	0.614	0.687
Facial axis angle	Pearson Correlation	0.024	0.053
	Sig. (p-value)	0.885	0.745
ANB angle	Pearson Correlation	0.062	-0.064
	Sig. (p-value)	0.703	0.693
Porion location(Mm)	Pearson Correlation	0.567(**)	0.552(**)
	Sig. (p-value)	0.000	0.000
Ramus Position angle	Pearson Correlation	-0.216	-0.094
	Sig. (p-value)	0.181	0.563
Condylar length(mm)	Pearson Correlation	0.354(*)	0.241
	Sig. (p-value)	0.025	0.135
Symphysis width(mm)	Pearson Correlation	0.439(**)	.466(**)
	Sig. (p-value)	0.005	0.002
Cranial deflection angle	Pearson Correlation	-0.114	0.046
	Sig. (p-value)	0.483	0.777

assess the association between sphenoid sinus height and width with other parameters taken from Lateral Cephalogram. These parameters were Maxillary length,Mandibular length, SN-MP angle ,Facial axis angle, ANB angle ,Porion location,Ramus position, Condylar Length, Symphysis width, Cranial deflection angle.

Results

The descriptive statistics of all the variables are given in **Table I**. The mean sphenoid sinus height and width are 17.68mm and 35.43mm respectively.

The pearson correlation between the sphenoid sinus height and width and other variable maxilla-mandibular growth are given in **Table II**.

The results show a positive correlation (r=0.507) between sphenoid sinus width and mandibular length which,is highly significant. Also a positive correlation is observed(r=0.440) between sphenoid sinus height and mandibular length which ,is highly significant..

Other variables that show significant positive correlation with sphenoid sinus height and width are maxillary length(0.424,0,547), porion location(0.552,0.567) and symphysis width(0.466,0.439). However Condylar length(0.354) shows a significant positive correlation with sphenoid sinus width only. Also a Negative but non significant correlation between sphenoid sinus height and ANB angle (r = -0.64) shows a small ANB angle may go with Large sphenoid sinus height .

Discussion

Prediction of abnormal skeletal growth pattern based on morphologic analysis can represent an important step in orthodontic diagnosis and treatment planning. Subjects with mandibular prognathism who can be properly treated by orthodontic tooth movement alone must be distinguished from subjects with mandibular prognathism that require orthognathic surgery.

The size of sphenoid sinus on radiographs is one of the factor that may help the clinician to determine whether he would be able to attain stability by treating a class III malocclusion. For example, with only orthodontic appliances, whether he could expect relapse of the post-treatment results, or whether he should refrain from doing extractions as part of treatment regimen.

A negative ANB angle is indicative of a small maxilla and a large mandible as expressed in the class III syndrome. This is confirmed when the negative correlation for ANB (-0.064) and positive correlation for maxillary(0.424) and mandibular(0.440) lengths are compared with the sphenoid sinus height **(Table II)**.

A long condylar dimension and wide symphysis play a major part in the makeup of a large mandible as seen in Class III subjects. These values show a positive correlation with the large sphenoid sinus size (both height and width).

Thus our study shows that sphenoid sinus can be used as an additional indicator of mandibular growth. The time thus demands a growth of sphenoid sinus with mandibular growth in growing subjects.The guest for use of sphenoid sinus as a skeletal maturity indicator has thus been ignited.

Conclusion

It has been statistically demonstrated in this study that the sphenoid sinus (as seen on the lateral cephalogram) may be a valuable indicator of excessive mandibular growth.Its role in diagnosis shall be a help to the clinician in his attempt to attain excellent treatment results.

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Case Report

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Delayed Teeth Eruption A Mirror To Systemic Deficiency Of Vitamin D

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Abstract
Severe chronic vitamin D deficiency [25(OH)D level less than 15 ng/ml] leads to overt skeletal abnormalities in children that is typically defined as rickets. Rickets can be of two types, vitamin D sensitive rickets and vitamin D resistant rickets, depending on the response of the patient to vitamin D therapy. However, there are number of infants, children, and adolescents who are vitamin D insufficient but have no apparent skeletal or calcium metabolism abnormalities. Here is an interesting case of delayed teeth eruption associated with vitamin D deficiency without any skeletal abnormalities.

Key Words
Delayed tooth eruption, Vitamin D Deficiency, chronology of eruption, Triiodothyronine (T3), Thyroxine (T4), Thyroid Stimulating Hormone (TSH).

Introduction

Tooth eruption is defined as the movement of the tooth from its site of development in alveolar bone to the occlusal plane in the oral cavity. The eruption process is complex and many different mechanisms are involved. It is divided into five stages: pre eruptive movements, intra-osseous stage, mucosal penetration, pre-occlusal and post occlusal stages.[1] A tooth or a group of teeth or entire dentition may be impacted at one of the above mentioned stages.

The eruption time of both primary and permanent teeth have got a specific date and variations of 6 months on either side of the usual eruption date may be considered normal for a given child. These days' parents are worried about the variation in eruption timing, particularly delayed eruption of permanent teeth, which is considered as an important milestone in the growth and development of a child. Normally, the permanent teeth eruption into the oral cavity occurs at six years of age and continues up to thirteen years of age except third molars.

There are several factors which influence the eruption of permanent as well as primary teeth into the oral cavity that include local and systemic factors. In some cases, delayed tooth eruption, could be the first and foremost manifestation of local or systemic disease.[2] Marks and Cahill[3] stated that "tooth eruption is a series of metabolic events in alveolar bone characterized by bone resorption from occlusal surface of the developing tooth and bone formation takes place on opposite sides of the dental follicle and the tooth does not contribute to this process". The factors that have related to the eruption of teeth include elongation of the root, forces exerted by the vascular tissues around and beneath the root, growth of alveolar bone, growth of dentin, growth and pull of periodontal ligament, nutritional and hormonal influences, pressure from muscular action and resorption of alveolar bone.[4] As the child grow, the metabolic demand of the tissues also increase, which might influence the eruption process as well. Aggarwal et al.[5] reported delayed eruption in deciduous dentition in malnourished Indian children. There is evidence that chronic malnutrition extending beyond the early childhood is correlated with delayed teeth eruption.[6] Delayed teeth eruption is also found to be one of the manifestation in syndromes like Cleidocranial dysplasia, Gardner syndrome, Down syndrome, Achondroplastic dwarF, Dysosteo sclerosis etc.[2]

Nutritional deficiency can affect endocrine glands of the body. Endocrine glands usually have profound effect on the entire body, including the dentition. Tooth eruption is influenced by pituitary growth hormone and thyroid hormone and parathyroid hormone related protein is required for tooth eruption.[7] Hence hypothyroidism, hypopituitarism, hypoparathyroidism and pseudo hypoparathyroidism are the most common endocrine disorders associated with delayed tooth eruption.[8] Vitamin D helps in the metabolism of calcium and phosphate which further are essential elements for skeletal and dental growth. Vitamin D also acts in concert with parathyroid hormone to maintain tight control of blood calcium concentration and stimulates secretion of parathyroid hormone, which mobilizes calcium and phosphorus from the skeleton to reestablish calcium homeostasis in the blood.[9]

Vitamin D refers to a group of fat-soluble secosteroids responsible for enhancing intestinal absorption of calcium, iron, magnesium, phosphate and zinc. In humans, the most important compounds in this group are vitamin D3 (cholecalciferol) and vitamin D2 (ergocalciferol). Cholecalciferol and ergocalciferol can be ingested from diet and from supplements. The body can also synthesize vitamin D especially cholecalciferol in the skin, from cholesterol, when sun exposure is adequate. Ultraviolet rays from the sun trigger vitamin D synthesis from its precursor, 7-dehydrocholesterol, in the skin.[10] In a country like India, where there is abundant sunlight throughout the

year, vitamin D deficiency is unexpected. Because vitamin D is an essential nutrient for proper skeletal development, children who receive too little can develop the bone disease like rickets.[11] Rickets is characterized by bone deformities, poor muscle development, spinal curvature and bowed legs.[12],[13] The presence of rickets during tooth development may result in enamel and dentin hypoplasia, incomplete development and delayed tooth eruption.[14]

Presented herewith is a case report wherein patient's systemic deficiency of Vitamin D was diagnosed based on the clinical features of oral cavity (delayed teeth eruption).

Case Report

A patient of 10 years and 1 month old, belonging to a low-socioeconomic group family, presented with the chief complaint of not erupting permanent teeth. The child's medical history was noncontributory. He was born with normal delivery and on proper time (such as in the ninth month of pregnancy). The patient's height and weight was found to be matching with the chronological age **(Fig 1)**. Extra-oral examination was also observed to be normal. On intra-oral examination, complete set of primary dentition was observed with caries in relation to maxillary and mandibular primary molars with generalized attrition **(Fig 2, 3, 4)**. There was no mobility in any of the primary teeth present. The permanent first molars and mandibular permanent incisors were not erupted into the oral cavity, both of which should have been erupted at 6 years of age **(Fig. 5)**. There were physiological spacing between incisors and primate spaces were present in canines, in both maxillary and mandibular arches.

The dental age of the child seemed to be of less than six years since there is no permanent teeth present in the oral cavity. The chronological age of the child is more than10 years hence; there is delayed eruption of permanent teeth by 4-5 years. Clinically, there were no symptoms of child suffering from hypopituitarism or hypothyroidism or any other systemic disorder related to calcium and phosphate metabolism. The child was found to be receiving adequate sunlight exposure but there was history of inadequate intake of milk, green vegetable and required pulses.

The child was subjected to the following investigations of panaromic radiograph

Fig. 1: Extra-oral Photograph

Fig: 2: Intra-oral Photograph

Fig: 3: Intra-oral Maxillary Arch

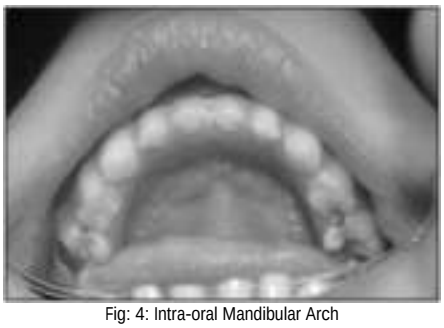

Fig: 4: Intra-oral Mandibular Arch

Fig: 5: Orthopantomogram

of jaws, serum level of T3, T4, TSH, PTH, Calcium, Phosphate and Vitamin-D. Radiographic investigation **(Fig. 5)** revealed the presence of all succedaneous teeth buds except mandibular lateral incisors at various levels of developmental stage. All the permanent first molars crowns were completed and initiation of root formation started. There were presence of crypts of developing permanent second molars seen in the OPG. No supernumerary or extra tooth buds or odontomes obstructing the eruption of permanent tooth or teeth were observed in the radiograph **(Fig. 5)**. The radiographic evaluation confirmed the delayed eruption of permanent teeth.

Blood and hormonal investigations revealed severe deficiency of Vitamin-D (<12ng/ml), the normal ranges of Vitamin-D is considered to be in the range of 30.0 to 74.0 ng/ml. The levels of T3, T4, TSH and PTH were 120ng/dl, 5.2µg/dl, 20mg/l and 9.8mg/dl respectively. Other blood investigations were found to be within normal limits. Based on the clinical examination and investigations, final diagnosis of delayed eruption of teeth due to Vitamin-D deficiency was made.

Patient was prescribed oral Vitamin-D supplements 6,00,000 I.U weekly, in the form of powder which is to be taken with milk, for 1 month. Patient was also given instructions regarding good diet containing milk, milk products and green vegetables. He was reviewed after 1 month and again the blood investigation of 25-hydroxyvitamin D {25(OH)D} was done. The investigations revealed significant increase in the 25-hydroxyvitamin D levels (42 ng/ml) which comes well within the normal range.

Discussion

The eruption date of permanent maxillary and mandibular first molars are observed to be around 6-7 years, followed by mandibular central incisors 6-7 years, maxillary central incisors 7-8 years, mandibular lateral incisors 7-8 years, maxillary lateral incisors 8-9 years, mandibular canine 9-10 years, maxillary first premolar 10-11 years, mandibular first premolar 10-12 years, maxillary canine 11-12 years, maxillary second premolar 10-12 years, mandibular second premolar 11-12 years, mandibular second molar 11-13 years, maxillary second molar 12-13 years, and maxillary and mandibular third molars which erupt around 17-21 years of age.[15] Variation of six months on either side of eruption is considered to be normal and when there is excessive delayed of tooth eruptions are considered to be abnormal.

There is universal acceptance of eruption date of permanent teeth based on which

we calculate the dental age of the child but there are some deviations of eruption time of permanent teeth observed in different ethnic groups in clinical practice.[1],[16] Pre-mature tooth eruption has also been reported in the literature,[17] but delayed tooth eruption is the most commonly encountered deviation from normal eruption time. By the term early or delayed tooth eruption, we mean entire dentition and not an individual tooth or a group of teeth. Delayed or early tooth eruption might be the primary or sole manifestation of systemic pathology.[18]

There are several systemic conditions which can lead to delayed tooth eruption.[19] These causes are related to pituitary, thyroid, parathyroid hormones and vitamin D deficiency or calcium, phosphate along with vitamin D deficiency.[18] There are few syndromes associated with the delayed eruption of teeth, which we discussed earlier. Hence diagnosis is an important but complicated process to establish the final diagnosis.

The local factors which are associated with premature or delayed eruption of teeth are also important to a pediatric dentist, to diagnose a tooth or a group of teeth which are erupting out of their time. The most common causes for delayed eruption or impaction of tooth or teeth are mesiodens and other supernumerary teeth,[20] ectopic eruption path, retained primary tooth, trauma, globulomaxillary cyst, odontomes, and lack of space in the dental arch.[21],[22] The most common cause for premature (early) eruption of tooth is caries associated with primary teeth, which causes destruction of bone above the growing tooth bud.[14] There is another factor such as dentigerous cyst (Odontogenic Cyst)[20] developed above the crown of a developing tooth bud and if the deciduous tooth is extracted for marsupialization, is seen with the early eruption of permanent tooth. The early eruptions of a tooth or group of teeth are utilized during the serial extraction plan cases which are not being discussed in this case.[1]

In the present case, there were no clinical symptoms of any systemic disorder observed which might help for the diagnosis. The delayed eruption of teeth led us to go for systemic investigations to find out the causes. Although data on nutrition (calcium, phosphate, vitamin D) influence on tooth eruption is scarce,[6],[23] there is evidence that chronic malnutrition extending beyond the early childhood is correlated with delayed teeth eruption.[24] Another important systemic factors which could cause delayed teeth eruption are hormonal (discussed previously) and or vitamin D deficiencies. Having reviewed all the systemic factors of delayed tooth eruption, emphasis was given on systemic investigations for the diagnosis in this particular case. Therefore, we investigated blood for T3, T4, TSH, serum calcium, phosphate and vitamin D levels. The result showed that there is deficiency of vitamin D (<12 ng/dl) in this particular case and all other factors were normal.

Vitamin D is important to bone mineralization because of its role in the maintenance of adequate serum calcium and phosphorus concentrations.[25] Vitamin D deficiency results in osteomalacia in adults or rickets in children and is a frequent source of occult muscle and bone pain.[26] There is increasing evidence that vitamin D can protect against the development of many chronic diseases, including type 1 diabetes mellitus, hypertension, cardiovascular disease, common cancers, multiple sclerosis and rheumatoid arthritis.[27] Rickets in infancy has also been reported to be associated with lower respiratory tract infections, the largest cause of infant mortality in India.[9] Other features of rickets could be craniotabes (areas of thickening and softening of bones of the skull), frontal bossing, delayed closure of anterior fontanelle, and weight bearing bones produces deformities such as bow-legs and knock-knees could be seen,[28] all of which were absent in this present case.

The condition presenting only vitamin D deficiency with the absence of any other systemic symptoms is otherwise called as "subclinical vitamin D deficiency". In northern India, the vitamin D deficiency could be the result of taking solely vegetarian diet and not taking adequate fat containing diet inspite of good sunlight. Moreover, we do not have milk supply with added vitamin D supplements. This may lead to the deficiency of vitamin D in this particular patient, which might cause delayed eruption of teeth. Fatiha Zeghoud et al.[29] reported that subclinical low vitamin D status seldom causes neonatal rickets and had normalized serum PTH within 1 month only, when they were given vitamin D supplements.

After the proper diagnosis of vitamin D deficiency, the patient was later prescribed vitamin D supplements. He was prescribed vitamin D supplements in the form of sachets consisting 6 lakh units of vitamin D for 2months and was on follow up for 6 months, to which he responded well. On blood examinations, his vitamin D levels improved in subsequent follow-up visits following vitamin D therapy.

Conclusion

Delayed tooth eruption in a child is a worrisome experience for parents and it necessitates early investigations and interventions. There is rare literature or reports on delayed eruption of teeth due to vitamin D deficiency. This particular case is very interesting because delayed tooth eruption was the sole feature in this patient and without any other clinical symptoms of Vitamin D deficiency.

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Parable Of Joubert Syndrome Related Disorder

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Abstract
In pediatric dental practice it is not uncommon for practitioners to come across children suffering from syndromes. To render comprehensive and effective treatment to the child, a practitioner must be well versed with the various medical conditions that present with concomitant oral findings. One such case report of a child suffering from one of the neurological syndromes is presented here.

Key Words
Joubert Syndrome, Molar Tooth, Oro Facial Digit Syndrome Type VI

Introduction:

Joubert syndrome (JS) is an autosomal recessive disorder characterized by hypotonia in infancy with later development of ataxia, abnormal breathing pattern, abnormal eye movements, development delays and mental retardation. It arises due to the hypoplasia of cerebellar vermis and brainstem malformation[1],[2],[3]. As the cerebellum governs movement and balance, the patients of Joubert syndrome suffer from hypotonia and ataxia. Other variable features that are associated with this syndrome include nephronophthisis, retinal dystrophy, ocular coloboma, occipital encephalocele, polydactyly, hepatic fibrosis and endocrine abnormalities. The multitude of signs associated with Joubert syndrome has given rise to a broader nomenclature called Joubert syndrome related disorders (JSRD)[4].

Recently, based on the systemic multiorgan involvement, six phenotypes of the JSRD spectrum have been described[5]: 1) "pure" JS (purely neurological without retinal, renal, or liver involvement); 2) JS with ocular defect (neurological features associated with retinal dystrophy); 3) JS with renal defect (neurological features with renal involvement, mostly nephronophthisis); 4) JS with oculorenal defects (association of neurological signs with both retinal dystrophy and nephronophthisis); 5) JS with hepatic defect (neurological features with congenital liver fibrosis); and 6) JS with oral-facial-digital defects.

A review of literature reveals that case reports of Joubert syndrome and related disorders are few and the oral-facial-digit subtype of this rare neurological condition is of particular interest to the dental professionals.

Clinical Case Presentation:

A three and a half year old girl reported to the private practice with the chief complaint of swelling on right side of tongue since birth and multiple carious teeth. The swelling was not painful, and did not cause any discomfort during mastication. The child's parents gave a history of consanguineous marriage. The delivery was normal and at full term. **(Fig 1)**

The child's medical history revealed:

- Enlarged head since birth. She was diagnosed as suffering from congenital hydrocephalus
- Breathlessness in early infancy which disappeared at the age of one and half years
- Delayed milestones
- Mental retardation
- Speech delay

On general examination, the following findings were noted:

- The patient had frontal bossing, hypertelorism, flat nasal bridge and lack of head holding.
- She displayed signs of generalized hypotonia and ataxia. She could not sit, stand or walk without support
- The patient was found to be mentally challenged. She could not follow any instructions given to her
- The patient had post axial polydactyly affecting all four limbs and pre axial polysyndactyly in both feet **(Fig 2, 3 & 4)**

Complete intraoral examination revealed, **(Fig 5, 6)**.

- Central notching of vermillion border of upper lip
- An enlarged and protruded tongue
- An oval, pink, firm swelling measuring 5 mm (approximately) in diameter

Fig 1: Pre-operative Extra Oral Photograph Of Face

Fig 2: Post Axial Polydactyly Present In Both Hands

Fig 3: Post Axial Polydactyly With Pre Axial Polysyndactyly In Feet

Fig 4: Post Axial Polydactyly With Pre Axial Polysyndactyly In Feet

Fig 5: Intraoral Photograph Showing Notched Upper Lip And Swelling On Tongue

Fig 6: Intraoral Photograph Showing Carious Teeth

Fig 7: Axial Mri Image Showing Molar Tooth Sign (Mts)

present on the right lateral border of the anterior 2/3rds of the tongue. The lesion was sessile, not tender and had a smooth surface.

- The oral hygiene status was poor with root fragments in relation to 51, 61, 71, 72, 81 and 82. Tooth no. 54 was grossly decayed and fractured. Teeth no. 52, 54, 62, 63, 64, 73, 83, 84 and 85 were decayed.

The patient was thoroughly investigated for multisystem involvement. Based on the complaints and extra and intra oral findings, the following investigations were carried out,

- Skull radiographs: Posteroanterior and lateral skull views were taken which showed enlarged skull and confirmed the hydrocephalus
- MRI scan of head revealed the classic 'Molar tooth sign' (MTS). It is the appearance caused due to the hypoplasia of the cerebellar vermis and the accompanying brain stem abnormalities which resemble the section of a molar tooth **(Fig 7)**.
- Radiographs of the hands and feet were taken which confirmed the extra digits along with the underlying bone **(Fig 8, 9)**
- Chest radiograph revealed normal lung parenchyma
- Routine blood and urine analysis was found to be within normal limits.

A provisional diagnosis of Joubert syndrome was reached on the account of: hypotonia and ataxia, Molar tooth sign on CT scan, developmental delays,hypertrophy of tongue along with the presence of fibroma on the lateral border of the tongue, polydactyly of all limbs, syndactyly of toes.

The 'molar tooth sign' (MTS) seen in CT scan images in Joubert syndrome is also seen in a few other conditions such as COACH syndrome (Cerebellar vermis hypoplasia, Oligophrenia, Ataxia, Coloboma, Hepatic fibrosis)[6],[7] Senior-Loken syndrome (retinopathy, juvenile onset nephronophthisis)[8],[9] and Dekaban-Arima syndrome (cystic dysplastic kidneys)[10]. In the present case, ophthalmologic and nephrologic investigations were non contributory. Some individuals exhibiting molar tooth sign also have sever retinal dysplasia with congenital blindness resembling Leber congenital amaurosis.

Differentiation should also be made from Dandy Walker malformation which is a hindbrain malformation characterized by hypoplasia of the cerebellar vermis and/or the cerebellar hemispheres. This

Fig 8: Radiographs Of Hands

Fig 9: Radiographs Of Feet

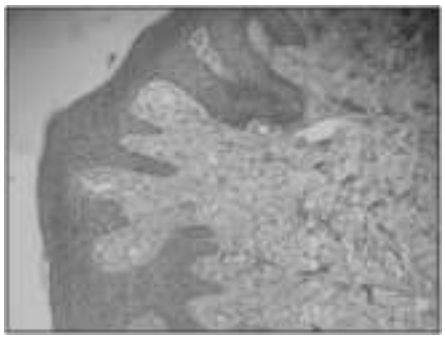

Fig 10: Histopathological Image

Fig 11: Post Operative Intraoral Photograph

condition also involves an enlarged retrocerebellar cerebrospinal fluid collection that is continuous with the fouth ventricle (often misnamed as 'cyst' of posterior fossa). Associated findings in some individuals include agenesis or hypoplasia of the corpus callosum and hydrocephalus[11]. MRI findings are helpful in distinguishing Dandy Walker malformation from the molar tooth sign[12].

The treatment was planned to be carried out under general anesthesia after obtaining fitness from the child's

neurologist the anesthetists. An excisional biopsy of the lesion on the tongue was planned. The lesion was excised followed by placement of suture for hemostasis. The specimen was sent to pathology laboratory for histopathological examination. Root fragments in 51, 61, 71, 72, 81, 82 region were extracted along with tooth 54. One suture was placed in relation to 51, 61 extraction sockets and another suture in extraction socket of 54. Teeth no. 52, 62, 63, 64, 73, 84, 85 were restored using glass ionomer cement.

Histologically, the excised lesion showed parakeratinized, stratified squamous epithelium with elongated rete pegs. The connective tissue showed dense fibrous tissue, blood vessels, muscle fibres and a few salivary acini. The overall histopathological pattern was suggestive of irritational fibroma **(Fig 10)**. On recall appointment, satisfactory healing of the excision wound and extraction sockets was noted **(Fig 11)**. The patient was referred for genetic testing and a six monthly recall was advised.

Discussion

Joubert syndrome was first reported by a French neurologist, Marie Joubert in the year 1969[1]. She described the condition in four siblings with agenesis of the cerebellar vermis, episodic hyperpnea, abnormal eye movements, ataxia and intellectual disability. Flannery et al[13] found the prevalence of Joubert syndrome to be 1:100,000-1:150,000. A male preponderance ratio of 1:2 over females has been reported[14].

A few years later, researchers reported the presence of a pathognomonic midbrain-hindbrain malformation called the 'Molar tooth sign' (MTS) in cranial MRI images of patients with Joubert syndrome[15]. The presence of MTS was also reported in few other disorders previously considered as distinct entities, hence the term Joubert syndrome related disorders was coined to group all conditions sharing the MTS[4],[5]. MTS is the appearance given by hypoplasia of the cerebellar vermis and accompanying brainstem abnormalities on axial imaging through the junction of the midbrain and pons (isthmus region).[15],[16] The resulting images resemble a tooth. The molar tooth sign comprises an abnormally deep interpeduncular fossa; prominent , straight and thickened superior cerebellar peduncles and hypoplasia of primarily the superior vermis found at the midline of the cerebellum. The absence of a normal vermis creates a midline cleft between the two cerebellar hemispheres, which results in a characteristic 'bat wing' appearance of the fourth ventricle on transverse CT and MR images.

The cluster of other signs and symptoms seen in Joubert syndrome related disorder has variable presentation. Authors of case reviews of patients with JSRD have reported the prevalence of some of the associated findings as polydactyly (8%), ocular coloboma (4%), and hamartoma of tongue (2%).[17],[18] Many clinical features of Joubert syndrome are evident in infancy. Most children suffering from Joubert syndrome exhibit truncal ataxia and delayed motor milestones. Many also have rhythmic tongue movements which may lead to tongue hypertrophy and tumours. Surgical reduction of the tongue has been suggested only if the enlarged tongue interferes in speech, mastication or obstructs respiration[1],[19].

Many children with JSRD demonstrate horizontal nystagmus at birth, which improves with age. Ocular colobomas can occur in the iris, choroid, or retina[19].

The most common manifestation of renal involvement in JSRD is cystic dysplasia which on renal ultrasound is visualized as multiple small cysts in immature kidneys with fetal lobulations[14],[20]. Glomerulosclerosis and fibrotic changes of the kidneys have also been described. In general, renal involvement is rarely present at birth and requires monitoring since it can develop during childhood and adolescence[20].

Hepatic fibrosis has also been described in some children suffering from JSRD and is often associated with renal cystic dysplasia[21]. The present case had no signs of hepatic or renal involvement. Polydactyly can be unilateral or bilateral and is often postacial, although preaxial polydactyly of the toes is also frequently reported as is seen in the present case[4],[22].

Typical facial features seen in JSRD include high arched eyebrows, broad nasal bridge with anteverted nostrils, triangular shaped mouth, and low-set ears have been described. Most of these facial features were seen in the present case.

Considering the wide range of clinical presentations, prenatal diagnosis by means of ultrasound, CT and MRI scanning of women with a family background of JSRD gains special importance. With the help of MRI scans, the diagnosis of JSRD can be made prenatally before 24 weeks' gestation[23].

Initial prognosis is related to the extent and severity of breathing dysregulation. In particular, recurrent episodes of prolonged apneas can be life-threatening and require assisted ventilation. In most cases, these respiratory abnormalities resolve spontaneously in the first few months of life[5]. After infancy, prognosis depends mostly on renal and hepatic complications that, if not timely diagnosed and managed, represent the major causes of death in JSRD patients.

Conclusion

The dental management of children with systemic disorders and syndromes is challenging and tends to be a multidisciplinary one. Periodic recall and follow up care of such patients goes a long way in providing comprehensive care and improving the quality of life.

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Obturators - Right Of Being Human

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Quick Response Code

Abstract

Oro-facial clefts are birth defects in which there is an opening in the lip and/or palate (roof of the mouth) that is caused by incomplete development during early fetal formation. The cleft palate is associated with feeding difficulties, eustachian tube-dysfunction, middle ear effusions, middle ear infections, hearing loss, speech disorders, dental and orthodontic problems,making it one of the most common major birth defects. Clefts occur more often in children of Asian, Latino, or Native American descent. The good news is that both cleft lip and cleft palate are treatable. Feeding plate as an Obturator is a prosthetic aid that is designed to seal the cleft and restore the separation between oral and nasal cavities.

Key Words

Cleft Lip & Palate, Obturators,Feeding Plate, Oro-Antral Opening, Rubber Base Impression.

Introduction

Clefts of the palate and lip are the most commonly occurring congenital defects involving the oro-facial region. Despite remarkable advances in surgical management of oro-facial defects, many of them, especially involving ocular and auricular defects can't be repaired satisfactorily alone. This is where the role of a maxillo-facial prosthodontist becomes significant to meet such additional challenges.

Fig. Cleft Lip and Palate Situations (Courtesy: JA Napoli and LD Vallino in Oro-facial Clefts, 2011).

Most clefts can be categorized into three broad categories:

1. Cleft lip without a cleft palate
2. Cleft palate without a cleft lip
3. Cleft lip and cleft palate together

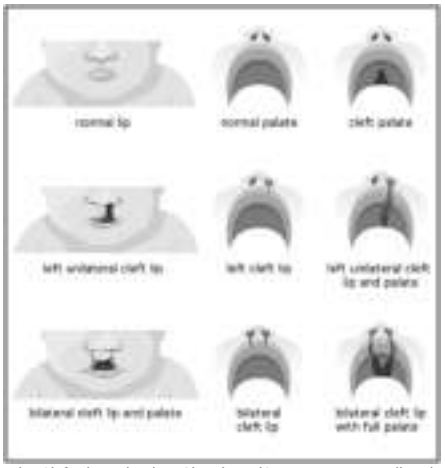


Fig. Cleft Lip and Palate Situations (Courtesy: JA Napoli and LD Vallino in Oro-facial Clefts, 2011).

A cleft can occur on one side of the mouth (unilateral clefting) or on both sides of the mouth (bilateral clefting).

Cleft lip with or without cleft palate is generally more common among boys; however, cleft palate occurring alone is more common in girls than boys.For the most part, because a cleft lip is visible it is often easier to identify than a cleft palate alone. A cleft lip may be detected through prenatal ultrasound; however, diagnosing a cleft palate this way is more difficult and it might not be seen.

Even if a cleft condition is detected during pregnancy, the diagnosis and extent of cleft lip and palate is confirmed by physical examination after the birth of the child. Moreover, increased lifespan, quality living and growing awareness of health care needs and services pose the operator to be very well-versed with the techniques and materials, along with the biological aspects of the patient's conditions and concerns (especially involving a newborn child) to be able to restore their smiles back to normal life-like appearance and utmost well-being.

Thefeeding plate obturates the cleft and restores the separation between oral and nasal cavities. It creates a rigid platform towards which the baby can press the nipple and extract the milk.[1],[2] It facilitates feeding,[3],[4] reduces nasal regurgitation,[3],[5],[6],[7] reduces the incidence of choking[3] and shortens the length of time required for feeding.[3],[4],[6],[8] The obturator also prevents the tongue from entering the defect[3],[4],[6],[7] and interfering with the spontaneous growth of palatal shelves towards the midline.[7] It also helps to position the tongue in correct position to perform its functional role in the development of jaws,[7] and contributes to speech development. The obturator reduces the passage of food into the naso-pharynx thus reducing the incidence of otitis media and naso-pharyngeal infections.[4],[9],[10],[11].

Causes

Sometimes a cleft occurs as part of a syndrome, meaning there are birth defects in other parts of the body, too. Other times, it's genetic and runs in families - the risk may be higher for children whose sibling(s) or parents have a cleft or who have a history of cleft in their families. In these situations, both mothers and fathers can pass on a gene or genes that can contribute to the development of cleft lip or cleft palate. Sometimes a cleft may be associated with environmental factors such as a woman's use of certain medications, exposure to cigarette smoke, or lack of certain vitamins while pregnant. Most of the time, though, the cause isn't known i.e.

ideopathetic.

Definition of an Obturator

GPT–7: Prosthesis used to close a congenital or acquired tissue opening, primarily of the hard palate and/or contiguous alveolar structures. Prosthetic restorations of the defect often include use of a surgical obturator, interim obturator, and definitive obturator.[14]

Functions of an Obturator (Biomechanics)

- Can be used to keep the wound area clean and to enhance healing
- To reshape or reconstruct the palatal contour/or soft palate
- Improves speech
- Can be used to correct lip and cheek position
- Improves mastication.

Types of Obturator

Obturators for Congenital Defects are of 3 types:

- A simple base plate type (Feeding Plate) helps to correct the swallowing, feeding and speech.
- Obturator with a tail: consisting of a speech appliance or a speech aid prosthesis which restores soft and hard palate defects and a velopharyngeal extension which corrects the speech.
- A type of overlay or superimposed denture

Obturators for Acquired Defects include:

Surgical Obturator

- Facilitates oral function immediately after surgery, significantly reducing the hospital stay and rehabilitation time.
- Patient may regain speech within a normal range.
- Wrought wire clasps are used
- Acrylic resin facilitates modification by adjustment or by addition with tissue conditioning material at the time of surgery.
- Constructed from preoperative impression cast.
- It eliminates the need for the nasogastric tube.
- It can serve as matrix for surgical dressing.
- Some surgeons dispute the necessity of surgical prosthesis.

Temporary Obturator

- After 7-10 days, the prosthesis is removed and reprocessed with new acrylic resin which becomes a temporary obturator and serves for 4-6 months of healing period.
- Periodic modifications with tissue conditioners.
- Multiple wrought wire clasps are used.
- Mastication on the surgical side are avoided.
- Prosthetic teeth may be added to enhance esthetics.

Definitive Obturator

- Constructed from the post surgical maxillary cast.
- Has a false palate, false ridge, teeth and a closed bulb which is hollow.

A Case Report

A seven months old male infant presented with a history of cleft palate associated with difficulty in feeding, recurrent respiratory tract infection, nasal discharge and recurrent ear infections. The mother reported that the baby is not able to take feed and suckle milk properly and he was not able to gain weight. There was no history of craniofacial clefts in maternal or the paternal family of the child. The pregnancy of the mother was uneventful and this baby was the first child. There was no history of previous treatment or surgery for the defect. Intraoral examination revealed a cleft in the soft palate and uvula. Feeding plate restores the basic functions of mastication, deglutition and speech production until the cleft lip and/or palate can be surgically corrected. The procedure for fabrication of feeding obturator is described.

Feeding Problems Infants with a cleft lip alone usually have fewer problems feeding than those with a cleft palate. Feeding can be a big problem for a newborn baby with a cleft palate. Normally, the palate prevents food and liquids from entering the nose. The baby with an unrepaired cleft palate has difficulty sucking on a regular nipple and will usually require a special nipple and bottle along with proper positioning in order to feed. With these techniques, the caregiver will learn how to feed the baby before taking the baby home from the hospital. The child's doctor will carefully monitor the child's weight.

Dental Abnormalities Children with a cleft lip and palate frequently have dental problems. These include small teeth, missing teeth, extra teeth (called supernumerary), or malpositioned teeth. They may have a defect in the gums or alveolar ridge (the bone that supports the teeth). Defects of the alveolar ridge can displace, tip, or rotate permanent teeth, or prevent permanent teeth from coming in properly.

Clefts lip and palate is associated constellation of problems that need to be solved for successful habilitation. Neonates with a cleft palate have difficulty in eating which may lead to failure to thrive. The oro-nasal communication diminishes the ability to create negative pressure which is necessary for suckling. To compensate, the baby presses the nipple between the tongue and the hard palate to squeeze out the liquids and milk, but this mechanism is insufficient if cleft is wide and the nipple gets trapped inside the defect. The feeding process is also complicated by nasal regurgitation of food, excessive air intake that requires frequent burping and choking. Feeding time is significantly longer and fatigues both baby as well as mother.

Early treatment in cleft lip and/or palate patients is mandatory. Ideally these patients should be evaluated and treated by a team approach. Cleft patients are associated with deficient facial growth, dental problems, velo-pharyngeal incompetence, articulation defect and otologic problems like eustachian tube dysfunction. This is coupled with delayed speech which leads to the impairment in the cognitive, linguistic and emotional development in these children, making it imperative to early repair of cleft palate.

Treatment

The complex needs of a child with cleft lip and cleft palate are best met by an interdisciplinary team of professionals from various specialties who work together. This is a standard of care that begins soon after the child's birth and continues to adulthood.The members of the cleft lip and palate treatment team includes - a Geneticist, Pediatrician, Plastic Surgeon, ENT Physician (Oto-laryngologist), Oro-Maxillofacial Surgeon, Orthodontist, a Dentist, Speech-language Pathologist, Audiologist, Nurse, Social Worker, Psychologist and a Team coordinator.[12]

The frequency of team visits will depend on the child's needs and can range from two to three times per year to once every 2 to 3 years. Which team members the child

needs to see during a given visit will depend on his or her health needs, including psychosocial issues.[13] After each visit, a team report will be sent to the family and other professionals involved in the child's care. The team coordinator will help organize the visits with team members and other professionals.

Fabrication of Feeding Plate

Primary impression made by molding the low-fusing impression compound with hand adaptation. **(Fig.1)**

The infant was held upright to prevent aspiration of any extra material during the procedure **(Fig.2)**

Primary cast was fabricated with dental stone using Type III Gypsum **(Fig.3)**

A customized special tray fabricated with auto-polymerizing acrylic resin from the diagnostic cast **(Fig. 4)**

Final impression made with rubber base impression material to record the precise details of the supporting structures and the defect. **(Fig. 5)**

Beading and Boxing of the final impression was done along with the required wax block-outs before pouring the impression for the Master cast **(Fig. 6)**

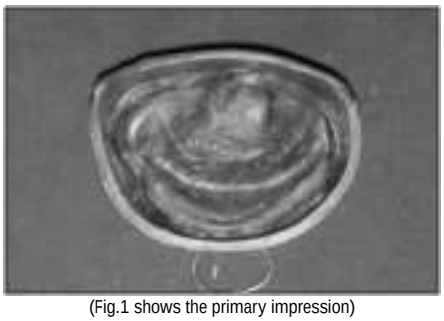
Master cast was fabricated and excessive undercuts were blocked out with modeling wax **(Fig. 7)**

The wax pattern of the feeding plate was adapted on the master cast. Flasking, de-waxing was done and feeding plate was fabricated with heat-activated acrylic for obturating the defect in the soft palate involving uvula. **(Fig. 8)**

Approximately 10 inch sterile threaded string was passed through and tied to the eyelet of the feeding plate so as to facilitate easy insertion and removal of the prosthesis and also it acted as a safety measure to prevent swallowing of the appliance. **(Fig. 9)**

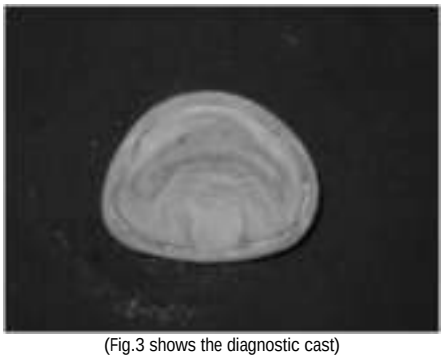
After proper trimming, finishing and polishing the feeding plate was tried in the patient's oral cavity, and minor adjustments were made and final polishing of the feeding plate was done **(Fig. 10)**

Prosthesis was tried in the dental clinic and the patient's mother was asked to feed the baby and it was noted that there was no nasal regurgitation. Infant's mother was instructed about the method of usage, function, cleaning and maintenance of feeding plate. A regular follow up of the patient was done after 24 hours and monthly follow ups were scheduled. At the ninth month, the



(Fig.1 shows the primary impression)

(Fig.2 shows the infant during impression)



(Fig.3 shows the diagnostic cast)

(Fig.4 shows custom-tray fabrication)

(Fig.5 shows final secondary impression made)

(Fig.6 shows beading and boxing of the final detailed impression)

(Fig.7 shows the master cast obtained pouring in Type III gypsum)

(Fig.8 shows feeding plate fabricated on the main cast)

(Fig.9 shows finished and polished feeding plate with safety string)

(Fig.10 shows feeding plate in mouth creating desired obturation)

feeding plate was changed following the same procedure. During the regular follow up, neonate weight gain was evident and no history of recurrent infections was observed.

Conclusion

Early intervention and treatment approach[15] provides a positive impact on the growth n development of infants with clefts. As multi-disciplinary care is essential and mandatory for such patients, the role of the prosthodontist, pedodontist, orthodontist and oral surgeon amongst the various other medical specialists is becoming more defined. Adequate knowledge of the various appliances available and the impression procedures followed lead to better understanding, preparation and coordination of the efforts of the various specialties involved in cleft palate and lip care.[16] A basic approach taken towards managing these complications makes us better equipped in handling emergencies of such kind when they arise to achieve satisfactory results.[17]

Dealing With Emotional and Social Issues[18]

Though they might encounter social, psychological, and educational challenges, kids with a cleft just want to be treated like everyone else. Some kid's struggle growing up with a cleft lip or cleft palate and might need help handling certain situations. The psychologists and social workers on the cleft palate team are available to guide you through these difficult times. The good news is that most kids with cleft lip or cleft palate grow up to be healthy, happy adults.

In the meantime, you can support your child with these tips:

- Try not to focus on the cleft and don't allow it to define who your child is.
- Create a warm, supportive, and accepting home environment where each person's individual worth is openly celebrated.
- Encourage your child to develop friendships with people from diverse backgrounds. Lead by example.
- Point out positive attributes in others that do not involve physical appearance.
- Encourage independence by giving your child the freedom to make decisions and take appropriate risks, letting his or her accomplishments lead to a sense of personal value. Having opportunities to make decisions early on - like picking out which clothes to wear - gives kids confidence and the skills to make bigger decisions later.
- Consider encouraging your child to present information about cleft lip and palate to his/her class with a special presentation that you arrange with the teacher. Perhaps your child would like you and/or a member from the cleft palate team to talk to the class. This can be especially effective with young children.

If the child is teased, talk about it and be a patient listener. It's important to keep the lines of communication open as your child approaches adolescence so that you can address his or her concerns about appearance. If your child has difficulty with self-esteem or other psychosocial situations, contact a child psychologist or social worker for support and management. Together with the cleft palate team, you can help your child through tough times.

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Case Report

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Non Surgical Management Of Mandibular Fracture In A Pediatric Patient: Outcome And Advantages

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Abstract

The management of pediatric mandibular fractures has long been controversial. The conservative management of mandibular fractures in children has always been preferred to avoid damage to the unerupted teeth and the mandibular growth centres. Owing to the discomfort and therapy related risks associated with open reduction methods and intermaxillary fixation techniques; the use of a simple acrylic splint has outweighed these techniques to serve as an efficient treatment option. The present case report describes the effective management of mandibular fracture in a 7 year old boy using a simple acrylic splint. The fracture was reduced and immobilized using an acrylic splint fixed with glass ionomer cement. PA views of radiographs of the mandible supported the pre- and postoperative findings throughout the study. Following the use of this conservative approach, successful healing of the fracture site clinically as well as radiographically has been demonstrated.

Key Words

Mandibular Fracture, Acrylic Splint, Glass Ionomer Cement

Introduction

The management of trauma induced maxillofacial injuries in growing children has long been an enigma to a pediatric dentist. The impact of such injuries on aesthetics and function demand appropriate diagnosis and management to avoid disturbances of future growth and developmentof the jaws and teeth.[1] The goal of treatment must be to restore the underlying bony architecture to its preinjury position in a stable fashion, as noninvasively as possible with minimal residual esthetic and functional impairment.

The small size of the jaw, existing active bony growth centres and the contained, overwhelmingly crowded deciduous teeth with permanent tooth buds located in great proximity to the mandibular and mental nerves, all significantly increase the therapy-related risks of pediatric mandibular fractures and their growth related abnormalities.[2] Open reduction and osteosynthesis of the pediatric fracture with titanium plates and screws are thought to have a negative effect on the skeletal growth and unerupted teeth.[3] Growth disturbances of the facial bones and injuries to the unerupted teeth germs and adjacent anatomic structures during drilling process may occur.[4]

Intermaxillary types of fixation (IMF) including arch-bars or eyelets for the closed reduction of mandibular body fractures in young children can cause avulsion of the primary teeth which are not sufficiently stable due to the pressure exerted.[2] The risk of ankylosis of TMJ and inadequate stability of the bars and wires because of the morphologic structures of the primary teeth should always be considered.[4] The conical shape of the primary teeth, with their wide cervical margins and tapered occlusal surface, makes the placement of these IMF devices or eyelets technically challenging.[2] IMF has also been found to restrict normal dietary intake in children resulting in significant weight and protein loss.[5]

The mandibular splint and circumferential wiring necessitate general anaesthesia for the management of mandibular fracture. In this present paper, we present a case of mandibular fracture successfully treated with a splint fixed in the mouth with Glass Ionomer Cement. The advantages of this type of splinting are that it is very simple, does not require help of anaesthetist and other specialists like plastic surgeon or oral surgeon, not requiring hospitalization and can be done in the outpatient department. However, this type of splinting cannot be done in complex type of fractures like multiple fractures or severe displacement of the fracture fragments.

Case Report

A 7 year old boy reported to the Department of Pedodontics of Himachal Dental College, Sundernagar, Himachal Pradesh with a history of fall from the stairs one day before. After the fall, the patient did not lose consciousness, was well oriented and had no history of convulsions or vomiting. The child was cooperative but anxious, and hence did not allow much conversation.

Clinical examination showed the presence of an oblique fracture line extending from the deciduous lateral incisor region towards the lower border of the mandible **(Figure - 1)**. A PA view of the skull and mandibular occlusal radiograph were recorded. In the PA

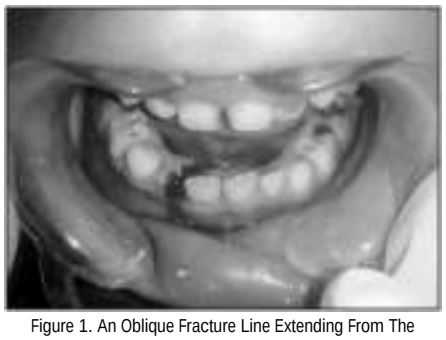

Figure 1. An Oblique Fracture Line Extending From The Deciduous Lateral Incisor Region To The Lower Border Of The Mandible

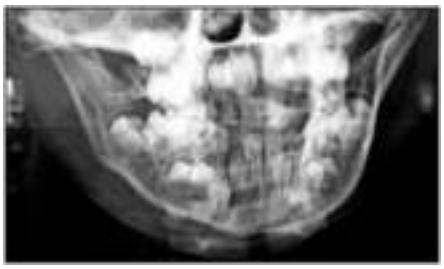

Figure 2. Pa View Of Mandible Showing The Oblique Fracture Line

Figure 3. Stone Model Showing Fracture Line And Disruption In Occlusal Plane

Figure 4. Fixation Of The Splint To The Dentoalveolar Segment Using Glass Ionomer Cement

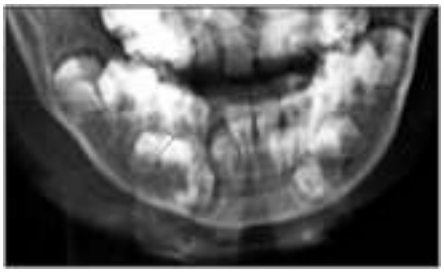

Figure 5. Pa View Of Mandible After Cementation Of The Acrylic Splint

view, an S-shaped fracture line was seen extending from the lateral incisor region through the succedaneous canine extending upto the lower border of the mandible **(Figure - 2)**. There were no other fracture lines on the TMJ or other bony structures. The deciduous lateral incisor in the line of fracture was found missing. There was grade II mobility seen in deciduous maxillary central incisors.

Under local anaesthesia, the dislocated segment was manually reduced and aligned by bi-digital pressure with the guidance of occlusal plane. The fracture fragments were temporarily stabilized by interdental wiring with 0.5mm stainless steel wire. Lower alginate impression was recorded before the reduction. A stone model was cast from the impression

Figure 6. Following Removal Of The Splint After 2 Months

Figure 7. Pa View Of Mandible Showing Healing At The Fracture Site

Figure 8. Healing At The Fracture Site And The Occlusion Relation Of The Jaws (Postoperative 6 Months Follow Up)

(Figure - 3). The model setup of the mandible was fractured and re-adjusted, to simulate the reduction that was done clinically. Meanwhile the fabrication of the splint was being done; the patient was referred for neurological consultation. No clinical evidence of intracranial injury was reported; however a CT scan was advised by the neurologist to rule out the same.

Self cure acrylic was used to fabricate the splint. The interdental wiring was removed and the fixation of the splint to the dentoalveolar segment was done using Type I (luting) Glass ionomer cement **(Figure - 4)**. A PA view was recorded following the cementation of the splint to confirm satisfactory reduction of the fracture fragments **(Figure - 5)**.

Tetanus toxoid had already been administered to the patient in the local Community Health Centre. The patient was discharged and antibiotic treatment was begun with Amoxicillin 250 mg (three times a day), Metronidazole 200mg (three times a day). An analgesic acetaminophen suspension (three times a day) and chlorhexidine mouth rinse (0.12%) twice daily was also prescribed. The patient was advised to avoid physical activity and to have soft and semi-solid diet (khichadi, Dalia, bread dipped in milk, milk with horlicks or complan, etc). Postoperative monitoring was done on a weekly basis for a period of one month. A PA view was recorded after two months and on observation of satisfactory healing response, the splint was removed **(Figure 6 & 7)**. The carious teeth were restored and stainless steel crown cemented. Clinical evaluation was repeated after six months and centric occlusion as well as healing at the fracture site was found to be excellent **(Figure - 8)**.

Discussion

In childhood a generally impetuous nature and adventurous spirit combine to encourage participation in physical activities with little thought to the consequences. However, paradoxically, facial injuries in children are much less common than in adults with an overall frequency of 5–15%.[1] The prevalence of pediatric facial fractures is lowest in infants and increases progressively with increasing age. Only 0.87–1.0% of facial fractures occur in children younger than five years, whereas 1.0–14.7% occur in patients older than 16 years.[6],[7] Boys are more commonly affected than girls by a ratio of 2:1. Approximately half of all pediatric facial fractures involve the mandible.[8] A fall from a bicycle, steps or climbing apparatuses is the most common cause of mandibular fractures in children.[9]

The management of mandibular body fractures in children differs from that of adults due to concern for mandibular growth and dentition development. Treatment principles of pediatric mandibular fractures differ in that a conservative approach is advocated in most cases.[10] Whereas absolute reduction and fixation of fractures is indicated in adults; concern for minimal manipulation of the facial skeleton is mandated in children.

Nondisplaced body or symphysis fractures without malocclusion can be treated by close observation, blenderized diet and abstinence from physical activity. If displaced, close reduction and immobilization must be performed. Exact method of immobilization depends upon child's chronological age and the state of dental development.[11]

The treatment modality for displaced

mandibular body fractures is debatable between conservative methods (arch bars, acrylic splints, and eyelets) and open reduction methods. The effect of implanted non resorbable plates in the mandible of the growing child is not completely understood; some evidence suggests that the disruption of the functional bone matrix and mandibular growth centres may result in alteration of development.[2] There is also potential damage to primary teeth and permanent tooth germs which may result in disturbance to their normal development and damage to their pulp causing its obliteration.[12],[13] Therefore, the decision to use Open reduction with internal fixation (ORIF) in children should be taken with great caution and only if other means of reduction and fixation are not attainable.

In the mixed dentition, attrition of deciduous teeth further compounded by resorption of roots results in quite a loose anchorage system. Partially erupted secondary teeth are also not yet sufficiently stable in the pediatric soft bone and hence do not provide sufficient support. The wires are uncomfortable and damaging to the periodontal tissues.[5] Therefore the lack of stable fixation units and the discomfort associated with Intermaxillary fixation (IMF) limits its use for the management of mandibular fractures in children. Some authors have indicated that IMF using arch bars is safe in children, especially those older than 9 or 11 years.[14],[15]

Due to the disadvantages of IMF and ORIF in children as mentioned, the simple splinting methods hold significance in trauma management in young children. In the present case, the fracture was immobilized with a simple acrylic splint fixed with GIC and not circumferential wiring. Due to the uncomplicated nature of fracture and presence of only a minor displacement, this modality could be effectively and efficiently used. The application of splint was done in the outpatient department without hospitalization and need of general anaesthesia. This method of reduction and stabilization reduced discomfort during feeding and the damage to the permanent tooth buds and mandibular growth centres associated with ORIF was also ruled out. In the six month follow up period, the patient neither showed any occlusal disharmony nor presented with any TMJ problems or any other developmental disturbances of teeth.

These clinical outcomes indicate that fabricated acrylic splints for conservative treatment of pediatric mandibular fracture are simple, cost-effective, and easy to apply and remove. Also, these are less time-consuming as well as provide maximum stability during the healing period with minimal trauma to the adjacent anatomic structures and thereby are more comfortable for young patients.

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Functionally Trimmed Denture For Atrophic Ridges

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Abstract
The success of a complete denture relies on the principles of retention, support and stability. The prosthodontist's skill lies in applying these principles efficiently in critical situations. Dentists have been very successful in treating edentulous patients with complete dentures. However the professions commitment to avoiding the edentulous state continues and this commitment has lead to an expanded knowledge on alternative clinical skills. The life expectancy of the general population is steadily increasing, which could lead to a rise in the number of complex complete denture cases. There is a need for an alternative approach when continued bone resorption has led to a progressively unsatisfactory denture. This paper presents a case report, where the complete denture has been shaped by muscle function in harmony with the surrounding oral structures, and functional impression technique is employed for attaining maximum retention, support and stability in the complete denture prosthodontic treatment.
Key Words
Unstable dentures, functional impression technique, muscle balance, piezography

Introduction

During childhood teeth erupt under the influence of muscular environment created by forces exerted by tongue, cheeks and lips, in addition to the genetic factors. These forces have a definitive influence upon the position of the resultant arch form, and the occlusion. After the loss of the teeth, it is important that the artificial teeth be placed in the arch form compatible with the muscular forces. As the area of the impression surface decreases (due to alveolar ridge resorption), retention and stability becomes more dependent on correct positioning of the teeth and the contours of the external or polished surface of the dentures. Therefore these surfaces should be so contoured that horizontally directed forces applied by the peri-denture muscles should act to seat the denture in this well balanced muscular space. This potential space is known as neutral zone or, which is bounded by the tongue medially, and the lips and cheeks laterally.[1]

The success of any prosthesis depends on the proper position of the artificial teeth within the neutral zone.[2] Dental implants placed with neutral zone technique stabilize the denture fabricated over atrophic mandibular ridge. However, there may be certain medical, surgical or economical conditions when it is not possible to provide implants. In such complex cases, the neutral zone impression technique is a good option for the stabilization of the complete denture.[3] It is not only a treatment of choice in atrophic mandible but also in patients with partial glossectomy, mandibular resections or motor nerve damage of the tongue, which have leads to either atypical movement or an unfavourable denture bearing area.[4]

Case Report

A female patient aged about 68 years reported to our department, with the chief complaint of loose, ill fitting and unstable lower denture. The patient stated that the lower denture dislodged while speaking and during chewing, causing extreme discomfort. On examination, it was found that the patient was completely edentulous and had atrophic mandibular residual ridge, loss of vertical dimension, collapse of facial profile and loss of muscle tonicity. Lack of nutrition was evident due to inability to chew food properly. After thorough evaluation of the patient's history and existing clinical conditions, a special functional impression technique was used to record the final impression of the mandibular arch followed by a functional moulding of surrounding structures and muscles during the jaw registration procedure.

Clinical Technique

Step I: Preliminary impressions

- The preliminary impressions were made in a stock tray using mucostatic impression technique using irreversible hydrocolloid impression material (high viscosity alginate).
- The maxillary and mandibular primary casts were obtained, over which the special trays were fabricated.

Step II: Functional secondary impressions

- The maxillary border moulding was done in conventional manner and final impression was made using zinc oxide eugenol impression paste.
- Denture bearing area of the mandible was recorded using a functional method of impression making whereby, three parts by weight of impression compound and seven parts by weight of tracing compound was used. (Admixed technique) The material was manipulated and loaded in the mandibular special tray. Various functional movements were carried out so as to accurately reproduce the denture bearing area. Patient ws then asked to recite the days of the week several times slowly and clearly, to functionally mould the material by muscles.[5] **(Fig. 1A)** The impression surface of the denture must be correctly extended to provide the maximum support from the underlying structures. The borders must be moulded in harmony with muscle activity, recording the functional depth and width of the sulcus. Furthermore, the wash impression was made in poly vinyl siloxane elastomeric material in light body consistency. **(Fig. 1B)**

Fig. 1a Mandibular Functional Impression

Fig. 1b Final Impression

Fig. 2 Self Cure Vertical Fin On Mandibular Denture Base At The Desired Ovd

- The impressions were then poured to obtain the final casts.

Step III: Jaw registration and Piezographic training

- The wax record rims were constructed on the acrylic bases and were assessed for extension, comfort and stability.
- Once the bases were assessed and modified, jaw registrations were carried out. The maxillary rim was carved to provide support for the musculature labially and buccally. It is vitally important that the record rim is correctly trimmed to the full width of the sulcus; otherwise the correct width of the lower arch cannot be developed.
- After establishing the correct incisal level, occlusal planes and palatal contour, the mandibular rim was adjusted to the correct occlusal vertical dimension (OVD).

Fig. 3 The Functionally Trimmed Impression

Fig. 4 Plaster Index Around The Nz Impression

Fig. 5 Teeth Arrangement Done In The Neutral Zone

- The rims were registered in the retruded arc of closure and thereafter, the rims were articulated.
- Special piezographic training was given to the patient during this appointment for the subsequent step of functional muscle trimming. The actions need to be rehearsed so that they were performed accurately and effectively.
- This was followed by construction of the vertical superstructure.

Construction Of The Vertical Superstructure

- The wax was removed from the mandibular denture base and a superstructure in the form of fin. This vertical fin was constructed using auto polymerising resin on the denture base along its center. **(Fig. 2)**.
- It served two functions: provides even occlusal stops at the correct OVD and support for the functional muscle moulding.

Step IV: Functional muscle trimming

- The patient was seated in a comfortable, upright position with the head supported.
- After this, light body poly vinyl sioxane material was placed along the fin, taking special care to keep the volume of the material to a minimum.
- This prevents the accumulation of the material in the sulcus, thus accurately reproducing the sulcus in the non distorted form.
- The denture base was then rotated into the patient's mouth and she was asked to perform series of actions as learnt during piezographic training appointment.
- During this period, the patient was instructed to perform the suggested piezographic actions: smile, grin, pout/purse lips, count from 60 to 70, talk aloud, pronounce the vowels, sip water, swallow, slightly protrude the tongue and lick the lips.[4]
- Phonetic registration was performed to determine the position of the tongue, lips and the physiological contraction of the orbicularis oris. The patient was requested to swallow, to confirm that the correct inter maxillary relationship is attained.
- The patient was asked to speak, move the tongue gently to the right and left, and swallow until the material is completely set. In this manner, registration of the modiolus, the lingual aspect of the tongue in its dynamic position, and the internal aspect of the cheek (the buccinators and masseter) was obtained. **(Fig. 3)**.
- All these actions were designed to simulate physiological functioning.

Laboratory Stage

- This functionally trimmed impression so obtained was placed on the master model and locating grooves were prepared on the cast.
- The plaster index was made around the impression which helped in the preservation of the space of the neutral zone.
- The impression was then removed from the denture base and the index replaced. **(Fig. 4)**.
- Wax was then poured into the space giving an exact representation of the neutral zone. Teeth were then arranged following the index. **(Fig. 5)**

Step V: Complete denture trial

- The trial was done to check for retention, stability and esthetics and the patient was also evaluated for speech and facial esthetics.

Fig. 6 Post Operative View

Step VI: Complete denture insertion

- Once the wax try-in was deemed satisfactory, the dentures were then processed and finished in the conventional manner.
- On final insertion the dentures were fully inspected and any minor occlusal errors were eliminated. **(Fig. 6)**.
- The dentures provided the patient with improved facial appearance, stability and retention during function as they have been constructed in harmony with their surroundings musculature.

Discussion

Severe ridge atrophy results in increased inter arch space, unstable and non retentive mandibular dentures with inability to withstand the masticatory forces. The negative effects of ridge atrophy are managed by modifying the impression technique and employing the concept of teeth arrangement in harmony with the surrounding musculature. Due to the anatomical differences between the maxilla and mandible, as well as the differences between primary and secondary load bearing areas, impressions of mandibular ridges require special considerations.[6] In the present case, functional impression technique as described by McCord and Tyson was used to record the mandibular secondary impression. The philosophy was that a viscous admix of impression compound and tracing compound removes any soft tissue folds and smoothes over the mandibular bone. This reduces the potential discomfort arising from the atrophic sandwich i.e. the creased mucosa lying between the denture base and mandibular bone.

Further neutral zone technique was employed to construct a prosthesis in muscle balance. In the highly atrophic mandible, muscular control over the denture is the main retentive and stabilizing factor during function.[1] Successful treatment of patients with complete dentures also depends upon the proper positioning of the artificial teeth. Weinberg[2] stated that buccal cusps and fossae of posterior teeth should be directly over the crest of the ridge. This results in more stability since the occlusal pressure on the tooth falls close to the fulcrum and creates little or no torque. In this case, mandibular impression in muscle harmony was recorded in order to determine the space within which the denture could be seated without being subjected to excessive displacing forces from the surrounding musculature and thus aid in denture base stability.

Various materials have been used to record the potential physiological space in the mandible in muscle balance like impression compound and tissue conditioner. Impression compound becomes hard on early setting before the material can be manipulated properly in the patient's mouth. Later tissue conditioner came into use which had the potential difficulty of material manipulation due to its tackiness. To overcome these disadvantages, light body poly vinyl sioxane material was chosen for this case.

Moreover, the potential error of distortion of maxillary rim while recording neutral zone impression caused by wire framework was overcome in this case by using self-cured vertical fin along the center of the denture base.

Maxillary neutral zone impression was not recorded as the effect of tongue size and position do not appear to have as profound an impact on the stability of a maxillary denture as compared to mandibular denture. Besides, the position of the mandibular teeth arranged in the neutral zone was used as a guide to position the maxillary teeth in the neutral zone. In this case, piezography was used to record denture space by means of the speech function of the patient. Patient was trained for the piezographic actions in the jaw relations appointment so that the clinical time for the piezographic appointment was reduced. Piezography is a technique used to record patient's denture space in relation to oral function by means of pressure.[7],[8] Piezographically produced lingual surface customizes the contour and precludes over-extension. This technique involves introduction of a mouldable material into the mouth to allow unique shaping by various functional muscle forces. This technique has several advantages e.g. the patients can practice before the impression is taken; the procedure is easy to understand, especially for the elderly, easy to inspect for proper oral function while the patients pronounce the phonemes.[8] Denture fabricated over a severely resorbed mandibular ridge by this technique will insure that the muscular forces aid in the retention and stabilization of the denture rather than dislodging the denture during function.

Conclusion

Prosthodontic rehabilitation of a patient with compromised edentulous ridges in a conventional manner is a difficult task. Modifications in the treatment procedures should be considered to fulfil the patient's functional and esthetic desires. The functionally trimmed denture in harmony with the surrounding musculature is an alternative technique for the construction of lower complete dentures on highly atrophic ridges. This method provides the patient with a great degree of comfort and confidence. When bone resorption is significant, as generally noted in the elderly patient, this technique allows for functional stability and facilitates adaptation to the new prosthesis.

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Case Report

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Reattachment An Immediate Emergency Protocol: A Case Report

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Abstract
The immediate fragment reattachment is a conservative treatment which allows the restoration of the original dental anatomy thus rehabilitating function and aesthetics in a shortest time available. Fracture reattachment posses challenging conservative and economically viable procedure within a single visit. This article discusses fragment reattachment technique and presents clinical case of coronal fracture involving enamel, dentin and pulp.

Key Words
Conservative Treatment;Crown Fractures; Traumatic Injuries; Tooth Fracture; Cracked Tooth Syndrome; Reattachment, Composite Resins.

Introduction

Crown fracture has been documented to account up to 90% of all traumatic injuries to the permanent dentition. Many epidemiologic studies show that most dental injuries involve just one tooth and maxillary incisors are the most commonly affected[1],[2]. It has been reported males are more frequently affected than females, particularly in the maxillary incisors[3]. An alternating treatment option for restoring fractured incisors is using bonding agent for the chipped fragment onto the natural crown. The first published case of reattaching a fractured incisor fragment was reported in 1964 by Chsuck A et al.[4] when clinicians described a case of rehabilitation of a fractured incisor using the patient's original tooth. After this many articles have been published regarding a variety of preparations designs and materials for reattachment. Many clinicians published articles for fragment and tooth preparation, using an acid etch technique and composite technique[5]. Introduction of new dentine bonding agent available, fragment reattachment is becoming more attractive and the introduction of fiber posts by Duret et al. in 1990 offered anaesthetic solution for the restoration of traumatized teeth. Uncomplicated crown fractures can be treated according to the extent of hard tissue loss with enamel recontouring, composite bonding, or porcelain veneers. Due to the reflection of metal shade through the remaining tooth structure, these posts present some aesthetic concerns[6],[7],[8],[9].

The educational attempts of dental professional regarding trauma have resulted in patients presenting with intact avulsed teeth, as well as fractured coronal tooth fragments. If an intact tooth fragment is present after trauma, the incisal edge reattachment procedure presents a conservative, simple and aesthetic alternative[6]. The advantages from reattachment of fractured tooth fragment are[6],[7],[8]

a) Reduced chair-side appointments.
b) Psychological acceptance by the patients and parents.
c) Accurate restoration of tooth morphology and texture, and using the natural tooth, the abrasion would be similar to that of the contralateral and opposing teeth,
d) Colour matching,
e) Wear similar to adjacent and opposing tooth,
f) Good aesthetics,
g) Preservation of incisal translucency,
h) Economical,
i) Preservation of occlusal contacts,
j) Colour stability of enamel,

The objective of this case report is to present the reconstruction of a traumatized and fractured right maxillary lateral incisor by building a composite resin core with a glass fibre post.

Case Report

A 26 year old patient sought treatment at Department of Conservative and Endodontics, after he sustained a crown fracture in the permanent maxillary right lateral incisor. A complete history of the incident was noted and then an elaborate clinical examination of the tooth and rest of the dentition were carried out. Ellis Class 111 fracture of right upper lateral Incisor was observed **(Fig 1a)** and the patient was more concerned about immediate restoration of aesthetics. Therefore we decided to restore aesthetics immediately by reattaching the original crown fragment after ruling out periodontal damage, root fracture and bony fracture. To prevent dehydration the original tooth fragment was kept in Hanks balanced salt solution (HBSS) till the completion of root canal treatment **(Fig 1b)**. Pulp vitality was checked thermally (sensitivity to cold stimulus) and confirmed with positive responses.
Subsequent to this, an intraoral periapical radiograph (IOPA) of 12 region was taken. The IOPA revealed pulpal involvement. The coronal fragment resembled a laminate veneer, and its cervical margin was slightly sub-gingival. No alterations in the periodontal and bone tissues were observed in the radiographic examination. As the first clinical step, the coronal fragment and remaining root portion were cleaned with rubber cup

Figure 1: The Preoperative photograph showing fractured crown in position (a). The extracted crown fragment placed in the HBSS solution (b). The radiograph immediately after obturation of root canal (c) and after space prepared for post placement (d).

pumice prophylaxis. After completing the endodontic treatment **(Fig 1c)** and post space preparation was done **(Fig 1d)** in the coronal fragment as well as in the root canal for proper retention of the fractured fragment assembly. Glass fibre post was selected as the patient was concerned more about his aesthetics. The coronal fragment and remaining root portion were then etched with 37% phosphoric acid **(Fig 2a)**, rinsed thoroughly, and gently air-dried. The coronal fragment was re-attached to the root remnant using an adhesive restorative technique with an etch-and-rinse adhesive system **(Fig 2b)** and a light-cured micro hybrid composite resin **(Fig 2c)** was spun into the root canal and the glass fibre post seated **(Fig 2d)** and cured **(Fig 2e)**.

Simultaneously, the coronal tooth fragment was placed into the stent, its bonding surface and pulp cavity loaded with dual cure cement. This was placed into position and held until the cement was light cured set **(Fig 3)**. All restored surfaces were finished with fine-grain diamond points and polished with fine and superfine grain polishing discs. Antibiotic therapy (amoxicillin 500 mg, 3 times / day) was started and maintained for 5 days. The use of 0.12% chlorhexidine oral rinse twice daily for 7 days was prescribed. After 15 days, a groove extending from the buccal to the palatal side of the tooth was prepared with a No. 1302 round diamond bur at high speed along the fracture line and was restored with composite resin in order to mask the union between the fragments and improve aesthetics. Follow-up after 6 months showed good adaptation of the

Figure 2: The fractured portion of the crown fragment being conditioned with 37% phosphoric acid gel (a), application of bonding agent (b), placement of resin composite (c), curing of the composite with fiber-post in position (d) and finally the cured post inside the fractured crown segment (e).

tooth fragment/composite resin restoration, pulpal vitality, no signs of root resorption, and no painful symptoms **(Fig 3e)**.

Figure 3: The application of etchant on the fractured tooth inside the mouth (a), application of bonding agent (b), fiber-post with crown assembly together luted in the root canal (c), curing of luted cement (d), and the final postoperative labial view (e).

Discussion

Traumatized anterior teeth require quick repair for both functional and aesthetic needs. By using the original tooth fragment to restore a fractured tooth, it is possible to achieve a very good aesthetics. Traumatic injuries involving tooth fracture can be treated by reattachment of the tooth fragment using a dentine adhesive system to provide what is considered to the most conservative to restoration. The traditional conservative treatment of crown fractures has been restorations with composite resin and a dental bonding system. Newer dentine bonding systems work well with such efficiency that they easily allow for normal masticatory forces. Adhesive systems can now be used to treat tooth fractures by reattachment of the tissue fragment to provide best restoration.

Factors influencing the extent and feasibility of such repairs include the site of fracture, size of fractured remnants, periodontal status, pulpal involvement, maturity of root formation, biological width invasion, occlusion and time. The fractured fragment needs to be preserved in sterile saline or water or HBSS to prevent color change due to dehydration of the tooth. Dehydrated fractured fragment might get rehydrated over few months. Survival rates for such restoration have been shown to the good with failure often only resulting from repeated trauma[10]. If the fracture involves two-third or more of the crown a post - reattachment is more commonly used.

The composite reinforcement technique together with this light-transmitting post had been widely used to functionally and aesthetically restore compromised root filled teeth[11]. Restoration with a post after endodontic treatment provides retention of a core to support coronal restoration especially with extensive tooth loss. Traditionally, these posts have been cast or machined from metals, and can be grouped as active or passive posts[12]. Active posts derive their primary retention directly from the root dentine by the use of threads. Passive posts rely primarily on luting cement for their retention.

The present case report indicated that reattachment of fractured incisal fragments by using new generation bonding agents was effective. The advantages of using the original tooth fragment over other materials include better color match, morphology, translucency, patient acceptance and economical[13]. If the fracture involves two thirds or more of the crown a post-reattachment was more commonly used. Post placement was also to be considered in fractures where the patient exhibits a large over jet and/or para-functional habits Post placement in addition to bonding, serves to retain the coronal portion via a friction bond, and assists in preventing dislodgement from non-axial forces. It is acknowledged that the placement of traditional metal posts weakens the roots and leads to root fracture, or may lead to caries that may cause irreversible failure and extraction of tooth in some cases[14],[15].

According to the findings of finite element analysis of stresses in endodontically treated teeth restored with posts, flexible glass post systems gave the most stressing condition as compared to carbon or steel posts[16]. In a retrospective study of the clinical performance of 1314 placed fibre posts, the survival rate was 96.8%[17]. For the

treatment of the present case, a composite core was built up over the fibre post to provide aesthetically pleasing temporary restoration to the patient. The composite core build up used in this case enabled the placement of a bracket to the tooth. Some of the disadvantages of reattachment includes: the necessity for continuous monitoring, its unknown longevity, and possibility of color changes of the bonded fragment[18]. Other treatment options which are available have associated limitations like multiple visits, stabilization and are less conservative in nature. Adhesive tooth fragment reattachment may provide good results on a short - and medium-term basis[19]. However, dehydration of the fragment when it remains dry after the accident is a major problem with this technique. Dentists should teach their patients about the importance of collecting fragments of teeth damaged due to traumatic injuries. They should provide instructions on the use of an adequate wet storage medium, so that the fragments can be suitable for reattachment.

In the present case, the fragment was maintained in the oral cavity since the accident, which avoided desiccation and color change. Our case was followed up for six months without noticeable color change of the crown or periapical radiological changes. The patient continued with the reattached fragment as a permanent restoration. Preparation of ceramic/porcelain fused to metal (PFM) restoration requires multiple visits, tooth preparation and laboratory procedures. Hence we recommended that the original reattached fragment be allowed to continue as permanent restoration unless tooth exhibits color changes or there is subsequent trauma[13],[20]. Limitations of tooth tissue reattachment include those associated with dental adhesion restorative cement in particular control of operating field from contamination and force application, particularly indirect or shear forces working in directions where bonding forces are weakest.

Conclusion

Reattachment of the intact fractured segment can be considered as an ultraconservative method for aesthetic rehabilitation. Reattaching a tooth fragment with the superior quality adhesive materials make this procedure viable. This procedure helps us to preserve maximal natural tooth structure. The need of the day is to educate the public to preserve the fractured segment and seek immediate dental treatment.

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Crown Lengthening By Apically Displaced Flap And Ostectomy : A Case Report

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Abstract
Few of the conditions like deep subgingivally located carious lesions, crown and root fractures, preexisting deep preparation margins are unfavorable for successful restorative procedures. In such situations, surgical lengthening of the clinical crown will improve the anatomical conditions and facilitate restorative procedures. An apically repositioned flap with ostectomy/osteoplasty procedure enables the positioning of the alveolar crest at a distance of at least 3 mm from the future reconstruction margin and leads to stable periodontal tissue levels over a period of 6 months.

Key Words
Apically Displaced Flap, Crown Lengthening, Fiberotomy, Ostectomy, Osteoplasty

Introduction

Crown lengthening procedures are required to solve problems such as (1) inadequate amount of tooth structure for proper restorative therapy, (2) subgingival & subcrestal location of fracture lines, and (3) subgingival location of carious lesions. The techniques used to accomplish crown lengthening include (1) apically positioned flap procedure including osteoplasty and ostectomy, and (2) forced tooth eruption with or without fiberotomy.

In the 1950s and 1960s this new surgical technique for the removal of soft and hard tissue (i.e. alveolar bone) was described emphasizing the importance of maintaining an adequate zone of attached gingiva. One of the first authors to describe such technique was Nabers (1954) was originally denoted "repositioning of attached gingiva" and was later modified by Ariaudo & Tyrrell (1957). In 1962 Friedmanproposed the term apically repositioned flap to more appropriately describe the surgical technique introduced by Nabers.[1] Friedman emphasized the fact that, at the end of the surgical procedure, the entire complex of the soft tissues (gingiva and alveolar mucosa) rather than the gingiva alone was displaced in an apical direction. Thus, rather than excising the amount of gingiva which would be in excess afterosseous surgery (if performed), the whole mucogingival complex was maintained and apically repositioned.[2]

The apically positioned flap technique with osseous recontouring may be used to expose sound tooth structure. The length of the dentogingival complex (mean sulcus depth was 0.69mm, epithelial attachment 0.97mm, connective tissue attachment 1.07mm)was 2.73mm (Nevins et al.1984, Fugazzotto 1985). Based on these dimensions authors suggested that 3mm of supracrestal tooth structure be obtained during surgical crown lengthening. Rosenberg et al.1980 combined epithelial and connective tissue attachment of 2mm with 1 to 2mm for the restorative finish line, resulting in a recommendation of 3.5 to 4mm. During healing the supracrestal soft tissues will proliferate coronally to cover 2-3 mm of the root (Herrero et al. 1995, Pontoriero & Carnevale 2001), thereby leaving only 1-2 mm of supragingivally located sound tooth structure.[3]

When this technique is used for crown lengthening it must also be realized that gingival tissues have an inherent tendency to bridge abrupt changes in the contour of the bone crest. Thus, in order to retain the gingival margin at its new and more apical position, bone recontouring must be performed not only at the problem tooth but also at the adjacent teeth to gradually reduce the osseous profile. Consequently, substantial amounts of attachment may have to be sacrificed when crown lengthening is accomplished with an apically positioned flap technique. It is also important to remember that, for esthetic reasons, symmetry of tooth length must be maintained between the right and left side of the dental arch. This may, in some situations, call for the inclusion of even more teeth in the surgical procedure.[3]

The purpose of this paper is to present a case with inadequate amount of tooth structure for prosthetic crown placement. This case was treated by apically displaced flap technique and ostectomy.

Case Report

A 25 year old male patient referred to the department of periodontology in need of crown lengthening of maxillary central incisors. Patient gave history of having sustained fractured maxillary central incisor 1 month back following road traffic accident, for which he had to undergo root canal treatment immediately.

The patient's medical history was non-significant for major conditions or allergies and free of contributory factors (e.g. systemic disease and smoking), making him an ideal surgical candidate. After discussion with the restorative dentist, esthetic crown-lengthening was recommended to allow a healthy, optimal relationship between the teeth and the periodontium.

Intra oral examination revealed that the

Ellis class III fracture of tooth 11 and 21, had been treated endodontically. Periodontal examination revealed good oral hygiene with minimal plaque and calculus deposits. The gingiva was pink and firm, and the papillae were intact. Clinical examination revealed shallow probing depths, no mobility and inadequate amount of keratinized attached gingival on labial aspect of 11 & 21**(Fig.1)**.

To start, thorough scaling was done followed by oral hygiene instructions. After 3-4 weeks of initial therapy patient was recalled for next phase of surgical procedure aiming to displace the flap apically. On the labial side a crevicular incision was given and two vertical releasing incisions limiting the extent to 11 and 21 extending out into the alveolar mucosa (i.e. past the mucogingival junction) were made at each of the end points of the incision by using Bard Parker blade (No.15), thereby making possible the apical positioning of the flap **(Fig. 2), (Fig. 3)**.

On the palatal aspect an exaggeratedinverse bevel incision was given and at the same time an effort was made to retain scalloped margin using a Bard-Parker blade (No. 15). A full thickness mucoperiosteal flap including palatal gingiva and alveolar mucosa was raised by means of a mucoperiosteal elevator. The marginal collar of tissue, including pocket epithelium and granulation tissue, was removed with curettes, and the exposed root surfaces are carefully scaled and planed **(Fig. 4)**.

The alveolar bone crest was recontoured (ostectomy) with the objective of recapturing the normal form of the alveolar process i.e. positive architecture but at a more apical level. The osseous surgery was performed labially, palatally, and interproximally using carbide burs with external irrigant and every effort was made to meet the requirement of biologic width. Following careful adjustment, the labial flap was positioned apically and sutured to the level of the newly recontoured alveolar bone crest **(Fig. 5)** and the palatal flap was sutured back in an undisplaced manner **(Fig. 6)**. And over that a periodontal dressing (Coe-pak®) was placed for the better positioning of the apically displaced flap.Antibiotics (amoxicillin 500mg tid for 5 days) and analgesics (Diclofenac sodium 50mg bid for 3 days) were prescribed. After 24 hours 10 ml chlorhexidine gluconate rinse 0.2% bid was advised for 2 weeks, and the patient was given appropriate postoperative instructions.


Fig 1 : Preoperative View

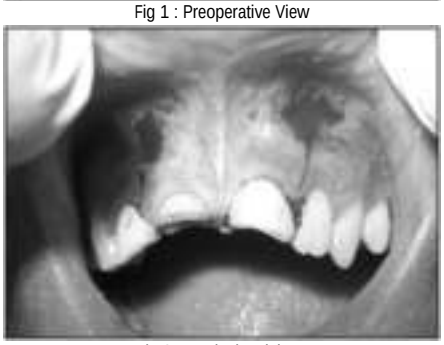
Fig 2 : Vertical Incisions

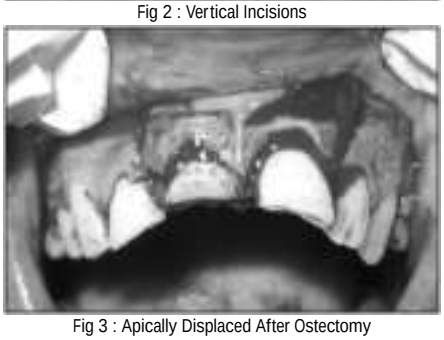
Fig 3 : Apically Displaced After Ostectomy

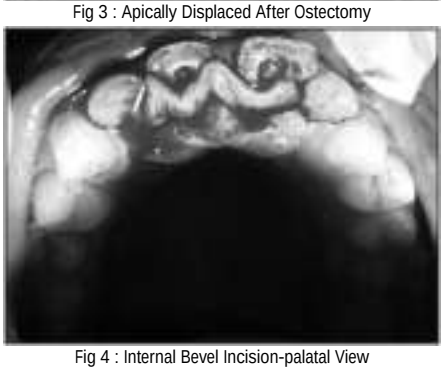
Fig 4 : Internal Bevel Incision-palatal View

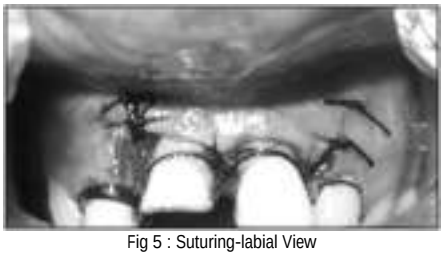
Fig 5 : Suturing-labial View


Fig 6 : Suturing-palatal View

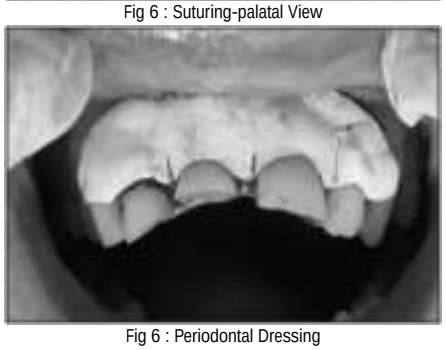
Fig 6 : Periodontal Dressing


Fig 7 : Post Operative-1 Week


Fig 8 : Post Operative 6 Months (Labial And Palatal View)

The sutures were removed after 7 days and the surgical site was irrigated with saline. The healing of the surgical site was quite uneventful & satisfactory **(Fig.7)**. After 6 months, the apical displacement of the free gingival margin was 3mm. Another prominent feature observed was increase in zone of keratinizing tissue on labial aspect of 11 and 12 **(Fig.8)**.

Final preparation of the teeth began a half year later, to confirm the final position of gingival margin following post surgical recession. Care was taken to ensure that the margins of the temporary crown were smooth and closely adapted to ensure gingival health. Final cementation of the crowns was performed after 6 months **(Fig.9)**.

Discussion

There is a significant relationship between restorative dentistry and periodontal health. Deeper subgingival margins, especially those encroaching the junctional epithelium, and placed near alveolar bone cause the gingival inflammation, loss of connective tissue

Fig 8 : Post Operative 6 Months (Labial And Palatal View)

Fig 9 : After Placement Of The Crown (Labial And Palatal View)

Fig 9 : After Placement Of The Crown (Labial And Palatal View)

and bone resorption. Thus, periodontal surgery is recommended to support restorative dentistry for allowing long clinical crowns and reestablishment of biological width.

The concept of the biological width stems from histologic description of the dentogingival complex by Gragiulo et al. 1961. He concluded the mean total length of the dentogingival complex was 2.73mm.[4] Rosenberg et al. 1980 combined epithelial and connective tissue attachment of 2mm with 1 to 2mm for the restorative finish line, resulting in a recommendation of 3.5 to 4.0mm. Wagenberg at al. 1989 suggested that at least 5.0 to 5.25 mm of tooth structure should be above the osseous crest.[5]

There is significant marginal tissue rebound following crown lengthening surgery that has not fully stabilized by 6 months. The amount of coronal rebound appears to be related to the position of flap related to the alveolar crest at suturing. These findings support the premise that clinicians should establish proper crown height during surgery without over reliance on flap placement at the osseous crest to gain necessary crown length.[6]

After the surgical clinical crown-lengthening procedure, the provisional restoration must be readapted. A waiting period of 12 weeks has been suggested prior to starting the final restoration, although Bragger et alreported no change in attachment levels or probing depths after six weeks of healing.However, due to the possibility of recession, Bragger et alrecommended a waiting period of six months for areas that held esthetic concerns.[7]

Alveolar bone loss caused by inflammatory periodontal disease often results in an uneven outline of the bone crest.The purpose of osteoplasty is to create a physiologic form of the alveolar bone without removing any "supporting" bone. Osteoplasty therefore is a technique analogous to apically positioned flap surgery. Patients not receiving adjunctive antibiotic therapy, apically positioned flap surgery with osseous recontouring is more effective than apically positioned flap surgery without osseous recontouring in reducing periodontal pocket depth and levels of major periodontal pathogens.[8]

Earlier it was assumed that the apical repositioning of the flap (ARF) would result in a perma3 wnent apical shift of the mucogingival junction (MGJ). However, a 18 year follow-up comparing ARF and gingivectomy (GE) study failed to confirm these assumptions. A possible reason why the MGJ on the ARF side is not located 2-3 mm more apically than on the GE side could be that the muscular attachments apically of the MGJ, after having been artificially repositioned, tend to push the MGJ back towards its original location.[9]

Crown lengthening involves the surgical removal of hard and soft periodontal tissues to gain supracrestal tooth length allowing for longer clinical crowns and reestablishment of the biological width. A human study to evaluate the positional changes of biologic width, following surgical crown lengthening, showed that biological width was reestablished to its original vertical dimension by 6 months.[10]

Conclusion

There is a significant relationship between restorative dentistry and periodontal health. Periodontal surgery is recommended to support restorative dentistry and improve long-term prognosis. Surgical crown lengthening should be the most immediate and common approach, since it will expose the sound tooth structure immediately after surgery.

Surgical crown lengthening done with apically repositioned flap, the bone level can be lowered to allow for the placement of the prosthetic margin. This surgical approach accomplishes the goal of reestablishment of the biological width with an increase in the width of keratinized tissue and a permanent apical shift of the mucogingival junction.Thus, stable margins are achieved exposing tooth structure for restorative therapy.

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Palatal Splinting Using Two Part Tray System – A New Approach Towards Flabby Ridges: A Clinical Report

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Abstract
The presence of fibrous or flabby tissue poses significant problems for the provision of stable and retentive complete denture. The problem arises because of distortion of mobile denture bearing tissue, when forces are applied on the complete denture. Surgical excision techniques or use of dental implants has provided clinicians with methods for addressing this particular difficulty. However, careful consideration and application of the principles of complete denture construction can provide a less invasive and less complex form of treatment. This article describes one such clinical scenario and demonstrates the use of a suitable impression technique for the treatment of edentulous patient with flabby anterior maxillary alveolar ridge.

Key Words
Fibrous Ridge, Palatal Splinting, Complete Denture, Impression Technique

Introduction

A fibrous or flabby ridge is a superficial area of mobile soft tissue affecting the maxillary or mandibular alveolar ridges. It can develop when hyperplastic soft tissue replaces the alveolar bone and is a common finding, particularly in the upper anterior region of long term denture wearers.

Various reasons have been cited for the development of flabby tissue, these include complete maxillary denture opposing natural mandibular anterior teeth and partial denture[1], not removing denture during night, dentures constructed with anterior porcelain teeth and posterior resin teeth, badly constructed dentures such as loose ill-fitting dentures as well as dentures with wrong centric occlusion relation, occlusal disharmony and traumatic occlusion.

Displaceable or flabby ridges present a particular difficulty when making complete dentures. Unless managed appropriately, such flabby ridges adversely affect the support, retention & stability of complete dentures.[2] Published studies indicate that the prevalence of flabby ridges can vary, occurring in upto 24% of edentate maxillae and in 5% of edentate mandibles.[3],[4]

Clinical Report

A 64 year old edentulous female sought treatment at the Prosthodontic Department in Subharti Dental College, Meerut, for prosthetic rehabilitation. On clinical examination, patient was found to be complete edentulous. It was noted that there was an extensive area of flabby tissue present on the anterior region of her maxillary denture bearing areas **[Figure:1]**.

History revealed that the patient was an old denture wearer and did not remove the denture at night. On examining the old denture, it was found that the teeth were attrited and the denture was not retained well in mouth. There was no suggestive history of diabetes, high blood pressure or any other systemic disease.

Following discussion with the patient regarding available treatment options, it was clear that she was very apprehensive regarding procedures such as surgical removal of flabby ridges, bone grafting or placement of dental implants due to her age, long treatment time and high cost ,so she wanted to avoid these procedures. Therefore, it was decided to fabricate a new complete denture, through modified impression technique - palatal splinting using two part tray system.

Procedure

Preliminary impressions for both dental arches were obtained with a low viscosity irreversible hydrocolloid impression material (Imprint, 3M ESPE, Germany) to ensure minimal distortion of the flabby tissue. The impressions were poured in Type III dental stone (Kalstone, Kalabhai Karson, Mumbai) to obtain the primary casts. The displaceable areas were identified on the maxillary cast.

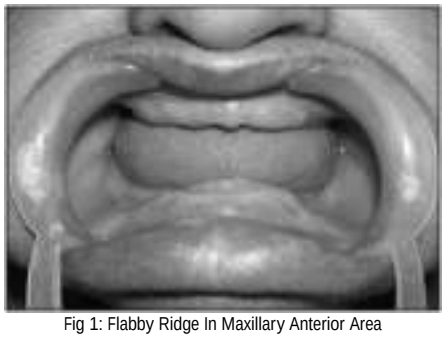

Fig 1: Flabby Ridge In Maxillary Anterior Area

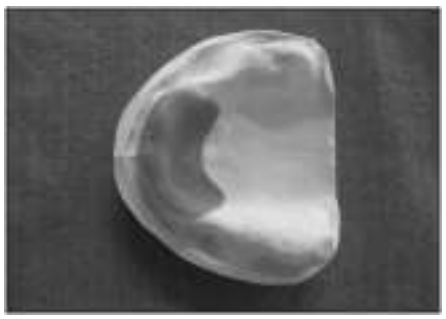

Fig 2: Wax Spacer Over Flabby Area

Single uniform thickness of modelling wax (Y Dents, MDM Corporation, Delhi) was placed as a spacer over the identified displaceable area on the maxillary cast **[Figure:2]**. Palatal tray was fabricated with the autopolymerizing acrylic resin (DPI RR cold cure, DPI, India) and over it three stops of acrylic were made **[Figure:3]**. Then, the custom tray was fabricated over the palatal tray **[Figure:4]**. The three acrylic stops allow the custom tray (second special tray) to be guided in an oblique upward and backward direction to envelope the palatal tray (first tray).

Border molding was done with low fusing compound (DPI Pinnacle tracing sticks, DPI, India) in the custom tray **[Figure:5]**. Then, wax spacer was removed from the palatal tray and an impression was made with zinc-oxide eugenol impression paste (DPI impression paste, DPI, India) **[Figure:6]**. When this impression was set, the final impression was made in the custom tray using medium body addition silicone (Aquasil Ultra Monophase, Dentsply, USA) with the palatal tray impression in place over the flabby ridge **[Figure:7]**. The presence of zinc-oxide eugenol impression paste in palatal tray prevents backward displacement of the mobile ridge when the custom tray was inserted in backwards & upward direction.

For mandibular ridge custom acrylic resin tray was fabricated and border molding was done with low fusing compound and final impression was made using zinc-oxide eugenol impression paste. Both the impressions were poured with Type III dental stone to obtain master cast. Jaw relation records were made with the occlusion rims oriented to the established vertical dimension of occlusion, the anatomic occlusal plane, and the patient's centric relation. After teeth arrangement, try-in was carried out. The denture was cured using heat cure acrylic resin (DPI-heat cure, DPI, India) in the conventional manner. Then, it was finished & polished and was ready to be delivered to the patient. During insertion of the complete denture, it was checked for border extension, proper adaptation and occlusion **[Figure:8]**. Home care instructions (oral hygiene instruction, insertion & removal of prosthesis) were imparted to the patient and routine follow-up appointments were scheduled.

Fig 3: Palatal Tray With Acrylic Stops

Fig 4: Custom Tray Envelop Palatal Tray

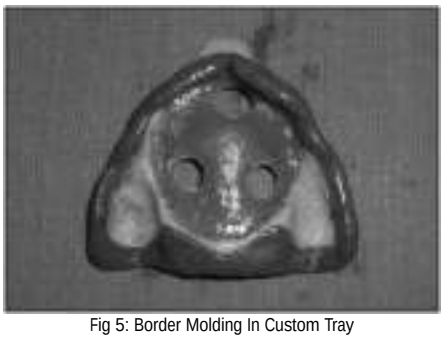

Fig 5: Border Molding In Custom Tray

Fig 6: Palatal Tray With Final Impression

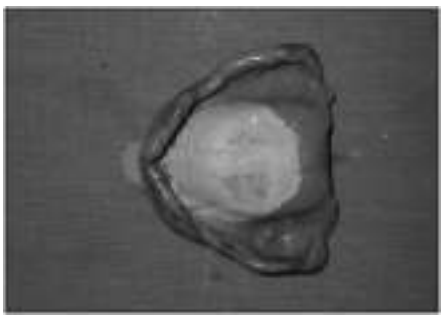

Fig 7: Custom Tray With Final Impression

Discussion

There are varieties of treatment options available for the management of flabby ridges, one is multitude of impression technique to record a suitable impression of a flabby denture bearing area.

Lidddlelow[5] described a technique whereby two separate impression materials are used in custom tray. Watson[6] described the window impression technique where a custom tray is made with a window or opening over the flabby tissue. Allan Mack described splint method in which plaster is used to record an impression of flabby tissue and when it becomes set, same material is used to record the full arch impression.[7]

Using the palatal splinting technique it is conceivable that a minimal degree of distortion occurs when upward force is maintained in first stage of impression and second stage of impression prevents backward displacement of the mobile ridge.

Other treatment modalities include surgical debulking of the flabby tissue, it would result in shallow ridge & it may provide little retention or resistance to lateral forces on the resultant denture. One is reminded of the concept that prosthodontic therapy should be considered with the conservation of what remains, rather than the meticulous replacement of what has been lost.[8] Implant retained prosthesis may offer a solution to the problem of stability & retention but they are not without their disadvantages i.e surgery, treatment time, cost, etc.

Conclusion

There are a variety of impression techniques available to address the problem caused by the unsupported tissue. This paper has described a modified impression technique - palatal

Fig 8: Denture In Occlusion

Fig 9: Post Rehabilitation Photograph

splinting using two part tray system. The denture with this modified impression technique brought about sufficient masticatory efficiency and denture stability and resulted in patient satisfaction **[Figure 9]**. The materials used in this technique are readily available and are used in contemporary dental practice. This technique does not require additional clinical visits & cause minimal discomfort to the patient as compared to other treatment modalities for displaceable tissues.

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Esthetic And Functional Rehabilitation Of A Patient With Ectodermal Dysplasia: A Case Report

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Abstract
Ectodermal dysplasia is a rare congenital disorder that affects several ectodermal structures. Patient with ectodermal dysplasia may have various manifestation of the disease that differ in severity and may or may not involve teeth, skin, hair, nails, sweat glands and sebaceous glands. The oral manifestations are hypodontia and poor bony foundation which impairs both aesthetic as well as the masticatory function. This case report describes the prosthetic rehabilitation of a patient with ectodermal dysplasia.

Key Words
Ectodermal Dysplasia, prosthetic rehabilitation, hypodontia

Introduction:

Ectodermal dysplasia (ED) is a hereditary disorder associated with dysplasia of tissues of ectodermal origin primarily nail, teeth, hairs and skin and occasionally dysplasia of mesoderm derived tissues. As de@257;ned by Freire-Maia the nosologic group of Ectodermal dysplasia is any syndrome that exhibits at least two of the following features, that is, abnormal hair (trichodysplasia), abnormal dentition, abnormal nails (onchodysplasia) and abnormal or missing sweat glands (dyshidrosis)[1]. More than 150 different variants of ED have been described [2].

EDs are a result of inheritance factors, rather than a single, direct genetic mechanism[3]. However, the mode of genetic transfer is debatable. Some are inherited as autosomal dominant or recessive trait disorders while others have a sex-linked mode of transmission. The majority of these abnormalities appear to be transferred by a dominant pattern with incomplete penetration and variable expression. The variable expression of the dominant trait explains the clinical diversity of the disease.

Hypohidrotic ectodermal dysplasia (HED) is one of the common types of ectodermal dysplasia. It is a specific syndrome manifested primarily by hypohidrosis, hypotricosis, and hypodontia[4]. In these patients the appearance of the teeth is extremely important because it can affect the patient's self-esteem[1], which creates treatment challenges for the clinician. Since hypodontia leads to atrophy of the alveolar bone, prosthetic treatment is of great value to these patients, from the functional standpoint as well as for psychologic and psychosocial reasons.

Case Report:

A 19-year-old male patient reported with the chief complaint of impaired esthetics, disturbed speech, and difficulty in chewing due to numerous missing teeth **(Fig.1)**. Patient presented dryness of eyes, lips, thin eyebrows, sparse, thin and lusterless scalp hair, dry skin and repeated episodes of hyperthermia.

Intraoral examination revealed teeth no.12,14,15,22,24,25 to be clinically missing with 11 showing severe proclination **(Fig. 2,3)**. In the lower arch 36, 46 and 47 were the only teeth present. The alveolar process in mandibular edentulous region was underdeveloped with minimal height and width **(Fig. 4)**.

The patient's initial psychologic evaluations revealed an introverted personality lacking in self-confidence.

Fig : 1

Several treatment options were presented to the patient which were as follows:

1) Fixed dental prosthesis (FDP) metal-ceramic/all-ceramic, tooth or implant

Fig : 2

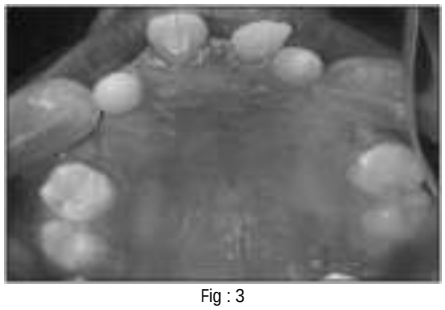

Fig : 3

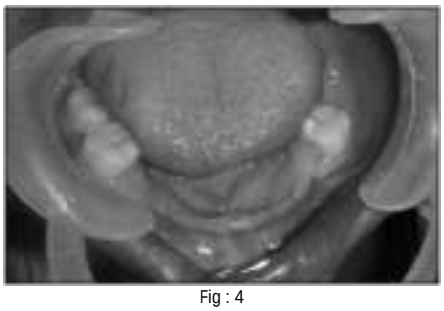

Fig : 4

Fig : 5

Fig : 6

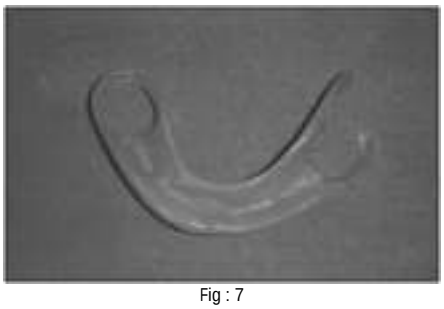

Fig : 7

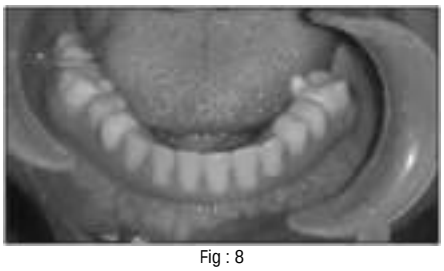

Fig : 8

supported [1],[5].

2) Overlay dentures[6] and teeth-supported overdentures[1],[7].
3) Removable dental prosthesis (RDP)[8], rigid and flexible.

After several considerations concerning advantages, disadvantages, prognosis and cost of the options, a combination of

Fig : 9

tooth supported metal-ceramic conventional FDP in upper arch and flexible RDP in lower arch was planned.

Prosthodontic Management:

After performing elective endodontics on 11,13,21 and 23, preliminary impressions were made with alginate impression material (Zelgan 2002, Dentsply) and poured in dental stone (Kalstone, Kalabhai). Full coverage crown peparations were done on 11,13,16,21,23,26. Final impressions were made using addition silicone putty-wash technique (Aquasil Soft Putty and Aquasil LV, Dentsply) and poured in die stone (Kalrock, Class IV, Kalabhai) and provisional FDP was fabricated and cemented. Try-in of metal framework FDP was done, and was followed by application of feldspathic-porcelain (VITA, VMK 95) and completed FDP 11 through 16 and 21 through 26 was cemented with glass-ionomer cement**(Fig.5)**.

Alginate impression of rehabilitated maxillary arch was made and poured.

Mandibular custom tray was prepared and impression was made with Aquasil Ultra Monophase (Dentsply) PVS impression material. On the master casts, acrylic bases with wax rims were made to establish maxillomandibular relations, and then they were mounted on an articulator. Try-in of waxed up mandibular PD was followed by fabrication of mandibular flexible (valplast) removable prosthesis. Final prosthesis **(Fig. 6,7)** was then adjusted and inserted in the patient's mouth **(Fig.8, 9)**.

Prosthesis was placed in hot water for about 1 min prior to insertion in patient's mouth. It was removed and allowed to cool just to the point when it was tolerated by the patient. This process made the PD as flexible as it would be at mouth temperature. The hot water treatment permitted a very smooth initial insertion and good adaptation with denture-bearing tissues. The clasps could be tightened or loosened by immersing clasp in hot water and bending the clasp inwards or outwards. After the final insertion of flexible PD the patient was instructed on the proper maintenance of the oral tissues and prostheses. The need for optimal oral hygiene and periodic check-up was emphasized to the patient.

Discussion:

An understanding of the ED patient's psychosocial status is crucial to any prosthodontic treatment effort. The unesthetic appearance that accompanies ED syndrome often has a negative psychological effect on the patient. Poor self-image, peer pressure, and school/job related discrimination have been directly related to psychological scarring experienced by ED patients.

Oral rehabilitation of ED has historically evolved from partial and complete RDP supported by tissue and teeth to screw type osseointegrated dental implants[9].The most frequent prosthetic treatment for the dental management of ED is removable prosthodontics[1]. The need for partial or complete dentures is critical during the pre-school years and continues into adulthood. Since alveolar bone development is dependent on the presence of teeth, ED patient have little or no bone ridge upon which to construct dentures. Hence, the problems involved in attempting to restore function and appearance are greater than usual[10]. Although complete dentures are an acceptable form of treatment, overdentures that are supported by natural teeth will preserve the alveolar bone. Implant-supported restorations can improve physiological and psychosocial function to a greater degree than can complete dentures[1].

In the present case report, considering the clinical situation, maxillary FDP and mandibular flexible partial denture (PD) were determined to be the treatment of choice. Conventional FDP in the maxillary arch and Valplast @258;exible partial denture was planned for mandibular arch due to its favourable properties like esthetics, strength, biocompatibility, and comfort to the patient[11]. The finger like extension of the material into undercuts acts as a clasp and provides very good retention.

Higher body temperature can develop during illnesses, during strenuous physical activity, when the environmental temperature is elevated, or even when the patient is wearing heavy

clothing. Treatments of these hyperthermic episodes are part preventive and part reactive in nature.

Conclusion:

This clinical report describes the characteristics and prosthodontic rehabilitation of a patient with ED. A combination of conventional fixed and removable prosthodontic therapy, as presented in this article, can be less complex and more affordable than some other therapies and resulted in a great improvement of the esthetics and function of the masticatory system.

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Prosthetic Management Of Velopharyngeal Defect – A Case Report

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Abstract
Pharyngeal obturator prostheses restore the congenital or acquired defects of the soft palate and allow adequate closure of palatopharyngeal sphincter. A patient with soft palate defect and subsequent velopharyngeal insufficiency was rehabilitated using pharyngeal obturator prosthesis. Since it is necessary for swallowing and intelligible speech, the patients was examined in terms of adequate velopharyngeal closure after prosthetic treatment. The results were satisfying for the patients and physicians.

Key Words
Velopharyngeal Defect, Speech Aid Prosthesis, Speech Bulb

Introduction

The soft palate establishes separation between oral and nasal cavities.[1] It moves in response to physiologic demand of speech, deglution and respiration. The soft palate, lateral and posterior pharyngeal walls forms the velopharyngeal (VP) closure so that all of them create a three dimensional muscular valve which is known as VP sphincter.[2] The VP closure pattern depends on the contraction degree of the sphincter components. Adequate VP closure is required during swallowing and production of all consonants except for the nasal ones.[3] Impairment of VP function can be due to insufficiency or incompetency.[3],[4],[5],[6],[7],[8] When some or all of the anatomic structure of the soft palate is absent, the term palatopharyngeal insufficiency applies.[9] Whereas when the soft palate is of adequate dimensions but lacks muscular and/or neurologic capacity, the term palatopharyngeal incompetence applies.[9] The term palatopharyngeal inadequacy includes incompetency and or in sufficiency but may also suggest a reduction or absence of pharyngeal wall function.[9]

The primary effects of the VP insufficiency are air-flow escape and hypernasality.[10],[11] VP insufficiency causes communication problems because of distortion in speech, resonance and articulation apart from swallowing disturbance.[11],[12] In this regard, patients usually have psychological problems together with physical difficulties.

Surgery in combination with speech therapy is a common approach to the treatment of VP dysfunction.[6],[11] There are several surgical procedures that can be performed to correct the physical malfunction. However, when surgical treatment is not considered as an option, prosthetic management of VP insufficiency is carried out by means of a pharyngeal obturator, whereas VP incompetence is traditionally managed by palatal lift prosthesis.[7],[8]

A pharyngeal obturator is a removable maxillary prosthesis which has a posterior extension to separate oropharynx and nasopharynx.[10] This obturator prosthesis restores the congenital or acquired defects of the soft palate and allows adequate closure of palatopharyngeal sphinter. The objectives of obturator are to provide the capability for the control of nasal emission and inappropriate nasal resonance during speech and to prevent the leakage of material into the nasal passage during deglutition.[9]

Case Report

A seventeen year old girl reported to our clinic with chief complaint of speech difficulty and communication problems. She had a history of cleft of hard and soft palate. In her medical history, she had undergone surgical correction of cleft palate two years back. **(Fig. 1)** She was speaking with soft intensity to decrease hypernasalance. Speech evaluation was performed by speech pathologists that assessed resonance, the occurrence of inappropriate nasal air emission, and articulation. **(Fig. 2a, 2b)**

The patient refused to undergo second surgery, therefore a pharyngeal obturator with clasp retention was planned for the patient. The impression of pharyngeal

Fig 1 : Velopharyngeal Defect

Fig 2 (a) : Speech Analysis

Fig 2 (b) : Speech Analysis

Fig 3 : Impression of the defect

Fig 4 : Wax Trial

Fig 5 : Final Prosthesis

bulb was made using putty elastomeric impression material (3M ESPE, St. Paul, USA) during the functional movements. The patient was instructed to flex the neck such that chin touches the chest. This movement will establish contacts of posterior aspect of obturator with the soft tissue covering the anterior tubercle of the atlas.[9] Lateral aspects of obturator are formed by rotation and flexion of neck. Patient is also asked to swallow. When border molding is complete patient's speech should sound normal and there should be no escape of water between oropharynx and nasopharynx. Then the final impression is made with light body elastomeric impression material. **(Fig 3)**

The framework with direct retainers on molar and premolar was fabricated. It consists of an extension on the pharyngeal part to support the acrylic bulb. The acrylic bulb was formed in wax, (Rolex, Ashoo Sons, Delhi, India) trial was done **(Fig 4)** and then it was fabricated with heat cure acrylic resin (Trevalon, dentsply, Gurgaon, India). The prosthesis was delivered to the patient with specific instruction for maintenance of the prosthesis. Speech pathologist assessed improvement in patient's speech after wearing the prosthesis. **(Fig 5)**.

Discussion

Prosthetic rehabilitation of the patients suffering from VP deficits with obturator prostheses varies according to the location and nature of the defect or deficiency.[4],[5],[7],[8] Pharyngeal obturator prosthesis may prevent the hypernasality and/or nasal emission associated with VP inadequacies.[5],[10] In order to obtain adequate VP closure during speech and swallowing a posterior extension is added to prosthesis. An acrylic resin extension must be formed functionally. This extension must be in static contact with the soft tissues and must not affect the stability of the prosthesis.[1],[10]

The success of the soft palate defect prosthesis depends on the functional adaptation of the impression material.[13] In this case elastomeric material was used to record the impression of the defect. High fusing compound, intra oral waxes can also be used for making impression.

Since the patient had complete maxillary dentition, direct and indirect retainers were used for retention. In case of partial or completely edentulous arches, the acrylic bulb can be a part of the partial or complete denture, however obtaining retention and stability can be difficult due to the weight of the prosthesis.[10] Dental implants have great importance for these patients.

The treatment of VP insufficiency requires multidisciplinary approach. Accordingly, a speech pathologist should participate in treatment of these cases to test articulation errors and inappropriate oro-nasal resonance balance.[7] Perceptual and instrumental measures of hypernasality and nasal escape along with a profile of the patient's articulation provide the diagnostician information about the frequency and consistency of VP insufficiency. These measures, however, provide only limited information about the functioning of the VP mechanism. The use of multiview videofluroscopy (MVF) and/or nasendoscopy (NE) may contribute to the diagnostic confirmation of the assessment of velar mobility, pattern of velar elevation, size of residual VP gap and lateral pharyngeal wall displacement while the patient is producing a standardized sample of connected speech. It may also contribute the assessment of treated patients with VP insufficiency.[14] In present cases, no nasopharyngoscopic evaluations were made. However instrumental measures showed improvement in hypernasality of the patient.

Conclusion

In this report patient with soft palate defect was successfully treated by pharyngeal obturator. Success of such treatment largely depends on patient's motivation and cooperation and ability to adapt with the prosthesis.

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Case Report

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Prosthodontic Management Of Atwoods Class V Mandibular Ridge Utilizing Neutral Zone Technique And Linear Occlusion Scheme - A Case Report

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Abstract
To achieve mandibular denture stability with resorbed ridges has always been a challenge for dental professionals. Unstable mandibular dentures are one of the most common problems faced by the completely edentulous patients. Optimum denture stability is dependent on three main factors i.e., external contours of the denture, position of the denture teeth and decreased transverse forces on the denture base. These factors can be achieved by incorporating Neutral zone technique and Linear occlusion scheme during denture fabrication. The purpose of this article is to provide a detailed outline of recording Neutral zone technique and Linear occlusion

Key Words
Resorbed mandibular ridge, unstable denture, Neutral zone technique, Linear occlusion

Introduction

Most of the complete denture patients find it difficult in carrying out functional activities such as mastication and speech due to their inability to control the dentures effectively. Loss of teeth leads to changes such as resorption of alveolar ridge, tongue expansion, loss of tonicity of facial muscles, reduction of lower face height, loss of vertical dimension of occlusion, anterior rotation of the mandible, increase in relative prognathia, changes in inter-alveolar ridge relationship, sharp, spiny, uneven residual ridges, resorption of the mandibular canal wall, location of the mental foramina close to the top of the mandibular residual ridge. This provides serious problems to the clinician on how to provide adequate support, stability and retention of the denture. For this reason, it is critical when constructing complete dentures to incorporate features that will aid in stability during function. In 1933, Sir E. Wilfred Fish introduced the concept of Neutral zone. Neutral zone is defined as "that area in the mouth where the forces of tongue pressing outward are neutralized by forces of cheeks and lips pressing inward. This concept is also termed as Reciprocal space, potential space, denture space, reciprocal zone, Zone of minimal conflict, Zone of neutral muscular force[1]. During fabrication of the complete denture the position of the teeth and the external surfaces of the denture should follow the Neutral zone so that the forces exerted on the denture are neutralized [2]. With resorbed ridges, the vectors of force that are transmitted through anatomic cusps will dislodge the lower denture hence Linear occlusion scheme was designed. In this scheme mandibular cuspless teeth occludes with maxillary anatomic teeth that have been modified (bladed teeth) in order to achieve Linear occlusal contacts which provides a stabilizing effect on the denture bases during function [3],[4]. Failure to recognize the importance of tooth position and flange contour often results in dentures which are unstable and unsatisfactory even though they are skillfully designed and expertly constructed [5].

Case Presentation

A female patient aged 47yrs came to the department of prosthodontics, with the complaint of missing teeth in the maxillary and mandibular arch and wanted an replacement withnew denture. History revealed she was edentulous since 4 yrs. On intraoral examination - Atwood's class v mandibular ridge, Ridge relation - class I, Interarch space was adequate, Frenal and muscle attachment close to the crest,tongue was slightly enlarged and partially extending onto the ridge. **(Fig.1)**.

Treatment Planning

Removable complete denture prosthesis was planned using Neutral zone technique for mandibular ridge and Linear occlusion. Ridge augumentation and implant procedure were ruled out as the patient refused to undergo any surgery.

Treatment Objectives

1) to rehabilitate the patient with complete denture prosthesis.
2) to preserve the remaining residual ridge.
3) to locate the Neutral zone for teeth arrangement and to contour the denture base.
4) to attain maximum stability,comfort and function.
5) to incorporate extremely efficient chewing mechanism with Linear occlusion [4],[6]

Figure 1: Resorbed Mandibular Edentulous Ridge.

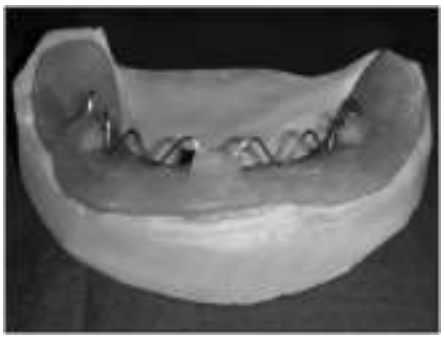

Figure 2: Mandibular Custom Tray With Metal Spurs That Acts As Retentive Components For The Impression Material.

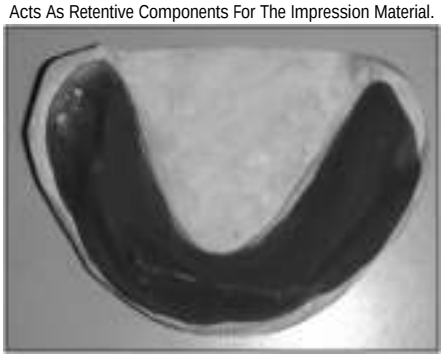

Figure 3: Greenstick Compound Molded As Per Patient's Neutral Zone.

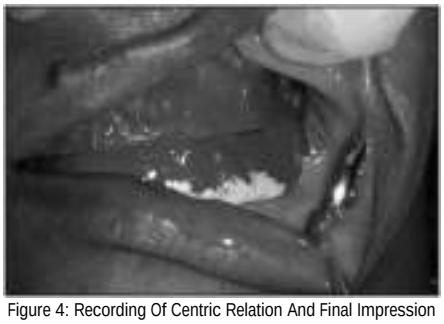

Figure 4: Recording Of Centric Relation And Final Impression (Close-mouth Impression Procedure).

Figure 5: Mandibular Master Cast Indexed With Two Notches In The Lingual Center And Two On Each Of The Buccal Sides.

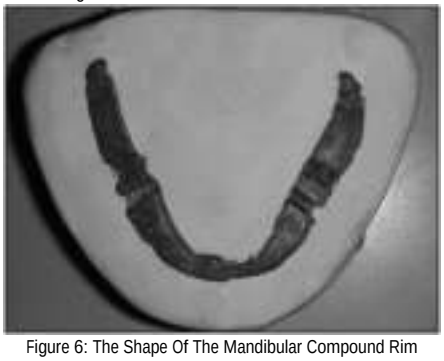

Figure 6: The Shape Of The Mandibular Compound Rim Captured With Buccal And Lingual Plaster Indices.

Primary impression for maxilla was made using impression compound.mandibular impression was made using alginate (mucostatic impression technique). Primary casts were poured with type II gypsum. Maxillary border molding and secondary impression was made, master cast was poured with dental stone. Maxillary denture base and occlusal rim were prepared . Maxillary rim was adjusted for proper esthetics, occlusal plane, phonetics and lip support . Midline, canine line, high lip lines were marked.Mandibular custom tray was a plate of acrylic, without the handle. Three vertical stops of acrylic were adapted over the special tray.These stops were joined by a wire bent in a sinusoidal manner extending from molar to molar. **(Fig.2)** Mandibular custom tray overextension and stability was checked. The patient was trained properly for various functional movements before inserting the tray. Two occlusal pillars were then built up with green stick compound on opposite sides of the lower arch. These pillars were moulded and adjusted to achieve 3mm freeway space and establish the correct vertical dimension. Green stick compound was softened and loaded on the mandibular tray and inserted into patient's mouth. Patient was instructed to do functional movements like sucking, swallowing, smiling, pursing of the lips, slightly protruding the tongue and licking the lips. These actions were repeated for 10 minutes until material got set. With these actions the greenstick compound gets molded between the lip and the tongue in the anterior region and cheek and lateral border of the tongue in the posterior region into the region of Neutral zone. **(Fig. 3)** These movements recorded a greater detail of action of lips, cheeks and tongue and also determined the thickness, contours and shape of polished surface of denture. The compound was reheated in water bath and the procedure repeated to confirm the shape of Neutral zone. After the vertical dimension and centric relation had been established, the final impression was made with closed-mouth procedure. **(Fig. 4)** Only after the final impression was made the centric relation was sealed.

The Plaster Index

Final impression was poured with dental stone. Before the stone set completely two notches were made in the lingual

Figure 7: Wax Rim Located In The Neutral Zone.

center section, and the other two were made on each of the buccal side, one in the cuspid and one in the molar region. **(Fig. 5)** Separating medium was applied all over the base. The green stick compound and the notches were covered with plaster in two sections, leaving a narrow dividing line of the compound at the occlusal and incisal edges of the pattern so that the lingual and buccal sections of the plaster index did not meet. After the plaster was set, the buccal and labial portions were removed in two sections. The lingual portion was removed as a single piece. The shape of the Neutral zone was permanently registered in the plaster index. **(Fig.6)** .The greenstick compound was softened and disposed. The plaster index was then coated with a separating media and assembled with the acrylic denture base in position. The red baseplate wax was slowly melted in an enamel bowl and poured into the plaster index through the space between the labial and lingual indices on the occlusal surface. **(Fig. 7)** When the plaster index was opened, Neutral zone recorded with greenstick was replaced by wax. Thus both the upper and lower occlusion rims were formed. Teeth were then be set up following the index.

Teeth Arrangement In Linear Occlusion:

Zero degree (monoplane) teeth were arranged in the maxilla opposed by

Figure 8: Denture Insertion.

bladed teeth in the mandible. The blades of the bladed teeth were in a precisely straight line over the crest of the ridge. There was no anterior tooth interference in protrusive or lateral movements. A Clinical wax try-in was done and checked for esthetics, phonetics and occlusion. Dentures were cured, finished, polished and inserted **(Fig.8)**. The mandibular denture was checked for stablity with all the movements of the lips, cheeks and tongue. Post insertion instructions were given and the patient was recalled for checkup.

Discussion

When the residual alveolar ridges have resorbed significantly denture stability and retention are more dependent on correct position of teeth and contour of the external surfaces of the dentures[7]. Hence the concept of Neutral zone philosophy and Linear occlusion and was advocated in this case report. The Neutral zone philosophy is based upon the concept that for each patient there exists within the denture space a specific region where the function of the musculature during chewing, speaking, swallowing and various other functional activities of the mouth will not unseat the dentures and where inward forces exerted by lips and cheeks, and outward forces exerted by tongue are in equilibrium [2],[6]. while recording this zone the internal and external muscle groups become activated, moving them through their respective action paths. With this activation,the reciprocating pressures from the muscles are exerted upon the compound, which gradually gets molded into a state of neutral balance and becomes centrally inert in relation to all of the complex forces acting upon it [5]. This technique provides a more stable and retentive mandibular complete denture with resorbed ridges. Greater comfort and improved speech clarity. Shorter treatment time as compared to conventional denture as bordermolding, final impression and jaw relation are completed in one appointment, more harmony with surrounding perioral musculature[1],[8]. Many materials have been suggested for this technique such as: impression compound, soft wax, silicone and tissue conditioners and resilient lining materials. In this case modeling green stick compound was found to be better than tissue conditioner to locate the Neutral zone, as the later sets gradually patient could not maintain the same position till the material sets. Due to its tackiness in tissue conditioner it was difficult to manipulate. Neutral zone formed with tissue conditioner is narrower posteriory thus limiting premolar and molar positioning[9]. In 1966 J.P. Frush described occlusion in geometric terms as one-dimensional (linear), two dimensional(flat plane), and three-dimensional(cusped). This classificationof occlusionspecifically classified the dimensional contactbetween occluding posterior teeth.In linear occlusion, the arch requiring the greatest stability may determine the archreceiving the bladed teethwhich is most often the mandibular arch.The occluding forces with linear occlusion are vertical in centric and eccentricpositions .The location offorce onthe mandibular edentulous ridge does not vary regardless of the occluding position.There is minimal surface contact area between theflat plane and bladed teeth thus denturebase movement is minimized. Since there is no anterior tooth interference in protrusive or lateral movementsprovidesa consistent vertical seating force in both centric and eccentric movement; hence, transverse force vectors are minimized.[3] In this case Linear occlusionwas chosen as the occlusal scheme to increasethe stability of denture bases by minimizing the lateral forces applied to the denture base.

Conclusion

With Neutral zone technique and Linear occlusion patients did report greater comfort and improved speech clarity. Exceptional mandibular denture stability due to lack of movement of the denture bases and fewer postoperative appointments compared to conventional denture could be achieved.

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Peripheral Osteoma Of Mandible: A Case Report

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Abstract

Peripheral Osteomas of the jaw bones is a rare entity with diverse etiologic and pathologic features. A clear and unequivocal description of a lesion like Osteoma is impossible. This entity can be undeciphered only through published reports.

Key Words

Osteoma, Peripheral, Bone, Tumour

Introduction

Osteoma is a benign osteogenic tumor arising from the proliferation of cancellous or compact bone. Depending on its location, osteoma may be classified as central, peripheral or extraskeletal type. As the name suggests, a central osteoma arises from the endosteum, a peripheral osteoma from the periosteum and an extraskeletal osteoma in the soft tissue. Peripheral osteoma is defined by centrifugal growth from the periosteum, while central osteoma arises centripetally from the endosteum.[1],[2],[3] Osteomas have a predilection for the head and neck region which includes the facial bones, skull, and mandible and is the most common benign tumour of the sinonasal tract.[4] Multiple osteomas of head and neck region can be presented as an isolated finding or may be associated with syndromes like Gardner's syndrome.

The pathogenesis of osteomas is not completely known. They are referred to developmental anomalies, true neoplasms, or reactive lesions triggered by trauma, muscle traction, or infection.[5] The growth rate of this tumour is generally very slow, but it can increase rapidly if the rate of osteogenesis increases. The most common clinical feature is a long asymptotic period until the first symptoms appear. In the later stages osteomas can cause deformation of the bone and/or compression of the adjacent structures.[6]

The purpose of this paper is to present a case report of peripheral osteoma originating from the mandible.

Case Report

A 30 year old female came to Govt. Dental College, Trivandrum with a chief complaint of painless swelling on the right side of the face since 5 years. She gave no history of previous facial trauma or infection and her medical history was not contributory. She noticed a gradual increase in its size to the extent of an aesthetic disfigurement. The lesion was not associated with pain, and there was no problem with mouth-opening or chewing.

On extraoral examination, her face showed mild asymmetry due to a swelling in the right side of face of approximate size 2X2.5cm located about 1.5 cm above and anterior to the angle of the mandible. **(Figure 1&2)** On palpation the swelling was non tender, fixed and firm in consistency, the skin over the swelling was pinchable. The regional lymph nodes were non palpable and even no tenderness and clicking were observed in temporomandibular joint. Intraoral examination revealed a non tender bony hard swelling in the buccal aspect of 47 adjoining the right lower mucobuccal fold with smooth surface and spherical in shape was palpated. The overlying oral mucosa was normal. Based on the clinical features, a provisional diagnosis of Osteoma of the right side of the mandible was given.

Blood investigations revealed all parameters within the normal range. Radiographic investigations were done. Intraoral periapical X-ray of the site **(Figure 3)** and mandibular topographic occlusal view **(Figure 4)** showed a well defined radiopacity of size 1.5 X 1.5 cm attached to the buccal cortical plate of the mandible in relation to 47, 48 region.The internal structure of the radiopacity appeared uniform with a granular internal

Figure 1 - Extraoral View Showing Swelling On The Right Side Of The Face

Figure 2 - Extraoral View Showing Swelling Near Angle Of The Mandible

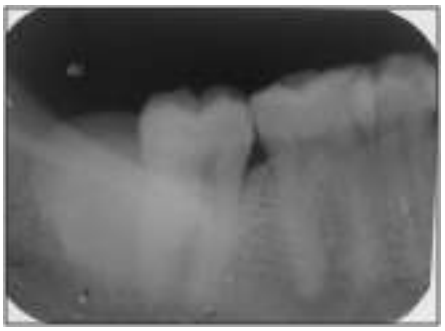

Figure 3 - Iopa Showing A Well Defined Radiopacity In Relation To 47 And 48 Region

Figure 4 - Mandibular Oblique Occlusal View Showing Pedunculated Radiopacity At The Angle Of Mandible

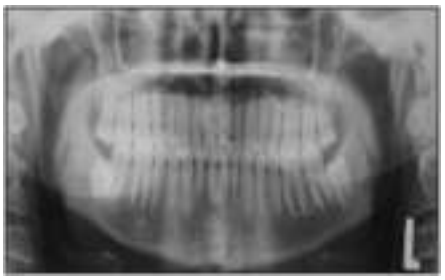

Figure 5 - Panoramic Showing Well Defined Radiopacity In Relation To 47 48 Region

Figure 6 - Photomicrograph (10x) Of Decalcified Section Showing Mature Compact Bone With Harvesian Canals.

Table - 1 : Proposed Etiology Of The Osteomas

1	Embryological
2	Traumatic
3	Inflammatory
4	Calcification Of A Polypus Sinus
5	Metaplasia
6	Hereditary
7	Alteration Of The Metabolism Of Calcium
8	Muscular Theory

density. The Panoramic view **(Figure 5)** revealed a well defined radiopacity in the 47 48 region of size 2 X 2 cm overlying the distal root of 47 approximately 1.5 cm above the lower border of the mandible.

Excisional biopsy was done and bony mass was sent for histopathological examination. The decalcified Hematoxylin and Eosin stained histopathological section **(Figure 6)** showed mature compact bone with numerous harvesian canals. Concentric and circumferential lamellae were also seen along with lacunae containing osteocytes. The final diagnosis of compact osteoma was given after correlating clinical and histological features. The patient was scheduled for regular follow up.

Discussion

Osteoma is a usually slow growing and asymptomatic benign lesion which mainly affects young adults. They are found mainly in the craniofacial bones but still its true prevalence is unclear. Peripheral Osteoma (PO) of the jawbones is a rare entity. These lesions usually appear as unilateral, pedunculated mushroom-like masses. They are more frequent in the mandible than the maxilla. Sayan et al.[3] reported 22.85% of the lesions in the mandible and 14.28% in the maxilla in their study. Even Woldenberg et al[7] reported 64% and Kaplan et al[2] 81.3%, and of cases occurred in the mandible. In the mandible, the most common sites are the angle and lower border of the body. Most cases of PO appear to have a very slow growth rate, without significant symptoms. In many cases, the discovery of the PO is an incidental finding. In some of the cases, however, depending on the location, the size of the tumor may cause facial deformity, deviation of the mandible on opening, headache or exophthalmos.[7] In our case, the lesion was present since 5 years which gradually increased in size causing facial asymmetry, without any other clinical symptoms.

Radiographic findings: Though the exact etiology and pathogenesis of osteoma is still unknown, there are some proposed etiologic factors[1] given in **Table 1**.

However, regarding the pathogenesis a combination of trauma and muscle traction which may initiate an osteogenic reaction has been suggested as possible mechanism.[3] However, in the case described in this paper, we have no information as to the possible cause, there being no history of previous facial trauma or infection.

Peripheral osteomas, in most cases, are easy to recognize because of their classic radiographic findings. On radiological imaging, a peripheral osteoma of the mandible is a classically well-circumscribed, round or oval, mushroom-like radiopaque mass with distinct borders.[8],[9] It is usually known to present as a small mass of dense bone situated below the level of roots of the lower molars. Compact osteomas otherwise known as Ivory osteomas is sometimes pedunculated, although this is unusual.[10] In our case the lesion appeared radiographically as well defined radiopaque mass.

Histologically an osteoma consists of either normal appearing dense mass of lamellar bone with minimal marrow tissue (Compact type osteoma) or of trabeculae of mature lamellar bone with intervening fatty or fibrous marrow (Cancellous osteoma). Similarly histological features in our case were compatible with compact osteoma.

Removal of an asymptomatic peripheral osteoma is not generally necessary. Surgical intervention is indicated only if it becomes large enough to cause facial asymmetry and functional impairment.[1],[7],[11] In the case of mandibular peripheral osteomas, an intraoral approach is preferable to an extraoral approach mainly for cosmetic reasons, as in our case. Recurrence after surgical excision is extremely rare.

Conclusion

We have presented a case of a peripheral osteoma on the buccal surface of the mandible which had grown gradually for five years causing painless facial disfigurement.

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C - Shaped Canal Configuration: A Report Of Two Cases

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Abstract
A thorough knowledge of canal morphology is inherent to cleaning, shaping and obturation of the root canal system is. Recognition of unusual canal configurations and variations are paramount, since it has been established that the root with a single tapering canal and apical foramina is the exception rather than rule. Once recognized the C-shaped canal turns out to be a great challenge to manage as it is unpredictable whether the C-shaped orifice found on the floor of the pulp chamber actually continues to the apical third of the root. The high frequency of transverse anastomoses, apical deltas and lateral canals compels the clinician to use every resource at his disposal to achieve an adequately prepared canal. Thus a thorough understanding of this configuration with knowledge of its prevalence, diagnosis, classification and the numerous challenges appearing to the clinician at each step is necessary. A report of two cases is discussed here.

Key Words
C-canal configuration; Root canal anatomy; Obturation

Introduction

The failure of Hertwig's epithelial root sheath to fuse onto the buccal or lingual root surface may be the main cause of the C-shaped root formation. The prevalence of C-shaped canal systems has been reported to range from 2.7% to 44.5% in mandibular second molars, depending on the population.[1] The main anatomic feature of C-shaped canals is the presence of a fin or web connecting the individual canals. The coronal orifice of these canals is usually located apically to the cement enamel junction level and may appear as a single, ribbon-shaped opening with a 180° arc linking all the main canals or a ribbon-shaped canal that includes the mesiobuccal and distal canals.[2] There are many variations in the anatomical configurations along the length of the canal system in these types of teeth. The C-shaped canal system might appear completely normal-looking at the level of the pulp chamber but the apical anatomy can be extremely complex.[3]

Cooke and Cox first described the clinical significance of C-shaped canals, which present major challenges with respect to their debridement and obturation. This is especially true when it is uncertain whether a C-shaped orifice found on the floor of the pulp chamber may continue to the apical third of the root. Irregular areas in a C-shaped canal that may house soft-tissue remnants or infected debris may escape thorough cleaning or filling and may be a source of bleeding and severe pain.[4]

Case Report

A 23-year-old woman presented with history of spontaneous pain on the right side of her face for past several days. The patient's medical history was noncontributory . Clinically , the right mandibular second molar had a deep carious lesion. Intraoral periapical radiograph **(Figure 1)** revealed radiolucency involving pulp with periapical radiolucency. After extensive clinical and radiographic examination, diagnosis of acute apical periodontitis was made and the right mandibular second molar prepared for nonsurgical endodontic therapy.

The patient received local anesthesia of 2% lidocaine with 1:100,000 epinephrine. A rubber dam was placed and a conventional endodontic access opening was made. Clinical evaluation of the internal anatomy revealed a continuous canal orifice extending from the distal aspect to mesiobuccal aspect. It was evident that in the present case, the canal system of the tooth assumed a C-shaped anatomy. The working length of the canal was estimated by means of an electronic apex locator (Root ZX; Morita, Tokyo, Japan), then confirmed by a radiograph. The canal was initially instrumented with #15 nickel titanium file (Dentsply Maillefer) under irrigation with 5% sodium hypochlorite. Coronal flaring was carried out using Gates-Glidden burs (nos. 3 and 2; Dentsply Maillefer).The canal was cleaned and prepared by hand nickel titanium files using a crown-down technique similar to that described by Saunders and Saunders. Intracanal medicament of calcium hydroxide was placed in the canal for a week.

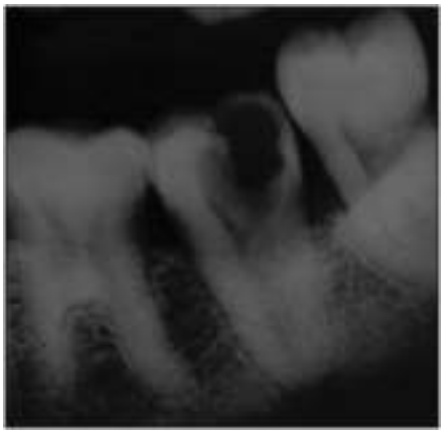

Figure 1. Preoperative Iopa 47

One week later, the canal was obturated with conventional lateral compaction gutta-percha technique and AH-Plus sealer (Dentsply De-Trey, Konstanz, Germany) as used by most of the Indian dentists. A final radiograph was taken to establish the quality of the obturation **(Fig.2)**. After completion of root canal treatment, the tooth was restored with a posterior composite filling (P60; 3M Dental Products, St. Paul, MN) **(Fig.3)**

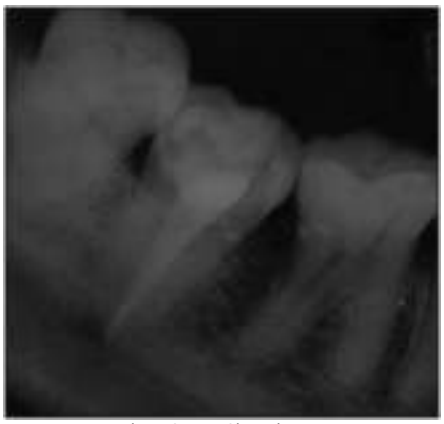

Figure 2. Post Obturation 47

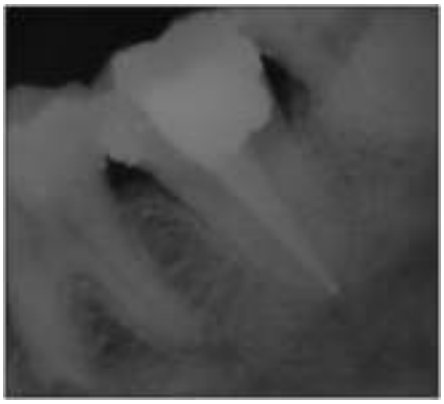

Figure 3.Post Obturation Restoration 47

Figure 4. Preoperative Iopa 37

Figure 5. Post Obturation 37

Case 2

Twenty seven year old patient presented with the chief complaint of pain in lower left region of jaw for past several days. Clinical and radiographical examination revealed caries on the occlusal surface approaching pulp. The patient's medical history was noncontributory. Clinically, the left mandibular second molar had a deep carious lesion. Intraoral periapical radiograph **(Figure 4)** revealed radiolucency involving pulp with periodontal widening. After extensive clinical and radiographic examination, diagnosis of acute apical periodontitis was made and the left mandibular second molar prepared for nonsurgical endodontic therapy.

The patient received local anesthesia of 2% lidocaine with 1:100,000 epinephrine. A rubber dam was placed and a conventional endodontic access opening was made. Clinical evaluation of the internal anatomy revealed two different canal orifices connected with a C configuration. The working length was estimated by means of an electronic apex locator (Root ZX; Morita, Tokyo, Japan), then confirmed by a radiograph. The canals were initially instrumented with #15 nickel titanium file (Dentsply Maillefer) under irrigation with 5% sodium hypochlorite. Coronal flaring was carried out using Gates-Glidden burs (nos. 3 and 2; Dentsply Maillefer).The canals were cleaned and prepared by hand nickel titanium files using a crown-down technique. Intracanal medicament of calcium hydroxide was placed in the canal for a week.

One week later, the canals were obturated with conventional lateral compaction gutta-percha technique and AH-Plus sealer (Dentsply De-Trey, Konstanz, Germany) as used by most of the Indian dentists. A final radiograph was taken to establish the quality of the obturation **(Fig.5)**. After completion of root canal treatment, the tooth was restored with a posterior composite filling (P60; 3M Dental Products, St. Paul, MN)

Discussion

The variability of the root canal system of multi rooted teeth represents a challenge to both endodontic diagnosis and treatment. The preoperative awareness of potential anatomic variations is essential for the success of the endodontic treatment. The C-shaped canal is not uncommon and this is confirmed by studies in which frequencies ranging from 2.7% to 8% [5] have been reported. The prevalence is higher in the middle Asia upto 10.6% in Saudi Arabians and 14% in Lebanese. In northeast Asia, the prevalence is 31.5% in Chinese and 32.7% in Koreans.[6] This variation may occur in mandibular first molars, maxillary molars, mandibular first premolars and even in maxillary lateral incisors, but it is most commonly found in mandibular second molars. In the view of above incidence and variability in canal configuration in our present case report, all the necessary steps to locate, debride and clean and shape the complex anatomy have been followed. Thermoplasticized gutta-percha technique is the recommended technique for obturation but as the most of dental practitioners use only lateral condensation technique so we used the same and found excellent results with gutta-percha and AH Plus sealer into the complex anatomy of the canal.

Conclusion

Although the prevalence is less, C-shaped canals can vary in number & shape along the length of the root, with the result that debridement, obturation & restoration in this group may be unusually difficult.Therefore, careful location & negotiation of canals & meticulous mechanical & chemical debridement of the pulp tissue should be carried out in order to successfully treat a C-shaped canal.

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Cutaneous Sinus Tract Of Odontogenic Origin – An Unusual Presentation

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Abstract
Cutaneous sinus tract of odontogenic origin is a relatively uncommon orofacial pathology. It is usually misdiagnosed as a local dermal lesion and often attempted to treat by systemic antibiotics and surgical intervention. Hereby presenting an unusual case report of a 75 year old male patient presenting with a cutaneous sinus tract with purulent discharge at the apex of right nasolabial fold near the medial canthus of right eye. The importance of accurate diagnosis, etiology and management of this condition for the general practitioner is highlighted in the present case report.

Key Words
Cutaneous sinus tract, odontogenic origin, dermal lesion, purulent discharge.

Introduction

Cutaneous sinus tract (CST) of odontogenic origin is a pathway through the alveolar bone which typically begins at the apex of an infected tooth or an infected portion of the dental alveolus and empties the infected material, usually pus, through the skin. It is an uncommon condition which may present a diagnostic challenge to the clinician and may have profound effect on the facial esthetics.[1],[2] The CST usually arises as a sequel of the bacterial invasion of dental pulp through a carious lesion or trauma.[3] Dentocutaneous sinuses present most frequently over the mandible and the maxilla but less commonly may appear over the neck, medial canthus of eye or at distant sites.

Case Report

A 75 year old male patient reported to the dental clinic with the chief complaint of pain and swelling in relation to right upper region of face for last 5 days. The pain was moderate, intermittent, throbbing, radiating to the right temporal region of face and associated with swelling and extra oral sinus discharge near medial canthus of right eye, at the apex of right nasolabial fold for last 2 days. The swelling had gradually increased to the present size.

Patient's medical history was not significant. His extra oral examination revealed gross asymmetry of face with a solitary, diffuse swelling measuring approximately 10.5x10 cm on the right side of face, extending from infra orbital rim superiorly to lower border of mandible inferiorly, from nasal bridge medially to pre auricular region laterally. **(Figure 1)** The swelling was soft, tender, mobile, fluctuant and compressible. An extra oral draining sinus measuring approximately 0.5x0.5 cm in size, spherical in shape and with ulcerated margins was present at the apex of right nasolabial fold, approximately 1 cm near medial canthus of right eye. **(Figure 2)** The sinus opening was tender with fresh pus discharge on palpation. His intra oral examination revealed carious 13, which was tender on percussion. Multiple teeth were missing in both maxillary and mandibular arch and the remaining teeth were periodontally involved.

Based on the complaint and clinical examination of the patient, a provisional diagnosis of right canine space infection in relation to 13 with extra oral draining sinus was given.

The intra oral periapical radiograph in relation to 13 revealed coronal radiolucency involving enamel, dentin and pulp. The periodontal ligament space was widened at the apical third of root of 13. A gutta percha point inserted extra orally into the sinus tract revealed it's tip

Figure 1 - Extra Oral Photograph Revealing Gross Asymmetry Of Right Side Of Face.

Figure 2 - Draining Sinus Tract Near The Apex Of Right Nasolabial Fold, Approximately 1 Cm Near Medial Canthus Of Right Eye.

Figure 3 - Gutta Percha Point Inserted Into The Sinus Tract Approaching Root Apex Of 13 In Standard Maxillary Occlusal Radiograph.

approaching root apex of 13 in standard maxillary occlusal radiograph. **(Figure 3)** The ultrasonographic examination revealed areas of hypo-echoic density in relation to the right canine space and right infra orbital space of face. The microbial culture of the pus revealed presence of Staphylococcus aureus in the discharge.

Based on the complaint, clinical examination and investigations of the patient, the final diagnosis of right canine space infection extending to right infra orbital space with extra oral draining sinus at the apex of right nasolabial fold near medial canthus of right eye was given.

The tooth 13 was non- restorable and was advised for extraction. The accumulated pus was drained partly through opening the sinus tract and rest through an incision made about 2 cm below the lower border of mandible under local anesthesia.

Discussion

The CST usually arises as a sequel of the bacterial invasion of dental pulp through a carious lesion or trauma. If the tooth is not treated at this stage, the infection spreads to the peri-radicular area which may induce inflammatory and immunological processes at the site locally. These processes can lead to bone resorption and subsequent formation of an intraoral or CST.[3] Drainage by perforation of bony plate occurs along the line of least resistance.[1] The attachment of muscles may determine the rate of that infection. If the tooth infection occurs below the muscle attachment, labial / vestibular abscess may result and if infection occurs above the muscle attachment, it may result into fascial space infection. Sometimes this infection may move through the cutaneous barrier and drain through the cutaneous extra oral sinus tract. Intra oral sinus tracts are more common than extra oral sinus tract.[4]

Canine space is situated between the anterior surface of maxilla and overlying levator muscle of upper lip. Canine space infection is the sequelae of dental pulp necrosis of maxillary canine tooth. Canine space abscess occurs when pus exists above the levator muscle of upper lip. It manifests as swelling with obliteration of the nasolabial fold and rarely pus may drain through inner canthus of eye as a cutaneous sinus tract when it distresses the quadrates labii superioris and levator muscle of upper lip.[2]

In order to make a correct diagnosis, the clinician must be aware of the fact that any cutaneous lesion of the face and the neck can be of dental origin. A thorough history is very crucial and can reveal a previous dental problem. The differential diagnosis of such a lesion include suppurative apical periodontitis, osteomylitis, congenital fistula, infected cyst, furuncle, malignancies of head and neck region and deep myotic infection.[5]

The importance of considering an odontogenic source is essential even when clinical examination of the mouth fails to suggest dental pathology. Vitality testing of teeth in conjunction with dental radiographs such as periapicals, occlusals and orthopantomograph are essential. In cases where the diagnosis is uncertain the lesion should be probed for a sinus. Radiographs taken with the probe or gutta percha cone in the sinus tract will confirm the origin of the infection. Non-surgical endodontic therapy is the treatment of choice if the tooth is restorable.[6] Most of the authors believe that once the primary cause is removed like extraction of the abscessed tooth, the cutaneous lesion heals without any special treatment.

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Maryland Bridge - A Case Report

Abstract

Maryland Bridge is a good conservative option for patients who are in their growing age and therefore having larger pulp chambers of abutment teeth in whom full veneer crowns may lead to unnecessary destruction of sound tooth structure and sometimes iatrogenic pulp exposures . The following case report deals with successful prosthetic management of a missing central incisor of a young boy with a Maryland Bridge. The esthetic and functional outcomes of the prosthesis was good.

Key Words

Resin Bonded Bridge , Rigid Fixed Partial Denture

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Clinical Implications:

Maryland Bridge can be a conservative and good esthetic treatment option for patients who are in their growing age and want only fix prosthesis. Proper patient selection and skillfull tooth preparation result in a long lasting, esthetic and functional prosthesis .

Introduction:

In young patients, pulp chambers are large and preparation of teeth for complete veneer retainers may cause injury to the pulp and lead to hypersensitivity or pulpal damage. To delay this line of treatment an immediate replacement with minimum preparation should be taken up as a treatment of choice for younger patients. One way to replace a tooth is the Maryland bridge. This bridge technique was first developed at the University of Maryland, and this is where it gets the name. A Maryland bridge consists of a metal framework with a porcelain tooth baked on to the front of the framework. The framework then ends up as a false tooth with two metal wings on the side. These metal wings are prepared to have a porous surface so that they can receive a bonding agent, and then the wings are bonded to the back sides of the teeth on either side of the missing tooth.[1],[2]

Case Report:

A 14 years male patient **(Fig.1)**, reported to the department of Prosthodontics with chief complaint of poor looks due to a missing front tooth on recording detailed history of the patient , it was known that the patient met with an road traffic accident four years back which led to loss of his right central incisor .The patient insisted for the fixed prosthesis only and therefore he was not willing for any treatment partial or cast partial denture . Implant as a treatment option was also ruled out keeping in view the growing age of the patient.On radiographic examination , it was evident that the pulp chambers of the abutment teeth i.e. of 12 and 21 were large. Looking into all these aspects it was decided to manage the case with Maryland Bridge. The patient was convinced and reassured regarding the success of the type of treatment and prosthesis which will be made.

Tooth preparation was done on the palatal aspect of 12 and 21 , Carefull minimal reduction was done , finish line was given chamfer margin , three retentive grooves were made on the palatal aspect of abutments . Final finishing of the preparations were done , impression were made with putty reline technique . Working cast obtained , wax pattern made **(Fig. 2)** , sprue attached , casting was done , metal framework obtained **(Fig. 3)** and tried in the patient **(Fig.4)**.

Finally the prosthesis was ready **(Fig. 5)** and cemented in the patient **(Fig. 6)** with resin cement . The patient was happy with the prosthesis as remarkably good esthetics was obtained .

Fig : 1

Discussion

Etched, cast, resin-bonded fixed partial dentures were first developed at the University of Maryland Dental School in 1980.The advantages of bonded cast

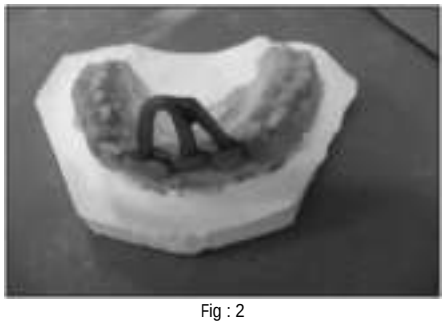

Fig : 2

Fig : 3

Fig : 4

Fig : 5

Fig : 6

restorations include (1) minimal tooth reduction without dentinal or pulpal involvement, (2) avoidance of anesthetics or gingival displacement cords, (3) use of relatively reversible procedures, (4) use of thin, highly polished supragingival retainers, (5) potential for improved esthetics, and (6) reduced fees. Despite acceptance, there are limitations to the use of resin-bonded restorations.

They are not indicated for long-span FPD or when abutments have large restorations, extensive caries, short clinical crowns, or extensive abrasion, erosion, or wear. There are several disadvantages to resin-bonded prostheses. The restoration cannot be temporarily cemented like conventional FPD; therefore there is no trial period to evaluate occlusion, contour, or esthetics, and the retainer is slightly overcontoured to resist flexure of the metal. Despite these limitations and disadvantages, this method of treatment has become popular[3].

In today's dental practice a missing tooth in the anterior region of mouth is not only a physical loss, but also an emotional experience for the patient as well. Replacing a congenitally missing tooth or a tooth lost by decay, trauma, root fracture or failed root canal treatment need a conservative and reasonable treatment option[4]. Many treatment modalities are available for replacing a single missing tooth such as removable partial denture, fixed partial denture or dental implant but each modality has its own advantages and disadvantages. For the success of prostheses patient awareness is very important for treatment planning , hence it is one of the most challenging restorations in dentistry. Satisfaction with RPDs depends upon technical and patient-related variables[5].

For the acceptance of prosthesis comfort, masticatory ability, esthetics, and retention seem to be the most important factors . The traditional treatment for a single edentulous space is a conventional fixed partial denture. A major drawback of this alternative is the significant tooth reduction of the abutments. The use of fixed partial denture should be avoided in young patients because the rigid fixed partial denture could interfere with jaw growth. Even after a decade of service the periodontal response for resin bonded fixed partial dentures is minimal. The three most common complications associated with resin-bonded prosthesis are debonding , tooth discoloration and caries . The implication of interim prosthesis for young patients can serve as a shelter from invasive procedure like fixed partial denture and implants in growing patients[6],[7],[8].

Conclusion

Caries and trauma remained the most common cause of replcement of missing teeth. As these are the most common modes of loss of teeth in adoloscent patients Resin bonded bridge's may be proposed as a suitable treatment modality especially in patients who are mindful of aesthetics and are not amenable to removable options.

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Review Article

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The Occlusal Splint Therapy: A Literature Review

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Abstract
There is substantial evidence that occlusal splints alone or in combination with other treatment modalities are efficacious in the management of pain in patients with temporomandibular disorders. The aim of this paper is to review the types of the splints, their specific clinical usage and success rates of the various appliances reported in the literature. This will provide the general practitioner and specialist with useful information that may be of assistance in the prediction of outcome and success of splint therapy. A literature search for relevant articles was performed up to December 2013 using pubmed and MEDLINE database searches. The search was based on the following keywords: 'occlusal splints, occlusal devices, stabilisation devices, soft splint, and hard splint, splint therapy for TMD and bite planes for TMJ problems. Altogether, 133 references were read and evaluated, out of which 65 were included in this review.

Key Words
Occlusal Splint, Splint Therapy, Treatment of TMJ Disorders.

Introduction

An occlusal splint is a removable appliance, usually fabricated of resin, most often designed to cover all the occlusal and incisal surfaces of the teeth in the upper or lower jaw.[1] Occlusal splint therapy has been shown to be useful for the diagnosis and management of various masticatory system disorders.[2]

A definite relationship between occlusal interferences and TMJ dysfunction has been reported.[3] However, various combinations of emotional stress and occlusal interferences may also be responsible for TMJ dysfunction[4]. Clinical and subjective evaluation of stress is often not valid and patients seldom admit to having stress [5].

A reduction of pain with splint therapy is well documented. Many studies[6],[7],[8],[9],[10] have reported resolution of symptoms after insertion of a splint. Clark, in an excellent pair of articles published in 1984, reviewed the design, theory and effectiveness for specific symptoms of orthopaedic interocclussal devices. He reviewed studies in the literature through 1980 and pointed out that in general there is 70-90% rate of clinical success in treatment of temporomandibular dysfunction with splints[6],[9].

The aim of this paper is to review the types of the splints, their specific clinical usage and success rates of the various appliances reported in the literature. This will provide the general practitioner and specialist with useful information that may be of assistance in the prediction of clinical outcome and success of splint therapy.

A literature search for relevant articles was performed up to December 2013 using Pubmed and MEDLINE database searches. The search was based on the following keywords: 'occlusal splints, occlusal devices, stabilisation devices, soft splint, and hard splint, splint therapy for TMD and bite planes for TMJ problems. No language restriction was applied. The titles and abstracts of all the resulting articles were independently screened by two reviewers (SC and AR) to identify the articles pertinent to the subject of the review. Where the title and abstract were not sufficiently perspicuous to make a clear decision, it was decided to include the article for subsequent evaluation. The full texts of the identified articles were obtained and further analysed. Additional manual search of reference lists of retrieved publications was carried out to find any potentially relevant articles not identified during the main search. Altogether, 133 references were read and evaluated, out of which 65 were included in this review.

Purpose Of Splint Therapy

Occlusal splint therapy is well advocated for following purposes:

(1) To provide diagnostic information [11]

Occlusal splints provide diagnostic information in different ways. The restorative dentist can determine the envelope of function, potential neutral zone impingements, parafunctional habits and anterior guidance requirements, as well as obtain information about vertical dimension from patients who wear a splint. The treating clinician can predict from this information that a large percentage of patients requiring restorative treatment may exhibit lateral parafunctional forces that could damage the natural and prosthetic dentition.[11]

(2) To protect the teeth, cheek and /or tongue in patients with Bruxism

Bruxism may be defined as clenching or grinding of the teeth when the individual is not chewing or swallowing.[12] Parafunctional clenching and grinding is considered one of the common etiologic factors in temporomandibular dysfunction.

A study of patients with nocturnal bruxism revealed that 13% exhibited isometric clenching, 71% exhibited bilateral clenching, 13% exhibited unilateral excursion and 3% exhibited

protrusive movement.[13] The average force generated by normal chewing is 162pounds per square inch.[14] The forces generated during bruxism can be as much as 6 times the maximal force generated by normal chewing. The highest measured force in one bruxing individual was 975 pounds.[15]

It is important to remember that splints do not prevent bruxism, rather, they distribute the force across the masticatory system. These appliances can decrease the frequency but not the intensity of the bruxing episodes.[13]

Richardt[16] in a study found that splint therapy in sleep bruxism patient led to a change in the topographical condyle fossa relationship and seemed to create an "unloading" condition for the TMJ.

(3) To stabilize unstable occlusion

Occlusal splints have been shown to reduce the symptoms of TMJ dysfunction and are thought to relieve the neuromascular responses caused by occlusal interferences.[17] The literature has shown that tooth interferences to the CR arc of closure activate the lateral pterygoid muscles.[18] The clinical benefits of anterior guidance were demonstrated by Williamson and Lundquist.[19] A splint limiting excursive contacts to the anterior teeth shut down the masseter and anterior temporalis activity that normally occurred with posterior tooth contact. They concluded that anterior guidance was necessary to reduce muscle activity. Even 50µm occlusal interferences can initiate changes in coordinated muscle activity.[20]

(4) To promote jaw muscle relaxation in patients with stress related pain symptoms like tension headache and neck pain of muscular origin.

Headache is observed in many TMD patients.[21] The effectiveness of splint therapy in reducing head and neck pain and muscle hyperactivity is well documented.[22] It has also been demonstrated that hyperactive temporalis muscles are responsible for tension headaches as well as creating a noxious stimulus for sympathetic vascular changes that provoke migraines.[23] A specific anterior deprogrammer known as the nociceptive trigeminal inhibition(NTI) appliance has recently been approved by the FDA for the prevention of medically diagnosed migraine headache pain.[24]

Splint Types

Two basic types of splints according to Dawson are: permissive and directive[25] (Annexure-I)

Permissive Splints

Permissive splints represent the flat plane appliances which alter the occlusion so that teeth do not interfere with complete seating of the condyles and to control muscle forces. The two classic designs of permissive splints are anterior midpoint contact splints and full contact splints.

Anterior Midpoint Contact Splints

Anterior midpoint contact permissive splints are designed to disengage all teeth except incisors.[23] EMG studies by Becker has shown that molar contact allows 100% clenching force; cuspid contact permits approximately 60% maximum clenching force; and incisor contact minimizes elevator muscle clenching force to 20% to 30% of maximum clenching force.[26] Therefore, muscle clenching forces are reduced significantly when contact is isolated exclusively on the incisors. The width of the midpoint contacting platform is limited to the width of the two lower incisors, measuring 8-10mm. Anterior midpoint contact permissive splints include nociceptive trigeminal inhibition(NTI) splint, Lucia Jig (Great Lakes Orthodontics, LTD, Tonawanda,NY) and the B splint(Bruxism).

Full Contact Splints

Full contact splints create uniform contacts on all teeth when the joints are fully seated by the elevator muscles or manually by the clinician. Dawson's bimanual manipulation technique[25] is used to seat the joints when adjusting the splint occlusion in CR. In excursive movements, only the anterior teeth touch, so as to reduce elevator muscle activity. A smooth, shallow cuspid to cuspid ramp is designed to provide anterior guidance, which provides horizontal freedom of movement as well as immediate disclusion of all posterior teeth. The benefits of such splints include elimination of discrepancies between seated joints and seated occlusion(CR=MI); provide large surface area of shared biting force and gives idealized functional occlusion.

Directive Splints

Directive splints guide the mandibular condyles away from the fully seated joint position when a painful joint problem is present. Such splints prevent full seating of the joints by guiding the mandible into a forward posture on closure into the occlusal splint.

The non permissive or directive splints have ramps or indentations that limit the movement of the mandible. These include an anterior repositioning appliance (MORA).

The proper position of the condyle to the meniscus and fossa is generally thought to be necessary for normal function. While there is some variation in condylar position in an asymptomatic population,[27],[28] derangement of the disc with displacement of the condyle is implicated in disturbances of motion and degenerative join changes.

Most clicking is caused by a rapid change in position of the condyle or disc sometime during condylar translation.[29] Since the direction of pull of the external pterygoid is anterior and medial, in derangements the meniscus is usually dislocated forward and inward.

Conceptually, keeping the mandible forward with a splint would recapture the normal disc-condyle orientation and eliminate the clicking. The initial enthusiasm for repositioning was supported by studies showing good clinical success.[29],[30] clicking was eliminated in 66-86% of the patients treated. Comparisons with flat plane splint treatment showed the superiority of repositioning appliances.[31]

While a study by Mona[32] in 2004, showed through, both anterior repositioning splint and the canine protected splint were effective in eliminating pain and clicking in patients with anterior disc displacement with reduction. MRI measurements showed that the canine protected splint was superior to the anterior repositioning splint, as it allowed the articular disc to resume its normal length and shape while moving in a posterior direction during recapture. Disc recapture was demonstrated via MRI in 25% of the subjects from the anterior repositioning splint group, in 40% of the subjects from the canine protected splint group, and in 33.3% of the subjects from both groups.

Splint Materials

The most common material used for fabrication of splints is heat cured acrylics .splint can also be made in soft materials **(Table No 1)**.

Table No 1

Splint types: Based on Material
Hard splint – heat cure and self cure
Soft splint – rubber and hydrostatic splints

Soft rubber splints and hydrostatic splints (Aqualizer) function by separating the teeth. Hydrostatic appliance was designed by Lerman[33] over 30 years ago. In its original form, it consisted of bilateral water filled plastic chambers attached to an acrylic palatal appliance, and the patients posterior teeth would occlude with these chambers. Later this was modified to become a device that could be retained under the upper lip, while the fluid chambers could be positioned between maxillary and mandibular teeth.

Aqualizer has flexible fluid layer that equalizes all bite forces by preventing tooth to tooth contact. It has a unique water system that immediately optimizes biomechanics , supports the jaw in a comfortable position, removes the teeth from dominance, placing bite and body in harmony.[34]

Soft resilient splints are easily constructed. Their value for protection from trauma in athletics is well substantiated; their use to reduce parafuncional clenching and grinding is not. Harkins and Mateney[35] tested prefabricated soft splints (a modified double gaurd appliance) in one-half of a sample of 84 dysfunction patients who had clicking and pain. The other half served as controls.the splints were worn full time for 10-20 days. Ten percent of the patients stopped clicking, 64% had less clicking, 7% increased and 19% had no change. Myalgia did not change or worsened in 26% of patients. Minor occlusal changes were noted in 67%. There were no changes in the controls.

Hard Vs Soft Splints

Okeson[36] tested the nocturnal bruxing response of the same person with a hard versus a soft splint. The hard maxillary stabilization splint and the soft vacuum formed splint were carefully constructed to the same vertical dimension. Compared with the control periods, 8 0f 10 subjects had significant decrease in muscle acivity wearing the hard appliance. When the soft splint was worn, 5 of 10 showed an increase in activity. Only one decreased. While the results with the hard splint ee consistent with other studies, use of a soft splint may not be indicated for reducing parafunctional activity in patients with symptoms.

Table No 2

Splint types: Based on anterior guidance[40]
Class I- Lateral excursion contact is on canines and protrusive contact is on central incisors
Class II- Lateral excursion contact is first on canines and then on central incisors, PEC is first on CI & then on canines
Class III- All excursions contact is solely on canines.
Class IV- missing posterior teeth that prevent proper anterior teeth contact.

Pettengil[37] in a study compared soft and hard acrylic resin stabilization appliance in the reduction of masticatory muscle pain in patients with temporomandibular disorders. With a small sample of 23 patients he found soft and hard appliances performed the same in reduction of masticatory muscle pain in short term appliance therapy.

Electromyographic study by Cruz Reyes[38] assessed the electrical activity generated in temporal and masseter muscles during voluntary muscular contraction of patients with bruxism, as a result of the use of two types of occlusal splints. There were rigid acetate plus heat cured acrylic splint (occlusal stabilization splint) and sheets of flexible acetate (soft occlusal splint). The increase in muscle electrical activity in the hard splints group was noted with a statistical significant difference and decrease in the soft splint group. This was mainly due to a neuromuscular recovery process occurring in hard splint while a negative or decremented process of muscular organization in soft splint group. Thus, he concluded that occlusal stabilization splints are therefore considered better than soft occlusal splints.

Quran and Lyons[39] did a study to compare the effects of hard and soft splints on the activity of the anterior temporalis and masseter muscles. Surface EMG recordings were made during clenching at 10% of maximum, 50% of maximum and at maximum clench, both before and after insertion of hard splint. This sequence was then repeated with a soft splint. The relative level of activity in he anterior temporalis and masseter muscles at all three activity levelswere quantified by means of an activity index, which provides a measure of the balance of activity in the masseter relative to the activity in the anterior temporalis muscle. The decrease in the activity of temporalis muscles relative to the masseter muscles was found as the therapeutic effect of both a hard and soft splint, this decrease was clearly greater with the hard splint.

Solow[40] presented a classification **(Table No 2)** of customized anterior guidance for occlusal devices and the rationale for optimum force distribution. He classified clinical anterior guidance for occlusal devices into 4 designs. Class I, where lateral excursion contact is solely on the canines and protrusive excursion contact is solely on central incisors. Class II, where all excursion contact is solely on the canines. Class IV, where there is unacceptable occlusal design with missing posterior teeth contacts or posterior teeth contact in excursions that can prevent proper anterior teeth contact.

Class III anterior guidance places all force in all excursions on the canine and has been termed the “Michigan splint”. [41]

Clinical Usage Of Various Splints

Permissive Splints

Anterior midpoint contact splints

Bite plane therapy may be used when a muscle disorder is suspected. Bite planes separate the teeth, allowing the muscles to relax. These appliances should not be worn for longer than 24-48 hrs continually, as they cover the maxillary anterior and may cause supra eruption of posterior teeth due to lack of contact.[11] This is also refered to as relaxation plate or Sved plate in which only anterior teeth make contact. It is not recommended if the patient has acute pain in the TMJ or feels pain or soreness at palpation of those areas. It is mainly recommended in patients with acute or chronic musle pain if the plane splint is without effect. It should only be used during night time and not more than 10-12 hrs/day.

Bite splint with a pivot was introduced by Krogh-Poulsen[42] and was supposed to be helpful in patients with disk displacement. The proposed effect is that the condyles are pulled downwards upon clenching on the pivot, thereby relieving traumatic load and giving the disk freedom to reassume a normal position. The contact in these splints is usually on most posterior tooth.

Lous[43] published the results in a study of 60 clicking patients treated with pivots. Previous traditional treatment methods had been unsuccessful. In these cases splint wear was supplemented with vertical pull head gear attached to a chin strap. The average treatment lasted 3-4wks with a 3 months follow up. 72% of the patients had elimination of symptoms. 17% had improvement but

reoccurring symptom episodes. Additional controlled studies of the pivot appliance are lacking. Because of the limited occlusal contact with this splint there is a possibility of change in tooth position.

Full Contact Splints

Stabilization splints are commonly used for treatment of masticatory dysfunction signs and symptoms such as muscular pain, TMJ pain, clicking, crepitus, and limitation of motion and in coordination of movement.

In a typical study Carraro and Caffesse[44] described the response of 170 TMD patients treated only with a full coverage stabilization splint. The splints were worn full time, except for eating and covered the maxillary or mandibular dental arches. 82% of subjects responded favourably to the splint therapy. Symptoms of TMJ pain, muscle pain or dysfunction all improved. Clicking was the most difficult dysfunctional symptom to eliminate.

Thirty three patients selected from a TMJ clinic population seeking treatment for pain, where the muscle and joint pain could be elicited by palpation, were evaluated by Okeson.[45] They were treated for one month with a maxillary stabilization splint. 28 of 33 (85%) showed a decrease in observable pain scores.

Kurita[46], did a retrospective study to evaluates the effect of maxillary full coverage occlusal splint (stabilization splint) therapy. The study was done on 232 patients who were suffering from chronic pain on movements, joints noise except reciprocal clicking, and difficulty of mouth opening. All were treated with stabilization splint alone. The authors resulted in total remission rate of 41% and, including those reporting some improvement, the rate was 84%. They found that the presence of displaced disk significantly decreased the success rate.

Ekberg[47] in a study evaluated the short term efficacy of a stabilisation appliance in patients with temporomandibular disorders of arthrogeneous origin , using a randomized ,controlled and double blind design. He concluded that the treatment group using stabilisation appliance showed higher significant improvement than the control appliance.

Turp[48] in a systemic review study concluded that hard stabilisation splints were helpful in the management of patients with masticatory muscle pain though they do not appear to yield a better clinical outcome when compared with a soft splint, a non occluding palatal splint, physical therapy or body accupuntcure.

Al - Ani et al[49] in his review study found stabilisation splint therapy was effective in reducing symptoms of pain dysfunction syndrome. But, when he compared stabilization splint therapy with acupuncture, bite plates, biofeedback / stress management, visual feedback ,relaxation ,jaw exercises, non occluding appliance and minimal /no treatment, there was no evidence of a statistically significant difference in the effectiveness.

The choice of arch for which the splint is fabricated is dictated by the type of bruxism habit. If the patient clenches isomerically, a full coverage maxillary guard with all of the teeth in contact is appropriate. With isometric clenching, the maxillary anterior teeth would not be covered on a mandibular splint, and since no movement takes place, this force would not be properly distributed using the type of the splint. If the patient demonstrates parafunctional movement in lateral and protrusive directions, a splint for mandibular teeth will be effective.[11]

According to Wilkerson, lower splints have certain advantages that make them a favourite for many experienced clinicians. These include lower visibility, fewer speech changes, shallower anterior ramps and better patient compliance when instructed to wear their splints during the day as well as at bed time.

Directive Splints

The anterior repositioning appliance (also known as an orthopaedic repositioning appliance) purposefully alters the maxillomandibular relationship so that the mandible assumes a more anterior position. Originally, this type of appliance was supposed to be used to treat patients with internal derangements (usually anterior disk displacements with reduction)[50]. Currently, it is recommended that this should be used primarily as a temporary therapeutic measure to allow for symptomatic control of painful internal derangements, but not to “permanently” recapture the TMJ disc. This type of appliance should be used with discretion, and only for short periods of time.[51]

Advanced disc and muscle disorders are identified in patients who experience jaw looking and/or noises painful joints, and sometimes increasing pain with splint wear. Patients with acute trauma may require an anterior repositioning appliance for 7-10 days to keep the condyle away from the retrodiscal tissues, so inflammation can subside.[11]

In a sample of patients with painful clicking on opening, closing or both, Tallents et al[52] described the results of examination with arthrograms amd arthrotomograms in 141 joints. The same investigative group[53] reported that of 72 joints with clicking; only 53 had arthrographic evidence of a reducing meniscus. Of the 53, 41 would be candidates for repositioning (53% of the clicking joints). These reports suggest that not all clicking patients are candidates for repositioning therapy and that clicking is not always caused by a displaced disc.

Rosquillo[54] and the group at Eastman Dental Centre studied the relationship between pretreatment position of the condyle in the fossa to unsuccessful protrusive splint therapy. Of 142 patients with internal derangements, 72 were arthrographically confirmed to be suitable for repositioning therapy. The initial condylar position was measured on CO tomograms. The patients were followed from 6months to 5 years. 71% of the patients in the sample were successfully treated while 29% had return of clicking, locking and/or return of pain. Whether the condyle was anteriorly, centrally or posteriorly positioned before splint therapy, had no bearing on the success of treatment.

Okeson[55] took a retrospective look at 40 patients treated for eight weeks with anterior repositioning splints. All patients had a primary diagnosis of a disc-interference disorder: disc displacement associated with distinct single joint sounds (n=25), a history of locking with recapture (n=8). After 8 weeks of therapy, 80% of the patients were free of pain, clicking and locking. The study concluded that repositioning therapy permanently resolves joint sounds only one third of the time but reduces long term pain ¾ of the time. The success rate was 25% if the patients were free of pain, clicking and locking. Accepting painless joint sounds, the success rate was 55%. 75% were successful if only pain resolution was considered and 80% were better according to the patient. Therefore, if resolution of pain is the primary objective, repositioning has a good log term prognosis. If elimination of all signs

of dysfunction is the goal, repositioning splint therapy is of limited value.

Naikmasur[56] concluded in a study that occlusal splint therapy has better long term results in reducing the symptoms of MPDS. It has better patient compliance, fewer side effects and is more cost effective than pharmacotherapy; hence it can be chosen for the treatment of patients with MPDS.

Lee[57] in a study evaluated the effect of simultaneous application of arthrocentesis and occlusal splint. A retrospective study of 43 patients (3males, 40 females) were divided into 3 groups – Group A (17 patients with arthrocentesis and occlusal splints simultaneously applied), Group B (13 whose symptoms did not improve with occlusal splints, undergoing arthrocentesis after occlusal splint used for 8 weeks), and Group C(13 patients that only used occlusal splints). They compared these groups in maximum comfortable opening (MCO) and the visual analogue scale of pain and noise. Follow up was performed at 1 week, 1month, 3 months and 6 months. The improvement of symptoms was noted in all three groups, but group A had a quicker improvement than the other groups, in terms of pain reduction and MCO increases.

Conti [58] in a study compared the efficacy of bilateral balanced and canine guidance (occlusal) splints with nonoccluding splint in treatment of TMJ pain and disk displacement. The author divided 57 subjects into 3 groups: bilateral balanced, canine guidance and non occluding. The authors followed the groups for 6 months using analysis of a visual analog scale (VAS), palpation of TMJ and masticatory muscles, mandibular movements and joint sounds. They concluded that the type of guidance used did not influence the pain reduction, yet both occlusal splints were superior to the non occluding splint, on the basis of VAS.

Despite similar outcomes in relation to opening, left lateral and protrusive movements, TMJ and muscle pain on palpation, subjects who used the occlusal splints had improved clinical outcomes. The frequency of joint noises decreased over time, with no significant differences among groups. Subjects in the groups using the occlusal splints reported more comfort.

Tecco[59] in his study evaluated whether an anterior repositioning splint could be more effective in the treatment of pain and joint noises associated with TMJ internal derangement than a full arch maxillary stabilization splint. The authors treated 40 patients with confirmed internal derangement, joint pain and joint noises in at 1 TMJ for at least 2 months, with repositioning splint (20 patients) or stabilizing splints(20 patients); 10 untreated patients comprised the control group. These were evaluated using visual analog scale (VAS), and the pain was characterized and evaluated monthly for eight months. Significantly fewer repositioning splint patients experienced pain after 4 months and intensity of pain was also reduced significantly after two months, but no significant difference amongst the groups in the treatment of joint noises.

Jokstad[60] in his study compared Michigan type and NTI splint therapy in treatment of TMD. He concluded with no differences in treatment efficacy when compared over 3 months.

Hagag[61] in his article reviewed the literature on the relationship between occlusal discrepancies and TMD and summarized the guidelines of treating TMD by prosthetic rehabilitation. He concluded that conservative treatments such as counselling, behavioural modification, physical therapy, pharmacotherapy and interocclusal appliances should be the first choice, and treatments that lead to drastic changes of occlusion are not recommended.

Macedo[62] in a review study evaluated the effectiveness of occlusal splints for the treatment of sleep bruxism in comparison of alternative interventions, placebo or no treatment and found no statistically significant difference amongst them.

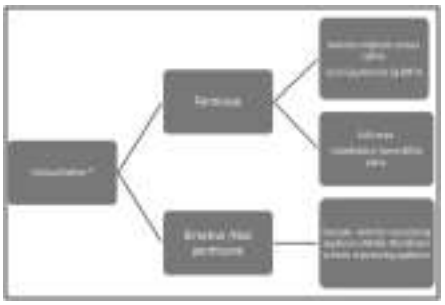
Use of hydrostatic splint (Aqualizer) is indicated in TMJ pain, headache, neck and shoulder pain and stiffness, orthodontic triggered muscle pain during treatment, pre surgical differential diagnosis, post surgical pain and inflammation[63]. Aqualizer's fluid system responds dynamically, continuously re-equilibrating and balancing bilaterally as the mandible shifts to the position most comfortable for the muscles to function[34].

Macedo and Mello evaluated the efficacy of the hydrostatic splint aqualizer, microcurrent electrical nerve stimulation (MENS) and transcutaneous electrical neural stimulation (TENS) therapies in patients with TMD in acute situations and concluded that the MENS and the hydrostatic splint were more effective than TENS[64]. The aqualizer is not indicated for patients with severe bruxism and those without normal gag reflex. If, Aqualizers are destroyed within hours or one or two nights, the patient is a parafunctional bruxer/clencher. Such therapy is not tough enough for them. During wear, it will gradually lose its fluid[51].

Lindfors[65], in a study evaluated the treatment effect of a combined treatment with a stabilisation appliance and a soft appliance in the opposing jaws in patient's refractory to previous TMD treatment. During a 5 year period, 2001-2005, a total of 98 patients received the combined treatment that had already been given several different TMD treatments during a long period of time, either before referral or at specialist clinic, with only minor or no effect on their TMD symptoms. The authors found that the clinical and anamnestic dysfunction index decreased statistically significantly in the retrospective material after the introduction of combined treatment. General conclusions should, however, be made with caution due to the fact that the study did not include any control group.

Discussion

Occlusal splints of varied designs and application have been employed in the treatment of myofacial pain dysfunction (MPD) and temporomandibular joint disorders (TMD). These appliances provide the practitioners with a non-invasive, reversible form of intervention to manage the patient's symptoms. An occlusal device should be stable, comfortable and have a proper occlusion so that the patient can use it consistently to assess the effects of occlusal change. Patients cannot be expected to use an occlusal device that rocks, exerts painful pressure on teeth, or introduces a malocclusion. Thus, review on the different designs available from the literature, their clinical use and effectiveness of these appliances has been mentioned. However, comparison of results from numerous studies making use of occlusal splints is difficult due to employment of various outcome measurement scales, subjective evaluation of patient outcome, and variability in reporting of treatment outcomes. Besides, controlling the effects of malocclusion and parafunction is typical successful through the selective



Annexure - I

application of the occlusal splint designs described in this article.

Summary And Conclusion:

A summary of all the splint types, descriptions of their designs and clinical usages are presented in **Table no 3**.

Occlusal splint therapy is although an effective means of diagnosing and managing temporomandibular disorders, but due to multifactorial etiology, some limitations may be encountered relative to creating long term joint stability.

Table No 3

Types of Splint	Design	Clinical usage	References
Stabilisation splint	Creates uniform contacts on all teeth. Allow complete seatingof condyles CI = MI Cuspid ramp for anterior guidance	TMJ pain,musle pain and dysfunction	Dawson25 Carrarroand caffesse44 Okeson36 Kurita46
Anterior midpoint contacting splints NTI Splint Lucia jig B splint	Desigened to disengage all teeth except incisors	Muscle disorder	Dylina11 Shankland23 Jokstad60
Anterior Repositioning splint	Guide condyles away from fully seated joint position Guide the mandible into a forward posture on closure	Acute trauma to the TMJ, jaw locking or noises painful clicking on opening or closing	Dylina11 Caswell29 Clark30 Lundh31 Lous43 Farrars50 Tallents52&53 Okeson55 Tecco59
Soft splints	Resilient material	Myofacial pain dysfunction Bruxism	Harkins and mateney35
			Okeson36 Pettengil37 Cruz Reyes38 Quran and lyons39
Hydrostatic splint	Fluid filled reservoir covering the teeth	TMJ pain, Headache,neck and shoulder pain &stiffness ,orthodontic triggered muscle pain, presurgical DD, post surgical pain and inflammation	Lerman33 Hagag61 Macedo62
Michigan splint	Even contacts at habitual closure All mandibular teeth except the cuspids are discluded at protrusive and lateral movements.	Signs and symptoms of jaw muscle hyperactivity.	Solow40 Ramfjord41 Jokstad60
Pivot splints	Mandibular splint with occlusal contact only on most posterior tooth.	Unload TMJ may be used in conjunction with vertical pull chin cup.	Krogh Poulson42 Lous43

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Medicinal Plants In Periodontics - A Review

Abstract

The present study was an attempt to highlight the use of medicinal plants in Periodontics. An attempt is made to evaluate four common herbs i.e Neem, Turmeric, Clove and Tulsi (Basil) from Indian flora and fauna as representatives for assessment of their use in Periodontics. The purpose for taking them as representatives is their vast utility as medicinal plants in traditional Indian medicine.

Key Words

Medicinal plants, Periodontal diseases, Natural Products, Traditional Medicine

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Quick Response Code

Medicinal plants have been used to treat diseases or to attain or maintain a condition of improved health from a long time. They are both promotive and preventive in their approach. It is a comprehensive system, which uses various remedies derived from plants and their extracts to treat disorders and to maintain good health. Natural herbs like triphala, tulsi patra, jyestiamadh, neem, clove oil, pudina, ajwain and many more used either as whole single herb or in combination have been scientifically proven to be safe and effective medicine against various oral health problems like bleeding gums, halitosis, mouth ulcers and preventing tooth decay. The major strength of these natural herbs is that their use has not been reported with any side-effects till date[1]. Use of herbal derivatives for oral healthcare and dental hygiene maintenance has been continuing since times immemorial. If we look back at the methods of oral hygiene maintenance, we can trace the use of herbal derivatives since 3000 B.C., when the ancient civilizations used what they called a "chew stick". The chew sticks were rubbed up against the teeth to clean the teeth. Similar use of plant sticks are reported from other parts of the world too - the ancient Arabs used a "Miswak". Use of Neem stick to clean the teeth has been reported in early Indian classics by Sushruta and Charaka[2],[3]. Among all, neem datun is most commonly in use[4].

Even today, 80 percent of the population in India that lives in rural areas still start their day with the datun.

It would be worth mentioning here that Medicinal plants have been used as traditional treatments for numerous human diseases for thousands of years and in many parts of the world. In rural areas of the developing countries, they continue to be used as the primary source of medicine[5].

As there are approximately 500,000 plant species occurring worldwide, of which only 1% has been phytochemically investigated, there is great potential for discovering novel bioactive compounds.

There have been numerous reports of the use of traditional plants and natural products for the treatment of oral diseases. Many plant-derived medicines used in traditional medicinal systems have been recorded in pharmacopeias as agents used to treat infections and a number of these have been recently investigated for their efficacy against oral microbial pathogens. The general antimicrobial activities of medicinal plants and plant products, such as essential oils, have also been reviewed in literature[6],[7].

As it is an exhaustive topic hence owing to limitations of time and space, the present study has been restricted to focus on the use of following four herbal sources:

1. Neem
2. Turmeric
3. Clove oil
4. Tulsi

Selection of these herbal sources of medicine has been made on the basis of their traditional use in India for oral healthcare and as a protectant against periodontal diseases.

Neem (Azadirachta Indica)

Azadirachta indica is popularly known as Indian neem (margosa tree) or Indian lilac. Neem is an evergreen tree, cultivated in various parts of the Indian subcontinent. Every part of the tree has been used as traditional medicine for household remedy against various human ailments, from antiquity[8],[9],[10]. The sanskrit name of the neem tree is 'Arishtha' meaning 'reliever of sickness'

Pharmacological Actions Of Neem Extract

Several pharmacological activities and medicinal applications of various parts of neem are well known. Biological activity of neem is reported with the crude extracts and their different fractions from leaf, bark, root, seed and oil. However, crude extract of different parts of neem have been used as traditional medicine for the treatment of various diseases.

Some of the medicinal attributes of various parts of neem[11] as mentioned in ayurveda[12],[13] have been summarized in **Table - 1**.

Neem In Periodontics

Given its immunostimulant, antiulcerative, antifungal, antibacterial, antiviral, anticarcinogenic and antioxidant activity as well as its varying degrees of effect on central nervous system, Neem has been tried as an excellent microbial agent, pain reliever

Table – 1: Medicinal Uses Of Neem As Mentioned In Ayurveda

Part	Medicinal Use
Leaf	Leprosy, Eye Problem, Epistaxis, Intestinal Worms, Anorexia, Biliousness, Skin Ulcer
Bark	Analgesic, Alternative And Curative Of Fever.
Flower	Bile Suppression, Elimination Of Intestinal Worms And Phlegm.
Fruit	Relieves Piles, Intestinal Worms, Urinary Disorder, Epistaxis, Phlegm, Eye Problem, Diabetes, Wounds And Leprosy.
Twig	Removing Plaque, Maintaining Oral Hygiene, Relieves Cough, Asthma, Piles, Phantom Tumour, Intestinal Worms, Spermatorrhoea, Obstinate Urinary Disorder, Diabetes.
Gum	Effective Against Skin Diseases Like Ringworms, Scabies, Wounds And Ulcers.
Seed Pulp	Leprosy And Intestinal Worms.
Oil	Leprosy And Intestinal Worms.
Root, Bark, Leaf, Flower And Fruit	Blood Morbidity, Biliary Afflictions, Itching, Skin Ulcer, Burning Sensation And Leprosy.

and tissue protector in Periodontics. Neem extracts are used to treat various skin diseases, as an antiseptic substance, against endo and ectoparasites or simply as a herbal mouthwash[14]. In test tubes, neem has been shown to have significant effects on both gram-positive and gram-negative organisms.

Extracts from neem sticks or bark have been shown to inhibit the growth of Streptococcus mutans. Some of the studies citing use of Neem in Periodontics have been enumerated in **Table - 2**.

Table – 2: Studies On Use Of Neem In Periodontics

Study	Study Design	Results
Patel and Venkatakrishna-Bhatt (1988)15	Study on Mango (Mangifera indica), Neem (Azadirachta indica; Melia azadirachta), Ocimum (Ocimum basilicum), tea-dust (Camellia sinensis) and uncommonly Murayya, i.e., currey leaf (Murayya koenigi)	The herbs used showed potential efficacy as compared to commercially available dentifrices.
Wolinsky et al. (1996)16	Examined the inhibitory effects of aqueous extracts derived from the bark-containing sticks (Neem stick) of Azadirachta indica upon bacterial aggregation, growth, adhesion to hydroxyapatite, and production of insoluble glucan.	Neem stick extract reduced the ability of some streptococci to colonize tooth surface.
Bhuiyan et al. (1997)17	Evaluated the antibacterial activities of aqueous and acetonic extracts of Neem bark (NBE) on agar plates by using Streptococcus sobrinus.	Neem bark constituents may have ability to suppress oral pathogens.
Vanka et al. (2001)18	Tested the antibacterial effect of Neem mouthwash against salivary levels of Streptococcus mutans and Lactobacillus over a period of 2 months. Also it's effect in reversing incipient carious lesions was assessed.	Neem mouthwash was effective in inhibiting S. mutans and reversing incipient carious lesions.
Pai et al. (2004)19	Developed a gel containing neem leaf extract and compared its antiplaque activity with a mouthwash containing chlorhexidine gluconate, a common ingredient in medicinal mouthwashes.	Neem extract gel proved useful for treating gingivitis and oral infections as it inhibited the formation of plaque and the growth of bacteria.
Subramaniam et al. (2005)20	Determined the influence of different concentrations of Neem leaves extract on the inhibition of Streptococcus mutans.	Neem leaves extract exhibited antibacterial effect towards Streptococcus mutans.
Lakshmi and Aravind (2010)21	Evaluated the antibacterial activity of ethanolic leaf extract of Azadirachta indica against selected acidogenic oral bacteria that causes dental plaque in fixed orthodontic appliance patients.	The extract exhibited significant antibacterial activity against Streptococcus mitis, Streptococcus mutans, Streptococcus sanguis & Streptococcus salivarius. Did not show antibacterial activity against Lactobacillus acidophilus.
Chatterjee et al. (2011)22	Carried out a double-blind, randomized, controlled trial to evaluate the antigingivitis and antipalque effect of an Azadirachta indica (neem) mouthrinse on plaque induced gingivitis.	A. indica-based mouth rinse was equally efficacious with fewer side effects as compared to chlorhexidine and may be used as an adjunct therapy in treating plaque induced gingivitis.
Jainet al. (2012)23	Evaluated the efficacy of neem chip as an adjunct to scaling and root planing (SRP) in patients with periodontitis.	Neem chip may prove to be beneficial in the treatment of periodontal pockets.
Rathod et al. (2012)24	Accessed the susceptibilities from aqueous and ethanol extracts of Neem (leaves and bark) and Tulsi (leaves) against some clinically significant bacterial species.	The study indicated that Neem bark was found to possess more significant antibacterial activity than Neem leaves and Tulsi leaves against two Gram positive bacteria (Bacillus subtilis and Staphylococcus aureus) and two Gram negative bacteria (Klebsiella pneumoniae and Escherichia coli).
Verma and Dixit (2012)25	Assessed the influence of Chlorhexidine (CHX) and Neem Extract (NE) on Cultured Human Gingival Fibroblasts (hGF).	CHX beyond 1% concentration exhibited toxic effect on hGF at 1 minute time exposure. However, NE did not adversely affect the fibroblasts even up to 50% concentration showing less toxic effect in comparison with CHX on these cells. The cytoprotective, oral friendly quality of NE emphasize the superiority of NE over CHX.

Turmeric (Curcuma Longa)

Turmeric or Curcuma longa, a perennial herb, is a member of the family Zingiberaceae (ginger). The plant grows to a height of three to five feet, and is cultivated extensively in India, China and other countries with a tropical climate.

The rhizome is the portion of the plant used medicinally; it is usually boiled, cleaned, and dried, yielding a yellow powder.

In old Hindu Medicine, it was extensively used for the treatment of sprains and swelling caused by injury. In recent times, traditional Indian medicine uses turmeric powder for the treatment of biliary disorders, anorexia, hepatic disorders, rheumatism and sinusitis.

Biological Activity of Turmeric and its derivative compounds

Turmeric powder, curcumin and its derivatives and many other extracts from the rhizomes were found to be bioactive. Some of the reported biological activities[26] are as follows:

1. Anti-inflammatory, antioxidant, anti-bacterial, anti-HIV, anti-tumor and arthritis.
2. Anti-bacterial, anti-HIV, antitumor, anti-inflammatory and anti-diabetic action.
3. Anti-bacterial, anti-HIV, arthritis, antioxidant, antitumor, anti-inflammatory, snake bite and apoptosis.
4. Antioxidant, anticarcinogenic effect, snakebite and arthritis.
5. Antioxidant, Alzheimer's disease, anti-bacterial and hepatoprotective effects.
6. Antispasmdic, anti-inflammatory, arthritis, gastrointestinal and cardiovascular effects.
7. Antioxidant, anticarcinogenic effect, antifibrotic effect and effect on immunity.
8. Anti-rheumatic activity, antioxidant and anticarcinogenic effect.
9. Arthritis, Alzherimer's and anti-inflammatory.
10. Abolished cytotoxic acitivity and antioxidant.

Table – 3: Studies On Use Of Turmeric In Periodontics

Study	Study Design	Results
Suhag et al. (2007)27	Compared curcumin irrigation with commonly used irrigant chlorhexidine (0.2%).	1% curcumin solution caused better resolution of inflammatory signs (BOP and redness) and PPD reduction than chlorhexidine and saline irrigation as an adjunctive therapy.
Murakami et al. (2008)28	Curcumin and its reduced derivative tetrahydrocurcumin have been shown to exhibit chemopreventive activity.	Curcumin has both oxidant and antioxidant properties. A causal link between the anti-inflammatory activities and molecular properties of phenolic antioxidants was suggested.
Habiboallah et al. (2008)29	Compared the effects of Curcuma longa-ghee formulation and hyaluronic acid on gingival wound healing following surgery in an animal model.	The results suggested a positive potential therapeutic effect on surgical wound healing particularly improvement of periodontal treatment consequences after surgery.
Waghmare et al. (2011)30	Compared chlorhexidine gluconate and turmeric extract mouthwashes for dental and gingival health.	Concluded that turmeric mouthwash could be a good adjunct to mechanical plaque control. Both mouthwashes showed efficacy and reduction of inflammation and plaque count, with the CHX mouthwash scoring better on the plaque index.
Behal et al. (2011)31	Effect of experimental local-drug delivery system containing 2% whole turmeric (gel form) as an adjunct to scaling and root planing (SRP) with the effect achieved using SRP alone	The experimental local drug-delivery system containing 2% whole turmeric gel can be effectively used as an adjunct to scaling and root planing and was more effective than scaling and root planing alone in the treatment of periodontal pockets.
Kim (2011)32	Investigated the effects of curcumin on the production of interleukin-6 (IL-6)	Curcumin may contribute to blockade of the host-destructive processes mediated by IL-6 and appears to have potential therapeutic values in the treatment of inflammatory periodontal disease.
Lopez-Jornet et al. (2011)33	Carried out an experimental animal study to show the effect of topical curcumin for the healing of carbon dioxide laser skin wounds in mice.	Topical curcumin applied to CO2 laser-induced skin wounds may be useful, because improved re-epithelialization was observed after 7 days.
Singh et al. (2012)34	Analysed insulin-mediated mitogenesis on curcumin(CUR)-treated hGF cells and developed an in vitro model of wound healing.	The in vitro model for gingival wound healing established that insulin significantly enhanced wound filling faster than CUR-treated hGF cells over 48 h. Reinforced the pivotal role of insulin in supporting CUR-mediated wound repair.
Zhang et al. (2012)35	Investigated the effect of curcumin on growth and apoptosis of myofibroblasts derived from human oral mucosa.	Results demonstrated the antifibrotic effect of curcumin in vitro. It may therefore be a candidate for the treatment of OSF.
Kudva et al. (2012)36	Carried out a compartive in vitro and in vivo study to evaluate the adjunctive efficacy of turmeric, curcumin, and traditional nonsurgical methods for treating periodontal pockets.	Plaque index and gingival index scores showed significant improvement from baseline to the end of the study

11. Ovarian and bone cancers.
12. Inhibitors of 5-lipoxygenase, cyclo-oxygenase and antileukemic.
13. CAKI-1 23 (renal cancer) and MCF-7 (breast cancer).
14. Inhibitors of HIV-1 integrase activity.
15. Antioxidant activity and hypocholestermic.
16. Turmeric also acts as a digestive agent.

Turmeric In Periodontics

Owing to its excellent anti-inflammatory, antimicrobial and wound healing properties use of turmeric and its derivatives has gained a momentum in the recent research in Periodontics. Some of the contemporary research with empirical evidence has been enumerated in **Table - 3**.

Clove (Syzygium Aromaticum)

Syzygium aromaticum(Linn.) Merr. & L.M. Perry (Syn. Eugenia aromatica) Kuntze, Eugenia caryophyllata Thunberg, belongs to family Myrtaceae, commonly known as clove, is an aromatic tree, native to Indonesia and used as a spice in cuisines in many parts of the world[37]. It is grown naturally in Moluku Islands of Indonesia and cultivated in many parts of the world like Tanzania, Madagascar, Sri Lanka, India, China, Indonesia, Malaysia, Brazil, Malagasy Republic, Jamaica and Guinea[38],[39]. It is an ever-green plant of 10 to 20 m in height with spear-shaped leaves and racemiferous yellowish flowers, has a strong phenolic smell and sharp acrid taste, whereas, essential oil of clove is a colorless or light yellowish fluid extracted from dried flower buds.

Clove In Periodontics

Although clove and clove oil have been used in dentistry as an analgesic from times immemorial and the use of eugenol, a derivative of clove has also a useful place in Endodontics, yet recent dental literature has shown empirical evidence of use of clove and its derivatives in periodontics.Some of the studies are enumerated in **Table - 4**.

Tulsi (Ocimum Sanctum)

Ocimum sanctumL. (also known as Ocimum tenuiflorum, Tulsi or Basil) has been used for thousands of years in Ayurveda for its diverse healing properties. Tulsi, the Queen of herbs, the legendary 'Incomparable one' of India, is one of the holiest and most cherished of the many healing and healthy giving herbs of the orient. The sacred basil, Tulsi, is renowned[45] for its religious and spiritual sanctity, as well as for its important role in the traditional Ayurvedic and Unani system of holistic health and herbal medicine of the East.

Marked by its strong aroma and astringent taste, it is regarded in Ayurveda as a kind of 'elixir of life' and believed to promote longevity. Tulsi extracts are used in Ayurvedic remedies for common colds, headaches, stomach disorders, inflammation, heart disease, various forms of poisoning and malaria. Traditionally, O. sanctum is taken in many forms, as herbal tea, dried powder or fresh leaf[46].

Ocimum sanctumL. (Tulsi) is an erect, much branched sub-shrub 30-60 cm tall, with simple opposite green or purple leaves that are strongly scented and hairy stems. Leaves have petiole and are ovate, up to 5 cm long, usually somewhat toothed.

Tulsi In Periodontics

Given its excellent antimicrobial, anti-inflammatory, wound healing and immunoregulatory properties, Tulsi has always generated interest from dental community for use in treatment and protection against periodontal diseases. Some recent evidence regarding use of Tulsi in periodontics has been enumerated in **Table - 5**.

Conclusion

Overview of use of herbs in periodontal practice revealed that although a lot of work to experimentally evaluate the efficacy of these herbs in clinical periodontics has been done and some

Table – 4: Studies On Use Of Clove In Periodontics

Study	Study Design	Results
Carrasco et al. (2009)40	-	Clove essential oil increased the total white blood cell count and enhanced the delayed-type hypersensitivity response in mice.
Mahadlek et al. (2010)41	The effects of clove oil and eugenol added into the prepared Zinc Oxide gel were studied.	The antimicrobial activity of the prepared gel was increased when the concentration of clove oil and eugenol was increased. The antimicrobial activity of systems comprising clove oil tended to be higher than that of eugenol.
Sikka, Dodwad and Chandrashekar (2011)42	Carried out a clinical study for a duration of four weeks and focused on two specific mouthwashes: HEXIDINE (0.2% chlorhexidine) and SEFDENT (a dual action mouthrinse with clove oil and sorbitol, sol isopropyl myristate, sodium saccharin)	Both the mouth-rinses studies turned out to be statistically significant but control group (HEXIDINE) showed significant improvement in plaque index, gingival scores, when compared to test group (SEFDENT). This showed that chlorhexidine remains a gold standard in improving the gingival status.
Moon et al. (2011)43	Evaluated clove oil and its major compounds, eugenol and ß-caryophyllene against oral bacteria, either alone or in combination with ampicillin or gentamicin,	The results suggested that the clove oil and eugenol could be employed as a natural antibacterial agent against cariogenic and periodontopathogenic bacteria. The antibacterial activity of the clove oil was higher than ß-caryophyllene but was similar to eugenol against all tested oral bacteria.
Kraivaphan and Amornchat (2012)44	Evaluated the efficacy of an essential oil (derived from clove) containing dentifrice on established plaque and gingivitis compared with a placebo dentifrice.	Essential oil containing dentifrice gave a 25.4% reduction ($p < 0.001$) in supragingival plaque accumulation and a 19.5% reduction ($p < 0.001$) in gingivitis compared to the placebo dentifrice.

Table – 5: Studies On Use Of Tulsi In Periodontics

Study	Study Design	Results
Singh et al. (2005)47	Assessed antibacterial activity of Ocimum sanctum L. fixed oil.	Ocimum sanctum fixed oil showed good antibacterial activity against Staphylococcus aureus, Bacillus pumilus and Pseudomonas aeruginosa, where S. aureus was the most sensitive organism.
Agarwal, Nagesh and Murlikrishnan (2010)48	Determined if Tulsi (Ocimum sanctum) extract has an antimicrobial activity against Streptococcus mutans.	At the 4% concentration of Tulsi extract, a zone of inhibition of 22 mm was obtained.
Agarwal and Nagesh (2011)49	Compared the effect of 0.2% Chlorhexidinemouth rinse, Listerine mouth rinse and 4% Tulsi extract mouth rinse on salivary Streptococcus mutanslevel.	Tulsi has stood the test and is as effective as Chlorhexidineand Listerine in reducing the salivary S. mutanslevels.
Malhotra et al. (2011)50	Compared the efficacy of a commercially available herbal mouthrinse (Herboral) with that of chlorhexidine gluconate.	Herboral. Herbal mouthrinse was found to be a potent plaque inhibitor, though less effective than Chlorhexidine Gluconate.
Rodrigues-Holanda et al. (2012)51	Evaluated the antiplaque and antigingivitis effect of 3% Ocimum gratissimum gel in human gingivitis.	Indicated that 3% OCG gel associated to brushing showed antiplaque and antigingivitis effect, being important as an adjuvant to plaque-induced gingivitis treatment.

promising results have been shown, yet there is almost no practical use in clinical practice as yet. It is time now to substantiate the evidence obtained in preliminary studies and to carry out multicentric trials to prove the efficacy of these herbal remedies and to ensure that if they have any beneficial effect then they should get place in contemporary clinical use.

There is a need to build up a industry-laboratory relationship, despite having shown a better efficacy in experimental studies, if these experiments do not transform into medicinal products that can be used clinically then all this work would prove to be a shear waste of resources.

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Clinical Significance Of Gcf In Periodontics

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Abstract
Gingival tissue is constantly subjected to mechanical and bacterial aggression. Gingival crevicular fluid (GCF) is an inflammatory exudate derived from the leaky venules adjacent to the sulcus and junctional epithelium. It is also called as sulcular fluid which passes from the blood stream through the tissues, and exiting into the gingival sulcus. Its composition and possible role in host defense mechanism were elucidated by Waerhaug et al. GCF is a complex mixture of substances derived from serum, leukocytes, structural cells of the periodontium, and oral bacteria. These substances posses a great potential to serve as indicators of periodontal disease and healing after therapy. In short, GCF acts as a window to the condition of the periodontium. This article addresses the role of GCF in and the important clinical changes that occur in periodontal diagnosis.

Key Words
Gingival crevicular fluid, biomarker, treatment planning

Introduction

Periodontitis is a chronic disease characterized by gingival inflammation, alveolar resorption, and destruction of periodontal ligament.[1] The goal of periodontal diagnostic procedures is to supply useful information on the type, location, and severity of the disease.[1] However, current diagnostic parameters only reveal the damage caused by the previous destructive episodes and not the present disease status.[1],[3] Enzymes and proteins that are released in health and disease differ significantly in their amount and type and their analysis can provide valuable information about tissues.[2],[5] Gingival crevicular fluid (GCF) is an important tool that makes such analysis possible.[6]

Gingival Crevicular Fluid

GCF is an inflammatory exudate that plays a major role in antimicrobial defence of the periodontium.[7] Formation of GCF depends upon the permeability of the junctional epithelium and sulcular epithelium. An important characteristic of the flow of GCF is its flushing action, which washes away bacteria, bacterial products, and foreign bodies.[6] GCF production is influenced by gingival stimulation, tooth brushing, bacterial insult, inflammation, IV injection of histamines. In inflammation, GCF flow rate increases and washes away the microbes and their metabolites from the gingival crevice and thereby controls their penetration into the tissues, and also facilitates the passage of more immunoglobulins into the sulcus and thereby enhances host defense.[8],[6] The flow might increase about 30-fold in periodontitis as compared to healthy sulcus and quantitative measurement of GCF may better indicate early inflammation as compared to subjective measures like colour change, bleeding, and gingival Index.[7],[6],[9] The negative side of increase in GCF flow is that, nitrogen, carbon, growth factors, vitamins, and minerals present in the GCF serve as a nutritional source for the microbes in the periodontal pocket.[10],[11]

GCF also plays a significant role in defense by transporting antibacterial substances of host origin & by introducing systemic antibiotics to the gingival crevice.[6],[12] GCF presents an efficient means to sample biomarkers of disease and provides a unique window to analyse the current condition of the periodontium.[7],[1](biomarker is a substance that is objectively measured that indicates the normal biologic processes, pathogenic processes, or responses to therapeutic intervention.[13],[1],[14]

In 1965, Löe et al started to explore the use of GCF to indicate periodontal diseases.[7] In 1971, Sueda, Bang and Cimasoni researched the proteins and enzymes present in the GCF and soon it was understood that the enzymes released from the damaged periodontal tissues had an enormous potential for periodontal diagnosis.[7]

Mechanism of GCF production

Alteration in microcirculation
Causing momentary blood vessel contraction
Followed by arteriolar vasodilatation
Increased vascular permeability
Seepage of fluids in sulcus
Exudate
Formation of GCF

Contents of GCF

The constituents of GCF are derived from serum, epithelium, connective tissue, host derived enzymes, electrolytes, proteins, tissue breakdown products, desquamated cells, inflammatory cells, inflammatory mediators, immune components, antibodies, bacteria and their metabolites.

Bacterial products in GCF

Bacterial products include endotoxin, collagenase, amines, butyrate, trypsin-like proteases. It also contains specific antibodies, organic compounds, lipids, drugs, etc.

Lipopolysaccharides (endotoxin) are molecules that are found in the outer membrane of the cell wall of gram negative bacteria. It is highly toxic to gingival tissues and is a potent stimulator of bone resorption. It also induces

production of collagenase and plasminogen activator and their levels positively correlate with gingival inflammation. Thus it is an important diagnostic factor in the GCF.

Trypsin-like enzymes are virulence factors produced by certain microbes that destroy the periodontium and their levels in the GCF provide useful information on the condition of the periodontium.[15]

Host Derived Enzymes

Host enzymes include collagenase, elastase, lactate dehydrogenase (LDH), acid phosphatase, aspartate aminotransferase(AST), alkaline phosphatase(ALP), lactoferrin, lysozyme, prostaglandins, β-glucuronidase, serum proteinase inhibitors, cycloperoxidase, pyrophosphatase, hyaluronidase.[4]

Neutrophil elastase(NE) is a neutral serine proteinase released by the neutrophils. It cleaves elastin and many other components of the gingival tissue and it has a positive relationship with inflammation and attachment loss.[4],[2] NE is the only enzyme to increase in gingivitis and a longitudinal study by Cox SW et al has shown that NE may predict future attachment loss.[4] Collagenase, another enzyme derived from neutrophils is also correlated with gingival inflammation.[7]

Cathepsin isa cysteine proteinase chiefly produced by macrophages. Cathepsin G converts inactive angiotensin-I to biologically active angiotensin-II and thereby regulates vascular permeability and monocyte chemotaxis. Cathepsin G and elastase and are capable or activating epithelial cells to produce IL-8, IL-6, PgE2, which increases chemotaxis and tissue degradation. Cathepsin levels are elevated in GCF in periodontitis but lower in gingivitis.[15]

Intracytoplasmic enzymes like lactate dehydrogenase (LDH) and aspartate aminotransferase (AST) are highly active biochemical markers.[4] Lactate dehydrogenase levels in GCF change at mild, moderate, and severe periodontitis and patients with increased probing depths show higher activity of LDH. Aspartate aminotransferase is a cytoplasmic enzyme which is released on cell death and its levels become higher in severe periodontitis.[4],[15]

β-glucuronidase is a hydrolysing enzyme produced by PMNs, macrophages, endothelial cells, and fibroblasts. Elevated levels of β-glucoronidase in GCF is associated with an increased risk for probing attachment loss and it is found to be increased six fold in periodontal disease.[15]

Myeloperoxidase(MPO) is an enzyme found in the primary granules of PMN. MPO levels in GCF increase propotional to the presence of plaque & severity of periodontitis and it has a good correlation with inflammatory response.[16]

Arylsulfatase activity in GCF is higher in gingivitis and periodontitis and their levels decrease following treatment.[15] β-N-acetyl-hexosaminidase (β-NAH) is an acid lysosomal hydrolase that is released during neutrophil phagocytosis and its levels are increased in periodontitis.[15]

Alkaline phosphatase (ALP) is a membrane-bound glycoprotein that is produced by polymorphonuclear leukocytes (PMNLs), macrophages, fibroblasts, osteoblasts, and gram-negative anaerobes.[1] It is involved in inflammation and also in regeneration and is a phenotypic marker for osteoblasts and is an indicator of bone formation.[11] However, the presence of ALP in the GCF usually indicates inflammation and/or destruction of periodontal tissues and it is an indicator of future periodontal breakdown.[1] ALP levels in GCF are detectable before the increase in gingival indices and hence it is a better marker of gingival inflammation.[1] Increased ALP activity in GCF has predictive value in terms of loss of attachment which is more accurate than clinical parameters and their levels are 20 times greater in diseased sites.[15],[1] Moreover, there is sustained, statistically significant decrease in ALP values after treatment.[2] Thus, the ALP levels precisely depict progression or regression of the disease and hence used in treatment planning and monitoring.[2]

Matrix metalloproteinases (MMP) are zinc and calcium-dependent endopeptidases (neutral proteinase) derived mainly from PMN and fibroblasts and they play an important role in initiation and progression of periodontal destruction.[17],[18] GCF levels of MMP-1 (collagen I), MMP-2 (gelatinase-2) and MMP3 (stromlysin). MMP8 and MMP-9 are higher in periodontitis patients.[17] Neutrophils are the major cells that produce MMP-8 & MMP-9. MMP-8, otherwise known as collegenase-2 potentially degrades interstitial collagen and rapid chair side test on detection of elevated MMP-8 in GCF helps in diagnosis and monitor the course and treatment of periodontitis. MMP-9, also known as gelatinase B degrades extracellular matrix proteins. MMP-9 too serves as a guide in periodontal treatment monitoring. In 1992, Tere showed a world ofincrease in mean MMP-9 levels in patients with recurrent attachment loss. MMP-13 is collagenase-3 that is expressed during bone formation and gingival wound healing. MMP-13 may be useful in monitoring periodontal attachment loss and in tracking the efficacy of therapy. MMP-2 is secreted by fibroblasts and its levels are lower in gingivitis and periodontitis compared to health.[17] Detection method for GCF MMPs include immunoblot, Elisa and Time involved immunofluorescence technique.

Non-specific neutral proteases are non-specific metalloproteaseswhich cleave fibronectin and collagen and their elevated level shows an active phase of periodontitis.[15]

Dipeptidyl Peptidases (DPP) are derived from macrophages, lymphocytes, and fibroblasts. They activate proforms of enzymes and cytokines and also degrade collagen and their levels are higher in GCF in diseased sites.[15]

Extracellular matrix components in GCF

Tissue destruction products of GCF include fibronectin(FN), osteonectin, hydroxyproline, glycosaminoglycans, collagen peptides, bone-specific markers like osteocalcin and collagen telopeptide fragments.[7] Collagen is the most important structural protein of the periodontium and the presence of greater amounts of collagenous products in the GCF represent a measure of periodontal destruction.[19] Collagen levels in GCF are usually measured by hydroxyproline assay.[19] FN is a component of the extracellular matrix (ECM) and its presence in GCF indicates tissue destruction.[15] Elastin and proteoglycan levels are also increased in periodontitis.

Laminin is a glycoprotein which is found in the basement membrane.[15] During inflammation, activated neutrophils cause an extensive destruction of basement membrane and higher amounts of laminin is released into the GCF.(35) Thus presence of laminin in GCF suggests the presence of hyperactive neutrophils.[15]

When periodontal tissues are degraded, glycosaminoglycans (GAG) are released

and considerable amount of sufated-GAGs are found in GCF in advanced periodontal disease.[15] Chondroitin-4-sulfate is the major GAG in periodontium. It is a potential marker for bone breakdownand its levels are increased in periodontitis.[15] Chondroitin-6 sulfate levels are also increased in periodontitis. Overall, the presence of increased levels of GAG reflects active destruction of alveolar bone and early preclinical changes in the periodontium can be analysed by the presence of GAG in GCF.

Calprotectin is a protein produced by PMNs, macrophages, and epithelial cells.[15] It has antimicrobial and antifungal properties and it is a proinflammatory protein for neutrophil recruitment and activation. It also plays a role in immunoregulation and its levels in GCF are higher in periodontitis.[15]

Osteocalcin is a non collagenous protein of bone chiefly synthesized by osteoblasts. It plays a role both in bone mineralization and resorption. It is chemoattractant to osteoclasts progenitors and monocytes and their levels in GCF are correlated significantly with pocket depths and gingival index scores.[14],[15] Also, Nakashimaet al has reported that osteocalcin levels significantly correlated with GCF levels of ALP.

Osteopontin is produced both by osteoblasts and osteoclasts and it functions in anchoring the osteoclasts onto the bone surface. It exhibits chemoattractive activity to osteoblast progenitor cells and monocytes. With progression of periodontal disease, GCF osteopontin concentration increased and their levels significantly reduced after nonsurgical therapy.[15],[20] Hence, it may be considered as a marker of progression of periodontitis.[20]

Pyridinoline cross-linked carboxyterminal telopeptide of type I collagen (ICTP) is the carboxyterminal telopeptide of type I collagen and it is released subsequent to osteoclastic resorption and collagen degradation.[15] These cross-linked telopeptides are produced as a result of post-translational modification of collagen and they could not be reused for collagen synthesis.[21] Their levels are increased in active bone destruction and they are good predictors of future bone loss and attachment loss.[15],[21].

Biochemical mediators and products of inflammation

In response to chemoattractant effects of bacteria, macrophages/neutrophils migrate to the sulcus, get activated and produce important mediators like TNF-alpha, IL-1, IL-6, which are related to host response and tissue destruction. Levels of IL-1alpha, IL-1beta, and IL-1Ra were significantly higher in GCF from diseased site compared to healthy sites.

Large proportion of B lymphocytes and plasma cells were present in advanced stages of periodontal disease. Interferon-inducible protein IP-10 and IL-1β are found to be much higher in sites that have BOP with IL-1β levels directly propotional to BOP, probing depth, and presence of P. gingivalis in the subgingival plaque.[22] Also, there is increase in levels of IL-1 alpha, IL-2, IL-6, IL-8, TNF alpha, interferon-gamma in periodontal disease. Interleukin-23 plays a role in the initiation and progression of periodontitis and its concentration in the GCF increases directly proportional to the periodontal damage.[23] RANTES is a proinflammatory cytokine present in GCF in periodontitis, which is undetectable in health.[24]

Other immune components in the GCF include complement, immunoglobulins, cytokines, eicosanoids, acute phase proteins, colony stimulating factor, leukotrienes, transferrin.[25],[19] At least 40 different cytokines and chemokines are present in the GCF.[22]

Complements in the GCF kill microbes directly or by teaming up with antibodies or by signaling the PMNs to migrate to the gingival sulcus and phagocytose the microbes. C3 and C4 are found in GCF, with C3 at higher levels in chronic periodontitis. When osteoclast like cells are stimulated by C5a, significant amounts of bone resorbing IL-6 are released, suggesting a potential tissue destructive contributor fromthis type of host response.

IgG predominate in GCF in advanced periodontal lesions and the levels of IgG1 and IgG4 are significantly elevated in the active sites relative to serum.[26],[25] Particularly, IgG4 was found to be almost 25 times that of serum level.[27],[25]. IgA levels were significantly higher in GCF of gingivitis sites compared that of periodontitis sites, which suggests that IgA can have a locally protective function.[25],[28]

Prostaglandin E2 (PgE2) is an arachidonic acid metabolite and the primary cells that produce PgE2 in the periodontium are macrophages and fibroblasts.[24] PgE2 causes bone resorption and inhibits collagen synthesis and is present in elevated levels in active phases of periodontitis.[24] Leukotriene B4 (LTB4) is another arachidonic acid metabolite produced by PMNs, macrophages, eosinophils.[24] LTB4 contributes to inflammation and bone destruction and their levels are increased in disease.[24]

The levels of the acute phase proteins C-reactive protein (CRP), lactoferrin, and transferrin increase in periodontitis.[24] Rapid and dramatic rise in blood levels of CRP is produced by inflammatory cells and its levels rise dramatically in inflammation in response to stimulation by IL-1. CRP binds to phosphocholine expressed on dead or dying cells and some bacteria and activates the complement system.[24] Lactoferrin (Lf) is an iron-bindingglycoprotein which is antibacterial against Porphyromonas gingivalis, Aggregatibacter actinomycetemcomitans, and Prevotella intermedia.[36] Lactoferrin levels are found to be increased two fold in the GCF in chronic and localised aggressive periodontitis and their levels are useful to assess of periodontal inflammation. Transferrin- is iron binding glycoprotein.[24] In the GCF, it limits the amount of iron and thus functions as an antibacterial agent.[24] Its levels are increased in both gingivitis and periodontitis and hence it does not distinguish between gingivitis and periodontitis.

α2- macroglobulin is a protease inhibitor produced by the tissues and its concentration in the GCF increases in inflammation.[15] TIMPs arelocally produced enzymes which defends the connective tissues against degradation by metalloproteinases and their levels are significantly greater in periodontitis.[15] Lysozyme levels in GCF are found to be increased in patients with aggressive periodontitis and experimental gingivitis Proteins in GCF include histones, keratins, beta 2-microglobulin, histones, lipoproteins, fibrinogen, and albumin, ALB protein, apolipoprotein A-I, etc. Proteins like annexin A3, myosin 9, L-plastin (plastin-2/LCP1), profilin-1, S100A8, S100A9, S100-P, cystatin-B , azurocidin, actin, myosin, vitamin D-binding protein, serotransferrin were present at higher levels in periodontitis

cases compared to healthy individuals. Protein Annexin-1 is at 5-fold greater concentration in GCF in healthy individuals compared to the diseased and the level of Cornifin-A is downregulated in periodontitis.[29] L-plastin (plastin-2/LCP1) and dermcidin are detected in the GCF only in periodontitis.[29] Azurocidin is a cationic antimicrobial protein that prevents alveolar bone loss by inhibiting the differentiation of macrophages to osteoclasts. It also exhibits antimicrobial activity against Gram-positive & Gram-negative bacteria, and fungi and its levels are highly elevated in the GCF in periodontitis.[29]

The levels of electrolytes sodium, potassium, and calcium in the GCF were higher in sites with gingivitis and periodontitis than their corresponding levels in serum.[30] Sodium is present in large amounts in the bone and with its destruction, more of sodium is present in the GCF.[30] The increased amount of potassium in periodontitis is probably due to its release by the disrupted epithelial cells, connective tissue cells, and blood cells in the periodontal pocket.[30]

Total oxidant status (TOS), receptor activator of nuclear factor-κB ligand (RANKL), and RANKL/OPG values are increased in the GCF in periodontitis, with the increase more evident in aggressive periodontitis than chronic periodontitis.[31]

Desmosomes establish and maintain the cell-cell contact.[36] In periodontitis, autoantibodies against desmosomes may be produced, which inhibit cell-cell contact and cause apical migration of the junctional epithelium.[24] Increased titers of anti-desmosomal antibodies in the GCF distinguish periodontitis from the unaffected sites.[24]

Melatonin is a hormone which has powerful antioxidant properties and is believed to play a protective role against periodontal disease.[32] GCF melatonin levels drop to the lowest concentrations in periodontitis compared to health.[32]

CD14 is a pattern recognition receptor and a key component of the innate immune system that is expressed on monocytes, macrophages, neutrophils, and fibroblasts.[33] Higher levels of mCD14 is found in clinically healthy tissues and low levels of sCD14 are associated with greater probing depths.[33] This implies that sCD14 might play a protective role against disease.[33]

Soluble cell adhesion molecules

Cell adhesion molecules (CAM) are cell surface proteins that facilitate cells to bind to each other, to endothelial cells or to the extracellular matrix. The soluble forms of CAMs are produced by proteolytic cleavage from the cell surface and are shed into the GCF. The CAM in GCF are s1CAM-1, sVCAM-1, and sE selectin. These potential markers may offer greater diagnostic sensitivity and specificity.

GCF as tool to diagnose systemic diseases

GCF can be analysed to determine the presence of specific markers for systemic diseases.

Diabetes is one of the most frequent metabolic disorder of which nearly half the cases are undiagnosed. As metabolic control of diabetes mellitus decreases, levels of beta glucoronidase increase. Beta glucoronidase is a periodontal disease activity marker and this reveals that diabetics with poor metabolic control are at a high risk for periodontitis. At the same time, no relationship was found between the amount of LDH and diabetic control. PgE2 and IL-1 beta levels are higher in insulin dependent cases, while IL-6 levels are higher in noninsulin dependent cases. Also, VEGF levels are found to be increased in periodontally inflamed tissue with diabetes mellitus.

The relationship of CVS/CNS & periodontal disease is of special interest. Leukotriene levels are found to be increased in periodontitis. The increased levels of cysteinyl leukotriens in GCF may be an important inflammatory marker for increase in risk of atherosclerosis associated periodontal disease.

Oxidative modification of low density lipoproteins (LDL) occur in diseased tissues and local inflammation sites.[34] The ratio of anti-oxidized low density lipoprotien (ox LDL) to LDL in GCF is found to be significantly greater in chronic periodontitis as compared to health.[34] A spike in ox LDL levels in systemically healthy patients may increase the patient's risk to develop atherosclerosis.[34]

GCF may be a significant source of hepatitis virus in saliva. Anti HCV antibodies are detected in GCF of HCV positive patients. Greater levels of HCV rna are present in GCF in hepatitis patient and hence analysis of GCF concentration of HCV rna reveal a better detection rate.

Increased levels of IL-1 beta, IL-6, TNF-alpha, interferon-gamma in GCF are found to be associated with periodontal disease in HIV-1 infected patients.

GCF can also be used to screen for the presence of hepatopathy. In hepatopathy, alanine aminotransferase (ALT) levels are increased in the GCF.

Smokers demonstrate higher levels of IL-6 &IL-8 but low levels of IL-4 & IL-1alpha. FGF-beta1 levels in GCF are greater than nonsmokers.

GCF and periimplantitis

As per Boutrous et al (1996), neutrophil protein levels are higher at moderate to severely inflamed implant sites. In osseointegrated implants, there is less activity of elastase and collagenase in GCF. But in failing implants, neutrophil elastase, myeloperoxidase, and beta glucoronidase levels are significantly higher.

Longitudinal studies have been conducted to evaluate the effects scaling and root planing (SRP) on GCF components and it was found that generally there was a decline of markers for progressive periodontitis after SRP.[35],[36] However, the markers stayed at an elevated level at sites unresponsive to nonsurgical therapy.[35],[37] This enables the clinician know if a particular site is at a risk of disease progression and thereby plan treatment strategy accordingly.[35]

Limitations

1. Multiple GCF samples are needed.
2. Selection of teeth and site to check for disease progression is difficult.
3. Lab diagnostic tests for multiple patient samples are difficult to adopt.

Conclusion

GCF is an inflammatory exudate that has wide clinical significance in assessing the severity of periodontal disease and effectiveness of periodontal therapy. It is an easier and noninvasive collection medium to assess changes in periodontal tissues and is one of the most reliable "predictor of periodontal health".

Researches in medicine and biotechnology are continuously investigating the use of oral fluids like saliva and GCF to diagnose oral and systemic diseases and to determine their response to therapy.[21] GCF and saliva are also under research to be used to detect toxins and to screen for metabolites of

drugs of abuse.[21] In the field of oral diagnosis, substantial improvements have been made in the detection of biomarkers in GCF and saliva with latest diagnostic techniques like protein and nucleic acid microarrays and microfluidics.[21],[38] GCF is closer to periodontal tissues compared to saliva, and hence it can provide more information about the periodontal condition than markers in saliva.[38] Also, the molecules in saliva might reflect the metabolic status and diseases of salivary glands instead of the periodontal condition.[38] As no single biomarker will fulfil all the criteria necessary for assessment of health of the periodontium, simultaneous screening of multiple biomarkers in the GCF may prove a valid clinical diagnostic tool.[21]

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Rationale For Early Treatment And Different Treatment Modalities Of Class I I I Malocclusion: A Review

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Abstract
Class III malocclusion is associated with a deviation in the sagittal relationship of the maxilla and the mandible, characterized by a deficiency and/or a backward position of the maxilla, or by prognathism and/or forward position of the mandible. 1 The incidence in Caucasians ranges between 1% and 4% depending on the method of classifying the malocclusion and the age group evaluated. 2,3 In the Asian populations, however, the incidence ranges from 9% to 19%, 4,5 and in Latin populations the incidence is approximately 5%. 6 The prevalence of Class III malocclusion in India was reported to be in the range of 0.5 % to 4%. 7

Key Words
Class III, gonial angle, maxillary protraction, sutures

Introduction

Class III malocclusion is associated with a deviation in the sagittal relationship of the maxilla and the mandible, characterized by a deficiency and/or a backward position of the maxilla, or by prognathism and/or forward position of the mandible.[1] The incidence in Caucasians ranges between 1% and 4% depending on the method of classifying the malocclusion and the age group evaluated.[2],[3] In the Asian populations, however, the incidence ranges from 9% to 19%,[4],[5] and in Latin populations the incidence is approximately 5%.[6] The prevalence of Class III malocclusion in India was reported to be in the range of 0.5 % to 4%.[7]

The etiology of Class III malocclusion is multifactoral because of an interaction of both hereditary and environmental factors such as habits and mouth breathing may also play a role. Individuals with Class III malocclusion may have combinations of skeletal and dentoalveolar components. According to Guyer and coworkers, 57% of the patients with either a normal or prognathic mandible showed a deficiency in the maxilla.[10] The contributions of the cranial base, maxilla, mandible, and temporomandibular articulation have been described in detail in the literature.[8],[9],[10],[11],[12] Class III malocclusions associated with craniofacial disharmonies are much more difficult to treat and tend to relapse.[13]

Early treatment of Class III malocclusion has been advocated to reduce the need of treatment in the permanent dentition.[1] However, one of the reasons orthodontists are reluctant to render early orthopedic treatment in Class III patients is the inability to predict mandibular growth.[14] Also patients who have received early orthopedic treatment could still require surgical treatment at the end of the growth period. The ability to identify Class III patients with excessive mandibular growth at an early age could help orthodontists to plan for future orthodontic care. The use of a single cephalometric radiograph to predict mandibular growth has limitations. Discriminant analysis from long-term results of early treatment identified several cephalometric variables such as the position of the mandible, corpus length, gonial angle, and ramal height that have predictive values.[15],[16],[17] These predictive formulae are better in predicting successful outcomes than unsuccessful outcomes.

Different treatment modalities and outcomes are explained in this article regarding early orthopedic treatment in Class III malocclusion so as to reduce the need of treatment in the permanent dentition, when camouflage orthodontic treatment or surgery become the only options.

Rationale for Early Timely Treatment of Class III Malocclusions

The objective of early orthodontic treatment is to create an environment in which a more favorable dentofacial development can occur.[18] The goals of early Class III treatment may include the following:

1. To prevent progressive irreversible soft tissue or bony changes. Class III malocclusion is often accompanied with an anterior crossbite. Uncorrected anterior crossbite may lead to abnormal wear of the lower incisors, dental compensation of mandibular incisors, leading to thinning of the labial alveolar plate and/or gingival recession.[19]
2. To improve skeletal discrepancies and provide a more favorable environment for future growth. Excessive mandibular growth is often accompanied by dental compensation of the mandibular incisors. Early orthopedic treatment using facemask or chin cup therapy improves the skeletal relationships, which in turn minimize excessive dental compensation such as overclosure of the mandible and retroclination of the mandibular incisors.
3. To improve occlusal function. Class III malocclusion with an anterior crossbite is often accompanied by a

functional shift. Early orthopedic treatment may help in eliminating centric occlusion/centric relation (CO/ CR) discrepancies and avoid adverse growth potential.

4. To simplify phase II comprehensive treatment. In mild and moderate Class III patients, early orthodontic or orthopedic treatment may eliminate the necessity for orthognathic surgery treatment. Even if surgery is eventually needed, early correction of the transverse dimension and maximizing the growth potential of the maxilla may minimize the extent of the surgical procedures.
5. To provide more pleasing facial esthetics, thus improving the psychosocial development of a child.[20] Studies have shown that treatment with facemask and/or chin cap improves lip posture and facial appearance.[21],[22]

Different Treatment Modalities for Early Treatment of Skeletal Class III Malocclusions

Chin Cup Therapy

Skeletal malocclusion with a relatively normal maxilla and a moderately protrusive mandible may be treated with the use of a chin cup. This treatment modality is popular among the Asian population because of its favorable effects on the sagittal and vertical dimensions. The objective of early treatment with the use of a chin cup is to provide growth inhibition or redirection and posterior positioning of the mandible. The orthopedic effects of a chin cup on the mandible include redirection of mandibular growth vertically, backward repositioning (rotation) of the mandible, and remodeling of the mandible with closure of the gonial angle. To date, there is no agreement in the literature as to whether chin cup therapy may or may not inhibit the growth of the mandible.[23],[24],[25],[26] However, chin cup therapy has been shown to produce a change in the mandible associated with a downward and backward rotation and a decrease in the angle of the mandible.[24],[25],[26],[27] In addition, there is less incremental increase in mandibular length together with posterior movement of the mandible. Because of the backward mandibular rotation of the mandible, control of vertical growth is difficult to manage, especially in long-face patients.

Chin cups are divided into two types: the occipital-pull chin cup that is used for patients with mandibular protrusion and the vertical-pull chin cup that is used in patients presenting with a steep mandibular plane angle and excessive anterior facial height. Most of the reported studies recommended an orthopedic force of 300 to 500 g per side.[28],[29],[30] Patients are instructed to wear the appliance 14 hours per day. The orthopedic force is usually directed either through the condyle or below the condyle. Evidence suggests that treatment of mandibular protrusion is more successful when it is started in the primary or early mixed dentition.[26],[29],[31] The treatment time varies from 1 year to as long as 4 years, depending on the severity of the malocclusion. The stability of chin cup treatment remains unclear. Several investigators reported a tendency to return to the original growth pattern after the chin cup is discontinued.[31],[34] Sugawara and coworkers published a report on the long-term effects of the chin cup on three groups of Japanese girls who started treatment at 7, 9, and 11 years of age.[33] The authors found that patients who started at an early age had a catch-up mandibular displacement in a forward and downward direction before growth was completed. However, several investigators believe that early correction of anterior crossbite reinforces the horizontal growth of the maxilla and prevents deterioration of horizontal jaw relationships.[30],[31]

Protraction Facemask Therapy

The protraction facemask has been used in the treatment of patients with Class III malocclusions and a maxillary deficiency. The facemask has an adjustable anterior wire that can accommodate a downward and forward pull on the maxilla with elastics. To minimize the tipping of the palatal plane, the protraction elastics are attached near the maxillary canines with a downward and forward pull of 30° from the occlusal plane.[34] Maxillary protraction usually requires 300 to 600 gm of force per side, depending on the age of the patient. Patients are instructed to wear the appliance for 12 hours per day. In the mixed dentition, a banded or bonded expansion appliance can be fabricated as anchorage for maxillary protraction. The expansion appliance is activated twice daily (0.25 mm per turn) by the patient or parent for 7 to 10 days. In patients with a more constricted maxilla, activation of the appliance is performed for 2 weeks or more. Several facial sutures play an important role in the development of the nasomaxillary complex (frontomaxillary, nasomaxillary, zygomaticotemporal, zygomaticomaxillary, pterygopalatine, intermaxillary, ethmomaxillary, and the lacrimomaxillary sutures). Animal studies have shown that the maxillary complex can be displaced anteriorly with significant changes in these facial sutures.[33],[35],[36] Maxillary protraction, however, does not always result in forward movement of the maxilla. With the same line of force, different midfacial bones were displaced in different directions depending on the moments of force generated at the sutures.[36] The center of resistance of the maxilla was found to be located at the distal contacts of the maxillary first molars one half the distances from the functional occlusal plane to the inferior border of the orbit.[37] Protraction of the maxilla below the center of resistance produces counterclockwise rotation of the maxilla, which may not be favorable for patients with an open bite tendency.[38]

Clinically, anterior crossbite can be corrected with 3 to 4 months of maxillary expansion and protraction depending on the severity of the malocclusion. Improvement in overbite and molar relationship can be expected with an additional 4 to 6 months of treatment. In a prospective clinical trial, overjet correction was found to be the result of forward maxillary movement (31%), backward movement of the mandible (21%), labial movement of the maxillary incisors (28%), and lingual movement of the mandibular incisors (20%).[39] Overcorrection of the overjet and molar relationship was highly recommended in anticipation of unfavorable mandibular growth. Overbite was improved by eruption of the posterior teeth. The total facial height was increased by inferior movement of the maxilla and downward and backward rotation of the mandible. The question arises as to when is the best time to start protraction facemask treatment. The main objective of early facemask treatment is to enhance forward displacement of the maxilla by sutural growth. It has been shown by Melsen in her histological findings that the midpalatal suture was broad and smooth during the “infantile” stage (8 to 10 years of age) and the suture became more

squamous and overlapping in the "juvenile" stage (10 to 13 years).[40],[41] Clinically, studies have shown that maxillary protraction was effective in the primary, mixed as well as early permanent dentitions. Several studies suggested that a greater degree of anterior maxillary displacement can be found when treatment was initiated in the primary or early mixed dentition.[42],[43] The optimal time to intervene a Class III malocclusion is at the time of the initial eruption of the maxillary incisors. A positive overjet and overbite at the end of the facemask treatment appears to maintain the anterior occlusion. Biologically, the circummaxillary sutures are smooth and broad before age 8 and become more heavily interdigitated around puberty.[40] Another question is whether early treatment can sustain subsequent mandibular growth during pubertal growth spurt. In a prospective clinical trial, protraction facemask treatment starting in the mixed dentition was found to be stable 2 years after the removal of the appliances.[34] This is probably due to the overcorrection and the use of a functional appliance as retainer for 1 year. When these patients were followed for another 2 years 15 of the 20 patients maintained a positive overjet.[39] In patients who relapsed back to a negative overjet, the mandible outgrew the maxilla in the horizontal direction. When these patients were followed for another 4 years (8 years after treatment until about 17.5 years of age), 14 of 20 patients (67%) maintained a positive overjet.[44] For the patients who relapsed back into a reverse overjet, the mandible outgrew the maxilla by four times, compared with twice that in the stable group. These results suggest that in a random clinical trial when patients are followed until after completion of pubertal growth, two of three patients or 67% will have a favorable outcome. About one third of the patients might be candidates for orthognathic surgery later in life because of an unfavorable growth pattern. In an implant study, Bjork and Skieller examined the normal and abnormal growth of the mandible found that condylar growth does not follow a circular or logarithmic spiral course.[45] It is characterized by individual variations both in the rate and growth direction. In addition, the rotation of the maxilla also varied from child to adulthood.

Fränkel's Function Regulator Type III

Among a great variety of appliances, Fränkel's function regulators (FR) have become a well-established adjunct for functional orthopedics. Their mode of action, however, is still a subject of controversy.[48],[49],[50] According to Fränkel, a Class III is the result of a maxillary growth deficit and concomitant excessive mandibular growth. Thus, the FR III aims to counteract the forces of the surrounding muscles which presumably restrict maxillary growth. Due to the appliance design, a reciprocal growth restricting force is believed to affect the mandible. It has been stated by Fränkel and McNamara that early treatment with FR III appliance offers some opportunities including normal displacement of teeth and facial bones and space gaining in dental arches.[51],[52],[53],[54] There are conflicting opinions regarding the treatment effects of the FR III appliance on maxillary growth. Some reports support the idea that FR III therapy produces a favourable growth effect on the maxilla and produced considerable improvements in maxillary size and position.[50],[52],[55],[56] Recently, Levin et al. showed that with the use of FR III appliance the SNA increased 1.3 degrees and effective midfacial length was 1.3 mm more than in the control group.[56] Also some studies failed to find significant improvements in the maxilla.[54],[57],[61] McNamara and Huge showed that FR-3 therapy directed mandibular growth in a vertical direction.[52] The vertical changes are in agreement with studies that found the FR III appliance to stimulate mandibular growth in a vertical direction.[54],[60],[61],[62],[63] Most of the studies on this subject evaluated the sagittal and vertical effects of the FR III appliance . According to those authors, correction of a Class III malocclusion is produced mainly by the downward and backward rotation of the mandible and/or alterations in upper and lower incisor inclinations.[54], [57], [59], [60], [61], [62], [63] Only a limited number of studies investigated the transversal dentoalveolar changes and demonstrated favourable maxillary dentoalveolar effects produced by FR III. The FR III appliance produced a significant dental and alveolar widening in maxilla, but it did not affect mandibular apical base.[54],[56],[57]

FR treatment never results in 'normalization' but only an approximation to normal parameters of the respective dental or skeletal structures. it is not an appliance to correct every Class III malocclusion. The Class III occlusion and overjet were improved by means of skeletal changes in conjunction with upper incisor proclination and lower incisor retroclination.[64] This is not a negative remark because the FR III will remain an indispensable treatment adjunct until replaced by a more effective one. The FR III will continue to be used until a more effective and comparably simple appliance for early treatment of patients with a developing Class III malocclusion.

Class III Twin Blocks

The Twin Block appliance is widely used for the treatment of Class II malocclusions. However, Clarke has also described a version of the twin block that may be used for Class III malocclusions. Clark states that reverse angulation of blocks harnesses occlusal forces to advance the maxilla and maxillary dentition while using the mandible as anchorage and restricting its development.[65] The appliance is effective at correcting reverse overjet during the mixed dentition as an alternative to the Frankel FR III appliance or an upper removable appliance alone. Changes are mainly dento-alveolar, due to proclination of the upper incisors and retroclination of the lower incisors.[65] Skeletal change is limited to slight downward and backward rotation of the mandible, with an associated increase in anterior, vertical dimension. Treatment during the deciduous or early mixed dentition has been shown to give more favourable skeletal changes during treatment with a functional appliance or rapid maxillary expansion and protraction headgear.[67],[68] The indications for treatment with the reverse Twin Block are those cases in the mixed dentition with a reverse overjet associated with a mild saggital skeletal discrepancy and an average or reduced anterior vertical dimension.

Class III Twin Block therapy is effective in the early treatment of a Class III malocclusion. However, long-term stability of the treatment effects will be influenced by favorable growth. The primary effects of the Class III Twin Block appliance are dental, as characterized by upper incisor proclination and lower incisor retroclination, with minimal skeletal effects. In contrast, significant maxillary

advancement and less pronounced dental changes occurred with Protraction Facemask therapy.[69]

Tandem Traction Bow Appliance (TTBA)

Orthopedic correction of the growing Class III patient is designed to improve the profile and occlusion by protracting the maxilla and repositioning the mandible. Although maxillary expander-facemask appliances and reverse headgears can achieve excellent orthopedic effects, they demand special patient compliance because they are worn extra - orally, and are not as esthetic or comfortable as intraoral appliances. Proffit believes the optimal age for maxillary protraction is about 6-7.[1] But because only a few permanent teeth have erupted at this young age, adequate anchorage for a maxillary protraction appliance can be problematic.

Chun and coworkers introduced the tandem traction bow appliance (TTBA) for the treatment of growing Class III patients. They defined the TTBA as a more aesthetic and comfortable device compared with conventional appliances because it is removable, easy to maintain oral hygiene, and worn intraorally. It allows early treatment of any Class III malocclusion, due to optimal retention in the deciduous, mixed, or early permanent dentition. TTBA distributes the force of protraction to all maxillary teeth and permits free mandibular movement, with its polished occlusal surface, so that a functional shift is easily corrected. It also maintains arch length, unlike extraoral maxillary protraction appliances that tend to produce anterior crowding. In two published case reports, it has been suggested that TTBA and modified applications have a similar treatment effect to that of an expander–facemask combination.[70],[71]

The TTBA comprises an upper splint, a lower splint, and a traction bow . Its design allows the patient to open the mouth freely .The upper splint, which can serve the same function as a rapid maxillary expander, covers the palatal and occlusal surfaces of the maxillary teeth . A portion of the buccal surfaces are also covered, providing adequate retention to overcome the maxillary protraction force of as much as 400-500g per side. During active treatment, the labial bow is embedded in the acrylic; it is uncovered and used to retain the incisors when the TTBA is reassembled as a monoblock retainer. The lower splint covers the buccal and lingual surfaces of the mandibular teeth to reinforce retention . The traction bow is a modification of a conventional headgear outer facebow . In the deciduous and mixed dentition, the applied force should be 300-500g for orthopedic effect; in the early permanent dentition, it should be 150-300g for orthodontic effect, avoiding undue stress on the TMJ. The patient is asked to wear the TTBA 12-14 hours per day for orthopedic effect, and more than 14 hours a day for orthodontic effect. After the crossbite is overcorrected, the two splints are fused into a monoblock and used as a retainer.[70]

In a study conducted to evaluate the dentofacial effects of a modified TTBA in skeletal Class III subjects and the effect of age on treatment response, satisfactory correction was obtained of the Skeletal and Dental Class III malocclusion. It was concluded that the indications for treatment with a modified TTBA include subjects with a skeletal Class III and an optimum SN/GoGn angle. As the extraoral view of the appliance is more aesthetic compared with a facemask, it could be a good alternative for non-compliant patients. In the study upper incisor protrusion and labioversion, lower incisors retrusion and tipping lingually, mesial movement of the upper molars and uprighting of the lower molar led to dental and skeletal changes due to which a positive overjet was obtained . As a result of the forward movement of the maxilla and the slight backward movement of the mandible, a significant increase was observed in ANB after TTBA treatment.[72]

Kim and other investigators in their study on Maxillary protraction effects of TTBA therapy in Korean Class III children found that the maxilla and maxillary dentition moved forward. The mandible moved backward, although not significantly, while the mandibular dentition moved forward. The net dental changes combined with the apical base change resulted in a favorable total molar relationship correction. The net dental movement was 26% and the apical base change 74% (MAX, 30%; MAND, 44%) of the total molar relationship correction, and the skeletal contribution to correction of this Class III malocclusion was higher than in other studies. These results suggest that TTBA has a maxillary protraction effect that is useful in the treatment of a growing skeletal Class III malocclusion with maxillary deficiency.[73]

Conclusions

Treating Class III malocclusion is one of the most complex problems arising in orthodontic practice because the growth patterns in such patients are unpredictable and unfavorable. The traditional orthopedic treatment for skeletal Class III malocclusion in children who have not yet reached the period of pubertal growth spurt involved correcting skeletal deficiencies. With the introduction of the new orthopedics based on bone-anchored systems has made it necessary to revise all of these previous concepts. In modern orthodontic practice, it appears possible to apply pure bone-borne orthopedic forces between the maxilla and the mandible for 24 hours per day, avoiding dentoalveolar compensations.[74]

This review compiles and analyzes the various possibilities of orthopedic treatment and conventional orthopedic appliances for Class III malocclusion in the scientific literature. The lack of long-term studies, however, means that further research, using well-designed studies and better clinical evidence, is necessary to assess the stability of orthopedic therapy in skeletal Class III malocclusions.

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Fixed Prosthodontics - Diagnosis With Recent Aids

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Abstract
Dentistry is rapidly evolving from a surgical and reparative profession into a healing profession focused on overall patient wellness. The focus is now disease prevention, early diagnosis, and intervention to minimize treatment, thus enabling the most desirable outcomes. Advanced diagnostic technologies are increasingly playing a more vital role in this process, both in data collection and assessment capabilities, and the utilization of the information obtained. Diagnostic modalities available to clinicians today expand greatly on the foundation of a comprehensive visual assessment , which has been and will be the cornerstone of the diagnostic process. The diagnostic clinician today is able to obtain a seemingly endless amount of information to assess the patient's oral health, which in turn gives them and the patient's other healthcare providers tremendous knowledge about the patient's overall health and wellness. This article reviews various advanced diagnostic aids like CBCT, Occlusal markers, biomarkers and genotype study etc. used now these days in fixed partial denture

Key Words
Diagnostic, Occlusal, Fixed Partial Denture.

Introduction

Diagnosis is the identification of the nature and cause of a certain phenomenon.Present day diagnosis, evaluation and examination is very important in the field of dentistry and medicine & Prosthodontics is no way exception to this.

"Diagnosis" – determination of the nature of a disease[1]. (GPT-8)

To achieve predictable success, there must be meticulous attention to every detail.Making the correct diagnosis is prerequisite for formulating an appropriate treatment plan. To arrive at the correct diagnosis and for confirming the diagnosis, use of diagnostic tools plays an important role.

In fixed partial denture advances occur in every field starting from diagnosis to impression to various new materials use in fabrication of fixed partial denture. Discussing modern diagnosis in fixed partial denture following topics will be covered:

A. In radiograph
B. Diagnosing of Temporomandibular Joint
C. Shade Selection
D. Establishing Occlusion

A. In Radiograph:

Radiographs provide the information to help, correlate all the facts that have been collected in listening to the patient and examining the mouth. They should be examined carefully for any signs of caries, periapical pathology or any bone pathology. This is the reason that radiographs play an important role in fabrication of fixed partial denture.

Computed Infrared Thermographic Imaging:

Thermographic imaging (TI) is a non invasive and highly accurate methodof measuring the surface temprature of a body of teeth as an indicator of pulpal blood flow. This technique is accurate and allows comparison of different areas of the tooth. A suitable device for infrared thermographic imaging is Hughes Probeye thermal video system.

Digital Subtraction Radiography:

It has made a significant improvement in detection of dental and maxillofacial lesions. DSR is a method that can resolve deficiencies and increase the diagnostic accuracy. DSR evaluates the alveolar bone change of 1 to 5% per unit volume and significant differences in crestal bone height of 0.78 mm can be detected[2].

Three-Dimensional Imaging:

Tuned- Aperture Computed Tomography:

Tuned- aperture computed tomography (TACT) works on the basis of tomosynthesis. Claimed advantages of TACT conventional radiographic techniques is that the images produced have less superimposition of anatomical noise over the area of interest. The overall radiation dose of TACT is not greater than 1 to 2 times that of a conventional periapical X- Ray film[3].

B. Diagnosing Of Temporomandibular Joint

Fixed partial denture can transform an unhealthy, unattractive dentition with poor function into a comfortable, healthy occlusion capable of giving years of further service while greatly enhancing esthetics. Proper history taking and initial examination plays an important role in achieving success of FPD. Same like taking history for any TMJ dysfunction play a significant role in fabrication of successful fixed partial denture.

Radigraphs For TMJ[4],[5],[6],[7],[8]

Tomography provides excellent bony details but no in formation of the soft tissue component of the joint. This technique is useful in demonstrating suspected hypoplasia, hypertrophy or

malformation of the condyles, in the case of maxillofacial trauma with fracture description, infections and tumors.

Artrography is performed to determine the status of the condyle-disk-glenoid fossa and eminence relationship with regard to the closed and open mouth position.

Computerized tomography (CT) is superior to conventional radiograšhy and conventional tomography for evaluating internal derangements of temporomandibular joint, trauma, degenerative processes and tumors. CT demonstrated good evaluation of soft tissue and excellent evaluation of bony structures.

Magnetic resonance (MR) has shown exquisite soft tissue contrast and provides a view of the structures of temporomandibular joint which cannot be differentiated by conventional radiography, conventional tomography and computerized tomography. MR of temporomandibular joint can distinguish internal anatomical features of the joint to a degree that no other imaging procedure can match. An image of the articular disk without contrast media as well an image of the posterior band has made the magnetic resonance the golden standard of temporomandibular joint imaging.

TMJ views including transcranial, transorbital and transpharyngeal are also of great importance.

Biomarkers As Diagnostic Aid[9],[10],[11],[12]:

Synovial tissue from patients with TMJ disorders are also a source for evaluating potential biomarkers. Investigators using these samples have shown that there is increased expression of Interleukin-8 and microvessel density in TMD patients. Assays on urine samples have shown elevated levels of pyridinoline (Pyr) and deoxypyridinoline (Dpyr) collagen cross-links, which are known markers of bone and cartilage turnover, in patients with osteoarthritis of the TMJ.

New technologies such as microarrays on tissue, synovial fluid or serum samples are the future scope to enable the identification of specific and sensitive biomarkers of TMJ disease. Microarrays permit the analysis of the expression of thousands of genes even with extremely small quantities of sample.

Recently, significant resources have been directed towards high-throughput genome sequencing , and it seems highly likely that in the next ten to twenty years health professionals will have their patients' genomes available for analysis.

C. Shade Selection[13],[14],[15],[16]:

Shade selection and colour perception are affected by several variables, and some precautions must be met to improve consistency.The ideal daylight source is a balanced daylight with an average colour temperature of 6500ºK. The dental office and dental laboratory should have daylight colour corrected fluorescent lamps installed so that shade selection and crown fabrication are performed in the same lighting environment. Incandescent or unbalanced light should be avoided, and the lighting equipment should be regularly inspected to detect fluctuations in colour temperature. It is wise to select the shade at an early stage, since some shades are more difficult to match than others.The natural tooth must be kept wet throughout the shade determination.

Computerized Shade Matching Systems

This innovative technology improves the quality and predictability of treatment and saves time.

Newer computerized instruments include the following:

- Spectro shade
- Shade scan
- Shade eye NCC
- IKAM
- Shade - Rite

Spectro Shade

The windows-based Spectro Shade system utilizes dual digital cameras linked through optic fibers to a fully functional spectrophotometer. As the system precisely measures the color characteristics of natural tooth, it indicates the deviations of value, chroma and hue from a standard, thereby providing information to modify the restoration and accurately match the tooth. The multifocal dual lighting mechanism illuminates the tooth in such a manner that the readings of its translucency and reflectivity are also taken, thereby allowing for shade measurements regardless of environmental lighting conditions. Dental images can be magnified, highlighted, rotated and measured. The split screen feature encourages the comparison of before and after images.

Shadescan

It employs digital artificial vision technology with integrated CAD/CAM technologies. Shade is measured by a hand-held optical device from the single image of the entire tooth at the click of a button. Dentists can instantly obtain a shade map of the entire tooth with various established and popular shade systems.

ShadeEye – NCC

It consists of two components – a main unit that includes an integrated printer mobile measuring unit that is the size of a cellphone.

The mobile wireless measuring unit analyses the tooth shade digitally and instantly transmits the information to the main unit through an infrared interface. The technique involves the placing of a disposable contact tip in the gingival one-third of the tooth and then a color and shade map of the tooth is generated.

Ikam

It combines the latest digital photographic technology and an innovative color analysis software. The color reference system of IKAM is based on actual fired ceramic samples rather than traditional shade guides, eliminating subjective interpretation.Dentist selects the level of detail for each specific case - coarse (predominant shade), medium or fine (detailed analysis). Selected image level produces a shade map of the tooth.

Shade-rite

This shade measuring device is handheld and portable, analyzing the shades of the tooth to be restored and the surrounding teeth with specialized imaging software.

D. Establishing Occlusion:

Occlusal contact plays an important role in establishing an occlusal harmony. Pokorny[17] described on FPD failures, indicates that deflective occlusal contact can loosen an FPD, cause sensitivity, and be a contributing factor to an acute periodontal disturbance. So, to prevent these deflective occlusal contacts various occlusal indicators have been used in establishing the occlusion.

Occlusal Indicators

Occlusal Indicators are used to locate and define occlusal contacts. The accuracy of these indicators is essential for the establishment of occlusal harmony, "The ultimate goal of treatment"[18].Occlusal contacts occur when the maxillary and mandibular dentition touch each other.Near contacts are those areas that

range from a contact to a gap of 0.5mm between the occluding surfaces. Whereas, non-contacts are those areas wherein there is a 0.5 to 2mm separation of teeth.

Types Of Occlusion Indicators
There are two types occlusion indicators. One is Qualitative Indicators and other is Quantitative Indicators[19].

Qualitative Indicators
It determines the location and number of tooth contacts. Its cost is low and its application is easy. There are number of qualitative indicators used in fixed partial denture are:

- Articulating paper
- Articulating silk
- Articulating film
- Metallic shim stock film
- High spot indicator

Quantitative Indicators
It determines the time and force characteristics of tooth contact not localization of occlusal contact point. It is expensive and requires precision technical skill to use.

- T-Scan occlusal analysis system
- Virtual dental patient

Articulating Paper
Most frequently used qualitative indicators to locate occlusal contacts intraorally. They differ in terms of width, thickness, and the type of dye impregnated.They are hydrophobic in nature.Their basic constituents are colouring agent bonding agent. On occlusal contact, the colouring agent is expelled from the film and the bonding agent binds it onto the tooth surface.The characteristic marking is observed as a central area that is devoid of the colorant and surrounded by a peripheral rim of the dye.

This region is called 'target' or 'iris' owing to their appearance, and it denotes the exact contact point.The density of these markings does not denote the force of the contact; instead, heavier contact tends to spread the mark peripheral to the actual location of the occlusal contact.Only the central portion in heavy contact areas indicates the interference requiring correction.

Disadvantage
They are easily ruined by saliva and hence require usage in a dry field. Their thickness of 40µ is well above the thickness perception level of the patient and their relatively inflexible base material leads to the formation of a large number of pseudocontact markings.

Articulating Silk
Made of micronized colour pigment, embedded in a wax-oil emulsion. It has a soft texture; therefore pseudomarkings not produced during use.

Disadvantage
Loses marking ability when stain components are dried and can be ruined by saliva.Hence its storage in a cool, closed environment is essential.

Articulating Film
The Artifol articulating film (Bausch Inc.) has only a thickness of 8µ, which is much less than the thickness perception level of the patient.Made up of an emulsion with a thickness of 6µ, which is hydrophobic and contained inside a polyester film.Must be used with special holders in a dry environment.Universally applicable, intraorally and on lab models.

Metallic Shim Stock Film
Has a metallic surface on one side and the other side is colour coded.Mainly indicated in occlusal splint therapy to mark contacts on the soft splint in the laboratory.

High Spot Indicator
Supplied in liquid form. Used in laboratory to check the proximal contact of crowns, inlays, etc.

The liquid is applied with a brush on the proximal surface of the coping and it forms a film with a thickness of 3µ. The dye is then seated on the cast, and on removal, the proximal contact area is delineated as an area of show through in the base material of the crown.

Two - Phase Occlusion Indicator Method
Sequential use of articulating paper and articulating film highlights the actual interference areas accurately and clearly.

Disadvantages Of Qualitative Occlusal Indicators
Density of occlusal contacts cannot be determined, although the opinion can be derived from the density of the contacts according to the darkness of the marks.They lack the quantitative time and force descriptive capacity incapable of measuring tooth contact events

Quantitative indicators
T-Scan
It is a Microsoft compliant system that can record a given contact sequence in 0.01s increments.It consists of piezoelectric foil sensor, a sensor handle, both hardware and software for recording, analyzing and viewing the data.It identifies the time magnitude and the distribution of the occlusal contact.
This device is indicated in any situation where the bilateral simultaneous occlusal contact is necessary including complete dentures, fixed or removable partial dentures, complete arch reconstruction involving FPD, natural tooth occlusal equilibration.

Conclusion

- Today's clinician has a wide array of diagnostic tools at his disposal. The CT gives the best information of the available modalities. More commonly though a combination of intraoral periapical radiograph and panoramic radiograph is used.
- To date no modality has been deemed perfect. So, the clinician has to carefully weight the pros and cons of each modality. The future for further development of diagnostic techniques specific for application in implantology is bright. We can definitely expect much more accurate, faster and safer modalities at lower cost to come into the field soon. Making the correct diagnosis is a prerequisite for formulating an appropriate treatment plan. To rightly diagnose and propose a comprehensive treatment plan, various diagnostic tools are made use of. One cannot restrict to just one diagnostic tool; instead a combination of the best available tools should be made use of to arrive at the correct diagnosis.

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Provisional Restorations In Implant Dentistry: Current Perspectives

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Abstract
With the improvement in implants, surgical armamentarium and implant placement procedures, implant dentistry has evolved into a modality with predictable outcomes. Esthetics has become increasingly important as one of the final outcomes which ultimately determines the success of the implant supported restoration especially in the maxillary anterior region. Provisional restorations can be a useful tool in the hands of the experienced dentist for improving the esthetic outcomes of implant restorations. In addition to their conventional role as an interim tooth replacement, they can also be used to condition the peri implant soft tissue contours and ultimately build an optimum emergence profile for the final restoration. Due care given at this step can ensure good esthetic results and a high patient acceptance level of the final restoration.

Key Words
Implants, Provisional restorations, Gingival conditioning, Transitional implants, Custom Impression coping

Introduction

Implant dentistry has been around for more than thirty years. From its humble beginnings in the early 80s, it has evolved into a highly specialized field with predictable treatment outcomes[1]. With improvements in the surgical procedures as well as implant surface and design, osseointegration and implant stability have become foregone conclusions to a certain extent. With increasing experience, there has also been an increase in expectations in treatment outcomes from both the clinician and the patient[2]. Two prime areas of concern include reduction in treatment time and greater emphasis on aesthetics as a criterion for implant success. With the success of the immediate loading and the immediate placement concepts, we have come into an era where people walk into the dentist's office with a missing or failing tooth and walk out with an implant supported restoration on the same day.

Provisionalisation has often been neglected in implantology. This is probably due to the past experience of dentists with provisionals in a conventional tooth supported fixed partial denture prosthesis. But a temporary prosthesis needs to remain in place for a very limited time in these cases. On the contrary, a provisional restoration over an implant might have to be retained for a few months and this could prove hazardous if adequate attention is not given to this step

Functions Of A Provisional Restoration

Provisional restorations have come to play an important role in implant dentistry. The time period for which they need to remain in place may vary depending on the implant site preparation required prior to implant placement, the loading protocol being followed and the soft tissue contouring required afterwards. Their primary function remains to provide the patient with an interim functional and aesthetic replacement for their natural teeth. They have also become an important tool for improving the aesthetic outcome for implant restorations. Today implant placement is carried out keeping in mind the position and requirements of the final restoration[3]. A properly fabricated provisional restoration can be used to determine various aspects including the tooth length, width, contours, embrasure form, midline positioning, incisal plane, gingival plane, symmetry, horizontal and vertical angulation, rotational alignment, vertical & horizontal overlap and anterior guidance[4]. These can further be utilized for designing a surgical template which ensures optimum implant placement.

The provisionals are also used to verify whether the implants have actually been placed in accordance with the planned positions of the surgical template. In case this is not so, then changes in the restorative plan will have to be made. They have also been used in impression procedures to accurately capture the soft tissue modality which ultimately helps ensure an optimum emergence profile for the final restoration[5]. The conditioning of the peri implant soft tissues can begin right after extraction of the tooth which is being planned to be replaced with an implant supported restoration. This can be done with the help of an ovate pontic attached to the adjacent teeth[6].

Types Of Provisional Restorations

The options available for temporarily restoring an edentulous space which is to be finally restored with an implant supported restoration can be classified as follows:

1. Fixed or removable
   a. Removable restorations
      i. Acrylic partial dentures
      ii. Vaccum formed appliances
   b. Fixed restorations
      i. Tooth supported
      ii. Implant supported
2. According to timing of fabrication:
   a. Prior to tooth extraction
   b. During socket healing
   c. Immediately prior to implant placement
   d. After implant placement
3. According to fabrication technique:
   a. Chairside
   b. Lab fabricated

Removable Provisional Restorations

1. Acrylic Dentures

These have been commonly used for both

partially and completely edentulous cases, though in the latter cases the patient's existing prosthesis is generally converted to an implant supported fixed interim prosthesis. The ease of fabrication & modification of these restorations are the prime reason for their popularity. They prove especially useful in cases requiring multiple hard & soft tissue altering procedures where they can be modified and reused[7]. They can also be used as a space maintainer in growing children where an implant supported prosthesis might have been planned sometime in the future. The aesthetics produced are generally good enough with proper shade selection of teeth. However, patient compliance can be poor due to the bulkiness of the prosthesis and the interference it can produce in speech & mastication. The bulkiness might be further increased by the presence of any wire components added to provide retention. Other limitations include the need for adequate interocclusal distance so that the denture base might have adequate thickness to prevent fracture. Also they are ineffective in space maintenance between the roots of the adjacent teeth. These prostheses need to be closely monitored to ensure that a passive fit is maintained and that the intaglio surface is maintained free of any areas which might result in soft tissue inflammation[8].

2. Vacuum Formed Appliances

These generally consist of an appliance fabricated from clear thermoplastic sheets which are moulded in vacuum using either the patient's pre-extraction models or after a diagnostic wax up on a post extraction model. The popular Essix appliance is a common example[9]. This appliance was initially introduced in the field of Orthodontics as a potential replacement for the Hawley's appliance[10]. The space which is created for the missing tooth can be occupied utilizing a denture tooth, light cure composite or a decoronated natural tooth. These appliances can prove superior to the acrylic dentures in terms of aesthetics . But the former share certain limitations with the latter like their dependence on patient compliance, lack of space maintenance in the radicular region and their inability to mould the surrounding soft tissue. In addition they are also prone to rapid wear & degradation in the oral cavity, especially in bruxers.

Fixed Provisional Restorations

1. Tooth Supported Fixed Restorations

Use of the adjacent teeth to retain a fixed provisional restoration has become quite popular in implantology. These can further be classified based on the type of pontic and the type of supporting framework utilized. The pontic that could be used in such restorations could include denture teeth, composite or ceramic pontics and the coronal portion of the natural teeth[11] with a variable amount of root portion remaining according to aesthetics and the magnitude of soft tissue moulding planned. Both denture teeth as well as natural tooth pontics can be directly bonded to the adjacent teeth thus eliminating any intervening lab steps. But they are generally preferred for a short duration only. Ceramic pontics, on the other hand are highly aesthetic and long lasting but require additional laboratory steps and expenditure.

The framework that can be used for these restorations could be made of cast metal alloys, fibre reinforced resin, autopoly merizing acrylic resin or even a wire of adequate thickness to maintain rigidity. In cases where orthodontic treatment precedes implant placement and the archwire is still in place, it can also be used to retain a restoration. The durability of the metal framework results in they being indicated in conditions where the provisional restoration needs to stay in the mouth for a long duration. But the use of a cast metal framework entails laboratory work and hence increases the final cost as well as duration of treatment. Aesthetics too may be compromised due to visibility of metal margins. This is not an issue with fibre reinforced composite framework, but they are less durable and might fracture during removal. In general both the cast metal and the fibre reinforced composite frameworks are not preferred in case multiple procedures are required prior to implant placement. This is because of the unpredictable retention and removal of the appliance and the difficulty in modifying the pontic (usually ceramic in these cases) for conditioning the healing ridge. To counter the problems that might be faced with a metal framework resin bonded prosthesis during repeated removal & insertion, a modified framework design has been described[12] wherein the pontic is split into a buccal and lingual portion which are retained by matrix and patrix components inserted adjacent to the edentulous space. In this way the implant site can be exposed by simply disassembling the pontic without the need to totally debond the whole prosthesis.

The use of 0.9 or 1 mm half round wire has also been mentioned in the literature. The wire can be adapted on a diagnostic cast and a pontic can either be attached or directly fabricated on the wire with composite resin. This can then be bonded to the adjacent teeth in the patient using flowable composite.

In patients who require multiple implant placement for rehabilitation, a staged approach might have to be followed sometimes due to different reasons. In such cases, some of the teeth which are ultimately planned for extraction might be retained to function as strategic abutments for a tooth supported provisional restoration over previously placed implants. They can be later extracted once the implant has osseointegrated and is able to support the provisional / definitive restoration on its own.

All tooth supported fixed restorations are "fixed" by the use of conventional luting agents or are resin bonded. In all these cases, it is important to ensure adequate clearance from opposing teeth. This might not be present naturally and could result in a significant amount of tooth reduction especially in case of deep anterior vertical overlap. In such cases a decision needs to be taken keeping in mind the benefit that such prosthesis will provide to the patient and whether a less invasive alternative (a removable appliance) could be used.

2. Implant Supported Fixed Restorations

Implant supported provisional restorations include restorations placed on transitional implants or those fabricated on the definitive implant (at the time of implant placement or after the elapse of a predetermined period of time for healing).

Transitional or provisional implants have been developed with the idea of supporting a provisional restoration (ranging from a single crown to a complete arch overdenture) till the definitive implants are deemed fit to be loaded. They are specifically indicated in conditions where immediate loading of the definitve implants is not indicated. These include implant placement in conjunction with ridge augmentation procedures, in medically compromised

patients, etc. They share similar characteristics with definitive implants like material, surface treatment and basic design, but are usually of a smaller diameter (less than 3mm). Various studies[13] have demonstrated the ability of the transitional implants to become osseointegrated though the bone to implant contact that has been reported is quite variable. For supporting a complete overdenture in an edentulous jaw, a minimum of four to six transitional implants have been recommended for both the mandible and the maxilla, though fewer implants have also been shown to be able to successfully support such restorations for short durations. It has been recommended that these implants should not be retained for more than a year as there would be a risk of bone fracture during implant removal after that. The basic disadvantages presented by this modality include the requirement for additional surgical procedures for implant placement as well as removal and adequate space to be present in the bone for harbouring both the transitional and the definitive implants at the same time.

Provisional restorations retained by the definitive implants can be either screw retained or cement retained. Further, they can be fabricated either before the implant placement, immediately after implant placement or after implant placement and a healing period.

The debate over preference for screw or cement retained prostheses is a long standing one and still remains inconclusive[14],[15]. Screw retained prostheses offers the advantages of easy retrievability which is very important in case of a provisional restoration. A cement retained restoration, on the other hand offers advantages of simplicity in fabrication and is especially indicated when implant angulation and positioning precludes the use of a screw retained one due to aesthetic reasons. In cases of multiple implants being used to support a single prosthesis, a screw retained prosthesis will require meticulous placement to ensure implant parallelism. The cement retained restorations are always subject to the dangers of excess cement contaminating the peri implant tissues, which has shown a positive correlation with increased risk of ultimate failure of the implant. This is especially likely to occur in instances where the margin of the restoration is kept subgingival.

Techniques for fabrication of the provisional before implant placement involve the use of a diagnostic wax up to fabricate a vacuum formed template[16]. A mock implant placement is simulated on the cast by drilling through the template and an implant analogue is placed in the site prepared. A temporary abutment can then be attached to the implant analogue, prepared and a provisional restoration can be fabricated over it using either a hollowed out denture tooth or a prefabricated polycarbonate crown. The provisional will require to be relined chairside using auto polymerizing resin or flowable composite once some amount of soft tissue healing has taken place around the implant. Occlusal contacts need to be adjusted according to the loading protocol being followed and may range from no contact to slight contact in centric relation contact position.

Provisional restorations can also be fabricated once the implant has been placed. This can again be started either at the time of implant placement itself (Stage I surgery) or immediately after implant uncovering (Stage II surgery) when either temporary or definite abutments are placed & modified. Furthermore, the technique for fabrication could be lab based or might be done chairside. Lab fabrication of a provisional reduces the actual chairside time required but adds to the cost factor. At Stage I surgery, to prevent contamination of the surgical site with impression material a technique has been described to transfer the position of the implant to a cast which has been fabricated pre-operatively[17]. It involves fabrication of a resin template on the cast encompassing teeth adjacent to the planned implant site. After implant placement, an impression transfer coping is placed over the implant. The template is seated over the adjacent teeth in the mouth, attached to the transfer coping with the help of autopolymerizing resin or flowable composite and removed together. An implant analogue is attached to the transfer coping. The cast is modified by drilling at the planned implant site so as to make space for the implant analogue and the template is reseated on the cast. The remaining space around the analogue can be filled up using a Type III or IV gypsum product and an optimum emergence profile can be created. A temporary abutment can now be placed over the implant analogue and a provisional restoration can be fabricated.

A simple alternative chairside procedure has also been mentioned in the literature where a provisional in the form of a denture tooth is selected based on the dimensions of the space available and is hollowed out to fit over an implant analogue[18]. It is then relined intraorally using flowable composite or autopolymerizing resin and is finished extraorally. Alternatively, a natural tooth can also be used in case of immediate implant placement[19].

Provisional Restoration As A Custom Impression Coping

A simple impression using standard impression copings helps record & transfer the position & orientation of the implant but gives no information regarding the soft tissue contours in the peri implant region or of the emergence profile of the planned restoration. This can be accomplished using impression copings whose margins have been customized either intraorally using autopolymerizing resin or extraorally using the provisional restoration. For the extraoral technique, the provisional along with the abutment is attached to an implant analogue and a mould is created. Once the mould is set, the restoration & abutment are removed and an impression coping is attached to the analogue. The space around the impression coping formed by the provisional restoration is filled with acrylic resin and it can then be used in impression making. A soft tissue cast is poured around the customised impression coping producing a cast with the implant position and soft tissue representing the intra oral conditions. An alternative technique involves placing the provisional restoration on the master cast that is made routinely and the existing soft tissue cast can be removed. The provisional restorations are removed from the patient and placed onto the master cast and impression material is extruded around the provisional restoration to form the soft tissue contours presenting intra orally. The provisional restoration can also be incorporated into the impression. When screw retained restorations are used, the provisional restoration itself can be used as a pick up type impression coping[20],[21]. A soft tissue cast is poured around the exposed provisional after an impression coping is attached, yielding a soft tissue cast which is identical to the soft tissue form intra orally.

Conclusion

Provisional restorations play a multi-faceted role in implant success. They have also proved to be a significant factor in implant failure when used improperly. Clinicians need to be aware of the range of techniques, materials and temporary implant components for short, medium and long-term provisionalization. The need for provisionalization should be considered during the treatment planning stage, and reassessed continually throughout the implant therapy.

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Mineral Trioxide Aggregate: An Overview Unsaid

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Abstract
Mineral Trioxide Aggregate (MTA) is a bioactive material with numerous exciting clinical applications. MTA promises to be one of the most versatile materials of this century in the field of dentistry. Some of the appreciable properties of MTA include its good physical properties and biocompatibility as well as its ability to stimulate tissue regeneration. In this article the composition of MTA, setting reaction, manipulation, mechanism of action for mineralization, antimicrobial property, calcific barrier formation in pulp capping and apexification, as well as its disadvantages which include tooth discoloration and post operative pain with MTA has been reviewed.

Key Words
Mineral Trioxide Aggregate, Bioactivity and Tissue regeneration

Introduction

It is estimated that over 24 million endodontic procedures are performed on an annual basis, with up to 5.5% of those procedures involving endodontic apical surgeries, perforation repairs, apexification, apexogenesis and now revascularization treatment. Endodontic surgery is performed to resolve inflammatory processes that cannot be successfully treated by conventional techniques, which may be due to complex canal and/or apical anatomy and external inflammatory processes. Surgical procedures may also be indicated for the resolution of procedural misadventures, to include root perforation that may occur either during canal instrumentation or post-space preparation.[1]

Surgical treatment usually involves achievement of apical seal by the placement of a material designed to seal the root canal contents from the periradicular tissues and repair root defects. An ideal endodontic repair material would adhere to tooth structure, maintain a sufficient seal, be insoluble in tissue fluids, dimensionally stable, non-resorbable, radiopaque, and exhibit biocompatibility if not bioactivity. A number of materials have historically been used for retrograde fillings and perforation repair, such as amalgam, zinc-oxide-eugenol cement, composite resin, and glass-ionomer cement. Unfortunately, none of these materials have been able to satisfy all the requirements of an ideal material.[2]

Mineral trioxide aggregate (MTA) is a biomaterial that has been investigated for endodontic applications since the early 1990s. MTA was first introduced by Mahmoud Torabinejad at Loma Linda University, California, USA and was given approval for endodontic use by the U.S. Food and Drug Administration in 1998. MTA materials are derived from a Portland cement (PC, parent compound), it is interesting that no information has been published regarding any investigations that led to the precise delineation of the present MTA materials.[3]

The aim of this article is to present a systematic review of MTA as a Bioactive Biomaterial.

Composition

According to Torabinejad et al (1993), the main constituents of this material are calcium silicate (CaSiO4), Bismuth oxide (Bi2O3), Calcium carbonate (CaCO3), Calcium sulfate (CaSO4) and Calcium aluminate (CaAl2O4).

MTA are of two types- grey and white. The white and grey MTA differs mainly in their content of iron, aluminium and magnesium oxides. Asgary et al(2005) claim that these oxides are present in less quantity in white MTA while others claim total absence of these oxides in white MTA. White MTA contains smaller particles with a narrower range of size distribution than grey MTA. Portland cement is the active ingredient in white MTA. GMTA(Grey MTA) basically consists of 22.5% dicalcium and 53.1% tricalcium silicate, 21.6% bismuth oxide and small Quantity of tricalcium aluminate and calcium sulphate. Bismuth oxide in MTA provides its radiopacity. Bismuth increases the radiopacity to 8.26mm thickness of Aluminum, which is higher than that recommended by ISO 6876. Bismuth oxide in MTA is not inert. It forms part of the hydrated phase forming a structure composed of calcium silicate-bismuth hydrate and the rest is leached together with calcium hydroxide formed from the hydration of the calcium silicates. The precipitation of calcium hydroxide (CH) in the hydrated paste is reduced in MTA compared to a PC with no addition of bismuth oxide.[4]

Several modifications of MTA are marketed. The original formulation developed at Loma Linda University is manufactured by Dentsply International (ProRoot MTA and Tooth Colored MTA; Dentsply-Tulsa Dental, Tulsa-USA; Dentsply-Johnson City-USA). Other types of MTA are Angelus (AMTA) from Brazil (white and gray: AGMTA, AWMTA; Angelus, Londrina, PR, Brazil), and Egeo (CPM) in white from

Argentina (Egeo, Buenos Aires, Argentina). Many other brands of experimental MTA have been developed and investigated, including MTA Bio, light-cured MTA, and an MTA root canal sealer named CPM sealer (Egeo) and MTA-Obtura (Angelus).

Setting Reaction

When MTA powder is mixed with water, calcium hydroxide (CH) and calcium silicate hydrate are initially formed and eventually transform into a poorly crystallized and porous solid gel. The ratio of calcium silicate drops because of the formation of a calcium precipitate. The precipitated calcium produces CH, which is the cause of MTA's high alkalinity after hydration. Bismuth affects CH precipitation after MTA hydration. Because bismuth oxide dissolves in an acidic environment, it has been suggested that placing MTA in an acidic environment such as inflammatory tissues might result in the release of bismuth oxide. This might decrease MTA's biocompatibility because bismuth oxide does not encourage cell proliferation in cell culture. The amount of sulfur at the surface of set MTA is 3 times higher than the powder forms of MTA, and that this layer protects the cement from further hydration and increases the cement's setting time.[5]

Tricalcium silicate sets by the following reaction:

2Ca3OSiO4 + 6H2Oà3CaO.2SiO 2.3H2O + 3Ca(OH)2

The setting of dicalcium silicate is given by:

2Ca2SiO4 + 4H2Oà3CaO.2SiO 2.3H2O + Ca(OH)2

The principle products are calcium silicate hydrates and calcium hydroxide.[5] During the hydration process, when calcium silicates react to form calcium hydroxide and calcium silicate hydrate gel, producing an alkaline pH. A further reaction forms a high-sulfate calcium sulfoaluminate during the reaction with tricalcium aluminate and calcium phosphate. The release of calcium from setting MTA diffuses through dentinal tubules, and the concentration of the calcium ions increases with time as the material cures.[6]

Manipulation

The MTA paste is obtained by mixing 3 parts of powder with 1 part of distilled water to obtain putty like consistency. Mixing can be done on paper pad or glass slab using a plastic agate spatula. This mix is then placed in the desired location and condensed lightly with a moistened cotton pellet. After mixing, the mix should not be left open on the pad as it undergoes dehydration and dries into a sandy mixture and should be consumed immediately.[7]

Mechanism Of Action For Mineralization

One of the characteristics of a bioactive material is its ability to form an apatite-like layer on its surface when it comes in contact with physiologic fluids. Apatite formation is a common characteristic of calcium silicate - containing biomaterials. MTA is a bioactive material that is mainly composed of calcium and silicate.[8] The mixed MTA primarily undergoes hydration process, as Calcium silicate reacts to form Calcium hydroxide and calcium silicate hydrate gel, producing an alkaline ph of 12.5. Further high sulfate calcium sulfoaluminate formation occurs due to the reaction of tricalcium aluminate with calcium phosphate. The release of calcium ions from the set MTA diffuses through dentinal tubules and the concentration of calcium ions increases with time as the material hardens completely. It appears that, the biocompatibility of the cement might be attributable to the release of hydroxyl ions and formation of calcium hydroxide during the hydration process.[9] When mixed MTA is compacted against dentin, the dentin MTA interfacial layer forms in the presence of phosphate. This adherent interstitial layer resembles hydroxyapatite in composition and structure, which leads to superior marginal adaptation moreover, the particle size and dimensional shape of MTA can occlude and penetrate dentinal tubules that might harbor micro-organisms after cleaning and shaping. MTA not only fulfills the ideal requirement of being bacteriostatic, but it might have potential bactericidal properties also.[10]

Antimicrobial Property Of MTA

The antimicrobial activity of MTA is related to the release of hydroxyl ions in an aqueous environment. Hydroxyl ions are highly oxidant free radicals that show extreme reactivity with several biomolecules.This reactivity is high and indiscriminate, so these free radicals rarely diffuses away from sites of generation.[11] The lethal effects of hydroxyl ions on bacterial cells are probably due to the anaerobic atmosphere during incubation procedure, since both MTA and Portland cement are rich in oxides. Subsequent to reaction with water on oxygen-rich environments, these compounds might generate reactive oxygen species, such as hydroxyl and hydroperoxyl radicals which exhibit antimicrobial activity.[12] Growth of anaerobes requires an appropriate environment to reduce the intracellular generation of reactive oxygen species; favoring the growth of anaerobic microorganisms in anaerobic environment, the formation of toxic oxygen radicals is likely to be reduced in intracellular location.[13] Moreover, antimicrobial activity of reactive oxygen species is usually impaired by the presence of antioxidants and other reducing molecules such as quinones.[14] MTA has an alkaline ph of 12.5. The pH gradient of the cytoplasmic membrane is altered by the high concentration of hydroxyl ions from calcium hydroxide acting on the proteins of the membrane this phenomenon is known as protein denaturation. The high pH of MTA alters the integrity of the cytoplasmic membrane through chemical injury to the organic components and transport of nutrients by means of the destruction of phospholipids or unsaturated fatty acids of the cytoplasmic membrane, observed in the peroxidation process, which is a saponi@257;cation reaction.[6] Saad Al-Nazhan et al (2003),conducted an in vitro study to investigate the antifungal effect of MTA using a tube-dilution test. The tested MTA was incubated with C.albicans for 1 hour, 24 hours & 3 days. They concluded that MTA was effective against C.albicans even after 3 days.[15]

Calcific barrier formation with MTA in pulp capping procedure

Pulp capping is an operative procedure designed to preserve the vitality of a potentially infected dental pulp.Main goal of pulp capping is to form a barrier at the site of pulp exposure. Difference between barrier formation stated by various authors. Maria de Lourdes et al (2008)[16] evaluated Mineral Trioxide Aggregate and Calcium Hydroxide Cement as Pulp-capping agents in Human Teeth. Pulpal exposures were performed on the occlusal floor of 40 human permanent premolars and the pulp was capped either with CH or MTA and

restored with composite resin. After 30 and 60 days, teeth were extracted and processed for histologic exam and categorized in a histologic score system. All groups performed well in terms of hard tissue bridge formation, inflammatory response, and other pulpal findings. However, a lower response of CH after 30 days was observed for the dentin bridge formation, when compared with MTA after 30 days and MTA after 60 days groups. Eduardo Galia Reston and Carlos Alberto de Souza Costa (2009)[17], carried out a SEM electron microscopy study for evaluation of the hard tissue barrier after pulp capping with Mineral Trioxide Aggregate (MTA) in 29 specimens and showed that in seven specimens (29.2%), the deposition of mineralized tissue occurred in the centroperipheral area, characterizing the complete hard tissue barrier formation. In the remaining 17 specimens (70.8%), the hard tissue barrier was formed only in the peripheral area. Five specimens did not present formation of a hard tissue repair barrier and were therefore not included in the statistical analysis because they did not produce any morphology or localization data.[18] MTA induces the formation of a hard tissue barrier without a significant local inflammatory response. It has been reported that, although MTA and calcium hydroxide have a similar mechanism of action on the exposed pulp tissue, the inflammatory pulp response to MTA seems to be less intense. This might be attributed to the fact that, immediately after preparation for use, MTA has a significantly lower pH (approximately 10.2) than calcium hydroxide (nearly 11.2).[19] At the end of the follow-up period after pulpotomy (90 days), the tested MTA cements presents a limited diffusion of their components from the pulp-capping site to the interior of the pulp tissue. Perhaps, it might be an important factor that contributed to presence of a complete (centroperipheral) hard tissue barrier in several specimens in MTA and to the small number of this type of barriers in the roots in which pulp remnant was capped with calcium hydroxide. With MTA, thicker bridges are formed and the presence of an odontoblastic layer is a frequent finding. In addition, only in few cases capped with MTA shows hyperaemia, whereas hyperaemia is seen in every sample capped with calcium hydroxide, and virtually no odontoblastic layer was formed in case of calcium hydroxide.After 6 months of pulp capping with MTA, 0.43 mm-thick dentin bridge and a nearly regular odontoblastic layer was observed.[20]

Calcific barrier formation with MTA in Apexification Procedure

Apexification is a procedure to promote the formation of an apical barrier to close the open apex of an immature tooth with a non-vital pulp such that the filling materials can be contained within the root canal space (Rafter 2005). Shabahang S (1999), placed MTA for apexification procedure into the root canal space and histologically observed three types of tissue formation. Firstly, their was dentin formation along the dentinal walls resulting in the thickening of the root canal dentin wall, secondly, the presence of bone-like tissue and thirdly, periodontal ligament like tissues were observed at the apical root end. The formation of calcific bridge at various levels of the root canal space was possibly the result of the osteo-inductive activity of the MTA. Aeinehchi M (2003)[21], also observed the histologic evaluation of calcific barrier formation with MTA & Calcium Hydroxide. He demonstrated less inflammation, hyperaemia and necrosis alongwith thicker dentinal bridge formation. The odontoblastic layer formation was observed with the MTA which was consistently more uniform & thicker than Calcium Hydroxide. Lidia Postek et al (2009)[22] and Anil Kumar G et al(2010)[23] reported that the primary advantage of MTA is early apical barrier formation, proper development of apical seal, excellent biocompatibility and reduction of number of appointments. Simon et al (2007)[24] stated that one step apexification using apical plug of MTA can be considered as predictable treatment and successful alternative to Calcium hydroxide

Tooth discoloration with MTA

Discoloration after placement of MTA has been one of the biggest problems related to its use in anterior teeth. Saeed Asgary (2005)[25] compared the composition of Grey and White MTA and observed that the concentration of aluminum oxide, magnesium oxide and ferric oxide in gray MTA is more than white MTA and is responsible for tooth discoloration. Watts J.D (2007)[26] and Boutsioukis C (2009)[27] repotted that both external and internal coronal discoloration are associated with white MTA. But still grey MTA causes grayish staining because of infiltration of ferric ion into the dentinal tubules near the CEJ which increases the discoloration with time.

Post operative pain when MTA placed in root end surgery

Chong BS & Pit Ford TR (2004), conducted a study to evaluate the post operative pain after surgical root end resection & then filling the root end cavity with MTA. A standardized surgical technique was employed. Post operative instruction along with pain questionnaire & visual analogues scale was given to each patient. All the patients were instructed to record the intensity of pain in the intervals of 5, 24 & 48 hours. They reported that there was no significant difference in the pain experienced by the patients. However, the reported post operative pain was of relatively of short duration at its maximum intensity early in the post operative period but it was progressively decreased with time.[28] Researchers are working in this field to overcome this. Jessyca Leal Moura FE et al (2014)[29] associated use of Mineral trioxide aggregate (MTA) with Aloe vera to verify the coadjutant action of that medicinal plant in the bone neoformation process in tibia of rats. The association of MTA and Aloe vera showed potential to reduce the effects of the inflammatory cascade and promote bone neoformation making it to a promising proposal for future use in endodontic therapy.

Conclusion

The present available literature is an important tool for rationalizing correct clinical decisions. This is why the scientific efforts to improve do not stop and include new concepts and treatment strategies in order to reduce the incidence of adverse effects and increase their biocompatibility. It may be concluded from this review that MTA appears to be a promising successor to Calcium hydroxide for variety of applications. That is because MTA is an excellent material with innumerable qualities required of an ideal material. There is, however, presently a definitive lack of long-term clinical studies to demonstrate the safety and effectiveness of this new material. MTA need to be explored by clinicians so that its more and more beneficial properties can be extracted.

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Management Of Salivary Gland Tumors: A Review

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Abstract
Salivary gland tumors are relatively uncommon, corresponding to approximately 3% to 10% of neoplasms of the head and neck region. These tumors occur commonly in the parotid gland (from 34% to 86%), but other major and minor salivary glands also may be affected. Minor salivary gland malignancies are uncommon accounting for between 10% and 15% of all salivary tumors. Unlike the major salivary glands where approximately 80% of tumors are benign, 80% or more of minor salivary gland tumors are malignant. Surgical excision represents the standard option in the treatment of resectable tumors of both major and minor salivary glands.

Key Words
Salivary gland tumors; parotid; submandibular; sublingual

Introduction

Salivary gland pathology is complex and is predominantly inflammatory or neoplastic. Neoplastic pathology may be benign or malignant with multiple complex histologic subtypes displaying widely differing behavioral characteristics.[1] Salivary glands, major and minor, are susceptible to a wide variety of pathological conditions. [2]

Salivary gland tumors are relatively uncommon, corresponding to approximately 3% to 10% of neoplasms of the head and neck region .The incidence of salivary gland tumors may be very low (1.8%) and claims to be influenced by geographic and racial factors. These tumors occur commonly in the parotid gland (from 34% to 86%), but other major and minor salivary glands also may be affected.[3]

Of all salivary gland neoplasms, those of the submandibular gland account for about 10%, whereas 80% involve the parotid gland. There is, however, a higher incidence of malignancy in the former. Neoplasms of the submandibular and sublingual salivary glands are much less numerous than those of the parotid gland, but they are more often malignant: nearly 50% for the submandibular and 80% for the sublingual glands.[4] Tumors arising in the sublingual glands are rare, and most of these tumors are malignant neoplasms.[5]

Minor salivary gland malignancies are uncommon accounting for between 10% and 15% of all salivary tumors. Unlike the major salivary glands where approximately 80% of tumors are benign, 80% or more of minor salivary gland tumors are malignant and they tend to have a great variation in presentation and histology. There are between 450 and 750 minor salivary glands in the head and neck region, scattered throughout the sinonasal cavities, oropharynx, larynx and trachea with the majority being found in the oral cavity. Heterotopic minor salivary glands can also occur at unexpected sites including lymph nodes, the capsule of the thyroid gland, facial bones and the hypophysis. All types of salivary tumors, both benign and malignant, can occur at any of these sites, including heterotopic locations thus accounting for their varied presentation.[6]

Surgical excision represents the standard option in the treatment of resectable tumors of both major and minor salivary glands. Radiotherapy may be a treatment option for inoperable locoregional disease. Surgery, irradiation or re-irradiation are treatment options for local relapse, whereas radical neck dissection is indicated for regional relapses. Metastatic disease may be either treated with radiotherapy or palliative chemotherapy, depending on the site of metastases.[7]

Management of parotid tumors

Parotid tumors are mostly benign, but their evaluation and treatment require a thorough knowledge of the relevant anatomy and pathology. Surgical treatment of benign tumors is aimed at complete removal of the mass with facial nerve preservation. Complete superficial parotidectomy is unnecessary in the treatment of benign localized parotid tumors. Limited parotidectomy is associated with very low rates of morbidity and recurrence.[8]

Parotid tumors are uncommon, with the majority presenting as discrete lumps arising within the superficial portion of the gland. Conventional teaching prescribes removal of these tumors by superficial parotidectomy, which encompasses facial nerve identification and en bloc removal of the superficial portion of the gland. Extracapsular dissection (ECD) is an alternative approach to the removal of such lumps involving meticulous dissection immediately outside the tumor capsule while still preserving the facial nerve, and is distinct from enucleation. As the needs for reducing morbidity and maintaining facial aesthetics increase, ECD represents the current limit of conservative parotid surgery. ECD is a scientifically valid and oncologically safe approach to the management of the clinically benign parotid lump.

Extracapsular dissection is a viable alternative to superficial parotidectomy for the majority of parotid tumors, associated with reduced morbidity without oncological compromise.[9]

Conservative surgical management for salivary gland cancers concerns only parotid gland cancers. For submandibular, sublingual and accessory salivary glands cancers, ablative surgery must always be radical. Conservative surgical management for parotid gland cancers means preservation of glandular (deep lobe), nervous (facial and other nerves) and vascular (intraparotid vein) components of the parotid surgical space. Technically, there is not any specific difficulty to achieve this goal, the surgical rules being the same as for conservative surgery of benign parotid tumors. Reconstructive surgery concerns the facial nerve, rarely the skin. If after skin resection, classical reconstruction methods must be applied (mostly local and free flaps), the facial nerve reconstruction remains controversial.[10]

In the surgery of malignancies of the parotid gland the management of the facial nerve and of the neck is very important. In fact, many authors declared as the surgery of parotid gland can be considered as the surgery of facial nerve and others underlined the role of the neck management in a complete treatment of these neoplasms. The neoplasms of the parotid gland can be treated sparing the facial nerve when it is clearly not involved without making worse prognosis; on the other side planning a neck dissection should be mandatory in case of high degree malignancies, and/or of tumors larger than T2, and/or of involvement of the facial nerve, and/or of the skin and/or cervical lymph nodes. [11]

Cervical lymph node metastases in patients with parotid gland carcinoma are not rare. Regional metastases have a significant influence on the prognosis of these patients. In spite of the clinical relevance of lymphogenous metastases, the indications for elective treatment of the neck are not well defined. An elective neck dissection is recommended in carcinomas with high percentage of lymphatic spread also in the N0 neck. Consideration of additional parameters (> T2, lymphangiosis carcinomatosa) is appropriate to perform also a neck dissection in carcinomas with low risk for lymphogenous metastases. An elective neck dissection should include levels I, II, III and upper V .[12]

Management of tumors of submandibular gland

Surgical management of the submandibular gland has proven itself over the past 35 years and has remained the same despite other advances in the field of head and neck surgery. Nevertheless, surgical management of submandibular gland diseases has always been a challenge. It carries a considerable risk of injury to the mandibular branch of the facial nerve, the hypoglossal nerve, and the lingual nerve .Complete surgical extirpation of the gland is standard in the treatment for all tumors of the submandibular gland. Excision of the entire gland with meticulous preservation of the tumor capsule is the therapy of choice for benign tumors .Submandibular sialadenectomy is a safe operation with a low rate of complications. Operations for a tumor should be performed without delay considering the high rate of malignant tumors. Generally, more limited exploratory excisions or biopsies must be avoided in neoplastic disease of the submandibular gland.[13]

Standard therapy for benign submandibular tumors involves extirpation of the diseased gland. Depending on the surgical technique used, the course of certain nerves in the submandibular region has to be considered (i.e. the marginal branch of the facial nerve, as well as the hypoglossal and lingual nerves).These nerves are at considerable risk during total excision of the gland, and have to be protected from injury. Extirpation of the diseased gland is considered to be the therapy of choice for benign tumors of the submandibular gland.[14]

The treatment of choice for benign tumors of the submandibular gland is surgery. Extirpation of the gland along with the tumor should always be performed. Benign submandibular gland tumors, although rare manifest a mild course of disease and local excision along with the gland is a safe and effective mode of treatment .Malignant tumors show a mild symptomatology resulting in late diagnosis, treatment should be a combination of radical surgery and postoperative radiotherapy .[15]

Malignancies arising in the submandibular gland consist of a high percentage of aggressive tumor types and have a poorer prognosis compared to parotid gland malignancy. Since benign and malignant disease can usually only be differentiated histologically, early and aggressive treatment for suspected submandibular gland neoplasia is advocated. [2]

Several clinical problems after surgery through the transcervical approach have been described. Hong and Kim introduced a new intraoral surgical approach for excision of the submandibular gland indicated in the chronically inflamed salivary gland with or without calculus and benign mixed tumor of the submandibular gland. Thirty-one cases of submandibular gland excision through the intraoral approach were reviewed, analyzing surgical technique and morbidity. Early postoperative discomforts developed, such as a temporary lack of function of lingual nerve and a temporary limitation of tongue movement, but recovery was within a short period of time in all patients involved. No symptomatic late complications appeared, such as residual inflammation of Wharton's duct and neurologic sequelae. They suggested that this approach can be extended to the excision of the submandibular gland as an alternative to the transcervical approach. The major advantages of this approach are the avoidance of an external scar and injury to the marginal mandibular nerve or the hypoglossal nerve .[16]

An endoscopic intraoral approach for excision of the submandibular gland is described by Guerrisi et al. This procedure is anatomically safe and can be made with minimal morbidity; a transcervical incision is avoided. Both specific instruments and solid anatomical knowledge are necessary to perform a safe and efficient glandular endoscopic excision.[17]

Although submandibular sialadenectomy with a minimal incision improves overall cosmetic outcomes, visualization of the surgical field exposure is relatively limited as compared with that in the conventional procedure. To overcome this limitation, endoscope system can be applied to the submandibular sialadenectomy. An

EASS (Endoscope Assisted Submandibular Sialadenectomy) with bipolar dissection is technically feasible and secures a better surgical view through a minimal incision. However, for patients with severe adhesion to the adjacent tissues, conversion to the wide-open procedure would be safer.[18]

Management of tumors of sublingual gland

The fact that tumors rarely arise in the sublingual salivary glands has long been appreciated. Batsakis has estimated that 80% of sublingual tumors are malignant .It is interesting to note that one of the first clear descriptions of a sublingual tumor by Brunschwig in 1930 proved to be a carcinoma arising in a benign pleomorphic adenoma.[19]

The majority of tumors of the sublingual gland are malignant, with adenoid cystic carcinoma and mucoepidermoid carcinoma being the most frequent. Many other malignant tumor types have also been reported. The sublingual gland anatomically is not a unit organ and while it is described anatomically as being confined to the anterior floor of the mouth, salivary tissue may be located laterally along the submandibular duct and posterior floor of the mouth. Diagnosis should be suspected when any thickening or raised lesion presents in this area and a biopsy performed to confirm malignancy before planning further treatment. Surgery is the treatment of choice, and should include an en-block resection of the anterior floor of mouth as a minimum, and may include a portion of mandible, as well as a supraomohyoid neck dissection. Adjuvant radiotherapy should be considered in most of the patients after surgical excision.[20]

In small tumors an adequate local excision is sufficient and when the tumour exceeds 2cm, a more aggressive en-block resection in pull through manner is desirable, especially considering the predominance of adenoid cystic histology. This will often necessitate the resection of lingual nerve with frozen section examination of the proximal line of transection. When the tumor involves the periosteum, a marginal mandibulectomy will usually suffice. Obvious bone involvement will occasionally necessitate a segmental mandibulectomy. Although the risk of nodal involvement is quite small, a selective level 1,2,3 node dissection is easily added to the procedure and may occasionally prove useful. The uncommon patient with obvious nodal involvement may require a more comprehensive neck dissection.

Postoperative radiation therapy is appropriate for selected patients with high stage, high grade tumors, or when there is concern about the adequacy of the resection. For small tumors, postoperative radiation therapy has no proven role unless the surgeon or the pathologist is concerned about the tumor margins.[19]

Management of minor salivary gland tumors

Tumors arising in the minor salivary gland accounts for 22% of all salivary gland neoplasms. Majority of them are malignant with only 18% being benign. Of the benign tumors pleomorphic adenoma is the commonest. The most common site of a pleomorphic adenoma of the minor salivary gland is the palate followed by lip, buccal mucosa, floor of mouth, tongue, tonsil, pharynx, retromolar area and nasal cavity.

The treatment of pleomorphic adenoma is essentially surgical. Though these benign tumors are apparently well encapsulated, resection of the tumor with an adequate margin of grossly normal surrounding tissue is necessary to prevent local recurrence as these tumors are known to have microscopic pseudopod like extension into the surrounding tissue due to "dehiscences" in the false capsule. Spiro reported a recurrence in 7% of 1342 patients with benign parotid neoplasms and 6% of patients with benign minor salivary gland tumors.[21]

The minor salivary gland malignancies often present as a submucosal swelling and have been reported at all anatomic subsites of the head and neck. Complete resection is the treatment of choice. Unfortunately, given the proximity of essential structures, the need to balance functional and cosmetic with oncologic consequences can interfere with an adequate “clear margin.” The neck should be treated when there is evidence of regional metastasis or when subclinical metastatic risk exceeds 15%. Surgery alone cures most low-stage, low-grade tumors, all other stages and grades require postoperative radiotherapy. Systemic treatment for locoregional and distant failure remains disappointing.[22]

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Small particles big wonders-Nanotechnology-A Review

Abstract

Man makes technology,but technolgy create wonders.Small ideas create big wonders,small things make world bigger.The background of the article is about the small particles-called Nano particles.The technology for these articles called- Nanotechnology.Coming into excistance this technology deals with particles at atomic level.Nanotechnology have been into all fields,likewise it is into medicine,dentistry giving newer dimensions to the fields. The science and technology of diagnosing, treating and preventing of disease and traumatic injury, of relieving pain and of preserving and improving human health, using nano scaled- structured materials, biotechnology and genetic engineering and eventually complex molecular machine systems and nano robots.

Key Words

Nanotechnology, Nano Particles, Nanodentistry, Technology

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Introduction

Nanotechnology is the science and technology of miniaturization. It primarily acts one billionth of a meter or one tenth thousandth the width of a human hair involving each individual atoms or molecules. The word NANO is derived from the greek word-meaning DWARF. It is basically engineering sense at a atomic or molecular level or scale. Thus extracting atomic or molecular scale of any material, and resulting with newer nano materials which are better in properties[1].

Nanoproducts are basically created with sophisticated equipments that are capable of making materials into newer materials of nanoscale.i.e.each indivual atoms combines with molecules or atoms done using equipments creating mechanical nanoscale objects with extraordinary properties.

Nano materials are capable of giving out light at different length depending on the size of the material. These materials at the miniature scale exhibit different property.i.e iron at nanodemension are no more magnetic, below 200 atoms of gold no more a metal and glistening. Taking advantage materials of high value properties like strength, lightness, flexibility are exhibited.

Mechanisms of nanotechnology, complies of three basic steps

1. Scientist must be able to manipulate individual atoms
2. Next step is to develop nanoscopic assemblers, that can be programmed to manipulate atoms and molecules at will.
3. In order to create enough assemblers to build functional structure, some nanomachines called replicators, will be programmed to build more assemblers. Assemblers and replicators will work together like hands, to automatically construct products. Thus nanotechnology stands for the technology to program and manipulate matter with molecular precision and to scale it to 3-d product of arbitory size[2].

Many fields like electronics, information technologies, optics, now recently with medicine, dentistry etc have been introduced.Nanomedicine, the science and technology of diagnosing, treating and preventing of disease and traumatic injury, relieving pain and of preserving and improving human health.

History

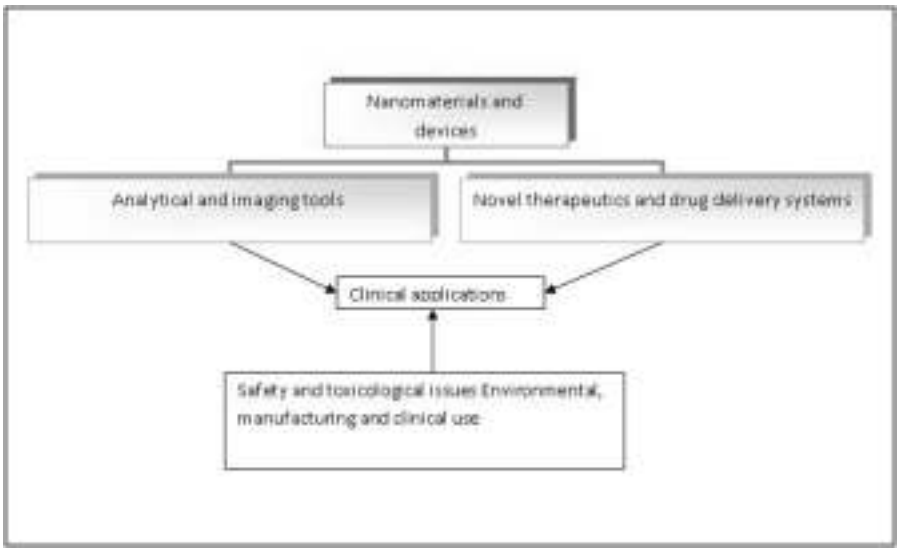
1959 The late Nobel Prize winner Physicist Richard P.Feynman envisioned and speculated the potential of nano sized devices. He said at the annual meeting of the American Physical Society presenting a talk entitled "There is plenty of room at the bottom". Feynman suggested that these small naomachines, nanorobots and nanodevices could be used to develop a wide range of atomically precise microscopic instrumentation and manufacturing tools. He concluded, "This is a development which I think cannot be avoided". Forty years ago, this talk astonished and created skepticism.However, since then, we have made remarkable progress towards realizing Feynman's vision. His vision remained undiscussed until the mid 80's, when the MIT educated engineer K Eric Drexler published 'Engines of creation' to popularize potentiality of molecular nanotechnology.

Chris Papadopoulos, nanotechie claimed that a carbon nanotube which is a poster boy of nanotechnology, which along with graphite tube can be used for applications for constructing high performance air crafts.

Ted Sergent Author of 'The dance of the molecules' elaborated that every matter are when tuned to a nanoscale can change enormously the function also.Eg: Guitar string when length and width changed the sound quality also changed.

Nanotechnology In Medicine

The science and technology of diagnosing, treating and preventing of disease and traumatic injury, of relieving pain and of preserving and improving human health, using nano scaled-structured materials, biotechnology and genetic engineering and eventually complex molecular machine systems and nano robots. This nanomedcine



Various Disciplines

perceived of five main sub disciplines with many overlapping common technical issues **Fig1**.

Regenerative Medicine

The tissue engineering methods and cell therapy and along with nanotechnology can manipulate cell proliferation and differentiation and the production and organization of extracellular matrices.

Programmable nanorobotic devices would allow physicians to perform precise interventions at the cellular level, technology can mechanically reversing artheroscelorosis,improving respiratory capacity, enabling near instantaneous haemostasis,supplementing immune system, rewriting or replacing DNA sequences in cells, repairing brain damage and resolving gross cellular insults

Feynman offered the first known proposal for a nanorobotic surgical procedure to cure heart disease, "A friend of mine(Albert R.Hibbs) suggests a very interesting possibility for relatively small machines. He says that, although it is a very wild idea, it would be interesting in surgery if you could swallow the surgeon inside the blood vessel and it goes into the heart and looks around. It finds out which valve is the faulty and takes a little knife and slices it out, that we can manufacture an object that maneuvers at that level, other small machines might be permanently incorporated in the body to assist some inadequately functioning organs."

We know bacteria and viruses are very small and not visible through naked eyes, the nanoparticles are still smaller than these bacteria and viruses ,then the action by these nano particles are very effective than any particles on these infection causing organisms, because they can penetrate at very lower level ,thus proving their ability and potentiality[1].

Regular antibiotics coated with nanoparticles are still effective in its action. Genomics and protomics are powerful diagnostic tool for detecting genetic predisposition of certain diseases, thus used in preventive medication for the individual for preventive measures. Lab -on –chip developed by Chris Backous analyses the genetic material in individual cells and can be done quickly for sequencing using blood, bone marrow etc[3]. Nanocoatings also offer for slow release of asthma medication.

Nanosensors help in recognizing airborne rogue agents drugs exhaled through breath. Drugs like marijuana, concentration of alcohol, can be checked where in future totally replacing with urine testing.

Nanotechnology also in field of orthopaedics for osteogeneration and biomineralization showing its presence. There is ongoing attempts where nanoparticles are intend to use as medical robots for carrying drugs/drug delivery system.Respirocytes,medical nanorobot is artificial red blood cell made of 18 billion precisely arranged atoms.

Nanogenerators, self powered implantable medical devices, sensors, and portable electronics by converting mechanical energy from body movement, muscle stretching, or water flow into electricity.

Nanodentistry, potential treatment opportunities may include in diagnostics, inducing local anesthesia, dentition renaturaliotion, permanent hypersensitivity cure, complete orthodontic alignments, and not least continuous oral health maintenance[4].

Inducing local anesthesia, a common procedure in dental practice. Dental professional will instill a colloidal suspension containing millions of active analgesic micron sized dental nonorobot particles on the patient gingivae.Soon after contact with the tissues they migrate into gingival sulcus and passing painlessly through lamina propria or the the 1-3 micron thick layer of loose tissue at the cementodintinal junction, then enters dentinal tubules to proceed further to reach the dental pulp, all guided by a combination of chemical gradients, temperature differentials, and even positional navigation, all under the control of the onboard nano computer as directed by the dentist[5].

This impulse traffic supervised by dentist once installed in the pulp can shutdown all sensory at region and at any level that requires treatment, the selected tooth on imparting nanorobots is anaesthetized at the stage. After the procedures sensation all restored by retrieving the nanorobots from the same as it was instilled again under supervision by the dentist, thus controlling the nerve traffic. Thus new era of painless, no needles, selectivity and controllability of the analgesic effect, fast and reversible action, and most important side effects and complications are avoided.

Dental Applications And Research

Tooth Repair

A one step in the dental research is the whole replacement of biological analogous of the tooth called dentition replacement therapy. The therapy should feasible with the economic and time constraints.

Dentin Hypersensitivity

Reconstructive dental nanorobots using native biological materials could selectively and precisely occlude specific tubules within minutes, offering patients a quick and permanent cure.

Tooth Repositioning

Orthodontic nanorobots could directly manipulate the periodontal tissues, allowing rapid and painless tooth straighting, rotating and vertical repositioning within minutes to hours.

Tooth Renaturalization

This procedure may become popular, providing perfect treatment methods for esthetic dentistry.

This trend may begin with patients who desire to have their 1) Old dental amalgams excavated and their teeth remanufactured with native biological materials, and 2) Full coronal renaturnalisation procedures in which all filings, crowns, and other 20th century modifications to the visible dentition are removed with the affected teeth remanufactured to become indistinguishable from original teeth[5].

Dental Durability And Cosmetics

Both can be tremendously improved with replacing upper layers with covalently bonded artificial materials such as sapphire or diamond which have 20-100 times the hardness and failure strength of natural enamel or contemporarary ceramic veneers and good biocompatibility. Nanorobotic dentifrice delivered by mouthwash or toothpaste could patrol all supragingival and subgingival surfaces at least once a day metabolizing trapped organic mater into harmless and odorless vapors and performing continuous calculus debridement. These nanorobots for dentifrice called dentifrobots are also capable of idententify and destroy pathogenic bacteria residing in plaque. These robots are also can be employed for halitosis prevention. Thus with this kind of protection at an early age will lead complete disappearance of dental caries and gingival diseases in near future.

Conclusion

Nanotechnology ,its just not a technology,it is the backbone for all reserach.Nano technology make its presence in medicine, dentistry,drug sciences adding more to the diagnosis,treatment, preventing diseases is more encouraging, The technology in pharmaceuticles also proved its importance.hence the research related to this field will be always rewarding.

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