



# Indian Journal of Dental Sciences

... an insight into DENTISTRY

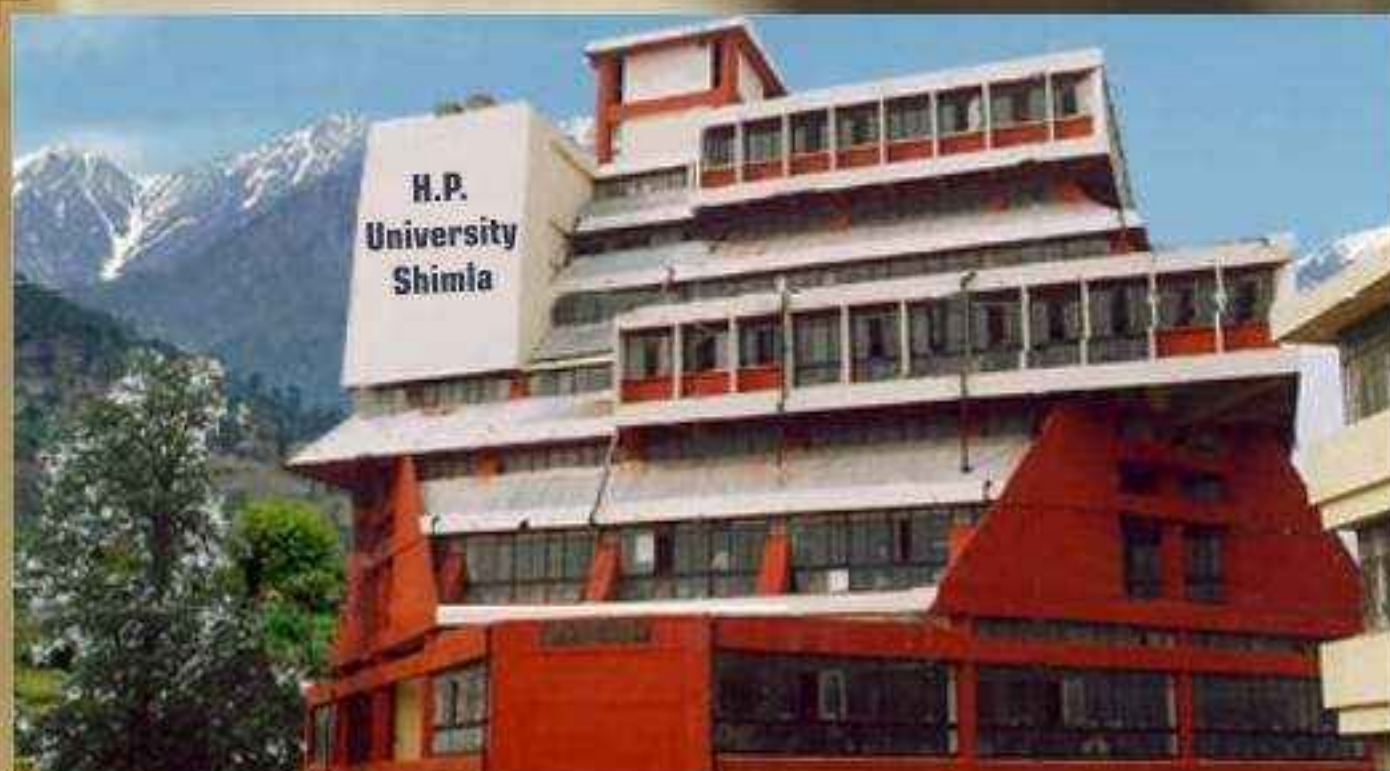
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## पुराने छात्रों ने साझा की यादें

मंडी। हिमाचल डेंटल कालेज सुंदरनगर में पूर्व छात्र मिलन समारोह साथ हुआ। कालेज कैम्पस में हुए इस आयोजन में देश भर ही नहीं बल्कि विदेशों से भी आए करीब एक सौ विद्यार्थियों ने भागीदारी की। इनमें वर्ष 1994-95 के शुरुआती सत्र के छात्र भी शामिल हुए। समारोह में प्राचार्य डा. विनोद सचदेव ने प्रतिभागियों का स्वागत करते हुए उनकी उपलब्धियों पर प्रसन्नता व्यक्त की। समाज के लिए उनके योगदान की सराहना की।

निदेशक डा. अनिल सिंगला ने उनके शानदार व्यक्तिगत उपलब्धियों पर कुछ पूर्व छात्रों को बधाई दी तथा कालेज का नाम ऊंचा करने के लिए उनके प्रति कृतज्ञता व्यक्त की। मुख्य अतिथि डा. वीके गुप्ता ने कहा कि छोटे से संस्थान ने संघर्ष करके आज एक विशाल संगठन का रूप धारण कर लिया। डा. गुप्ता ने कहा कि छात्रों ने समाज के प्रति महत्वपूर्ण भूमिका निभाकर कालेज को गौरवान्वित किया है। वरिष्ठ शिक्षकों और गैर शिक्षकों को भी सम्मानित किया। परस्पर परिचय के दौरान संस्थान के पुराने और नए स्नातकों ने कार्यक्रम को अविस्मरणीय बना दिया। छात्रों ने रंगारंग सांस्कृतिक कार्यक्रम प्रस्तुत कर समारोह का यादगार बनाया।

**Sundernagar, November 28**

An alumni meet was organised by Himachal Dental College, Sundernagar, on the college campus here yesterday. The meet was attended by over 100 participants from various parts of the country and even abroad, consisting of old students of the college belonging to all the batches starting with the first batch of 1994-95.

Speaking on the occasion, Chairman of college and chief guest Dr VK Gupta spoke on how the college had struggled initially and then turned into a successful organisation. He also applauded the role being played by the alumni of the college which gave him a sense of pride and contentment. He felicitated senior members of the faculty and non-teaching staff.

Welcoming the participants, Dr Vinod Sachdev, Principal, expressed happiness over students' achievements and praised their contribution to the society in general. He recited some old episodes much to the delight of the congregation.

Speaking on the occasion, Dr Anil Singla, Director, congratulated the alumni on their spectacular achievements and expressed gratefulness for having made the college proud.

Dr Vikas Jindal, Director, also spoke about old days of the college. While introducing themselves, the graduates of the college expressed their happiness over having shared moments of surprise, joy and exhilaration with their long-lost friends. — OC



## छात्रों की उपलब्धियों की सराहना

अखण्ड हिमाचल, सुंदरनगर।

हिमाचल डेंटल कालेज सुंदरनगर के परिसर में कार्यक्रम का आयोजन किया गया।

कार्यक्रम में देश के विभिन्न हिस्सों से 100 से अधिक प्रतिभागियों और विदेशों से वर्ष 1994-1995 से पहले बैच के छात्रों ने भाग लिया। प्रतिभागियों का स्वागत करते हुए कालेज के प्राचार्य डा. विनोद सचदेव ने छात्रों की उपलब्धियों पर अपनी प्रसन्नता व्यक्त की और समाज में उनके योगदान की सराहना की। इस अवसर पर निदेशक डा. अनिल सिंगला ने छात्रों की

शानदार व्यक्तिगत उपलब्धियों पर छात्रों को बधाई दी और कालेज का गर्व बढ़ाने के लिए कृतज्ञता व्यक्त की। उन्होंने इस कालेज के इतिहास पर प्रकाश डाला तथा उपस्थित लोगों को शायरी भी सुनाई।

इस अवसर पर अध्यक्ष और मुख्यातिथि डा. वीके गुप्ता ने कालेज की उपलब्धियों पर प्रकाश डाला और संकाय और गैर शिक्षण स्टाफ के वरिष्ठ सदस्यों को सम्मानित किया। इस दौरान कालेज के छात्र-छात्राओं की ओर सांस्कृतिक कार्यक्रम का आयोजन किया गया।



सुंदरनगर: डेंटल कालेज में आयोजित कार्यक्रम के दौरान छात्र-छात्राओं को सम्मानित करते मुख्यातिथि डा. वीके गुप्ता... अखण्ड हिमाचल



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# Indian Journal of Dental Sciences

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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

Dear Readers,

It is indeed a pleasure to present you with another issue of Indian Journal of Dental Sciences.



Dr. Vikas Jindal  
Editor in Chief

The IJDS is really fortunate to have a wealth of experienced academicians who have painstakingly reviewed and corrected the articles that the diligent and energetic minds across the country have worked hard to bring to your purview. I do hope you will relish the scholarly fair. I would like to particularly thank the publisher for painstaking work in the short time that we have had this year to bring out the issues. A special thanks to Prof. A.D.N. Bajpai, Vice Chancellor-HP University, Shimla for their help and encouragement.

Research has advanced in recent times and we Indians are also doing lot of research in different directions. However, many times we are not aware of the good work our fellow colleagues are doing. I appeal to all to contribute their scientific knowledge for the benefits of others.

I welcome your comments and suggestions on the IJDS and as it's Editor, I am fully committed to bringing about a IJDS that reflects quality and character of professional excellence of Periodontology in India and the world today.

Sincerely yours,

Dr Vikas Jindal  
Editor in Chief

## Effect Of Preoperative Aceclofenac On The Success Of Inferior Alveolar Nerve Block In Patients With Irreversible Pulpitis

### Abstract

**Introduction:** The purpose of this prospective, randomized, placebo-controlled study was to determine the effect of the administration of preoperative aceclofenac on the success of the inferior alveolar nerve block (IAN) in patients with irreversible pulpitis. **Methods:** Forty endodontic outpatients diagnosed with irreversible pulpitis of a mandibular posterior tooth were randomly administered capsules of either 100mg aceclofenac or placebo 45 minutes before the administration of a conventional IAN block. Endodontic access preparation was begun 15 minutes after completion of the IAN block, and all patients had profound lip numbness. Success was defined as no or mild pain (visual analogue scale recordings) on access or initial instrumentation. Data were analyzed by the chi-square and independent t test. **Results:** The success rate for the IAN block was 65% with aceclofenac and 35% with placebo, with a significant difference between the 2 groups (P-value < 0.01). **Conclusions:** Premedication with aceclofenac given 45 minutes before the administration of the IAN block significantly increased the anesthetic success rates in patients with irreversible pulpitis.

### Key Words

Aceclofenac, inferior alveolar nerve block, irreversible pulpitis

### INTRODUCTION

The inferior alveolar nerve block (IAN) is the most frequently used mandibular injection technique for achieving local anesthesia for endodontic treatment. However, the IAN block does not always result in successful pulpal anesthesia. Clinical studies in endodontics have found failure with the IAN block occurring between 44% and 81% of the time in patients with irreversible pulpitis<sup>1,2</sup>. Various mechanisms have been hypothesized to explain the failure of local anesthetics including anatomic variations like cross innervations and accessory innervations, decreased local pH, tachyphylaxis of anesthetic solutions, and activation of nociceptors like tetrodotoxin (TTX)<sup>3,4</sup>.

Many researchers have identified inflammation as an important component of the pathogenesis of hyperalgesia and failure of local anesthesia. Because NSAIDs reduce nociceptor activation by decreasing the levels of inflammatory mediators, it is hypothesized that premedication with NSAIDs will affect the success rate of local anesthesia in patients with irreversible pulpitis<sup>5</sup>. Aceclofenac used in the present study is a phenyl acetic acid derivative and

an effective analgesic and anti-inflammatory agent. It is a potent inhibitor of enzyme cyclooxygenase which is involved in production of prostaglandins.

Previous investigations using analgesics before administering inferior alveolar nerve (IAN) block have reported conflicting results. For example, in 2006, Modaresi<sup>6</sup> reported significant improvements in the success rate of IANB in teeth with inflamed pulps after the use of ibuprofen, acetaminophen-codeine and placebo premedication therapy. Ianiro<sup>7</sup> reported higher success rates although they were not significantly different with acetaminophen and acetaminophen-ibuprofen combination. Aceclofenac is not used in any of the previous studies. The use of aceclofenac to provide potential increased effectiveness for the IAN block needs further investigation to confirm its effectiveness. The purpose of this randomized, placebo-controlled study was to evaluate the effect of premedication of aceclofenac on anesthetic success rate in terms of reducing pain during endodontic procedures.

### Materials and Methods

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**Date of Acceptance :** 30<sup>th</sup> November 2011

40 adult patients participated in the study were all outpatients of department of Conservative dentistry, VMSDC, Salem. They were randomly assigned into two groups of twenty subjects each: Group I were administered 100 mg aceclofenac (altraflam, ranbaxy). group II were given placebo with sugar coated pills. Exclusion criteria were as follows: subjects who were younger than 18 years; had allergies or were unable to take aceclofenac; were allergic to local anesthetics; were pregnant or nursing; had a history of significant medical conditions; or were unable to give informed consent. The patients included had not taken any analgesics for at least 8 hours before enrollment in the study, and written informed consent was obtained from each patient.

To qualify for the study, each patient had a vital mandibular posterior tooth (mainly first and second molar), was actively experiencing pain, and had a prolonged response to cold testing with Green Endo-Ice. Patients with no response to cold testing, periradicular pathosis, or no vital coronal pulp tissue on access were excluded from the study. Therefore, each patient had a tooth that fulfilled the criteria for a clinical diagnosis of irreversible pulpitis.



Each patient rated his or her initial pain on a **Heft-Parker visual analogue scale (VAS)**<sup>8</sup> (Fig.1)

The VAS was divided into 4 categories. No pain corresponded to 0 mm. Mild pain was defined as greater than 0 mm and less than or equal to 54 mm. Mild pain included the descriptors of faint, weak, and mild pain. Moderate pain was defined as greater than 54 mm and less than 114 mm. Severe pain was defined as equal to or greater than 114 mm. Severe pain included the descriptors of strong, intense, and maximum possible. Patients also completed a Corah dental anxiety scale 9 to rate their level of anxiety. Corah developed a 4-item questionnaire that asks patients about 4 dentally related situations. The scale yields a score ranging from 4-20.

Forty-five minutes after administration of the capsules (100mg aceclofenac / placebo) standard IAN block and long buccal injection were administered. Two 1.8-mL cartridges of 2% lidocaine with 1:100,000 epinephrine (Xylocaine; Astra Zeneca LP, Dentsply, York, PA) were given for the IAN block, and 0.9 mL of lidocaine with 1:100,000 epinephrine was given for the long buccal injection. After the IAN block, the patient was questioned for lip numbness every 5 minutes for 15 minutes. If profound lip numbness was not recorded in 15 minutes, the block was considered missed, and the patient was eliminated from the study. No subjects were eliminated in this study as a result of lack of lip numbness.

At 15 minutes after injection (ie; 60 minutes after administration of aceclofenac or placebo capsules), the teeth were isolated with a rubber dam, and endodontic access was performed. If the patient felt pain, treatment was immediately stopped, and the patient rated their discomfort by using the Heft-Parker VAS<sup>8</sup>.

The success of the IAN block was defined as the ability to access and instrument the tooth without pain (VAS score = 0) or mild pain (VAS rating less than or equal to 54 mm). The patients who had moderate or severe pain (VAS rating greater than 54 mm) during access into dentin or when entering the pulp chamber received a supplemental buccal infiltration injection with 4% articaine. After removal of the rubber dam, a standard infiltration injection was administered buccal to the tooth under treatment. After waiting 5 minutes for the infiltration to take effect, the rubber dam was replaced, and endodontic access was continued.

Place a mark on the line below to show the amount of pain that you feel.

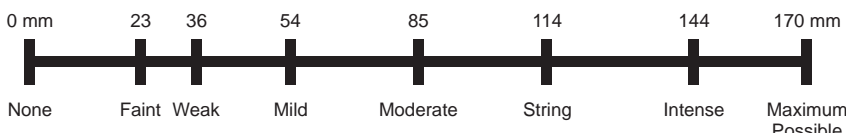


Fig1: Heft-Parker visual analogue scale (VAS)

The data from this study were collected and statistically analyzed. Comparisons between the aceclofenac and placebo groups for anesthetic success, gender, recent food intake, tooth type, Corah dental anxiety scale, age, and initial pain ratings were analyzed by using independent t test. Anesthetic success was analyzed using chi square test. Comparisons were considered significant if P value <.05.

### Results

The gender, age, initial pain, tooth type and corah dental anxiety ratings<sup>9</sup> of the patients are presented in table 1 and there was no statistical difference between the both groups. However, there was a significant difference between both groups in terms of anesthetic success. IAN block success was 65% for the aceclofenac group and 35% for the placebo group (P Value - .04763).

the effect of age, gender, initial pain, tooth type, and anxiety rating would be minimized between the two groups. The mean initial pain ratings of 96 for the aceclofenac group and 100 for the placebo group would correlate to moderate pain on the VAS. This pain is representative of patients with an irreversible pulpitis. The mean anxiety ratings in the current study were similar to the results of Lindemann<sup>10</sup>, who also studied patients with irreversible pulpitis.

If an analgesic decreases the amount of prostaglandins<sup>5</sup>, it might be able to increase the efficacy of local anesthetics. Aceclofenac(altraflam100mg,ranbaxy) used as a premedication in this study are relatively safe, fast-acting analgesics that control inflammation ,also they had not been used before in a similar study.

	<b>Aceclofenac Group</b>	<b>Placebo Group</b>	<b>P-Value</b>
<b>Total Subjects</b>	20	20	
<b>Gender</b>	M -12/20 F - 8/20	M -11/20 F - 9/20	0.30736
<b>Age</b>	30.4 ± 9.832	31.7± 8.933	0.33207
<b>Initial Pain</b>	95.2 ± 19.874	100.25 ± 13.452	0.17672
<b>Dental Anxiety Scale</b>	10.6 ± 1.3138	11.25± 2.245	0.13622
<b>Tooth Type</b>	IMOLARS - 60% II MOLARS- 40%	IMOLARS-70% IIMOLARS-30%	0.50736
<b>IAN Block Success</b>	65 %	35 %	<b>0.04763</b>

### Discussion

The patients' age, gender, initial pain, tooth type, and anxiety ratings were not significantly different between the aceclofenac and placebo groups .Therefore,

Aceclofenac<sup>5</sup> is a potent inhibitor of enzyme cyclooxygenase which is involved in production of prostaglandins. They also inhibit synthesis of IL-1, tumor necrosis factor and PGE2 production. Thus one might conclude that because aceclofenac

reduces the amount of prostaglandins, there might be an increase in the efficacy of local anesthetics.

In 2006 Modaresi<sup>6</sup> advocated premedication with ibuprofen and acetaminophen-codeine for achieving deep anesthesia in patients with irreversible pulpitis. They evaluated the depth of anesthesia with the help of electric pulp tester, but did not evaluate the success or failure rate on basis of pain during root canal treatment. According to Modaresi<sup>6</sup> and Ianiro<sup>7</sup>, the preoperative administration of ibuprofen increased the effectiveness of the IAN block. In the present study, effect of premedication with aceclofenac was studied by using pain response on modified Heft Parker VAS. Premedication was given 45 minutes before the procedure to allow NSAIDs to achieve satisfactory plasma concentration.

In the present study, aceclofenac group gave 65% anesthetic success rate while placebo group gave 35% success rate, which is comparable with previous studies (Aggarwal<sup>11</sup>, Nusstein<sup>12</sup>). Thus premedication with aceclofenac does significantly increase the success rate (65%) in the present study.

#### CONCLUSION:

In conclusion, for mandibular posterior teeth, 100 mg of aceclofenac given 45 minutes before the administration of the IAN block resulted in a significant increase in IAN block success in patients with irreversible pulpitis.

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## Evaluation Of Marginal Fit Of Castings Made With Nickel-chromium And Cobalt-chromium Alloys Using Varying Coats Of Die Spacers - A Laboratory Study

### Abstract

**Objectives of the study:** To study the marginal fit of artificial crowns made with two base metal alloys. To find out the effect of die-spacers on the fit of base metal alloy crowns. To evaluate comparatively the effect of number of coats of die-spacers with respect to marginal fit of crowns made with two base metal alloys.

**Materials and methods:** For each alloy material 20 specimens were made. A standardized die was prepared and impressions were made with polyether elastomeric impression material and dies were made with die stone. Wax patters were made on the dies with varying coats of die spacer. The wax patters were invested and castings were made with 20 specimens using Ni-Cr alloy and 20 specimens using Co-Cr alloy. The marginal fit of crowns were evaluated with optical micro scope.

**Results:** The mean and standard deviation of the marginal fit was calculated for castings made with Ni-Cr alloy and castings made with Co-Cr alloy. It was found that maximum mean was with castings made with Co-Cr alloy and minimum with castings made with Ni-Cr alloy.

**Conclusion:** Co-Cr alloy copings had lesser marginal fit when compared with copings of Ni-Cr alloy. Use of paint-on die spacer has the potential to ease insertion of coping without significantly affecting its marginal fit

### Key Words

Master die, Stone die, Die-spacer, Inlay wax, Castings, Copings, marginal fit,

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### Introduction

Base metal alloys have been in use in Prosthodontics as an alternative to traditional high gold content alloys. These alloys attracted the attention of the dental professionals due to their superior mechanical properties as well as low cost. The success of a cast metal frame work depends not only on selection of suitable material for investing procedure but also on meticulous laboratory procedures undertaken. Marginal fit of coping/crown is very important factor for the success of prosthesis/restoration to follow. Marginal integrity ranks high for the success of a restoration because good marginal fit is essential for maintaining gingival health and protecting the tooth from physical, chemical, thermal and bacterial injuries. To obtain this, there must be a band of close adaptation of casting with the prepared tooth at the margins of tooth preparation. At the same time, a space must exist between the internal surface of the casting and the prepared surface of the tooth to provide room for the luting agent. This space meant

for the cement allows the casting to be seated completely during cementation. If the available space for cement is too narrow, the casting will not seat properly.

Conversely, If the available space for cement is too wide, casting will be too loose on the prepared tooth, resulting in loss of resistance. Spacer alters the dimension of the die by coating the occlusal surface and vertical axial walls with a thin layer of rapidly drying paint. Seating of the crown depends on the thickness of the coating, which in turn depends on the number of coats.

### Materials and Methods

The study was done to evaluate the marginal fit of cast metal crowns made with two base metal alloys with varying coats of die spacers.

Two base metal alloys have been selected for this study. (Photo - 1 & 2)



Photo-1 Nickel - Chromium Alloy



Photo-2 Cobalt - Chromium Alloy

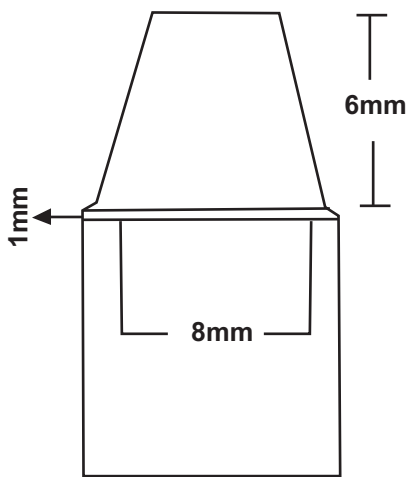
GROUP	TYPE OF MATERIAL	TRADE NAME	MANUFACTURER
A	NICKEL-CHROMIUM ALLOY	DURA BOND	MATECH Ltd.U.S.A. Batch No.BMM001
B	COBALT-CHROMIUM ALLOY	WIROBOND LFC	BEGO,GERMANY Batch No.11738

Nickel-Chromium alloys were designated as **Group A**

Cobalt-Chromium alloys were designated as **Group B**

All the alloy pellets were selected from the same batch to avoid variation in the values obtained.

A standardized brass die was machined to the following measurements: 6mm height, 8mm gingival diameter, 6 degree taper and 1mm chamfer margin to simulate the single tooth prepared for cast metal crown.



**Preparation of Stone Die**

The brass master die was duplicated with polyether impression material (Impregum-F, ESPE, and Germany) using custom made trays and these were poured with type IV improved stone (Ultra rock, India). (**Photo-3, 4&5**) A total number of 40 dies were prepared. Twenty samples each were prepared with group A and group B thus a total number of forty samples were prepared for this study.



**Photo - 3 Brass Master Die and Custom Trays**



**Photo - 4 Polyether Impression Material**



**Photo - 5 Die Stone**

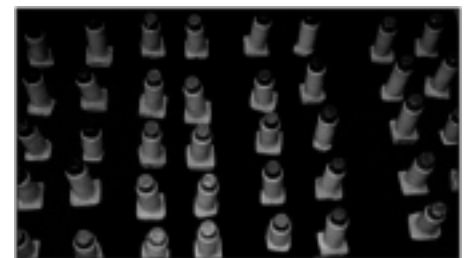
In each group, samples were divided into four sub groups. Five dies for **Group A** and five dies for **Group B** were chosen for each coat of die spacer and thus dies with 1 to 4 coats were prepared. Die surfaces were treated with one coat of die hardener (George taub products, N.J., U.S.A.) to preserve the integrity of stone margin during the preparation of wax pattern.

**Application of die spacer:**

The stone dies were treated with die spacer which was painted upon the dies. A band of 1mm in width at the cervical margin was left unpainted. Die spacer coating was painted on all dies. 5 dies for group A and 5 dies for group B were chosen for each coat and thus 1 to 4 coats of spacer samples were prepared. (**Photo-6&7**)



**Photo-6 Die Spacer And Lubricant**



**Photo-7 Dies With Spacer Coats**

**Preparation of wax pattern:**

The finish line of the die was highlighted with sharp, bright red pencil. Die lubricant (True release, George taub Ltd., U.S.A.) was applied with a clean brush. Wax patterns

Number Of Coats Of Die Spacer	Sample In Group A	Sample In Group B
1	5A <sub>1</sub>	5B <sub>1</sub>
2	5A <sub>2</sub>	5B <sub>2</sub>
3	5A <sub>3</sub>	5B <sub>3</sub>
4	5A <sub>4</sub>	5B <sub>4</sub>

were made by soft inlay wax (GC inlay wax, Japan) over the stone dies. (Photo-8)



Photo-8 Inlay Wax & Pkt Instruments

**Investing and casting:**

Each pattern was immediately invested after marginal refinement to minimize distortion. The lost-wax casting technique was used. The wax patterns were invested in graphite free, phosphate bonded investment material (Super vest, Matech Ltd., U.S.A.).(Photo-9) Burnout of the wax patterns were carried out. (Photo-10)



Photo-9 Phosphate Bonded Investment Material

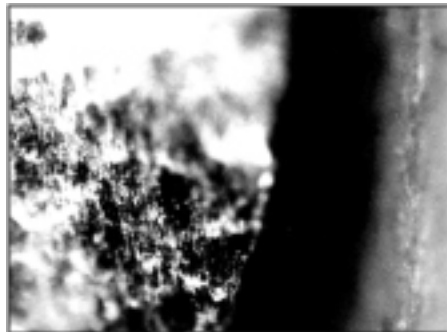


Photo-10 Burnout Furnace

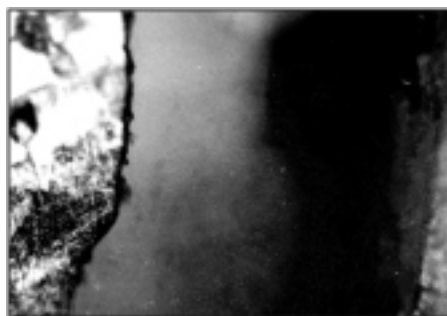
A separate ceramic crucible was used for melting each alloy and casting was carried out in an induction casting machine(Fornex,Bego,Germany).The castings were retrieved, sand blasted, all sprues were removed with thin carborundum disk and inspected with magnifying glass.

Each casting was seated on its respective stone die and secured with a spring-loaded

caliper exerting uniform for all samples during microscopic measurements. Optical microscope was used with  $\times 100$  magnification to measure the gap between the margins of the casting and marginal finish line of the die. (Photo-11)



Nickel - Chromium Alloy Casting with Maximum Marginal Fit (x 100)



Cobalt - Chromium Alloy Casting with Maximum Marginal Fit (x 100)

Photo-11 Photomicrograph

**Results:**

A total number of 40 crowns were made out of which 20 were made with Ni-Cr alloy and 20 were with Co-Cr alloy. The marginal fit was determined at four predetermined sites on the dies. Hence, there were twenty readings for different coats for Ni-Cr crowns (Group A) (Table-1) and twenty readings for Co-Cr crowns (Group B) (Table-II).

The mean and standard deviation of the marginal fit was calculated. It was found that maximum mean was with Co-Cr alloy group ( $59.82 \pm 23.5$ ) and minimum with Ni-Cr alloy group ( $41.72 \pm 23.17$ ). (Table III).

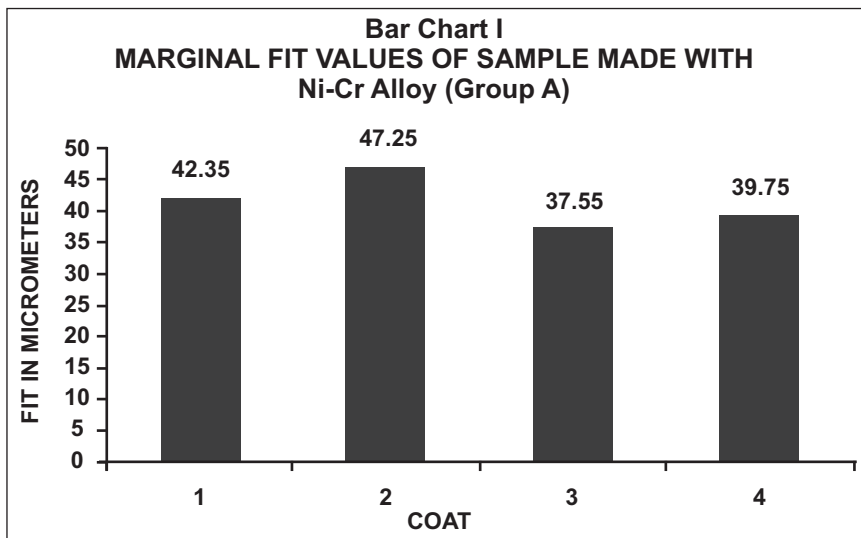
The mean and standard deviation of marginal fit, maximum mean was with four coats followed by two coats, followed by three coats and minimum with one coat. (Table-IV)

The average marginal fit for different coats for Ni-Cr (Group A) varies, with maximum discrepancy of  $47.25\mu$  for a die with two coats and minimum marginal discrepancy of  $37.55\mu$  for die with three coats.

The average marginal fit for different coats of Co-Cr (Group B) varies, with maximum discrepancy of  $75.90\mu$  for a die with four coats and minimum marginal discrepancy of  $46\mu$  for die with one coat.

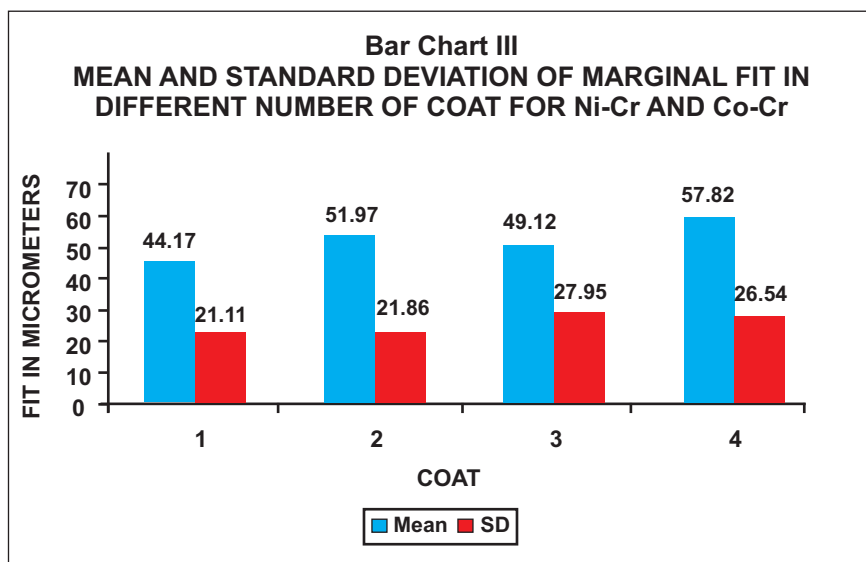
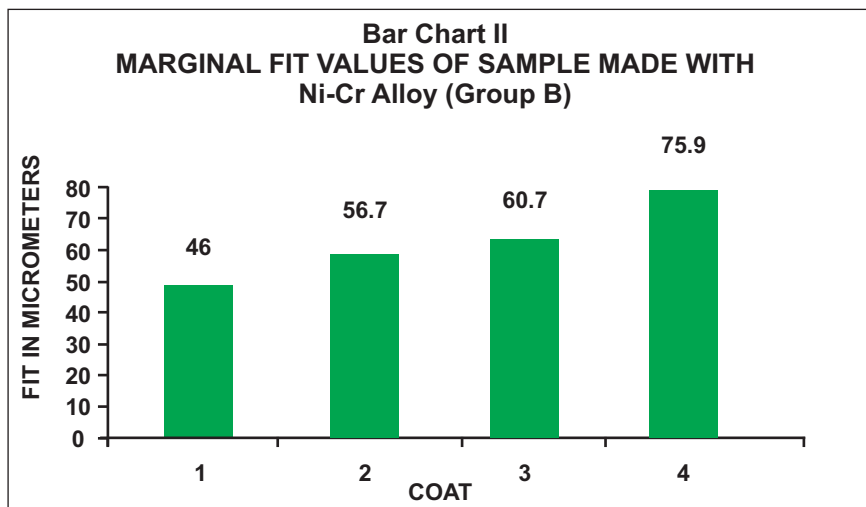
Table 1 - Marginal Fit Values Of Samples Made With Ni-Cr (Group A)

Coat	Sample (Co-Cr)																				Average			
	1					2					3					4						5		
1	18	17	13	10	40	35	50	45	85	100	85	85	45	40	42	44	28	28	18	19	42.35			
2	50	90	90	85	24	50	40	49	40	15	26	45	50	46	48	47	35	35	45	35	47.25			
3	15	11	15	12	50	42	27	50	45	32	42	30	68	90	100	40	16	12	20	34	37.55			
4	57	60	59	57	13	10	10	10	58	59	60	58	60	55	30	45	25	24	27	18	39.75			



**Table 2 - Marginal Fit Values Of Samples Made With Co-Cr (Group B)**

Sample (Co-Cr)																						
Coat	1				2				3				4				5				Average	
1	47	35	45	55	58	65	50	55	55	70	55	65	38	50	30	30	25	30	30	32	46.00	
2	65	68	76	100	40	20	20	40	80	90	80	70	25	42	70	60	50	55	47	36	56.70	
3	70	60	50	65	70	80	95	100	100	80	85	84	40	20	20	45	55	29	26	40	60.70	
4	95	100	100	100	100	95	75	60	80	80	60	60	73	80	72	75	66	45	42	60	75.90	



**Table-3**  
Mean And Standard Deviation  
Of Marginal Fit In Different  
Number Of Coats For Ni-Cr And Co-Cr

Coat	For Group A & B	
	Mean	SD
1	44.17	21.11
2	51.97	21.86
3	49.12	27.95
4	57.82*	26.54

**Table-4**  
Mean & Standard Deviation Of Marginal  
Fit For Each Alloy With Different  
Number Of Coats

Coat	A(n=20)		B(n=20)	
	Mean	SD	Mean	SD
1	42.35	26.76	46.00	13.85
2	47.25	20.13	56.70	22.99
3	37.55	25.13	60.70	26.26
4	39.75	20.59	75.90	18.26

Two-way ANOVAs was used to compare the mean values in all castings made with two alloys with different number of coats of spacer under each alloy. It was observed that the average marginal fit differs significantly between the two alloys ( $P < 0.001$ ). It was also inferred that the average marginal fit was different among different levels of coating but statistical analysis showed that it was not significantly different.

It was seen that there was a significant interaction between alloys such as Ni-Cr and Co-Cr and different number of coating of die spacers ( $P < 0.001$ ), i.e. As the level of coating increases in Co-Cr, the average marginal discrepancy increases but it is reversed with Ni-Cr. (Table-V)

**Discussion:**

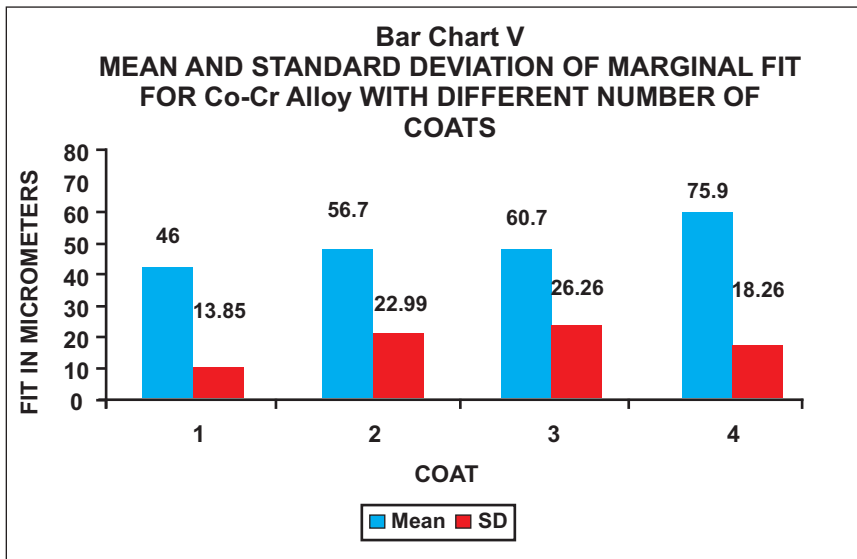
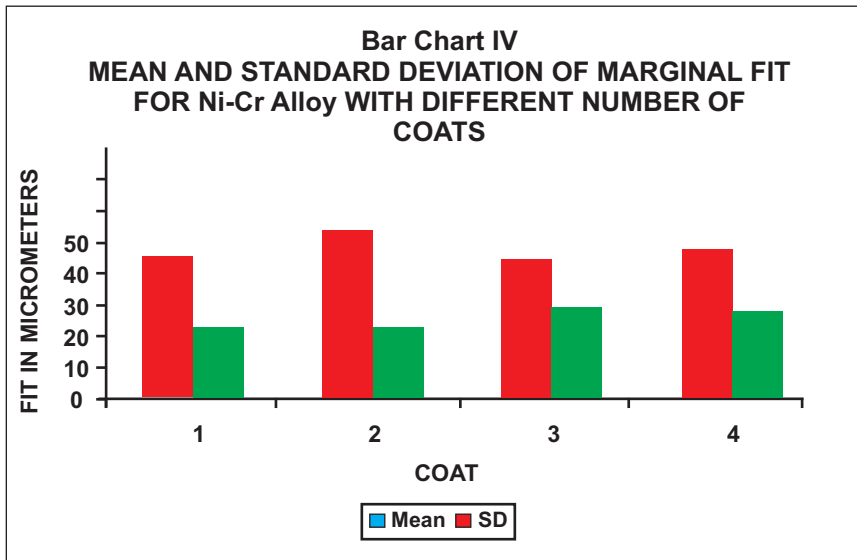
Marginal adaptation of the crown is a crucial factor in determining its clinical acceptability. Crown fit as judged by marginal seal influences the longevity of the cast restorations to a great extent. The results of dental lost wax casting techniques are greatly influenced by the expansion and contraction of all the materials used including impression materials, waxes, gypsum products, plastics and the alloys used in fixed partial dentures.

Fusayama, Eames et al, Campagni et al have demonstrated that the space between inner crown wall and the tooth preparation improves seating of crowns. When no spacer is used or at low spacer thicknesses, seating of the crown is arrested at the axial walls.

As one coat of a spacer has a specific thickness, by varying the number of coats, different amounts of relief can be produced on the internal portions of the wax patterns and subsequently on the resultant castings.

The findings of the present study reveal that the marginal fit of nickel chromium alloy castings are superior to that of cobalt chromium alloy castings. This is similar to the findings of Nitkin Asgar 5who said that nickel chromium alloys produced castings with very close fit. In terms of the number of coats of die spacers, nickel chromium alloy castings made with three coats of the die spacer had maximum marginal fit in the present study. Cobalt Chromium alloy castings made with one coat of die spacer resulted in best marginal fit.

In nickel chromium castings, maximum marginal discrepancy was observed when



**Table-5**  
**Two-Way Anova Table To Test Marginal Fit Between Alloys And Different Number Of Coats Of Die Spacers**

Factors	Sum of Squares	df	Mean Squares	F-Ratio	P- Value
Main Effect					
Group	13104.40	1	13104.4	26.73	0.001*
Coat	3897.00	3	1299.00	2.649	0.051
Interaction Group & Coat	6349.30	3	2116.43	4.317	0.001*
Residual	74523.20	152	490.28		
<b>Total</b>	<b>97873.90</b>				

two coats of die spacer were used. In cobalt chromium alloy castings more marginal discrepancy was observed compared to nickel chromium alloy castings. While it can be inferred from the above that cobalt chromium alloy castings exhibited proportionately increasing marginal discrepancy when coats of die spacer were increased, it was not so with nickel chromium alloy.

In the present study, nickel chromium alloy has been found to develop minimum discrepancy with three coats. Since the average value of a single layer of spacer coating is 20 m, present results are similar to the studies of Vermilyea et.al.12 and Campagni et.al.3.

Rafael Grajower<sup>11</sup> expressed a similar result that for spacer thickness of upto 70 m, retention of the casting was not affected, while lesser spacer thicknesses caused difficulty in insertion of the castings over the dies.

Grajower and Lewinstein concurred with this view and opined that appropriate use of die relief made bevels superfluous. They suggested that studies regarding cementation be done on teeth instead of on dies because mechanical properties of dentine may affect results. In the present study, dies were used to maintain uniformity in preparation.

**Conclusion:**

Cobalt - Chromium alloy copings had lesser marginal fit when compared with copings of Nickel Chromium alloy.

The average marginal discrepancy of Cobalt Chromium alloy coping was 59.8 m.

The average marginal discrepancy of Nickel Chromium alloy coping was 41.7 m.

Use of paint on die spacer has the potential to ease insertion of the coping without significantly affecting its marginal fit. Within the parameters of the study, it may be concluded that Nickel Chromium alloy copings produced minimal marginal discrepancy than Cobalt Chromium copings and that die spacer facilitates the insertion of casting without affecting the marginal fit significantly.

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**Source of Support :** Nil, **Conflict of Interest :** None declared

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## Cone Beam Computed Tomography In Implantology

### Abstract

Computerized tomography (CT)-based dental imaging for implant planning and surgical guidance carries both restorative information for implant positioning, as far as trajectory and distribution, and radiographic information, as far as depth and proximity to critical anatomic landmarks such as the mandibular canal, maxillary sinus, and adjacent teeth. Computed tomography imaging, also referred to as a computed axial tomography (CAT) scan, involves the use of rotating x-ray equipment, combined with a digital computer, to obtain images of the body. Using CT imaging, cross sectional images of body organs and tissues can be produced. Other imaging techniques are much more limited in the types of images they can provide. Cone Beam Computed tomography (CBCT) is a compact, faster and safer version of the regular CT. Through the use of a cone shaped X-Ray beam, the size of the scanner, radiation dosage and time needed for scanning are all dramatically reduced. A typical CBCT scanner can fit easily into any dental (or otherwise) practice and is easily accessible by patients. The time needed for a full scan is typically under one minute and the radiation dosage is up to a hundred times less than that of a regular CT scanner. In this article, the differences between the cone beam CT and conventional CT scans will be evaluated and their clinical applications in the implant therapy will be explored.

### Key Words

Computed Tomography, Cone Beam Computed Tomography, Imaging Techniques

### Introduction

There has been a rapid increase in the number of practitioners involved in implant placement, including specialists and general practitioners with different levels of expertise. Although the significance of accurate planning and surgical guidance as it pertains to critical anatomic landmarks such as the mandibular canal, maxillary sinus, and adjacent teeth cannot be overstated when reviewing imaging modalities for the preoperative assessment of the dental implant site, many conflicting variables need to be considered. The amount of information provided, its accuracy, and its applicability need to be weighed against cost, convenience, availability, radiation dose, and expertise required to produce and read the output of each modality. Currently there are a number of software systems that analyze computerized tomography (CT) scans to aid in planning surgery and produce the physical surgical drilling template guides. These templates are computer manufactured in such a way that they identically match the location, trajectory, and depth of the planned implant. As the dental practitioner places the implants, the templates stabilize the drilling by restricting the degrees of freedom of the drill trajectory

and depth. The quantitative relationship between successful outcomes in dental implant treatment and CT-based dental imaging, coupled with surgical template guidance, is unknown and awaits discovery through large prospective clinical trials. However, using CT-based dental imaging together with surgical template guidance is becoming a reliable procedure based on a series of recent preliminary clinical studies and case reports<sup>1-8</sup>.

The development of advanced imaging in recent years is breathtaking. Just a few years ago, 3D and sectional imaging were limited to conventional helical CT. 3D reconstruction and multiplanar reformatting can only be done with CT workstations. All images have to be printed on films and viewed using light box in clinic. Today, CT scans are considered essential for multiple dental implant placements. Quite a few dental surgeons installed their own in-house CBCT largely because of high demand for dental implants. The further development of CT in dentistry will certainly be higher infiltration of CBCT machines into dental clinics and broadening its application to almost all dental treatments. Dentistry, as a whole, still needs some time to adapt to this rapid development in imaging. With the

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vastly improved diagnostic ability from CBCT, the treatment outcome becomes highly predictable. The quality of all dental patient care will be enhanced by it. One thing is sure: the change has just begun.

### History

CBCT was first adapted for potential clinical use in 1982 at the Mayo Clinic Biodynamics Research Laboratory<sup>9</sup>. Initial interest focused primarily on applications in angiography in which soft-tissue resolution could be sacrificed in favor of high temporal and spatial-resolving capabilities. Since that time, several CBCT systems have been developed for use both in the interventional suite and for general applications in CT angiography.<sup>10, 11</sup> Exploration of CBCT technologies for use in radiation therapy guidance began in 1992,<sup>12, 13</sup> followed by integration of the first CBCT imaging system into the gantry of a linear accelerator in 1999.<sup>14</sup>

The first CBCT system became commercially available for oro-maxillofacial imaging in 2001 (NewTom QR DVT 9000; Quantitative Radiology, Verona, Italy). Comparatively low dosing requirements and a relatively compact

design have also led to intense interest in surgical planning and intra-operative CBCT applications, particularly in the head and neck but also in spinal, thoracic, abdominal, and orthopedic procedures<sup>15-19</sup>. The technical and clinical considerations pertaining to CBCT imaging in many of these applications have been the subjects of several recent reviews.<sup>20-24</sup> Commercially available CBCT systems for oro-maxillofacial imaging include the CB MercurRay and CB Throne (Hitachi Medical, Kashiwi-shi, Chiba-ken, Japan), 3D Accuitomo products (J. Morita Manufacturing, Kyoto, Japan), and iCAT (Xoran Technologies, Ann Arbor, Mich; and Imaging Sciences International, Hatfield, Pa). Similar systems designed for point-of-service head and neck imaging have also recently become available (MiniCAT, Xoran Technologies; 3D Accuitomo and 3D Accuitomo 170, J Morita Manufacturing; ILUMA Cone Beam CT, IMTEC, Ardmore, Okla and GE Healthcare, Chalfont St. Giles, UK).

### Oro-Maxillofacial Imaging

Advanced cross-sectional imaging techniques such as CT are used in Oro-maxillofacial imaging to solve complex diagnostic and treatment-planning problems, such as those encountered in craniofacial fractures, endosseous dental-implant planning, and orthodontics, among others. With the advent of CBCT technology, cross-sectional imaging that had previously been outsourced to medical CT scanners has begun to take place in dental offices.

Early dedicated CBCT scanners for dental use were characterized by Mozzo et al<sup>25</sup> and Arai et al<sup>26</sup> in the late 1990s. Since then, more commercial models have become available, inciting research in many fields of dentistry and oral and maxillofacial surgery. To date, multiple ex vivo studies have attempted to establish the ability of CBCT images to accurately reproduce the geometric dimensions of the maxillofacial structures and the mandible.<sup>27-30</sup>

A relatively low patient dose for dedicated maxillofacial scans is a potentially attractive feature of CBCT imaging. An effective dose in the broad range of 13-498  $\mu$ Sv can be expected, with most scans falling between 30 and 80  $\mu$ Sv, depending on exposure parameters. In comparison, CT with similar parameters delivers 860  $\mu$ Sv.<sup>31, 32</sup> Image quality can vary considerably with dose; images acquired with higher radiation

exposure often produce superior image quality.

### CBCT Benefits & Applications

- Indications of CBCT in the Maxillofacial Region
- Evaluation of the jaw bones to assess the feasibility of placing dental implants at specific sites in the jaws. This ensures that every possible precaution has been made to reduce the risk of involvement of the nerves in the lower jaw, and the sinuses and nose in the upper jaw.
- Evaluation of the status of previously placed implants
- Evaluation of the hard tissue (bones) of the temporo-mandibular joint (TMJ)
- Evaluation of abnormalities (pathology) in or affecting the bones
- Evaluate extent of alveolar ridge resorption
- Assessment of relevant structures prior to orthodontic treatment such as the presence and position of impacted canine and third molar teeth
- Assessing symmetry of the face (cephalometrics)
- Assessing the airway space (sleep apnea)
- To permit 3D reconstructions of the bones or the fabrication of a Biomodel of the face and jaws
- Assessing the mandibular nerve prior to the removal of impacted teeth, especially the lower wisdom teeth

### CBCT Versus Dental X-ray

Cone beam images provide undistorted or accurate dimensional views of the jaws. Panoramic images, by contrast, are both magnified and distorted. Magnification by itself is not a problem, as long as one knows or can calculate the magnification factor. Distortion, on the other hand, is the unequal magnification of different parts of the same image. Due to distortion panoramic images are notoriously unreliable to use for making measurements<sup>33</sup>.

In addition, while CT images can provide cross-sectional (bucco-lingual), axial, coronal, sagittal, and panoramic views, a panoramic film provides an image of only one dimension, namely a mesio-distal or antero-posterior perspective. Further, in a panoramic image all the structures between the x-ray tube and the image detector are superimposed on one another. With CT it is possible to separate out the various structures, for example, the left condyle from the right one.

### CBCT Compared to Tomography

Unlike panoramic radiography, plain-film tomography, if performed with the appropriate equipment, does not result in distortion. Like panoramic radiography, however, it does result in magnification, the degree of which differs from manufacturer to manufacturer. Plain-film tomography provides direct (as opposed to reconstructed) cross-sectional, sagittal and coronal views. The disadvantage of plain-film tomography is that it requires much more chair time than CT. It can thus be especially difficult to do on patients who are unable to sit or hold still for a period of time. Cone beam CT, on the other hand, can be performed within a 10-40 second range, depending on the region being imaged and on the desired quality of the image. Cone beam CT also provides stronger indication of bone quality.

### CBCT Versus CT (See Table-1)

- Cost of equipment is approximately 3-5 times less than traditional Medical CT
- The equipment is substantially lighter and smaller.
- Cone beam CTs have better spatial resolution (i.e. smaller pixels)
- No special electrical requirements needed
- No floor strengthening required
- The room does not need to be cooled
- Very easy to operate and to maintain; little technician training is required
- Some cone beam manufacturers and vendors are dedicated to the dental market. This makes for a greater appreciation of the dentist's needs
- In the majority of cone beam CTs the patient is seated, as compared with lying down in a medical CT unit. This, together with the open design of the cone beam CTs virtually eliminates claustrophobia and greatly enhances patient comfort and acceptance. The upright position is also thought by many to provide a more realistic picture of condylar positions during a TMJ examination
- The lower cost of the machine may be passed on to the patient in the form of lower fees
- Both jaws can be imaged at the same time (depending on the specific cone beam machine)
- Radiation dose is considerably less than with a medical CT.

**Table-1 Differences between conventional CT and cone beam CT**

CT	CBCT
<p><b>Technology</b></p> <ul style="list-style-type: none"> <li>Conventional CT scanners make use of a fan-beam.</li> <li>Transmitted radiation takes the form of a helix or spiral.</li> <li>The data are then interpolated or re-binned by the scanner into a set of slices making up a volume.</li> <li>Large anatomical regions of the body can be imaged during a single breath hold, reducing the possibility of artifacts caused by patient movement.</li> </ul>	<ul style="list-style-type: none"> <li>Cone Beam Computed Tomography (CBCT) utilizes a cone beam, which radiates from the x-ray source in a cone shape, encompassing a large volume with a single rotation about the patient.</li> <li>Images are then reconstructed using algorithms to produce 3-dimensional images at high resolution. breath hold, reducing the possibility of artifacts caused by patient movement.</li> </ul>
<p><b>Design of machine</b></p> <ul style="list-style-type: none"> <li>Conventional CT makes use of a lie-down machine with a large gantry.</li> <li>When patients lie down, the soft tissues tend to collapse. This is of particular importance to orthodontists when predicting the tissue changes likely to result from specific tooth movements.</li> </ul>	<ul style="list-style-type: none"> <li>Because -CBCT is a sitting-up machine, it offers more accurate information for dental practitioners.</li> <li>The radiation dose from a conventional CT also does not justify taking a CT scan of, for example, a child in order to make soft tissue measurements.</li> </ul>
<p><b>Size of machine</b></p> <ul style="list-style-type: none"> <li>The size of a conventional CT scanning machine precludes its installation and usage in a dental surgery.</li> <li>A conventional CT scanner has to be large (and utilizes heavy duty engineering) because the gantry rotates at a very high speed.</li> </ul>	<ul style="list-style-type: none"> <li>The CBCT is approximately the same size as a DPT/OPG machine, which makes it compact and easy to install</li> </ul>
<p><b>Radiation Exposure</b></p> <ul style="list-style-type: none"> <li>The radiation exposure to a patient from a conventional CT is approximately 100-300 microsieverts (<math>\mu</math>Sv) for the maxilla and 200-500 <math>\mu</math>Sv for the mandible 34.</li> </ul>	<ul style="list-style-type: none"> <li>The radiation exposure (for both mandible and maxilla) from the CBCT is between 34-102 microsieverts (<math>\mu</math>Sv) depending on the time and resolution of the scan 35.</li> </ul>
<p><b>Patient Positioning</b></p> <ul style="list-style-type: none"> <li>Conventional CT require the patient's head to be manually tilted to create images suitable for the dentist's needs (e.g. parallel to the occlusal plane, the hard palate, or the lower border of the mandible). When positioning to the lower border of the mandible, the patient's jaw is tilted quite far upward with strain to the neck, which patients find uncomfortable.</li> </ul>	<ul style="list-style-type: none"> <li>Patient positioning is the same for all patients in the CBCT. The patient's lower jaw is positioned in the chin cup and the forehead stabilized using Velcro straps if necessary. The scan is taken and the images can be re-positioned if necessary using the software.</li> </ul>
<p><b>Artifacts</b></p> <ul style="list-style-type: none"> <li>Artifacts arising from metal restorations are more severe using conventional CT.</li> <li>More imperative to scan the patient parallel to the occlusal plane to eliminate artifacts in all the slices.</li> </ul>	<ul style="list-style-type: none"> <li>Artifacts that arise from metallic restorations are less severe with the CBCT.</li> <li>It is less imperative to scan parallel to the occlusal plane to eliminate artifacts when using the CBCT.</li> </ul>
<p><b>Protocol Selection</b></p> <ul style="list-style-type: none"> <li>Protocol selection (e.g., slice thickness) is often problematic with conventional CT. Occasionally, the technical scanner settings are not correct and not enough information can be gathered from the scan.</li> <li>The patient may need to be exposed a second time using conventional CT. eliminate artifacts in all the slices.</li> </ul>	<ul style="list-style-type: none"> <li>The options on the CBCT allow for easy selection of the mandible, maxilla or both with no need to select the slice thickness or how many slices are necessary thus decreasing the likelihood of re-exposing the patient.</li> </ul>

**Imaging Modalities In Dental Implant Placement**

Implantologists have long appreciated the value of 3- dimensional imaging. Conventional CT scans are used to assess the osseous dimensions, bone density, and alveolar height, especially when multiple implants are planned. Locating landmarks and anatomy such as the inferior alveolar canal, maxillary sinus, and mental foramen occurs more accurately with a CT scan. The use of the third dimension has improved the clinical success of implants and their associated prostheses, and led to more accurate and aesthetic outcomes.<sup>36-42</sup> With CBCT technology both the cost and effective radiation dose can be reduced. CBCT has been in use in implant therapy and may be employed in orthodontics for the

clinical assessment of bone graft quality following alveolar surgery in patients with cleft lip and palate.<sup>43, 44</sup> The images produced provide more precise evaluation of the alveolus. This technology can help the clinician determine if the patient should be restored or if teeth should be moved orthodontically into the repaired alveolus. Anatomic structures such as the inferior alveolar nerve, maxillary sinus, mental foramen, and adjacent roots are easily visible using CBCT<sup>38</sup>. The CBCT image also allows for precise measurement of distance, area, and volume. Using these features, clinicians can feel confident in the treatment planning for sinus lifts, ridge augmentations, extractions, and implant placements.

Before implant placement and during treatment planning, the implant clinician must be able to measure the height and width of the alveolar process to ensure adequate bone and to select appropriately sized implants. In addition, the clinician must know the precise location of the mandibular canal (injury to the neurovascular bundle within the canal can result in facial paresthesia) and the maxillary sinuses (perforation of the sinuses creates the possibility of antral infections and increases the likelihood of implant failure). Multiple views of the proposed implant site should be taken, which often require the use of different imaging procedures. Various radiographic modalities are available to the clinician, including intraoral films (i.e., periapical and occlusal radiographs),

panoramic radiographs, cephalometric radiographs, plain (conventional) tomography, computed tomography (CT), cone beam CT, digital subtraction radiography, and magnetic resonance imaging.

Cross-sectional imaging techniques can be an invaluable tool during preoperative planning for complicated endosseous dental implantation procedures.<sup>45</sup> Conventional linear tomography and CT have traditionally been used in presurgical imaging, though the former has overlain ghosting artifacts and the latter has relatively high radiation exposure and cost.<sup>46</sup>

Practitioners have begun using office-based CBCT scanners in preoperative imaging for implant procedures, capitalizing on availability and low dosing requirements. A review by Guerrero et al<sup>47</sup> outlines the clinical and technical aspects of CBCT, which have popularized this new technique. Preliminary evidence addresses the ability of CBCT images to characterize mandibular and alveolar bone morphology, as well as to visualize the maxillary sinuses, incisive canal, mandibular canal, and mental foramina, all structures particularly important in surgical planning for dental implantation.<sup>46, 48, 49</sup> Several studies have described the 3D geometric accuracy of CBCT imaging in the maxillofacial and mandibular regions as well.<sup>50-53</sup>

#### Limitations Of Cbct Imaging

While there has been enormous interest, current CBCT technology has limitations related to the "cone beam" projection geometry, detector sensitivity and contrast resolution. These parameters create an inherent image "noise" that reduces image clarity such that current systems are unable to record soft tissue contrast at the relatively low dosages applied for maxillofacial imaging. Another factor that impairs CBCT image quality is image artifact such as streaking, shading, rings and distortion. Streaking and shading artifacts due to high areas of attenuation (such as metallic restorations) and inherent spatial resolution may limit adequate visualization of structures in the dento-alveolar region.

#### Controversies

As with any emerging imaging technology, use of CBCT scanners has been the subject of criticism as well as acclaim<sup>55</sup>. The technology itself is limited by lack of user experience and what is currently a relatively small body of related literature. The point-

of-service operational model that dominates diagnostic head and neck CBCT imaging practices has also drawn criticism. Because of the low radiation dose, CBCT can only provide bony detail and is unable to provide images of the soft tissues. Research on this technology is still preliminary, without prospective studies that convincingly demonstrate its benefit compared with conventional CT. Both in medical and oral and maxillofacial imaging in dentistry, CBCT has been largely adopted as an office-based service. This is a usage model purported to expedite patient diagnosis and treatment while simultaneously reducing costs, providing one-step management with fewer billed visits and no radiologist consultation fees. Point-of-service imaging and other self-referral services, however, have been widely criticized for encouraging overuse and directly inflating medical costs. The belief that financial incentives undermine the clinical decision-making process has been the basis for its criticism. The advent of CBCT technologies has also fueled the controversy surrounding office-based imaging, which is usually performed and interpreted by non-radiologists often without the accreditation, training, or licensure afforded by the radiology community.

#### Conclusions

Outcomes assessment in this area of dentistry is difficult, primarily due to bias and variability in clinical research. Observed differences can be due to differences among investigators and/or interest groups rather than differences in the treatments. Furthermore, once cost-to-benefit analyses are conducted, the increase in cost associated with CT-based implant planning and computer fabrication of surgical templates must be justified from a consumer perspective (i.e., the value associated with the increased safety and predictability of dental implants). It helps the clinician to safely and predictably transfer the optimal-implant trajectory and distances from the adjacent tooth and mandibular nerve to the patient's mouth. The final restoration becomes functional and esthetic. It does not compromise adjacent teeth or anatomic structures, yet was well accepted by the patient. CBCT is an emerging CT technology, which has potential applications for imaging of high-contrast structures in the head and neck as well as maxillofacial regions. Preliminary research suggests that high-spatial-resolution images can be obtained with comparatively low patient dose. To date, the

most researched applications for head and neck CBCT are in sinus, middle and inner ear implant, and maxillofacial imaging. This technology is not without controversy, and further research is required to establish informed recommendations about its appropriate use in a clinical setting.

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## Information For Authors

### Preparation of the Manuscript

The manuscripts should be typed in A4 size (212 × 297 mm) paper, with margins of 25 mm (1 inch) from all the four sides. Use 1.5 spacing throughout. Number pages consecutively, beginning with the title page. The language should be British English.

**Title Page** : The title page should carry

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The title of the article, which should be concise, but informative;

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### Abstract Page

The second page should carry the full title of the manuscript and an abstract (of no more than 150 words for case reports, brief reports and 250 words for original articles). The abstract should be structured and state the Context (Background), Aims, Settings and Design, Methods and Material, Statistical analysis used, Results and Conclusions. Below the abstract should provide 3 to 10 key word.

### Introduction

State the purpose of the article and summarize the rationale for the study or observation.

### Methods

Describe the selection of the observational or experimental subjects (patients or laboratory animals, including controls) clearly. Identify the age, sex, and other important characteristics of the subjects. Identify the methods, apparatus (give the manufacturer's name and address in parentheses), and procedures in sufficient detail. Give references to established methods, including statistical methods; provide references and brief descriptions for methods that have been published but are not well known; describe new or substantially modified methods, give reasons for using them, and evaluate their limitations. Identify precisely all drugs and chemicals used, including generic name(s), dose(s), and route(s) of administration.

Reports of randomised clinical trials should present information on all major study elements, including the protocol, assignment of interventions (methods of randomisation, concealment of allocation to treatment groups), and the method of masking (blinding), based on the CONSORT statement (Moher D, Schulz KF, Altman DG: The CONSORT Statement: Revised Recommendations for Improving the Quality of Reports of Parallel-Group Randomized Trials. *Ann Intern Med*. 2001;134:657-662, also available at <http://www.consort-statement.org/>).

Authors submitting review manuscripts should include a section describing the methods used for locating, selecting, extracting, and synthesising data. These methods should also be summarised in the abstract.

## Color Blindness - An Obstacle In Shade Selection For Restorations

### Abstract

Dentists having defective color vision may be unaware of their defect or may have problems in perceiving color as normal vision dentists do. People who are "color vision defective" tend to be missing some of the color-sensitive cones, so these colors will appear darker. The aim of the present study is to -

1. Estimate the number of dental students/ personnel having problems in color discrimination based on a color blindness test
2. To refer the students/ personnel to a specialist for confirmative diagnosis.
3. To provide alternate options for shade selection to the same.

Dental students, dental teachers and dental technicians/ dental auxiliaries were randomly selected for the study, with a sample size of 400 with age range of 17 to 35 out of which 200 were males and 200 females. An Ishihara color blindness test (numbers made up of color dots) was conducted to screen the dental personnel for color defective vision in the same room and in the same light source. 5% of the male and 0% of female dental personnel/ students were found to be color vision defective. Counseling to such students and personnel required to take assistance in appointments of shade selection / matching.

### Key Words

Color Vision Defect, Color Blindness, Shade Selection, Prosthodontics.

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### Introduction

In today's world of globalization, most of our dental patients are aware and conscious of their looks. They may lack the technician knowledge of fabrication of a prosthesis or restoration but can very well make out the difference between an artificial looking and a natural looking restoration /crown which does match in size, shape and color with the adjacent natural teeth. Hence it is of utmost importance for the dentist to select the shade of the artificial teeth to be an exact replica of their natural teeth. Hence shade selection becomes a very important criterion for success of the dentist in satisfying the patient with esthetically superior restorations.

Most of our dental fraternity uses the traditional method for selecting shade which is based on the experience and the judgment of the trained human eye of the operator. But not all dental personnel are lucky to have a perfect color vision.

Dentists having defective color vision may be unaware of their defect or may have problems in perceiving color as normal vision dentists do. "Color blindness" is a misnomer as only a small percentage of people are unable to see any color.

Hence the term can be replaced by color vision defect. Color vision depends on the absorption of light by visual pigments contained within specialized cells in the eye called photoreceptors. Cones are responsible for color vision. The human retina has cone cells which see mainly red, green and blue. Other colors are interpreted as mixtures of these. People who are "color vision defective" tend to be missing some of the color-sensitive cones, so these colors will appear darker.

Color defective vision is either inherited or acquired. Defect can be acquired as a result of eye diseases or normal aging or as a side effect of some medications. In acquired defects, other parts of the eye besides cones and cone pigments may be affected. There are three groups of inherited color vision defects:

**1.Monochromacy:** Rod monochromats, or complete achromats are truly "color blind" since they cannot distinguish any hues (e.g., blue, green, yellow and red). Different degrees of lightness can be seen by them. The world appears to be shades of gray, black and white

**2.Dichromacy:** less severe than

monochromacy, can distinguish some colors. Dichromacy is divided : protanopia, deuteranopia and tritanopia. Protanopia and deuteranopia are red-green defects. Persons with red-green defects cannot distinguish between red, greens and yellow but can discriminate between blue and yellow. Protanopes often can identify red and green correctly because green looks lighter to them than red. Hereditary tritanopia is rare, a blue-yellow defect. Persons with blue-yellow defects cannot see the difference between blue and yellow but can distinguish between red and green.

**3.Anomalous Trichromatism :** sensitivity to all three hues, with abnormality in retinal cones affecting one of primary pigments. A need was felt to atleast screen the dental personnel to make them aware of the possible color defect they may be having which may lead to wrong shade matching and hence repeating their restorations. This study could help them is modifying their method of shade matching.

### Materials and Methods

A sample size of 400 was randomly selected for the screening study comprising of dental students, dental teaching faculty and dental

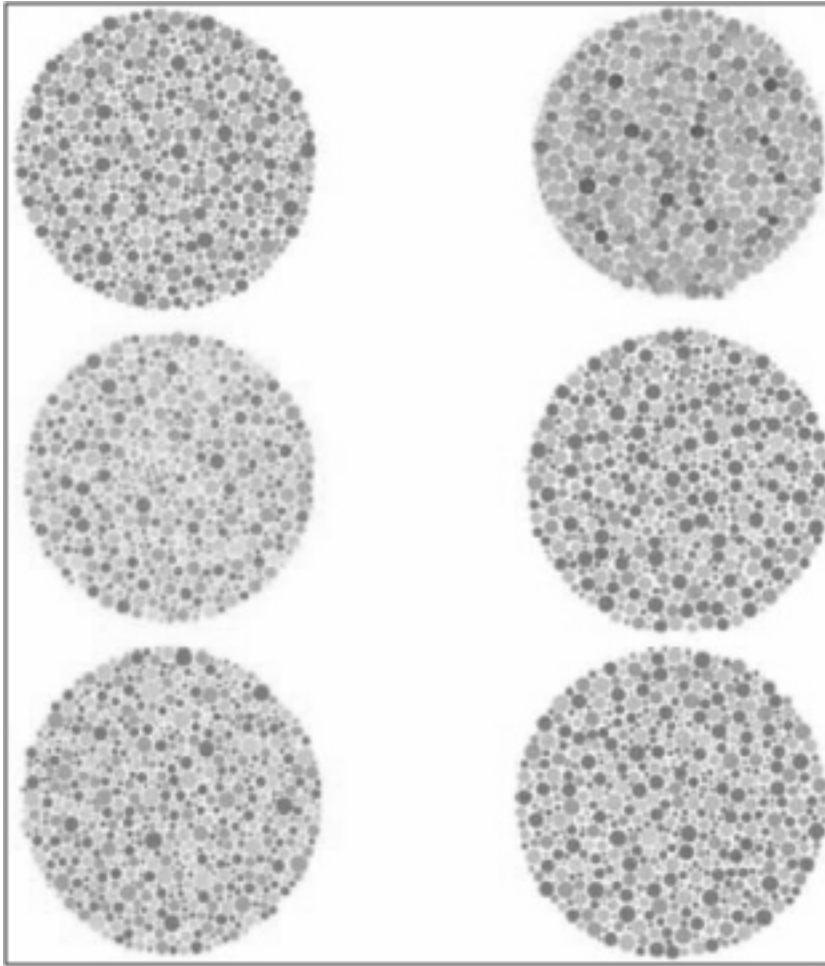


Fig.1 Ishihara color blindness test. Sample template: identify the numbers in the above colored circles.

technicians/ auxiliaries. 200 among the sample size were male and 200 female with age ranges from 17 to 35 years. Ishihara color blindness test (numbers made up of color dots) (Fig.1) was conducted to screen the color deficient individuals in the same room and in the same light source. Ten templates were prepared comprising of six circles. Each circle comprised of a number made up of colored dots as shown in the figure. Each study sample was asked to read the number from the colored circles. All other variables that would affect the study were kept constant for all the individuals.

**Eg:**

- 1) source of light and the room for study was kept the same for all the individuals
- 2) Eye fatigue each individual was given four seconds to identify the number
- 3) Test was carried out at the same time of the day.

Normal vision personnel could decipher the numbers. Individuals who were not able to

decipher the numbers or read the numbers incorrectly were marked as suspected color vision defects and the test was repeated for them. The data was analyzed and conclusions drawn.

**Results**

10 individuals were suspected of color vision defect. All the individuals were male (5% of the male sample study). None of the females were found to be color blind. All the individuals could differentiate between blue and red spots but all the color deficient subjects couldn't differentiate between green and red spots.

**Discussion**

Color blindness is one of the common genetic disorders observed. It is a sex linked recessive trait. The genes are located on the X chromosome within the Xq28 band. If a man is a carrier of a defective X-chromosome he will suffer from color blindness. On women the not defective chromosome is in charge and therefore she

is not colorblind but a carrier for color blindness. In our study it was found that 5% of the males were color blind while 0% of the females were color blind. This result was almost comparable to many studies done on the same ground. In the study conducted by Al Aqtum, it was found that 0.33% females were color blind: one of them showed protanomalopia; 1 protanopia; and 2 deutanopia. In males - 8.72% were color blind: 4 showed protanopia, 8 deuteranomalopia and 4 deutanopia.<sup>1</sup> In the another study, it was found that 9.3% of men and none of the women were color blind.<sup>2</sup> The prevalence of color defective vision in male dentists was found to be 8.2% by Mc Maugh,<sup>3</sup> 9.9% by Moser et al<sup>4</sup> and 14% by Barna et al.<sup>5</sup> Previous studies have shown that color defective personnel were found to make significant errors in hue and chroma selection than normal vision people.<sup>6</sup> Observers were more sensitive and critical of crowns where color differed in redness as opposed to crowns whose color differed to the same extent in yellowness.<sup>7</sup>

There are many tests for color blindness eg. Pseudoisochromatic plates like Ishihara test and Dvorine, Bostrom, AO HRR, Farnsworth-Munsell 100 Hue Test which gives a person many colored caps with slight variations of colors, and asks him to sort colors that are very close together.

However, it is slow and expensive to administer by a specialist, and is not common. Anomaloscope is a better test requiring a specialist which gives exact result of red and green problems. In our test, Ishihara plates were used to screen the individuals. It is not a confirmatory test and it was only used for screening defective vision people who were later advised to refer a specialist for confirmatory diagnosis. The personnel suspected with a color defect can be counseled on other alternate options of shade matching instead of the traditional trained human eye method. Electronic shade matching devices like colorimeters, spectrophotometers and digital color analyzers are available. Colorimeters use photodiode filters to control light reaching the specimen. The light reflected from the specimen is then measured by a detector. Colorimeters are easier to use and are less expensive than spectrophotometers. However, repeatability may be poor due to aging of filters, and object metamerism can be a challenge to their accuracy.<sup>8,9</sup> Of all devices, a spectrophotometer is the most accurate for absolute color measurement. These instruments have a longer working



life than colorimeters and are unaffected by object metamerism.<sup>8-11</sup>

There are many self contained systems of shade matching available: They include the VITA Easyshade by Vident, Spectroshade by Posey Dental Technology, Shadeye NCC by Shofu, Shadescan by CYNOVAD, and Shadevision by XRite. Color measurement is determined either by a colorimeter (Shadye NCC, and Shadevision), spectrophotometer (Vita Easy Shade and Spectroshade), or a proprietary system called "artificial vision" (Shadescan) ShadeVision (X-Rite, Inc, Grand Rapids, Mich), SpectroShade Micro (MHT SpA, Verona, Italy) and Easyshade (VITA Zahnfabrik). Spectrophotometers generally can provide more systematic and precise measurements than colorimeters because of their ability to measure the amount of light reflected from objects over a full spectral wavelength.

Two-dimensional image capture also provides a visual image of the target tooth. It can also be suggested to have an assistant trained in color matching to the operator, who has color defective vision.

#### Summary and Conclusions:

Males (5%) show color defective vision more than females( 0%) due to its genetic predisposition. Dental students and personnel were screened for color defective vision and referred to the ophthalmologist for more accurate investigations. Alternate means of shade selection/ matching be advised for color defective personnel. Defective color vision students and personnel were advised to take assistance in appointments of shade selection/ matching.

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### Information For Authors

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When reporting experiments on human subjects, indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000 (available at [http://www.wma.net/e/policy/17-c\\_e.html](http://www.wma.net/e/policy/17-c_e.html)). Do not use patients' names, initials, or hospital numbers, especially in illustrative material. When reporting experiments on animals, indicate whether the institution's or a national research council's guide for, or any national law on the care and use of laboratory animals was followed.

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When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Report losses to observation (such as dropouts from a clinical trial). Put a general description of methods in the Methods section. When data are summarized in the Results section, specify the statistical methods used to analyse them. Avoid non-technical uses of technical terms in statistics, such as 'random' (which implies a randomising device), 'normal', 'significant', 'correlations', and 'sample'. Define statistical terms, abbreviations, and most symbols. Use upper italics ( $P < 0.05$ ).

#### Results

Present the results in logical sequence in the text, tables, and illustrations. Do not repeat in the text all the data in the tables or illustrations; emphasise or summarise only important observations.

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As an appendix to the text, one or more statements should specify

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## Salivary Diagnostics: An Insight

### Abstract

Saliva is a diagnostic medium that can be easily collected and with minimal invasion but it has been neglected in the past. It is now systematically being researched and oral fluid analysis is being compared with the analysis of other diagnostic media such as blood and urine. Today, saliva is being used more often to diagnose: hereditary diseases, autoimmune diseases, infectious diseases, endocrine disorders as, well as in the assessment of therapeutic levels of drugs and in forensic field. A number of recent studies have focused on oncogenic marker detection and its monitoring in saliva. The latest clinical and laboratory findings on diagnostic markers of oropharyngeal carcinoma in saliva could be the beginning of their wider use as a diagnostic medium. With the addition of modern techniques and chemical instrumentation equipment, there has been an increase in its use for laboratory investigations, applicable for basic and clinical analyses in the fields of medicine and dentistry. The value of these methods for the diagnosis of oral and systemic diseases has been the subject of study by several researchers with the aim of increasing its use alongside complementary exams.

### Key Words

saliva, biomarkers, noninvasive, diagnostic fluid, systemic diseases

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### Introduction

"Saliva is a clear liquid secreted into the mouth by the salivary glands & mucous glands of the mouth." Saliva is one of the most complex, versatile, and important body fluids, supplying a large range of physiological needs.<sup>1,2</sup> The fluid has an old history of study but its physiological importance has only been recognized recently. In the past 50 years the pace of salivary research has accelerated with the advent of new techniques that illuminated the biochemical and physicochemical properties of saliva. Interest in saliva increased more with the finding that saliva is filled with hundreds of components that may serve to detect systemic disease or evidence of exposure to various harmful substances, as well as provide biomarkers of health and disease status.<sup>3,4</sup> The pithy expression by Mandel (1990) was that "saliva lacks the drama of blood, the sincerity of sweat and the emotional appeal of tears".<sup>5</sup> Despite the absence of charisma, the diversity and the orchestration of the many protective agents in saliva started to become clearer during 1960s to '70s, when new molecules with multiple functions were repeatedly revealed and explored.<sup>5</sup> Although historically scorned in literature, viewed by many cultures as the ultimate insult and

clinically "damned," investigators, clinicians, and our patients are increasingly turning to saliva as a safe and "non-invasive" indicator of health and disease. Many biomarkers may be measured using oral fluids. Saliva fulfills several of the chief diagnostic concerns for a diagnostic biofluid in as much as it is obtained noninvasively requiring no special skill. (ii) saliva flow rate and ionic composition are easy to measure by straightforward methods (iii) recent advances in understanding the salivation mechanism should help to confirm the molecular basis of many disorders and thus provide critical information for developing more specific and efficient treatment modalities. This opens up the extraordinary opportunity of enhancing research conducted in the field or expanding the versatility of point-of-care diagnostics by using saliva as the diagnostic fluid.<sup>6</sup> Saliva has been demonstrated to be an excellent test material for many types of systemic markers including those for endocrine function, stress or psychological state, exposure to infectious agents, use or metabolism of drugs or other xenobiotics, and other cancers.<sup>6</sup> This list of uses of saliva is increasing day by day as more and more molecules and markers have been described.<sup>1</sup> Nowadays, the saliva research

field is rapidly advancing due to the use of novel approaches that include metabolomics, genomics, proteomics and bioinformatics. However, the use of saliva as research material may pose particular problems due to its complex biochemical and physical chemical properties and its inherent variability and instability.<sup>4</sup>

### Methods Of Collection

Several methods have been suggested to collect resting and stimulated whole saliva. Most commonly, saliva is collected by draining or spitting into a tube, or chewing on an absorbent material. Collection of pure glandular secretions is possible with the use of special collection devices, for example the Lashley-cup for collection of parotid saliva. Standardization of saliva collections is important when saliva is used as research material, since saliva composition varies greatly both intra- and inter-individually. Non-standardized methodology has partly contributed to the high variability in the data published for saliva parameters, like composition, viscosity and lubrication properties.<sup>4</sup>

### Saliva-Based Diagnostic Technologies

The barriers to widespread implementation of saliva diagnostics derive from

technological problems in achieving sensitivity, miniaturization, high throughput, automation, portability, low cost, high functionality, and speed to enable high-content chemical and biochemical analyses Today, the potential of microsensor and microfluidic technologies to facilitate the decentralization of medical testing is becoming accepted as one element in the next evolutionary stage of healthcare. Microfluidic systems can be designed to obtain and process measurements from small volumes of complex fluids, such as saliva, with efficiency and speed, and without the need for an expert operator. This unique set of capabilities is precisely what is needed to create portable point-of-care medical diagnostic systems allow miniaturization, integration, and multiplexing of complex functions,- could move diagnostic tools out of the laboratory and closer to the patient.<sup>6</sup>**Microsphere-based nano-bio chip:** Microfluidic lab-on-a-chip device is being designed and developed that mates with bead-based microarrays to detect cytokines/chemokines and nucleic acids in oral fluids. **Microsphere-based optical fiber arrays:** Directed toward the development of a fully functional integrated platform that is capable of testing for both cellular and soluble analytes. Investigators are now focusing on the development of saliva-based cardiac diagnostic tests. **On-chip PCR system, Electrochemical sensing system:** Intended clinical application of the OFNASET will be for the saliva-based molecular screening for oral cancer detection. Research group has identified five salivary proteins and seven salivary RNAs that are highly discriminatory for oral cancer.<sup>6</sup>

#### The Diagnostic Potential Of Saliva

Blood will always be a primary bio fluid for diverse diagnostic tests, but it has distinct limitations and disadvantages. Other body fluids collected non invasively and without the need for skilled personnel can fulfill select niches for different diagnostic purposes. Saliva has shown its value for a number of tests already being widely implemented, but current research suggests the full potential of this bio fluid remains to be explored further. Saliva fulfills several of the chief diagnostic concerns for a diagnostic bio fluid in as much as it is obtained non invasively requiring no special skill. Several saliva collection kits are already marketed and some have gained FDA approval for various diagnostic tests.<sup>4</sup>

#### Advantages Of Saliva

#### Salivary Biomarkers with Their Possibilities for Use

Saliva/Oral Fluid Biomarkers	Possibilities for use
DNA	Standard genotyping Bacterial infection Diagnosing carcinomas of head and neck Forensics
RNA	Viral/bacterial identification Carcinomas of the head and neck
Proteins	Diagnosing periodontitis Diagnosing carcinomas of the head and neck Detecting dental cavities
Immunoglobulins	Diagnosing viruses (HIV, hepatitis B and C)
Metabolites	Diagnosing periodontitis
Drugs and their metabolites	Monitoring drug abuse Detecting of drugs in the body
Viruses, bacteria	Epstein-Barr virus reactivation (mononucleosis)
Cellular material	Diagnosing carcinomas of the head and neck

Courtesy: Pink A et al . Saliva as a Diagnostic Medium. Biomed Pap Med Fac Univ (Palacky Olomouc Czech Repub. 2009, 153(2):103-110.)

Saliva collection is inexpensive. It is easy to collect, store, ship and it can be collected with the help of very little armamentarium and can be stored easily without requirement of any special instrument. Its collection is safer than blood tests, which could expose health care workers to HIV or hepatitis virus. It is easier to handle for diagnostic procedures, since it does not clot, thus lessening the manipulations required. Saliva based diagnostics is therefore more accessible, accurate, less expensive, and presents less risk to the patient than current methodologies.

#### Use Of Saliva As Diagnostic Fluid

Historically this diagnostic value may have been recognized first by the ancient judicial community who employed salivary flow (or its absence) as the basis for a primitive lie detector test. Saliva found its widest use at the race track where the saliva test for drugs became the determinant of a "fixed" horse race.<sup>8</sup> Saliva has proved to be of value in the

confirmation or rejection of self-reports of cigarette usage among children and adolescents because there is present high concentration of thiocyanate in saliva of smokers as compared to non-smokers.<sup>9</sup>

#### Saliva & Caries

A number of antimicrobial agents have been identified in human saliva. These are usually divided into nonimmune and immune (immunoglobulin) factors. A vast number of reports document how these factors alone or in combination affect cariogenic microorganisms, in particular mutants Streptococci.<sup>10</sup> Different saliva based caries activity test are :**Lactobacillus Colony Count Test-** It estimates the number of acidogenic and aciduric bacteria in the patient's saliva.<sup>10</sup>**Snyder Test-** The Snyder test measures the rapidity of acid formation when a sample of stimulated saliva is inoculated into glucose agar adjusted to pH 4.7 to 5 and with bromocresol green as color indicator. Indirectly, the test is also a measure of acidogenic and aciduric

bacteria.<sup>10</sup>**Reductase Test:** The test measures the rate at which an indicator molecule, diazoresorcinol, changes from blue to red to colorless or leukoform on reduction by the mixed salivary flora.<sup>10</sup> Other test Buffer Capacity Test, Fosdick Calcium Dissolution Test, S. Mutans Adherence Method, S. Mutans Dip-Slide Methods.

### Saliva As A Diagnostic Tools For Periodontal Disease

The use of saliva as a diagnostic and monitoring method for periodontal disease has been increasingly studied.<sup>3</sup> Given the specificity and sensitivity for bone resorption, pyridinoline crosslinks, such as pyridinoline cross-linked carboxyterminal telopeptide of type I collagen (ICTP), represent a potentially valuable diagnostic aid for periodontal disease.<sup>11</sup> When a combination of the biochemical markers such as osteocalcin, collagenase, PGE2,  $\gamma$ -2 macroglobulin, elastase, and alkaline phosphatase was evaluated, increased diagnostic sensitivity and specificity values of 80 and 91%, respectively, were reported.<sup>11</sup>

### Systemic Diseases

**Coeliac disease** - Serum IgA antigliadin antibodies (AGA) are increased in patients with coeliac disease and dermatitis herpetiformis. Measurement of salivary IgA-AGA has been reported to be a sensitive and specific method for the screening of coeliac disease. In a more recent study, salivary IgA-AGA produced sensitivity of 60% and specificity of 93.3% in the detection of coeliac disease. In comparison, serum IgG-AGA produced excellent sensitivity (100%) but lower specificity (63.3%).<sup>1</sup>**Diabetes Mellitus:** Glucose concentration in saliva of diabetic patients was mildly increased compare to healthy population, but this difference was not statistically significant ( $t = 0.451$ ,  $p = 0.05$ ).<sup>12</sup> Some authors suggested that mean salivary glucose levels were found to be significantly elevated in both uncontrolled and controlled diabetics, as compared to healthy non-diabetics.<sup>13</sup> The EGF concentration was significantly lower ( $p < 0.05$ ) for the diabetic patients compared to control patients. Reduced levels of salivary EGF in diabetic patients may contribute to the development of oral and systemic complications of diabetes, which may have future clinical applications.<sup>14</sup>**Parkinson's disease-** Salivary production in patients of the Parkinson group was significantly lower than in controls ( $0.68 \pm 0.26$  mg vs.  $1.27 \pm 0.65$  mg, respectively;  $p=0.009$ ). Salivary concentrations of sodium,

potassium, chloride were higher but amylase was lower than in controls ( $p=0.02$ ,  $p<0.001$ ,  $p=0.003$ ,  $p=0.04$ , respectively).<sup>15</sup>

### Autoimmune Diseases-sjögren's Syndrome

Sjogren's syndrome(SjS) is an autoimmune exocrinopathy which includes complaints of oral and ocular dryness, a result of salivary and lacrimal dysfunction. From Luciferase Immunoprecipitation Systems (LIPS) testing anti-Ro60 autoantibodies were detected in the saliva of 70% (19/27) of SjS patients with 96% specificity. Positive anti-Ro60 autoantibodies were also found in 70% of the matched serum samples (96% specificity). LIPS detected Ro52 autoantibodies in the saliva and serum of 67% of SjS patients with 100% specificity.<sup>16</sup>

### Infectious Diseases

**Helicobacter pylori infection:** Saliva samples were tested for the presence of H. Pylori DNA by polymerase chain-reaction (PCR) assay, and sensitivity of 84% was reported. Salivary antibodies are secreted during the immune response to infectious agents. Surprisingly, detection of specific IgA to H. pylori could not distinguish between infected or noninfected individuals but detection of IgG could. A method has been proposed using a special device (OraSure; Epitope, Beaverton, OR), a swab to be rubbed on the gums to obtain a gingivalmtransudate, enriched in IgG. Sensitivities and specificities obtained in these studies tend to be low, rarely reaching 90%.<sup>17</sup>**Entamoeba histolytica-** Detection of salivary lectin antigen of E. histolytica for the diagnosis of amoebic liver abscess (ALA) with a sensitivity and specificity of 22% and 97.4% respectively was reported.<sup>18</sup>**Mycobacterium tuberculosis:** 98% detection rate of Mycobacterium tuberculosis was obtained by polymerase chain reaction (PCR) using mixed saliva, in contrast to a 17.3% detection rate by cultivation.<sup>7</sup>**Pneumococcal pneumonia:** The detection of pneumococcal C polysaccharide in saliva by ELISA may offer a valuable complement to conventional diagnostic methods for pneumococcal pneumonia. Detection of this antigen in saliva demonstrated a sensitivity of 55% and specificity of 97%. The positive and negative predictive values were 0.94 and 0.73, respectively.<sup>1</sup>

### Malignancy

Salivary analysis may aid in the early detection of certain malignant tumors. Tumor markers that can be identified in <sup>saliva</sup>

may be potentially useful for screening for malignant diseases. **Squamous cell carcinoma:** p53 antibody can be detected in the saliva of patients diagnosed with oral squamous cell carcinoma (SCC), and can thus assist in the early detection of, and screening for, this tumor. Investigators have found that 13% (3/23) of patients with oral squamous cell carcinoma had antibodies against p53 in the saliva, by ELISA.<sup>7</sup> Elevated levels of salivary defensin-1 were found to be indicative of the presence of oral SCC. A high-positive correlation was observed between salivary defensin-1 levels and serum levels of SCC-related antigen ( $r = 0.879$ ). Potential salivary RNA biomarkers were IL8, IL1B, DUSP1, HA3, OAZ1, S100P, and SAT, and in combinations yielded sensitivity (91%) and specificity (91%) in distinguishing squamous cell carcinoma.<sup>6</sup>**Breast cancer:** Elevated levels of recognized tumor markers c-erbB-2 (erb) and cancer antigen 15-3 (CA15-3) were found in the saliva of women diagnosed with breast carcinoma, as compared with patients with benign lesions and healthy controls. Sensitivity and specificity of salivary c-erb B-2 protein were 87% & 65% respectively.<sup>19</sup>**Ovarian cancer:** CA 125 is a tumor marker for epithelial ovarian cancer. Elevated salivary levels of CA 125 were detected in patients with epithelial ovarian cancer as compared with patients with benign pelvic masses and healthy controls. Saliva demonstrated a somewhat lower sensitivity than serum (81.3% vs. 93.8%, respectively); however, the specificity and positive predictive value were higher for saliva vs. serum (88.0% vs. 59.8% and  $54.2\%$  vs.  $28.8\%$ , respectively).<sup>6</sup>**Leukemia:** The oral manifestation of leukemias occur early in course of disease & these oral features can at times act as a diagnostic indicator. A rise in salivary amylase levels in leukemic patient has been reported ( $p<0.01$ ).<sup>20</sup>**Gastric carcinoma:** It has been suggested that salivary nitrate, nitrite, and Nitrosamine may be related to the development of Oral and Gastric Cancer. Higher levels of salivary nitrate and nitrite, and increased activity of nitrate reductase, were found in oral cancer patients compared with healthy individuals, and were associated with an increased odds ratio for the risk of oral cancer.<sup>1</sup> High levels of nitrate in the saliva might therefore be associated with carcinoma of the digestive tract, and there is evidence from several localities of an association of increased incidence of gastric and hepatic carcinoma with high nitrate intakes and high salivary concentrations of

nitrate.<sup>9</sup>

### **Viral Diseases**

**Hepatitis:** Saliva has also been utilized to detect very low levels of antibodies to HAV associated with vaccine-induced immunity. Comparison of serum and saliva levels of infection and vaccine-induced HAV-specific IgG have demonstrated excellent agreement (sensitivity = 98.7%, specificity = 99.6%). In comparing oral fluids to serum, sensitivity and specificity of 100% for the detection of HB surface antigen and antibodies to HCV, respectively, were reported.<sup>21</sup> Comparing the detection of HbsAg in saliva with that in serum by means of a commercially available serological kit yielded a sensitivity of 92% and specificity of 86.8%.<sup>1</sup>**Measles, mumps, rubella:** The detection of antibodies in oral fluid samples from subjects having received a measles/mumps/rubella vaccine produced sensitivity and specificity of 97% and 100% for measles, 94% and 94% for mumps, and 98% and 98% for rubella, respectively, in comparison with detection of serum antibodies for these viruses.<sup>21</sup> About the suitability & potential of oral fluid (OF) to substitute serum in estimating measles IgG antibodies, during community surveys by comparing optical densities (OD) of measles IgG antibodies in OF & serum in asymptomatic children was analyzed & found that Sensitivity : 89.5%, Specificity: 90.6%, Correlation coefficient : 0.97.<sup>22</sup>**Dengue:** Salivary levels of anti-dengue IgM demonstrates sensitivity of 90.3% and a specificity of 92.0% and demonstrating that salivary IgM is a useful diagnostic marker for DEN infection. Detection of IgA in serum may be another feasible alternative for the diagnosis of DEN infection, with serum IgA found in 68 (94.4%) of the IgM-positive cases.<sup>23</sup>**Human papillomavirus-** Only 57% of these patients had detectable HPV-16 DNA in salivary rinses, a sensitivity of 32.6%. Specificity of 98.7% can be achieved with this technique. Technologies such as competitive PCR coupled with mass spectrometry have promise to yield more specificity with positive results of one-copy number of DNA over real-time PCR, but the issue of false-positive nonpathologic detection of HPV remains.<sup>6</sup>**Human immunodeficiency virus (HIV)-As** compared with serum, the sensitivity and specificity of antibody to HIV in saliva for detection of infection are between 95% and 100%.<sup>1</sup> Salivary diagnostic Kits available are Aware BSP with a sensitivity of 99.4% and specificity of 99.9%, Aware OMT rapid

test used for assessing the detection of antibodies to HIV-1 and HIV-2 in human oral fluid specimens. The sensitivity and specificity of the rapid HIV test kit are 99.5% and 99.98%. The OraQuick ADVANCE Rapid HIV 1/2 antibody test is intended for use as a point of care test to aid in the diagnosis of infection with HIV-1 and HIV-2 with a sensitivity of 100% and the specificity of 99.87%.

### **Drug Monitoring**

Similar to other body fluids (i.e., serum, urine, and sweat), saliva has been proposed for the monitoring of systemic levels of drugs. **Therapeutic Drugs monitored** are Antipyrine, Caffeine, Carbamazepine, Lithium, Diazepam, Cyclosporine, Digoxin, Ethosuximide, Irinotecan, Methadone, Metoprolol, Oxprenolol, Paracetamol, Phenyltolin, Quinine, Procainamide, Sulfanilamide, Theophylline, Tolbutamide, Cisplatin **Drug Abuse/Recreational Drug** monitored are Amphetamines, Ethanol, Marijuana, Nicotine, Opioids, Phencyclidine, Barbiturates, Cocaine Benzodiazepine.<sup>1</sup>

### **Monitoring Of Hormone Levels**

Hormones whose salivary levels reflect serum levels are Cortisol, Progesterone, Aldosterone, 17beta-Estradiol, Dehydroepiandrosterone, Testosterone, 5alpha-Dihydrosterone, Estriol, Estrone, Insulin, Melatonin.<sup>8</sup>

### **Heavy Metals Found In Saliva**

Heavy metals such as lead and cadmium are important occupational toxins and can also be found in saliva. A study by Pan reported a strong correlation between saliva and blood lead (correlation coefficient,  $r=0.72$ ) among adult males over a wide range of blood lead measurements. Blood contamination of saliva during sampling can spuriously raise salivary lead levels because the lead level in whole blood is 2-6 times higher than that in saliva. Normal range of lead in serum & saliva are 5-15 microgram/dl and 0.7-7.5 microgram/dl respectively.<sup>24</sup> Cadmium is another heavy metal that has been detected in the saliva. The secretion of cadmium into saliva seems to occur by passive diffusion.<sup>24</sup>

### **Saliva In Forensic Genetics**

Due to the presence of significant numbers of nucleated buccal epithelial cells in saliva, it is an excellent source of DNA from which a genetic profile of the donor is relatively easily obtained. Approximately 0.5-1.0 ng of DNA is required for such analysis, which represents approximately 80-160 cells.

There is currently no definitive test for the positive identification of saliva, although there are a number of substances present in. These include the enzymes alkaline phosphatase and  $\alpha$ -amylase and the inorganic anions thiocyanate and nitrite.<sup>6</sup> The starch-digesting enzyme amylase is present in high concentrations in human saliva. In forensic investigations, amylase activity testing has been used to locate saliva stains on surfaces for over three decades. Presently, a screening method based on amylase testing could be useful to lower the number of negative DNA samples from crime scenes. A positive amylase result is indicative, not conclusive, for human saliva. The correlation between amylase activity and amount of cells/DNA in saliva therefore needs to be investigated.<sup>25</sup>

### **Future Diagnostic Tool**

**Tag-It** device is a DNA-based test to detect cystic fibrosis from a patient's blood or saliva. The **AmpliChip P450** Genotyping Test is a DNA test that measures how quickly particular drugs are cleared from the body so that medication levels can be customized for individual patient.<sup>6</sup> **TRUGENE HIV-1** genotyping test determines if a patient has a drug-resistant form of the virus.<sup>6</sup>

### **Conclusion**

Saliva is a complex and dynamic biological fluid which contains a myriad of compounds. The biochemical and physical chemical properties of these salivary components and their interaction, accomplish the numerous functions that saliva performs in the oral cavity. Nowadays many assays are available to analyse various salivary parameters, however, standardization of collection and storage methods is essential to obtain meaningful results. The last few years saliva has gained increasing scientific interest not only for the excretion of various compounds, e.g., drugs, pollutants, hormones into saliva, but also the well documented relation of saliva with bacterial, viral and systemic diseases. The relatively easy non-invasive nature of collection and the relationship of saliva with plasma levels make saliva an attractive diagnostic tool. Nowadays, state-of the art proteomic methods are applied to search for the complete saliva protein composition. In addition, high throughput RNA and protein microarrays will be valuable tools for the identification of diagnostic biomarkers for a variety of diseases or description of whole body physiological changes.<sup>4</sup> Right now saliva diagnostics is not as mature as blood-

based tests. In order for this area to evolve there needs to be further development of the mini-sensors systems. The infrastructure has to be put into place and the dental community would need to change its practice at some level and be open to this option of serving as a health-screening center in a new type of role.

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## Evidence-Based Dentistry-A New Paradigm

### Abstract

The world in which we learn and practice dentistry is changing at an astonishing rate. Two phenomena - the information explosion and the consumer movement, both of which are fortified by the extraordinary advance of the Internet - are coming together to change the way all businesses, including health care, will function in the very near future. The nature of the relationship between the patient and the clinician is changing. Patients are becoming partners in the decision-making process. When many of us attended dental school, our primary sources of information were our teachers, textbooks and, occasionally, journal articles. But the methods of delivery of information are changing. There is an increasing trend toward Web-based courses and instruction, as well as computer-based interactive learning.

Evidence-based care is a technology that provides the best available current evidence on the basis of a proven and objectives set of principles. The goal of evidence-based health care is to identify the best available clinical evidence and combine this with clinical experience to meet the patient's needs. Like any scientific endeavor, the object is to find the best evidence that will facilitate good clinical decision making. This article discusses what exactly is evidence based dentistry is and how to use it in the questions encountered in everyday's clinical practice.

### Key Words

Evidence-Based Dentistry, Systematic Reviews, Meta-Analysis, research design hierarchy

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### Introduction

Dentistry is both an art and a science. It is a science because our fundamental understandings - or building blocks of knowledge are founded on the scientific process of research. This includes basic, applied, and clinical research. It is an art in that it draws on experience and personal observation, because science cannot account for the complexity of all variables in each situation. The synthesis of scientific understanding and clinical observation provides the basis for meaningful dental care.<sup>1</sup> Evidence-based dentistry is an attempt to synthesize both these aspects of dentistry.

### What is Evidence-Based Dentistry?

The foundation for evidence-based practice was laid by **David Sackett** who has defined it as "integrating individual clinical expertise with the best available external clinical evidence from systematic research".

The **American Dental Association** (ADA) defines evidence-based dentistry (EBD) as, "an approach to oral health care that requires the judicious integration of systematic assessments of clinically relevant scientific evidence, relating to the patient's oral and medical condition and history, with the

dentist's clinical expertise and patient's treatment needs and preferences (**figure-1**).<sup>2</sup>

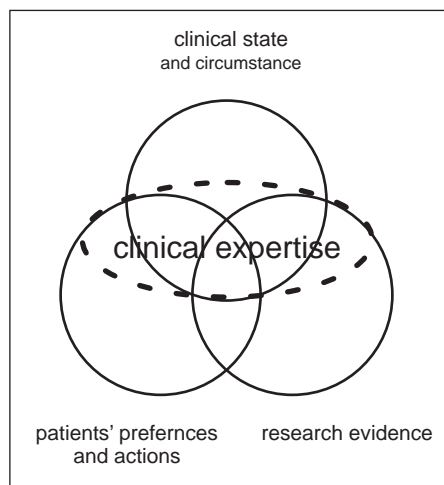


Figure 1: Evidence - Based Dentistry

The principles of evidence-based dentistry are finding the best information quickly when it is needed, assessing its quality and deciding whether it is relevant - will help practitioner to use research evidence in making everyday clinical decisions.

### Steps involved in evidence-based learning process:

**Step-1:** Convert the need for information about prevention, diagnosis, prognosis, therapy etc, into an answerable question which relates specifically to the patient's requirements and the population of interest.

The first step in the quest for answers to clinical questions (and often the first stumbling block) is the formulation of a clear and focused question - one that is relevant and will help to carry out a quick and effective search. Most often, the original question is too broad. The first step consists of narrowing the question by deciding which elements are the most important to answer with a "hit and run search".

It may not always be easy to formulate good clinical questions. This is especially true when dealing with situations that are not routinely familiar. In such situations, we can consider that our questions take 1 of 2 forms; those that are "**background**" and those that are "**foreground**" in nature. Background clinical knowledge would include basic knowledge such as, "what is this disorder? "What causes it? "How does it present?" Considering such background clinical

knowledge, we might develop a foreground question such as "in patients with severe xerostomia, would a course of pilocarpine improve oral comfort and the quality of life (QOL) (over doing nothing) to be worth the potential side effects and cost?" Although foreground questions usually have 3 or 4 parts, background questions do not. These usually start with what, where, when, why, how and who, and end with a clinical entity, such as a health state or health intervention.<sup>4</sup> The practitioner must decide which questions to pursue in the limited time available. The first criterion in selecting which questions to pursue is to choose questions from the patient's perspective. The second criterion suggests that practitioners seek evidence on questions that assist in staying current and in preparing for the next occasion.<sup>3</sup>

**Step-2:** Track down the best evidence with which to answer the question.

Several options are available, which could include asking a colleague (or expert), checking text books and their references, looking through articles in journals, or searching through a bibliographic database. But the clinician must check for quality (strength) of evidence while obtaining best possible answer to his/her question.

#### *Quality of evidence and research design hierarchy*

All clinical research studies are encompassed under the broad heading of epidemiologic studies. These studies can be further divided into- **descriptive** and **analytical** studies (observational studies) and **Intervention** studies or clinical trials.

A new type of studies has emerged after the advent of evidence based research i.e. **integrative studies**, which includes **systematic reviews** and **meta-analysis**. When the information from all relevant trials addressing the same question is combined using well-established, rigorous methodology, the result is a systematic review or overview. If the results of each trial were reported in such a way that they can be combined statistically by the researcher, the result is a quantitative systematic review or meta-analysis.

The quality of various research designs can be placed in a "**research design hierarchy**." The position of each research design within the hierarchy is a function of the strengths and weaknesses of features within each

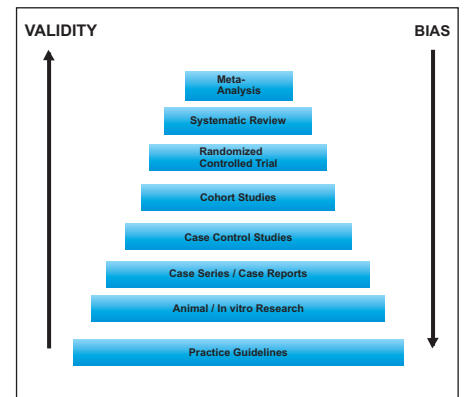
design. The higher the study design ranks in the research hierarchy, the better the study design minimizes bias and distributes random variation equally between the study groups.<sup>4</sup> The strongest evidence is replication of the study findings. Independent replications provide clear evidence that the finding is not just a random event. The researcher demonstrates that the finding is not just an artifact of a single study but a consistent event.

Next slot in the hierarchy is given to systematic review or meta-analysis. When the results of primary studies are summarized but not statistically combined, the review may be called a qualitative systematic review. A quantitative systematic review, or meta-analysis, is a systematic review that uses statistical methods to combine the results of two or more studies. By combining randomized, selected studies (or the universe of available studies) from a pool of studies meeting explicit, predetermined, experimental design criteria, the researcher can counteract and eliminate bias that occurs in each individual study reviewed.

Randomized, controlled trials represent the next highest level of evidence. This level of evidence is supported by single (nonreplicated) experimental studies in which the experimental and control conditions are clearly specified and in which assignment to the experimental and control conditions is random.

Epidemiologic surveys in which the population is sampled systematically (random, stratified sampling) and the observers are calibrated serve as the next level of evidence.

Nonrandomized studies with controls such as case controlled studies and field studies form the next level of evidence. Studies using historical controls but using randomized sampling or selection serve as the next level. Cohort studies in which disease like assignments are made using correlational analysis are next in terms of evidence. Case reports and related anecdotal or descriptive evidence are next. Finally, the reports of expert committees and the opinion of experts form the lowest level of evidence. **(Figure-2)**



**Figure-2: Evidence Hierarchy Pyramid**

### **Step-3: Critically appraise the evidence**

Once the evidence is collected it must be screened for validity (closeness to the truth), impact (size of the effect), and applicability (usefulness in clinical practice). The user's guides are designed to test an article on these three parameters. These guides are basically a set of questions whose answers should be provided to the reader by the article in order to obtain best clinical evidence for the question in focus. A study is said to possess external validity when it can provide unbiased inferences regarding a target population (beyond the subjects of study). The impact of the evidence can be measured by the size of treatment effect for therapeutic interventions. This effect may be reported in a number of ways, depending on type of interventions.

#### **Need for the users' guides:**

When you conduct a search, how do you quickly know which article(s) to read? Are there key features to look for which can guide you to the strongest evidence? By using **3 key questions** from the format of the Users' Guides, one can screen the titles and abstracts from a search to decide which are worthy of more careful study:

1. What are the results?
2. Are the results valid?
3. Will the results help me in caring for my patients?

Once these articles are identified, and if careful evaluation reveals that the results are of interest and possibly applicable to the question, then the research methods can be evaluated to determine whether they are valid or close to the truth.<sup>5</sup>

#### *Deciding if an article is likely to provide valid results*

The first question applied to any article



tracked down in an effort to find an answer for a clinical problem concerns its closeness to the truth: are the results of this article valid? The **Table -1** presents two key guides to assess validity for primary studies (those that provide original data on a topic) and integrative studies (those that summarize data from primary studies). For each type of integrative study, the first criterion has to do with whether the question is appropriately framed, and the second with whether the evidence was appropriately collected and summarized. The clinician can use these most important criteria to rapidly screen an abstract to determine whether it warrants the additional time required to read it in detail. These criteria can also be used to reduce the clinical literature to a manageable size when trying to keep up with new advances that are pertinent to one's practice.

**Step-4:**

Integrate the critical appraisal with clinical expertise and with the patient's unique biology, values and circumstances.

**Step-5:**

Finally, evaluate performance in terms of effectiveness and efficiency by questioning the ability to complete steps 1-4 successfully, and seek ways to improve performance in future.

**Problems And Promises With Evidence - Based Dentistry**

*Dental profession: in midst of lack of evidence?*

With regard to dentistry, these are indeed the best of times. We have available materials and techniques that visionaries could only dream of 25 years ago. We can predictably replace missing teeth with implant-supported prosthesis. We can regenerate tissue lost to disease and trauma. And yet, as our profession entered the 21st century, these are also the worst of times. As a profession, we have become so enamoured with our new technologies that we seem to have lost our collective common sense. We have many wonderful new materials and

techniques, but do we have the wisdom to use them appropriately?

The dental profession has received a great deal of criticism in the public press because of findings that enormous variations exist in treatment recommendations and health care practice. These variations have been attributed to (1) poor science underlying the clinical decisions, (2) poor quality of clinical care decisions and (3) variations in clinical skills. To counter these criticisms and to respond to the challenge of modern health care, ***the dentist must combine evidence-based information with practical clinical experience*** when engaging in the process of diagnosis, treatment planning and treatment.<sup>7</sup>

Due to rapid flux of materials, the idea has insidiously crept into our thinking process that clinical research data is not necessary in our decision-making process. Since nature abhors a vacuum, the void created by this lack of relevant clinical research has been filled with anecdotal information. Hence, the genesis of our newest source of information, the ***nonrefereed dental "journal"***. This new class of literature is based on the premise that the refereed literature is too slow and cumbersome. It is most often written with two overriding purposes: (1) to promote a product or device and (2) to promote the career of the author.

Three factors are primarily responsible for this trend. ***First*** is the lack of an evidence-based educational philosophy in dental education. Dental schools have traditionally placed a much greater emphasis on the mechanistic aspects of dentistry. An understanding and appreciation of the dental literature as a basis for clinical decision-making has never been the primary educational focus in dental schools.

The ***second*** factor is the market forces that have created the dental infomercial. The vast majority of the nonrefereed literature is sponsored by dental manufacturers. It is packaged to simulate traditional refereed journals and is not presented as the commercial advertising it truly is.

***Third*** and certainly the most important factor is that many of us suffer from the late 20th-century malady of busyness. With all of the activities in our personal and professional lives, it is difficult for us to maintain our commitment to reading current literature. Since time is limited and the infomercial literature is more entertaining,

**TABLE - 1<sup>6</sup>**

**Guides on selecting articles that are most likely to provide valid results**

Therapy	Primary studies <ul style="list-style-type: none"> <li>• Was the assignment of patients to treatments randomised?</li> <li>• Were all of the patients who entered the trial properly accounted for and attributed at its conclusion?</li> </ul>
Diagnosis	<ul style="list-style-type: none"> <li>• Was there an independent, blind comparison with a reference standard?</li> <li>• Did the patient sample include an appropriate spectrum of the sort of patients to whom the diagnostic test will be applied in clinical</li> </ul>
Harm	<ul style="list-style-type: none"> <li>• Were there clearly identified comparison groups that were similar with respect to important determinants of outcome (other than the one of interest)?</li> <li>• Were outcomes and exposures measured in the same way in the groups being compared?</li> </ul>
Prognosis	<ul style="list-style-type: none"> <li>• Was there a representative patient sample at a well- defined point in the course of disease?</li> <li>• Was follow up sufficiently long and complete?</li> </ul>
Overview	Integrative Studies <ul style="list-style-type: none"> <li>• Did the review address a clearly focused question?</li> <li>• Were the criteria used to select articles for inclusion appropriate?</li> </ul>
Practice Guidelines	<ul style="list-style-type: none"> <li>• Were the options and outcomes clearly specified?</li> <li>• Did the guideline use an explicit process to identify, select, and combine evidence?</li> </ul>
Decision Analysis	<ul style="list-style-type: none"> <li>• Did the analysis faithfully model a clinically important decision?</li> <li>• Was valid evidence used to develop the baseline probabilities and utilities?</li> </ul>
Economic Analysis	<ul style="list-style-type: none"> <li>• Were two or more clearly described alternatives compared?</li> <li>• Were the expected consequences of each alternative based on valid evidence?</li> </ul>

we read it instead of refereed journals. However, it is the dentist, not the manufacturer, who makes the treatment decisions. Therefore, the ultimate responsibility for making these decisions, based on the best available evidence, lies with the dentist.<sup>8</sup>

### **Barriers to using evidence-based methods**

Barriers in using EBD in everyday practice include lack of appropriate skills for formulating clear questions, executing efficient electronic searches and evaluating the literature.

Often cited as a barrier to EBD is the lack of good clinical research in the form of well-designed, adequately powered randomized trials. The rigorous methodology demanded by systematic reviews for organizing and analyzing the literature in an area provides a valuable tool for identifying areas where the evidence is weak and where research is needed and feasible.

Perhaps the greatest impediments to the evidence-based movement are the fear and mistrust on the part of practitioners that the evidence will be misused by decision makers, particularly third-party funders and regulatory bodies, and that the individual autonomy of dentists, in caring for their patients, will be threatened. This is another compelling reason why the profession must embrace EBD and provide the leadership needed to protect the scientific integrity of the evidence. Practicing dentists must ensure, through direct involvement with the process, that guideline development methods are open and transparent and that the resulting guidelines are practical, useful and relevant.

Overcoming these barriers, exploiting the potential of information technology and applying sound scientific principles to everyday practice will allow dentists to meet the greatest challenge of practice- the provision of high quality, effective oral health care.<sup>9</sup>

### **Problems of introducing evidence based dentistry**

1. Amount of evidence : Currently over 2 million biomedical articles are published annually in some 20,000 journals. There are about 500 journals related to dentistry. Clearly not all of these articles are relevant to all areas of dental practice, nor can one hope to read more than a small minority.
2. Quality of evidence : Much of the ever

increasing volume of evidence is produced to enhance career prospects rather than to increase knowledge. This can compromise quality. A number of publications that are widely read in dentistry are not subject to peer review and even when they are there is the tendency for publication bias. This bias may not be explicit but there is a tendency both by the researchers and editors to publish positive reviews. Negative trials can be equally valuable, and concerns have been raised that increasing sponsorship of medical trials by commercial concerns could result in non-publication of negative or unhelpful findings.

3. Dissemination of evidence : Unless good methods of dissemination are available even where there is good evidence it can take many years for a particular treatment to become the norm.
4. Practice based on authority rather than evidence : The use of techniques or therapies based on the views of authority rather than evidence may lead to the wrong treatment being performed.<sup>10</sup>

### **The Beginning**

Dental speciality groups are now beginning specifically to address the clinical applications of evidence-based methods in clinical care. Several forums are now in place to facilitate these (r)evolutionary changes:

The new journals- Evidence-Based Dentistry and Evidence - Based Practice brings oral health into the fold of a burgeoning field of medical speciality journals focused on evidence-based health care.

Dental school curriculum are being revised to include basic information on EBD and to ensure that course content is evidence-based.

The Centre for Evidence-based Dentistry at Oxford University offers short-term intensive courses in Evidence-based Dentistry, a Critical Appraisal Skills Programme, and serves as the editorial centre for the journal Evidence-Based Dentistry.

The Harvard School of Dental Medicine's Office of Evidence-based Dentistry initiated a course "Evidence-based Dentistry" in its pre-doctoral dental curriculum, and offers a short-term, intensive graduate-level, clinical trials training program in Evidence-based Dentistry that includes an MPH degree in clinical effectiveness.<sup>11</sup>

The American Dental Association

Commission on Accreditation requires , as part of the accreditation process of dental school curricula, that students develop the skills needed to manage scientific information will critical thinking. The requirement that students be able to locate, understand, and critically evaluate the dental literature provides some of the skill required to properly treat the patient in the clinical setting- in other words, the skill to understand, decipher, and apply evidence.<sup>1</sup>

### **Who will benefit from evidence- based dentistry?**

In the current information era, knowledge is both a tool and a commodity that can be used to improve the decisions made by dentists every day. Information summarized within systematic reviews should assist dentists in making appropriate treatment decisions with patients. Evidence-based dentistry help dentists by providing simple and validated scientific summaries. Personal experience, because of its potential for bias, should no longer be the sole source of life long learning in dentistry. Furthermore, the lack of consistency in treatment decisions among dental and medical practices is problematic. Shifting from a reliance on the experimental model of decision making to an evidence based model would benefit all health care professions, as well as general public.<sup>12</sup>

1. The ultimate beneficiaries of EBD are members of the **public**, who will reap the rewards of better care. The internet allows patients, as well as professionals, access to health care information. The public, however, does not have the tools to evaluate the data adequately and must rely on their educated dentists to help sort fact from fiction. Patients will be more educated, more involved in their treatment decisions, and more appreciative of quality care.
2. **Dentists**, who will also benefit from EBD. Instead of conducting free product testing for dental product manufacturers, practitioners will have at their disposal more valid research on which to predicate their clinical decisions.

Other advantages dentists may garner include:<sup>13</sup>

- Improved patient, staff, and dentist satisfaction.
- Greater pride among patients, staff and dentists in high quality care.
- Improved clinical decision making capability
- Greater confidence in treatment

- planning
  - More opportunity to provide treatment choices selected for minimizing risk of harm and maximizing treatment safety
  - Greater satisfaction derived from creating customized treatment plans based on the powerful combination of stronger clinical evidence, clinical judgment and experience, as well as patient preferences and values
  - Reduced overhead and improved production by saving time and money using techniques and materials that are effective and efficient
  - Higher treatment acceptance as dentists add to their presentation tool box the sharing of high quality meaningful evidence with patients
  - Enhanced patient trust and rapport
  - Improved practice building opportunities as patients share with others their trust, confidence and pride in their EBD practicing dentist.
- 3. Researchers**, who will benefit by being called upon to do the clinical testing necessary before new products are placed on the market.

### Conclusion

Evidence-based care is a global movement in all the health sciences disciplines. It represents a philosophical shift in the approach to practice - a shift that emphasizes evidence over opinion and, at the same time,

judgment over blind adherence to rules. This approach provides a bridge between research and everyday patient care. In near term future for evidence -based practice is likely to be characterized by continuation of current trends in dissemination of evidence-based information to clinicians. The primary means for dissemination will consist of evidence summaries and evidence- based treatment recommendations and guidelines.

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## Role of Copper in Oral Submucous Fibrosis: A Cytological Correlation

### Abstract

Oral submucous fibrosis is a chronic fibrotic disease of the oral cavity and oropharynx and is associated with the habit of chewing areca nut. Areca nut has a high copper content that plays a definitive role in the etiopathogenesis of Oral submucous fibrosis.

The present study was contemplated to evaluate and compare the intensity of copper specific Rhodanine stain in buccal epithelial cells of 10 cases of normal oral mucosa, 20 cases of arecanut chewer patients without lesion and 10 histopathologically confirmed cases of oral submucous fibrosis using Rhodanine stain. Smears from non-chewers dipped in a copper sulphate solution were used as positive control for copper. A comparison was also done between these patients in relation to duration of the habit.

The unpaired student's 't' test was used to compare the mean scores of copper analyzed between the groups mentioned above. A 'p' value of less than 0.05 was considered to be statistically significant.

The mean value of cells with copper granules showing positivity score in Normal oral mucosa, arecanut chewers and oral submucous fibrosis were  $0 \pm 0$ , 31.13.8237 and 44.32.9833 respectively.

The z test was applied to compare the values with regard to duration of arecanut chewing habit. The results showed a 5 % level of statistically significant difference between normal, arecanut chewer subjects, and OSMF subjects.

Copper granules in large number of epithelial cells in cases of OSMF were more compared to that of the chewers without lesion, thus suggesting the role of copper in the pathogenesis of oral submucous fibrosis.

### Key Words

Oral submucous fibrosis, Areca nut, Copper, Rhodanine stain.

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### Introduction

Oral submucous fibrosis has been present most probably for centuries but was not described in the medical literature until 1952.<sup>1</sup> The concept of precancers was put forward by the World Health Organization (WHO) in 1972. According to this concept, a premalignant condition is defined as "a generalized state associated with significantly increased risk of cancer". Thus by this definition the oral submucous fibrosis is classified as a premalignant condition.<sup>2</sup>

Oral submucous fibrosis is a well-recognized potentially malignant disorder, malignant transformation rates as high as 7.6% have been reported from the Indian subcontinent over a 10-year period.<sup>3</sup>

OSMF is believed to have multi factorial cause. Numbers of factors that trigger the disease process are mainly betel nut alkaloids, ingestion of capsaicin, nutritional deficiencies, autoimmunity and genetic predisposition. However the role of betel nut

chewing in one form or another remains a common denominator. Approximately 200 million people regularly chew areca nut on its own or as a part of quid, a majority of them in South East Asian countries.<sup>4</sup>

Arecanut has shown to have a higher copper content compared to the commonly eaten nuts. The copper dependent enzyme lysyl oxidase is found to be upregulated in OSMF pathway leading to increased cross-linking of collagen and elastin. Lysyl oxidase cause post-translational modification of collagen fibers rendering them resistant to the action of collagenases.<sup>5, 6</sup> These studies indicate that copper has a definitive role to play in the etiopathogenesis of Oral submucous fibrosis.

### Aim Of The Study

The present study was under taken to evaluate the pattern of copper specific Rhodanine stain in the buccal epithelial cells of areca nut chewers, non-chewers and confirmed cases of oral submucous fibrosis and to determine its role in etiopathogenesis

of Oral submucous fibrosis.

### Materials & Method

This exfoliative cytological study was carried out in the Department of Oral Pathology and Microbiology.

### Sample Size

For the purpose of this study, samples were distributed in three different groups.

**Group A-** was considered as control group i.e. Areca nut non-chewer subjects with normal oral mucosa.

**Group B-** Areca nut chewer subjects without clinical manifestation

**Group C-** Areca nut chewer Subjects having Oral Submucous Fibrosis

The samples in each group included

Group A- 10

Group B- 20

Group C- 10

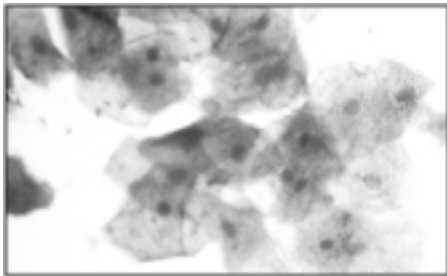
Exfoliative cytology was performed for each subject using soft baby tooth brush from buccal mucosal site. Two smears were taken from each subject of a non-chewer,

one smear was dipped in a copper sulphate solution for 1 hour and taken as positive control and the other smear was stained with Rhodanine to assess copper content of cells. The smears were prepared on glass slides, fixed by a commercially available alcohol based fixative and stained with Rhodanine (Lindquist method 1969) for light microscopic study.

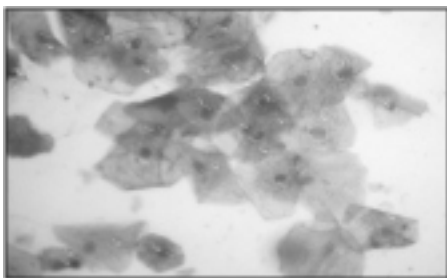
### Results

A total 40 cases were studied to analyze the presence of copper granules in buccal epithelial cells of normal oral mucosa (Group A), areca nut chewers without lesion (Group B), and OSMF patients with areca nut chewing habit (Group C) and comparison was also done between these patients in relation to duration of the habits.

The control smears dipped in a copper sulphate solution showed pale red copper granules within the cytoplasm of all the epithelial cells. (Photomicrograph- 1, 2)

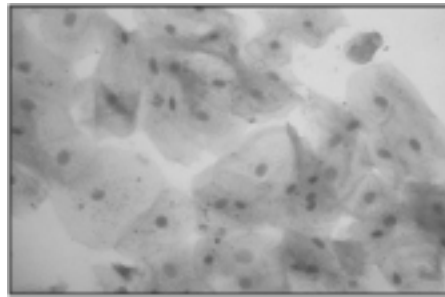


Photomicrograph- I Smear from normal oral subjects dipped in copper sulphate solution showing copper granules taken as positive control (X40)

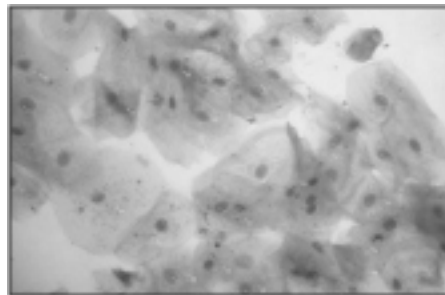


Photomicrograph- II Smear from normal oral subjects dipped in copper sulphate solution showing copper granules counted by manual tag taken as positive control (X40)

The smears of OSMF cases showed dark red stained copper granules in a large number of epithelial cells. These granules were larger and more in number and had well defined shape. The staining exhibited a granular pattern in the cytoplasm. (Photomicrograph- 3, 4)

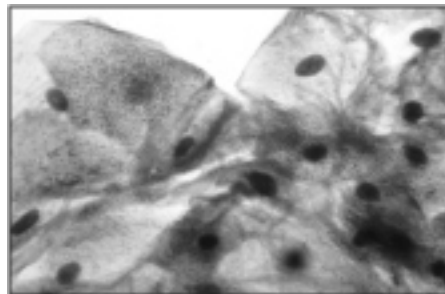


Photomicrograph- III Smear from chewer subjects showing copper granules stained with rhodanine (X40)

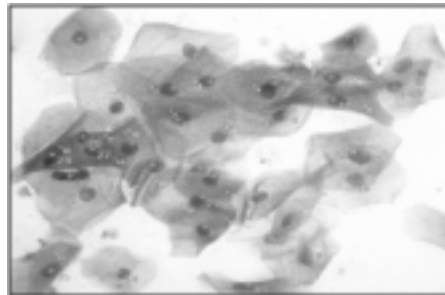


Photomicrograph- IV Smear from chewer subjects showing copper granules stained with rhodanine counted by manual tag (X40)

While the smears of areca nut chewers showed varying shades of pale orange red to dark red stained copper granules in a lesser number of the epithelial cells and the staining pattern was diffuse in the cytoplasm. (Photomicrograph- 5, 6)

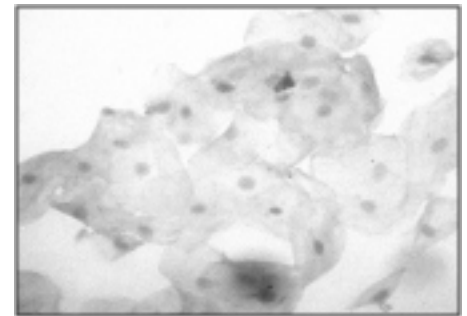


Photomicrograph- V Smear from oral submucous fibrosis subjects showing copper granules stained with rhodanine (X40)



Photomicrograph- VI Smear from oral submucous fibrosis subjects showing copper granules stained with rhodanine counted by manual tag (X40)

Smears of non-chewers didn't take up any stain. (Photomicrograph- 7)



Photomicrograph- VII Smear from normal oral subjects taken as negative control (X40)

Findings were entered in the proforma prepared for record keeping. The results were then tabulated. (Table 1) and subjected to statistical analysis using 't' test for comparing the mean score of copper granules analyzed between the groups mentioned above. The 'p' value < 0.5 was considered to be statistically significant. (Graph 1)

**Table 1**  
Comparison Of Cells With Copper Granules In Different Groups

S.No.	Groups	No	Number Of Cells With Copper Granules Showing Positivity
			Mean ± SD
1	A (Normal Oral Mucosa)	10	0 ± 0
2	B (Chewing Habits)	20	31.1 ± 3.8237
3	C (OSMF)	10	44.3 ± 2.9833

The mean value of cells with copper granules showing positivity score in Normal oral mucosa, arecanut chewers and oral submucous fibrosis were 0±0, 31.1 3.8237 and 44.3 2.9833 respectively.

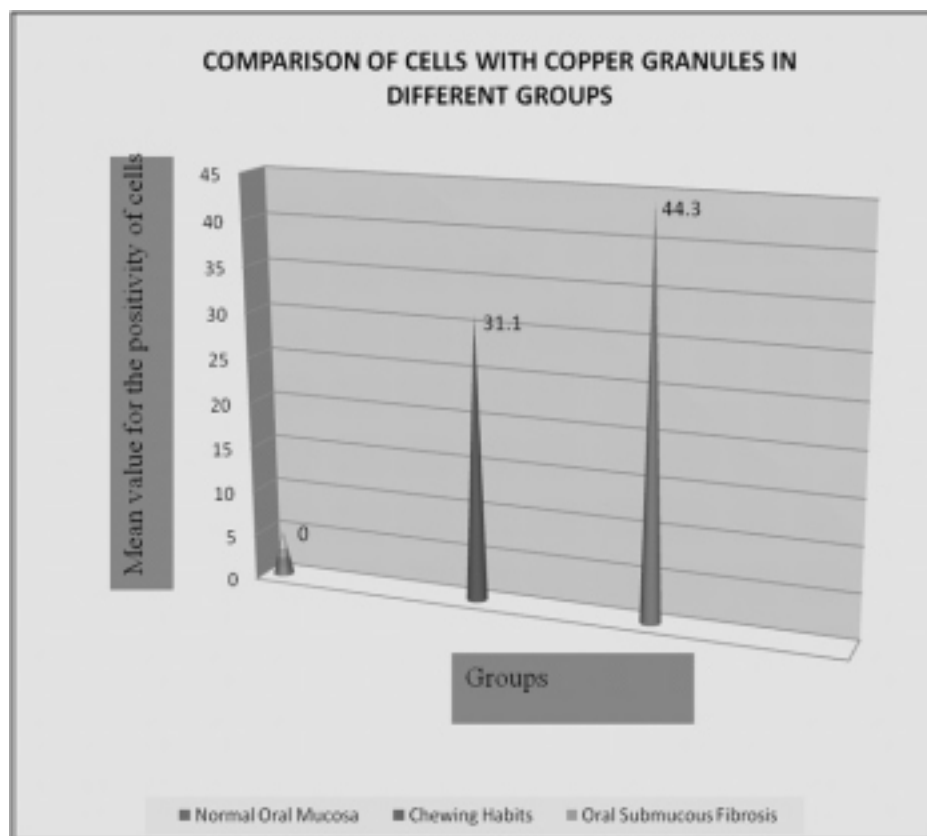
The z test was applied for the duration of arecanut chewing habits. The results showed statistically significant difference between normal, arecanut chewer subjects, and OSMF subjects at 5 % level of significance.

Then the duration of habit was compared between the chewers without lesion and OSMF patients and analyzed statistically using 'Z' test. A 5% statistically significant correlation was found. (Table 2, 3, 4)

### Discussion

Recent rise in oral submucous fibrosis in globalised world, and in India particularly, has been attributed to rise in the consumption of commercially available

**GRAPH-I**



during chewing brought in direct contact with the oral mucosa.<sup>10</sup> This copper causes upregulation of lysyl oxidase in oral submucous fibrosis patients which initiates crosslinking of collagen, which makes it relatively resistant to digestion by mammalian collagenase. Therefore it is envisaged that increased lysyl oxidase activity can result in collagen accumulation.<sup>10,11</sup>

Earlier several studies were performed on serum copper levels in oral premalignant and malignant conditions and they revealed serum copper level to be decreased in OSMF and oral cancer (Varghese et al in 1987)<sup>12</sup>. In other study by Trivedy et al (2000) the serum samples did not display any significant alterations in OSMF subjects.<sup>13</sup>

Meghji et al (1997) had questioned the hypothesis of association of copper with OSMF on the basis that patients with OSMF have low to normal serum concentration of copper. This may be explained in several ways. Following areca nut chewing, unlike the ingestion of copper from dietary sources, effects are more likely to be local within the area of prolonged contact. Small quantities that may be absorbed by swallowing the areca containing quid will be transported to the liver by the function of copper chaperones such as Caeruloplasmin and Transcuperin. These have the buffering capacity to maintain the serum copper at a steady state, unlike in systemic disorders of copper metabolism such as Indian childhood cirrhosis or Wilson's disease in which serum copper is reported to be raised.

The above studies demonstrated that there was no increase in serum copper levels in Oral submucous fibrosis patients and studies have shown that systemic copper metabolism was not deranged. With these studies, it could be assumed that oral submucous fibrosis possibly arises due to a local abnormality of collagen metabolism rather than with a systemic basis.<sup>13</sup>

Oral submucous fibrosis is believed to be loco-lesional disease as fibrosis was evident only in the area of local contact of copper with the oral mucosa but no evidence of visceral organ fibrosis is seen (Rajendran et al 2001).<sup>14</sup> Several factors may influence the bioavailability and subsequent absorption of copper by the oral mucosa. These factors include binding to non-soluble complexes, such as hemicellulose, dietary carbohydrates, dietary fats, the presence of amino acids, other mineral elements and the pH of the oral environment.<sup>15</sup> This would suggest that the composition of the quid or pan masala may

**TABLE 2**  
Comparison Of Duration Of Chewing Habit Between Group A & Group B

S.No.	Groups	No.	Duration of Chewing Habit in years			'Z' tabulated (28,0.05)	Probability value
			'Z' calculated				
			1-5	5-10	>10		
1	A	10	2.91	3.6811	2.49	1.96	P<0.05
2	B	20	3.625	3.7216	3.192		

Table showing statistically significant difference between group A and group B by applying 'Z' test.

**Table 4**  
Comparison Of Duration Of Chewing Habit Between Group A & Group C

S.No.	Groups	No.	Duration of Chewing Habit in years			'Z' tabulated (28,0.05)	Probability value
			'Z' calculated				
			1-5	5-10	>10		
1	A	10	2.91	3.6811	2.49	1.96	P<0.05
2	C	10	3.53	2.78	4.671		

Table showing statistically significant difference between group A and group C by applying 'Z' test.

**Table 3**  
Comparison Of Duration Of Chewing Habit Between Group B & Group C

S.No.	Groups	No.	Duration of Chewing Habit in years			'Z' tabulated (28,0.05)	Probability value
			'Z' calculated				
			1-5	5-10	>10		
1	B	20	3.625	3.7216	3.192	1.96	P<0.05
2	C	10	3.53	2.78	4.671		

Table showing statistically significant difference between group B and group C by applying 'Z' test.

arecanut/gutkha. Several investigators have studied the effects of the constituents of areca nut, such as arecoline and arecaidine, on oral fibroblasts in vitro in order to elucidate the etiopathogenesis of oral submucous fibrosis.<sup>7,8</sup> While initial studies suggested stimulation of fibroblasts in vitro by the addition of arecoline and arecaidine while others showed an inhibition.<sup>9</sup> There has been a recent interest in the role of copper as a possible etiological factor in the development of this disorder.

In a recent study, it was reported that areca nut contains a high copper content and chewing areca nut for 5-30 minutes significantly increases soluble copper in whole mouth fluids and the copper released

have a significant effect on the availability of copper in the oral cavity. The mechanism that regulate the uptake of copper by cells of the oral mucosa are also not fully understood. At a cellular level, there is evidence to support the role of membrane bound copper transporting adenosine triphosphates in the uptake of copper by cells. The exact mechanism for this is not known, but it is thought that the copper binding sites form an extended polypeptide chain at the amino terminus of the transmembrane domain.<sup>6</sup>

The reason for accumulation of copper by cells are explained by the extracellular presence of tripeptide glycyl-L-histidyl-L-lysine (GHL), where the first two residues of the GHL molecule are involved in the binding of copper, whereas the side chain of lysine may be involved in the recognition of receptors that function in the uptake of copper into cells. This tripeptide may be liberated within the lamina propria of areca chewers during the initial inflammatory phase of OSMF.<sup>16</sup> Interleukin -1 beta which has been shown to potentiate collagen synthesis in vitro is another important regulator of fibrosis that participates in the mediation of OSMF. Any interaction of copper with other agents in the nut, such as arecoline, and mediators of inflammation, such as cytokines, need further study.<sup>6</sup>

The relative risk of chewing arecanut was assessed by comparing the duration of the habit in subjects of chewers without lesion and in oral submucous fibrosis patients. Statistical analysis was performed using 'Z' test to compare the values between the study samples.

It was found in our study that the duration of chewing was statistically significant between the groups. This is in support of a study by **Sinor et al 1972**<sup>17</sup> where it was found that both duration and frequency of chewing arecanut was directly related to the manifestation of oral submucous fibrosis. This means that exposure to total burden of various harmful substances for a long time increases the risk of OSMF.

To the best of our knowledge, till date only one study has been done to demonstrate copper in oral cytological smears of chewers and oral submucous fibrosis. (**Rooban et al 2004**).<sup>18</sup>

The variation in intensity, appearance and number of positive staining epithelial cells in OSMF patients could be due to changes in the permeability of the epithelium. The changes could be either due to the disease process itself i.e. atrophic epithelium or the alteration in the metallothionein that transports the copper into the cell or there is

change in the spatial arrangement of copper within the cell accounting for the granular appearance in OSMF patients (**Rooban et al 2004**).<sup>18</sup>

Our study strongly suggests that copper in the buccal mucosal smears of OSMF patients supports the hypothesis of copper as an initiating factor in OSMF, playing a role in stimulating the fibrogenesis by the up regulation of Lysyl oxidase activity.

### Conclusion

The findings of this study of orange-red stained copper granules in the cytoplasm of the epithelial cells of the Oral Sunmucous Fibrosis in oral cytological smears supports the hypothesis that transmucosal transport of copper occurs through the epithelial cells to reach the connective tissue from the saliva and play a role in the pathogenesis of Oral Sunmucous Fibrosis

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## Dental Implants As An Option In Replacing Missing Teeth: A Patient Awareness Survey In Khammam, Andhra Pradesh

### Abstract

#### Aim

The purpose of this survey was to evaluate the knowledge about dental implants among dental patients in Khammam district, Andhra Pradesh

#### Materials and methods

A standardized self-explanatory questionnaire was used to assess the patients' knowledge and awareness in using dental implants as an option for replacing missing teeth. Questionnaire was distributed in two places in Khammam: Mamata dental college and private dental clinics. It was handed to the patients during their regular dental visits. A total of 600 subjects were included in this survey.

#### Results:

Out of 600 participants, 535 responded to the questionnaire with a response rate of 89.16%. Among these 319 (59.63%) were males and 216 (40.37%) were females. Nearly half of the patients were in the age group of 31-50 years. For most of the participants, dentist was the main sources of information about dental implants (38.25%), and 85.65% of them were found to have interest to know about implants. Of the total sample, only 4.83% of the participants were aware about dental implants. They felt its high cost to be a major disadvantage and its fixed nature to be the major advantage of it. Misconceptions prevailed regarding survival rate of implants and care to be taken for maintaining them.

#### Conclusion

The results of this survey showed a low level of awareness about dental implants among a selected sample of dental patients attending the outpatient ward of the department of Prosthodontics and private dental clinics in Khammam, Andhra Pradesh, India. It also showed the need for providing more general and accurate information to the patients about this treatment modality.

### Key Words

Dental implant, Awareness, Dental patient, Khammam, India

### Introduction

Dental implant is an artificial tooth root fixed into the jaws to hold a replacement tooth or bridge. They are an ideal option for people in good general oral health who have lost a tooth or teeth due to periodontal disease, failure of endodontics, an injury or for any other reason. They are also used for the treatment of edentulous patients and are associated with improved denture retention, stability, functional efficiency, and thus improving the quality of life.<sup>1,2,3</sup> At present, they are widely practiced as a treatment priority of completely or partially edentulous patients leading to widespread acceptance and popularity of dental implants within the dental professional community<sup>4</sup>

Dental implants are proved to be having high efficacy rates which is evident from several long term clinical trials<sup>2,3</sup>. Patients' acceptance of dental implants was found to be high. Grogono et al<sup>5</sup> in his study reported

that, 88% of the sample had an increase in their self confidence after implant treatment, 89% said that they would accept to go through implant treatment procedure again, and 98% said their oral health had generally improved. Similarly several other studies reported that patients after implant therapy were highly satisfied with the esthetic results, function, and were willing to undergo the same procedure again<sup>6</sup>

Level of awareness about dental implant treatment varied among several studies in different countries. Public awareness, positive attitude and acceptance of dental implants were found to be high in a study conducted in America. Reports from Finland<sup>7</sup> found low levels of awareness among patients about dental implant treatment procedures. A survey report from Austria<sup>8</sup> reported that the awareness rate of dental implant procedure was 72%, and 42% of those who questioned said that they were not informed at all about dental implants,

while only 4% said they were well informed about dental implants. The study concluded that the information about conventional dentistry was only marginally higher than that about implant dentistry.

Source of information plays a key role in improving the level of awareness of dental implants which can be provided by various means. In some countries like United States media played a major role in public dental education when compared to the contribution from dentists<sup>9</sup>. Similarly, In Japan, a study showed that dentists provided no more than 20% of the information about dental implants<sup>10</sup>. While other report<sup>8</sup> showed that, dentist played a major role in providing information about implants to patients followed by print media and by friends and acquaintances. Berge concluded that mass media like periodicals, TV, and broadcasts are reported to be the main sources of mostly negative information about dental implants<sup>4,11</sup> and that the

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treatment cost, fear of surgery, and long post surgical period may prevent people from undergoing dental implant treatment. Similarly few other studies<sup>8</sup> revealed misinformation or incomplete information and false beliefs of the public towards implants in terms of a major information gap.

As India is still considered as a developing country, with people having low levels of literacy and awareness regarding dental implants and their uses, there is paucity of information regarding the awareness of patients about dental implants in this country. Considering this, a study was conducted with an aim to assess the sources, level of awareness, and need for information about dental implants among patients attending the outpatient ward of department of Prosthodontics and private dental clinics in Khammam, Andhra Pradesh, India.

### Materials And Method

This Questionnaire based survey was conducted during August 2011 for a period of 10 days. All patients attending the outpatient department of Prosthodontics in Mamata dental college and private dental clinics in Khammam were included. They were informed about the aims and objectives of the study after which a verbal consent was obtained for their participation. Those who were not willing to participate were excluded.

Ethical Clearance was obtained from the ethical committee of Mamata Dental College and Hospital, Khammam, India.

A self explanatory questionnaire was designed to assess the patient's knowledge and awareness about dental implants. It consists of 14 questions in 3 sections, first section includes source of information about dental implants, second section consists of

questions evaluating the level of information about implants and finally third section consists of questions that find out the need of dental implants as a treatment option. The questionnaire was prepared bilingually (English and Telugu) to correspond with the reading and comprehension levels of patients with different levels of education.

Questionnaire was pilot tested on a representative sample of 20 patients. Test-retest reliability was performed to test the reliability and internal consistency of the questionnaire, it was found to be good with Cronbach's alpha ( $\alpha$ ) 0.75

The questionnaires were handed to the patients during their regular dental visits. The collected data was analyzed by using Statistical Package for Social Sciences 16 (SPSS Inc., Chicago, IL) software. Descriptive statistics were generated to summarize the responses.

### Results

#### Demographic data (Table 1):

In this study, 600 questionnaires were distributed, among these only 535 responded to the questionnaire with a response rate of 89.16%. Of the total sample 319 (59.63%) were males and 216 (40.37%) were females. Nearly half of the patients were in the age group of 31-50 years (48.79), 34.7% were in 15-30 years age group and only 16.45% were above 51 years.

Patient occupation was classified based on their self responses. Here few occupations like laborers, gardeners, mechanics etc. were placed in unskilled group, and occupations like engineers, doctors, inspectors etc in professional group. Majority of the sample were from unskilled group (37.20%) and very few were students (9.16%). Patient education status was also included in our demographic data. Almost half of the patients completed secondary

**Table: Demographic Data Of The Participating Patients N=535**

Demographic Data	Number	%
Gender		
Male	319	59.63
Female	216	40.37
Age Groups		
15-30	186	34.77
31-50	261	48.79
> 51	88	16.45
Occupation		
Student(ST)	49	9.16
Unemployed (UNEMP)	94	17.57
Housewife (HW)	66	12.34
Unskilled (UN)	199	37.2
Professional (PRO)	77	14.39
Business (BUS)	50	9.35
Education		
Illiterate	63	11.78
Primary (PRIM)	85	15.89
Secondary (SEC)	258	48.22
Graduate (GRAD)	101	18.88
Postgraduate (PG)	28	5.23
Total	535	100

**Table 2: Patient responses to source of information about implants**

Q.No	Response	Total	Gender		Age Groups			Education				
			Male	Female	Age 1	Age 2	Age 3	Uneducated	Primary	Secondary	Degree	Postgraduate
1	1	38.25	45.6	39.87	42.54	41.25	40.99	49.58	41.25	43.5	43.25	42.6
	2	24.25	36.25	29.38	31.2	31.57	32.34	23.25	38.25	27.25	36.25	24.65
	3	28.54	11.25	24.28	16.25	19.25	21.25	18.25	14.26	20.15	18.25	19.21
	4	8.96	6.9	6.47	10.01	7.93	5.42	8.92	6.25	9.1	2.25	13.54
2	1	85.65	79.68	91.58	88.25	81.25	79.11	84.65	85.68	90.25	79.99	88.69
	2	14.35	20.32	8.42	11.75	18.75	20.89	15.35	14.32	9.75	20.01	11.31

**Table 3: Patient Responses To Level Of Information**

			Gender		Age Groups			Education				
Q.No	Response	Total	Male	Female	Age 1	Age 2	Age 3	Uneducated	Primary	Secondary	Degree	Postgraduate
1	1	71.45	72.21	70.68	58.45	62.32	60.39	51.47	56.28	61.25	54.54	49.58
	2	22.41	21.25	23.58	38.25	34.25	36.25	28.35	33.25	21.25	35.68	34.15
	3	6.14	6.54	5.75	3.3	3.43	3.37	20.18	10.47	17.5	9.78	16.27
2	1	51.4	52.35	50.45	55.01	61.51	58.26	48.98	55.21	50.96	54.55	49.99
	2	37.64	39.11	36.16	29.98	28.68	29.33	36.15	25.2	29.47	24.25	30.14
	3	6.13	4.4	7.87	5.51	3.58	4.55	6.25	5.47	5.68	7.14	3.15
	4	4.83	4.14	5.52	9.5	6.23	7.87	8.62	14.12	13.89	14.06	16.72
3	1	12.5	13.26	11.74	9.5	16.26	12.88	9.58	14.25	11.65	8.68	13.25
	2	10.83	11.25	10.42	7.83	4.54	6.19	16.25	14.25	12.36	10.2	8.97
	3	12.92	14.68	11.15	9.92	7.68	8.8	15.25	14.1	11.21	9.65	10.58
	4	10.63	9.42	11.84	17.25	11.02	14.14	11.25	12.47	10.25	14.25	13.25
	5	53.12	51.39	54.86	55.5	60.5	58	47.67	44.93	54.53	57.22	53.95
4	1	61.14	54.58	52.35	49.58	55.24	51.23	49.25	48.99	48.88	51.27	55.36
	2	15.68	18.9	20.25	20.21	19.8	17.58	19.33	16.58	14.8	19.99	18.88
	3	15.24	11.25	12.35	13.25	14.98	12.88	14.77	12.65	13.57	14.25	12.65
	4	7.94	15.27	15.05	16.96	9.98	18.31	16.65	21.78	22.75	14.49	13.11
	1	43.49	43.72	43.26	50.23	53.57	51.9	41.45	42.83	43.58	52.82	50.15
5	2	16.95	20.17	21.52	21.48	21.07	18.85	20.6	17.85	16.07	21.26	20.15
	3	13.6	9.61	10.71	11.61	13.34	11.24	13.13	11.01	11.93	12.61	11.01
	4	25.97	26.5	24.52	16.68	12.02	18.01	24.82	28.31	28.42	13.31	18.69

school which is up to 10<sup>th</sup> standard in this country. Very few patients had post graduation; this distribution corresponds to the statistical data of our country.

**Source Of Information (Table 2):**

For most of the subjects, dentist was the main source of information about dental implants (38.25%), which is followed by friends and relatives (28.54%). General practitioner played a very minor role in providing information to the patients about implants (8.96%).

When asked about their interest to know about dental implants, 85.65% of them were found to have more interest, only 14.35% were less interested.

**Level Of Information About Implants (Table 3):**

In our study, 71.45% of the participants felt that missing teeth should be replaced, while

22.25% felt that replacement of teeth is required only if it is aesthetically unpleasant. Only 6.14% of them felt that replacement of teeth is not necessarily required.

When asked about the different alternatives of replacing teeth they know, only 4.83% of the participants were aware about implant supported prosthesis, half of the patients were aware about fixed prosthesis as a means of replacement and 37.64% were aware of removable partial denture. Only 6.13% of the sample knew about removable complete dentures as a means of replacing teeth.

Most of the patients (53.12%) reported that they were least informed about implants while 12.50% felt to be very well informed.

When asked about survival rate of dental

implants, majority of them (61.14%) felt that they will survive only for a period of less than 5 years, while 7.94% felt that they would last for life time.

Of the total participants, 43.49% believed that implant failure is due to poor oral hygiene, and 25.97% of them blamed themselves for implant failure. 16.95% felt that failure of implant depends on quality of implant placed and 13.60% believed that it is due to the poor quality of treatment provided by the dentist.

**Information About Need For Implants (Table 4):**

When patients were asked about their opinion for removable partial denture as a means of replacement, 61.43% of them showed disinterest towards it and favoured fixed prosthesis as their choice for replacing missing teeth.

**Table 4: Patient Responses To Need For Implants**

			Gender		Age Groups			Education				
Q.No	Response	Total	Male	Female	Age 1	Age 2	Age 3	Uneducated	Primary	Secondary	Degree	Postgraduate
1	1	38.57	41	36.14	39.58	41.32	40.45	41.25	39.25	37.25	45.25	41.25
	2	61.43	59	63.86	60.42	58.68	59.55	58.75	60.75	62.75	54.75	58.75
2	1	57.23	55.64	58.81	54.23	58.64	56.43	62.54	57.58	52.24	49.58	47.25
	2	33.59	29.36	37.82	44.25	32.36	38.3	28.54	29.35	31.25	33.21	27.88
	3	19.31	15	23.63	16.31	22.01	19.16	18.25	14.9	26.58	37.25	28.65
3	1	41.91	42.14	41.68	48.65	51.99	50.32	39.87	41.25	42	51.24	48.57
	2	13.58	14.22	12.93	10.58	7.58	9.08	11.25	12.97	15.27	15.39	13.52
	3	7.56	8.41	6.71	8.25	8.18	8.22	6.54	7.25	9.58	11.25	11.25
	4	36.96	35.23	38.69	32.52	32.25	32.39	42.34	38.53	33.15	22.12	26.66
4	1	41.25	42.35	44.25	39.25	40.35	39.62	38.25	42.35	41.11	38.39	43.31
	2	35.26	25.36	31.24	30.25	29.58	25.21	24.38	23.98	21.54	28.37	25.39
	3	23.49	32.29	24.51	30.5	30.07	35.17	37.37	33.67	37.35	33.24	31.3
5	1	72.54	73.25	74.35	81.25	80.65	73.25	76.35	69.99	71.28	70.99	73.25
	2	27.46	26.75	25.65	18.75	19.35	26.75	23.65	30.01	28.72	29.01	26.75
6	1	41.91	39.58	38.36	42.25	33.85	42.17	35.38	39.54	0.84	41.29	38.74
	2	58.09	60.42	61.64	57.75	66.15	57.83	64.62	60.46	99.17	58.71	61.26

More than half of the patients (57.23%) felt, high cost as a major barrier for dental implant treatment, one third (33.59%) of them expressed need for surgery as a disadvantage for implant treatment and 19.31% felt that long periods of treatment with many appointments as a disadvantage.

When asked about the advantages of dental implants, fixed nature of it was viewed as major advantage by 41.91% of the patients, while 36.96% of them felt avoidance of grinding of natural teeth as the biggest advantage. Only 7.56% felt, functional improvement as the major advantage.

When asked about the care to be taken for maintaining implants, most of them (41.25%) felt that equal care should be given both for natural teeth and implants, while 35.26% of them felt that implants require less care when compared to natural teeth and only 23.49% believed that they require special care when compared to natural teeth.

Most patients (72.54%) were willing to opt for dental implants while remaining wanted to go for the alternative options. When asked about who should opt for implants 58.09%

felt that it was an expensive treatment and only rich and affluent should opt for it as they are not affordable

**Discussion**

With increasing success rates of implant treatment more patients are opting for dental implants as premier choice for replacement of missing teeth. Rising knowledge of this advanced treatment modality in the society paves way for its ready acceptability. But for this a baseline data on their levels of awareness is required. Thus, a study was conducted to assess the patients' awareness towards dental implants. This kind of survey provides data on patients awareness level, knowledge, acceptance and mindset towards a particular treatment modality which can be used to formulate patient education and motivation strategies, treatment policies and guidelines for dental implants in this region.

The present survey gives information about subjects' knowledge and their need for more information related to dental implants as an option in replacing missing teeth, in a selected sample of dental patients attending the outpatient ward of department of

Prosthodontics and private dental clinics in Khammam, Andhra Pradesh, India. This specific group sample was selected for ease of access and to increase the response rate as they are dental patients who were approached during their regular dental visits. Due to the limited access to the female patients, the responses of the females to the survey were less. The age distribution was chosen randomly.

This survey showed that, the main source of information about dental implant was from the dentists followed by friends and acquaintances, books, magazines and internet, and lastly the general practitioner. This finding is contrary to that reported by Berge and Zimmer et al <sup>4,9</sup> who reported media as the main source of information about dental implants, while the dentists were the source to not more than 17% of the cases.

Around 85.65% of the dental patients questioned in this survey were interested in knowing more information about dental implants. This indicates the real need for dental education about dental implants.

The subjective level of information about dental implants varies, only 4.83% knew

about dental implant as an option in replacing missing teeth. This differs significantly than the results reported by Tepper et al, Zimmer et al<sup>8,9</sup> which reported the level of awareness as 77%, and 70.1% respectively. This can be attributed to the lower socioeconomic and education levels of this region. Also, majority of the participating patients were unskilled workers and educated only till secondary school level or less.

Most of the patients felt that the fixed prosthesis gives a better feeling in the mouth and appears more natural. This result was similar to that concluded by Tepper et al. and Zimmer et al<sup>8,9</sup> that fixed prosthesis is esthetically more attractive than removable prosthesis and less annoying in the mouth. But, 37.64% felt removable partial denture as a means of replacing missing teeth. This finding differed significantly from that reported by Sulieman Al-Johany<sup>12</sup> where only 3.3% of the subjects chose removable prosthesis as the best treatment in replacing missing teeth.

Here we found that around 53.12% of the sample didn't have any idea about implants and most of them (85%) were willing to know more information about implants, their advantages and disadvantages. This finding is similar to that reported in an Indian study conducted by Satpathy et al<sup>13</sup>. Breakup analysis shows that this was consistent across all gender, age groups, occupational and educational status. This can be fulfilled by implementing patient education programmes and counseling centers on dental implant use and advantage. None of the patients had a correct idea regarding implant survival rate which is evident from the varied responses given for that question. This shows their lack of awareness and knowledge about implants. Few patients felt that it would last for life time; these misconceptions may be due to misinformation of the public in terms of a major information gap.

Most of the patients were not interested in having removable prosthesis as the treatment in replacing missing teeth, which confirms the fact that most patients prefer fixed prosthesis in replacing their missing teeth regardless of the clinical situation they have. This result was in accordance with those concluded by Tepper et al, Zimmer et al.<sup>8,9</sup> Patients of older age group were more willing to accept functionally poor dentures. This may be because of the fact that they tend to develop compensatory adaptive processes and to some extent unconsciously accept age-related losses of masticatory function

When patients were asked about the disadvantages of implants, the responses were high cost, long treatment time and fear from surgery. Among these high cost was the major contributing factor. Some patients think that, the implant is a major surgical procedure because of the use of the word surgery. These results are in agreement with the results of most of the previously mentioned studies<sup>8,11</sup>

Misconceptions also prevailed regarding care to be taken for maintain implants, most of them felt that there is no need to take care at all and few said that equal importance should be given for both natural teeth and implants. These misconceptions should be eliminated through educational programs and the patients should be well guided towards maintenance of implants.

### Conclusion

The results of this survey among a selected sample of dental patients showed that the majority of the questioned subjects were not aware about dental implants, their uses, advantages and disadvantages. They should be informed about implants by conducting and implementing various public awareness campaigns, counseling centres should be established in patient outpatient ward in Prosthodontic departments of dental colleges and in private dental clinics. Various efforts should be made by the public sector to lower the cost of implants so that they can be made affordable to all who are in need and to improve their oral health.

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## Comparison Of The Solubility Of Luting Cements Immersed In Artificial Saliva - An Invitro Study

### Abstract

**Background and Objectives:** Luting cements are susceptible to attack by moisture during the initial setting period that can result in an increased solubility. The purpose of this study is to observe the effect of early water contact on solubility of zinc phosphate cement, glass-ionomer cement, resin cement and resin-modified glass-ionomer cement when immersed in artificial saliva.

**Material and Methods:** Four commercial luting cements were used (Fuji I, De Trey Zinc, Rely X ARC, Fuji CEM). For each material, 5 resin cement holders were made with 2 circular cavities, (diameter of 5mm and depth of 2mm). One minute after start of mixing, the specimens are placed in a humidifier at 37°C and 100% relative humidity. After 2 minutes, 5 minutes and 8 minutes of storage time, they were immersed in 50 ml of artificial saliva in a glass weighing bottle where they were stored for 3 hours at 37° C. Next, the specimens are removed and water was evaporated from the weighing bottle at 130° C for 2 hours. The difference between the final and initial weight of the bottle was taken as amount of solubility. Data were analysed by analysis of variance and Duncan's test.

**Results:** The lowest cement loss was for Rely X ARC at 9 minutes immersion time (1.475 mg/cm<sup>2</sup>). The greatest loss was for Fuji CEM after 3 minutes immersion time (14.758 mg/cm<sup>2</sup>). The solubility of cements decreased by 33% for Fuji I, 33% for De Trey Zinc, 50% for Rely X ARC, and 17% for Fuji CEM at various time intervals between the various groups. The percentage reduction in solubility at 6 minutes immersion time was 45% for Fuji I, 40% for De Trey Zinc, 41.7% for Rely X ARC, and 28% for Fuji CEM cement. The degree of solubility of these cements from 3 minutes to 9 minutes from start of mixing was 71.2% for Fuji I, followed by 71.1% Rely X ARC, 59.8% for De Trey Zinc, and 33.3% for Fuji CEM.

**Interpretation and Conclusion:** Increasing the time from start of mixing until immersion in artificial saliva from 3 to 9 minutes resulted in a marked decrease in loss of substance from the surface of all 4 cements. Resin cements were less sensitive to early water contamination.

### Key Words

Solubility, Luting cements, artificial saliva.

### Introduction

'Luting' is a word that is often used to describe the use of a moldable substance to seal a space or to cement two components together. They can also be described as the use of a flowable substance to seal joints and cement two surfaces together. Traditionally, the term 'Cements' in dentistry has been applied to a powder liquid material which when mixed to a creamy consistency sets to a hard mass which is used clinically to join the restoration to the teeth. Cements have been used in restorative dentistry for luting purposes for a long period of time. However, since the properties of various cements differ from each other the choice of cement depends on a larger degree to the functional and biological demands of the particular clinical situation. If optimal performance is to be attained, the physical and biological properties along with working characteristics like manipulation time, working time and ease of removal of excess

flash must be considered when selecting cement for a specific purpose. Solubility is one of the most important essential factors in assessing the quality of luting agents in restorative dentistry. Generally the luting cements require an extended setting time and a working time which makes them more susceptible to intraoral saliva contamination<sup>[1]</sup>. Early cement exposure to saliva during setting of cement not only alters most of its properties, especially solubility and resulting in microleakage and affecting durability of the restoration. Luting cements have been known to undergo early dissolution when exposed to moisture immediately after initial hardening. Prevention of moisture contamination is therefore necessary<sup>[2]</sup>.

However, even with utmost care, sometimes it is not possible to have a moisture free environment when rubber dam is not applied. During the recent years, several

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thickness also play an important role<sup>14</sup>.<sup>5</sup> Third, the dimensional changes occurring in the cement during setting should be minimized. Sources include, gain or loss of water and differences in the coefficients of thermal expansion among the tooth, the prosthesis, and the cement<sup>16, 7</sup>. It is, therefore, important to isolate the cement immediately after removal of the excess<sup>14</sup>.

Fixed prosthesis can debond because of biologic or physical reasons or a combination of the two. Recurrent caries results from a biologic origin<sup>18</sup>. Disintegration of the cements can result from fracture or erosion of the cement. In the oral environment luting cements are immersed in an aqueous solution<sup>16</sup>. In this environment, the cement layer near the margin can dissolve and erode leaving a space. This space can be susceptible to plaque accumulation and recurrent caries; therefore the margin should be protected with a coating to allow continuous setting of the-cement<sup>19</sup>.

A study was therefore undertaken to compare the solubility of some of the conventional luting cements during their initial contact with water or moisture. In this study, solubility of four types of luting cements during initial moisture contamination and effect of time lapse between mixing and moisture contamination on solubility of these four luting cements is being compared.

### Material And Methods

The conventional specification test for assessing the solubility and disintegration of dental cements was developed by Paffenbarger et al<sup>118, 191</sup>. It consists of immersing 2 thin flat disks of cement in water 1 hour after preparation. Twenty-four hours later, the disks are removed from the water and the water evaporated to dryness. The amount of material lost is determined from the weight of the residue and is usually expressed as a percentage of the original weight of the cement. This method consists of the basis of solubility evaluations because the organic or polymeric materials that might be collected would not have been degraded or volatilized during the drying steps. The conventional method was originally intended for the quality control of commercial products. However, the method has often been altered by research workers to evaluate new materials and to compare different types of dental cements.<sup>115, 16, 17</sup> Um and Øilo<sup>115</sup> altered the conventional method to evaluate the solubility of luting cements at

the early stages after mixing. Instead of thin flat disks, they used resin molds as cement holders and immersed cements in distilled water at the early stages of mixing before the final set of the cement. The same method, except immersion times and immersion in artificial saliva<sup>114</sup> was used in this study to record the early solubility of luting cements.

To quantify loss of substance from 4 different luting cements (**Table 1**), 2 circular cavities (diameter of 5 mm, depth of 2mm) were made in resin block (**fig 2**). The cements were all mixed on a glass slab at room temperature by the stiff blade. The powder/liquid ratios used were in accordance with the manufacturers' recommendations. If the powder/liquid ratios were not given in the instructions, they were calculated from the proportioning system given by the manufacturer by weighing scoops of powder or drops of liquid. The powder/liquid ratios of each cement are given in **Table 1**. In each case, the powder was weighed on a digital balance (**fig 3**) that had a measuring accuracy of 0.1 mg and the liquid was dispensed from a 1 mm tuberculin syringe calibrated to the nearest 0.1mL. All cements were mixed within 30 seconds and placed in small resin cups in 30 seconds. The surface was flattened all the excess cement was removed with a spatula and a dry cotton pellet. One minute after the start of mixing, the specimens were placed in a humidifier (**fig 4**) at 37°C and 100% relative humidity. After 2, 5, or 8 minutes of storage time, specimens were removed from the humidifier and immersed in 50 ml of artificial saliva in a glass weighing bottle with the exposed surface area pointed upward.

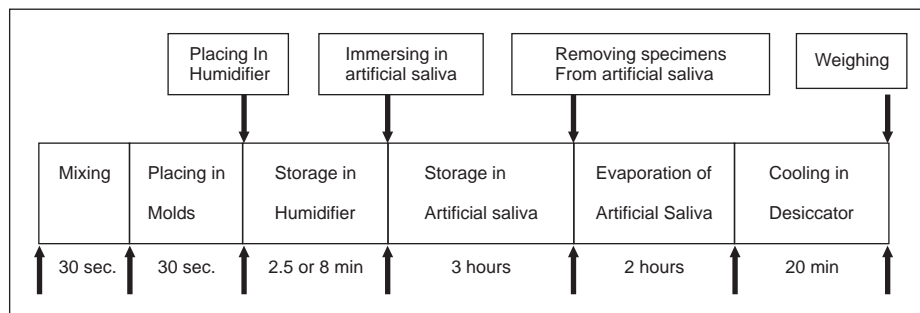
The mass of the empty bottle had been previously established by using a digital balance that had a measuring accuracy of 0.1mg. Before weighing, the bottle was carefully rinsed, dried at 130°C for 2 hours

in hot air oven (**fig 5**), and cooled in a desiccation for 20 minutes. Bottles were stored for 3 hours at 37° C and thereafter, the cement holders were removed from the water and the bottles were stored at 130° C for 2 hours to allow evaporation of water. Bottles were then cooled in a desiccators (**fig 6**) and weighed as previously described. The amount of substance dissolved was determined by subtracting the first established weight of the bottle from the second. The time schedule for the total procedure is illustrated in Flow chart. Five specimen of each type of cement were used at each immersion stage. The mean weight loss per square centimeter was calculated. The exposed surface area of each specimen was calculated ( $r = 2.5$  mm) and the exposed surface area was doubled as each cement holder had 2 cavities. Data were analyzed by 2-way analysis of variance ( $p < 0.01$ ). Duncan's multiple range test analysis was also used to distinguish statistically significant groups.

### Results

The recorded mean values and the standard deviations for each luting cements at each immersion time are presented in **table 2**. The lowest cement loss was recorded for resin cement after 9 minutes immersion time (1.47 mg/cm<sup>2</sup>). The greatest loss was for resin modified glass ionomer cement after 3 minutes immersion time (14.75 mg/cm<sup>2</sup>). For all of the observed luting cements, resin cement showed the lowest mean loss of substance at all immersion times. However, the loss of resin cement was significantly different from all cement at 3 minutes immersion time. Increasing the time from the start of mixing until immersion in artificial saliva from 3 to 9 minutes resulted in marked decrease in loss of substance from the surface of all 4 cements (**Graph 1**.) This inter-comparison result was obtained from the "BONFERRONI". The solubility of the cement decreased by 33% for Fuji I, 33% for

Flow chart 1. Time schedule for experimental procedure.



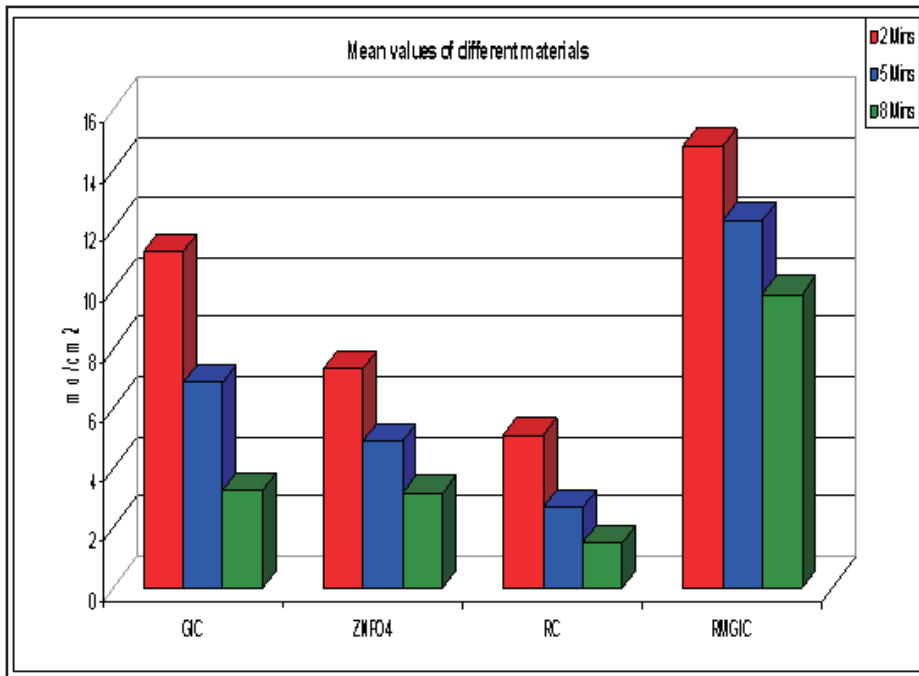
**Table 1.**

Product Name	Manufacturer	Composition	Scoops
			P:l/two paste system
FUJII	GC	Powder:- Calcium Fluoroalumino Silicate Glass Liquid:- Conc.aqueous Solution Of Polyacrylic Acid	1.8:1 g
DeTreyZinc Crown & Bridge Fixodont Plus	DENTSPLY	Powder:- 10% Mgo, 90% Zno Liquid:- 67% Phosphoric Acid 33% Water With Aluminium And	2.8:1 g
Rely X ARC	3M ESPE	Base:- Strotium Alumino Fluoro Silicate Glass Aerosol Initiator Catalyst:- Macromonomer Aminopenta	1:01
FUJI CEM	GC	Base:- Fluoroalumino Silicate Glass, Poly Hema (Resin) Catalyst:- Aqueous Solution Of Modified Polyalknoic Acid.	

De Trey Zinc, 50% for Rely X ARC, and 17% for Fuji CEM at various timer intervals between the various groups. The pair wise comparison was done using the "ANALYSIS TEST". For all the four groups there is a significant reduction in solubility at 3 minutes versus 6 minutes and 3 minutes versus 9 minutes and 6 minutes versus 9 minutes. When the specimens were immersed in artificial saliva 6 minutes after

mixing, the difference in solubility between 3 and 6 minutes was most marked for RC cement, which was around 50%.The percentage reduction in solubility at 5 minutes immersion time to be 45% for GIC, 40% for ZnPO4, 41.7% for RC, and 28% for RMGIC cement. The degree of solubility of these cements from 2 minutes to 8 minutes from start of mixing was 71.2% for GIC followed by RC by 71.1%, 59.8% for

**Graph 1. graphic representation of solubility of luting cements in relation to immersion time.**



**Table 2. Mean and standard deviations of loss of substance (mg/cm<sup>2</sup>) for 4 luting cements immersed in artificial saliva at different intervals.**

Cement	3min		6min		9min	
	Mean	SD	Mean	SD	Mean	SD
Fuji I	11.2	0.3	6.8	0.6	3.2	0.3
De Trey Zinc	7.3	0.7	4.8	0.4	3.1	0.2
Rely X ARC	5	0.6	2.6	0.5	1.4	0.3
Fuji CEM1	14.7	0.4	12.2	0.3	9.8	0.2

ZnPO4, and 33.3% for RMGIC.

**Discussion**

From the results obtained, it can be seen that the resin cement, gave the least solubility at all periods of time. This can be explained by the fact that principle cement is more of resin cement and less of glass ionomer cement. Also it has a dual cure capability and the margins can be light cured. The next ideal cement in terms of reduced solubility was the century old zinc phosphate cement. As far as its solubility was concerned, it was found less soluble than glass ionomer cement in our vitro study. Studies <sup>[2]</sup> have shown the importance of protecting the glass ionomer cements immediately after cementation, as they have been shown to disintegrate rapidly in the presence of moisture. Zinc phosphate showed a lower solubility than the glass ionomer cement, therefore it is necessary that adequate protection is given against water after cementation. The reason for the dissolution of glass ionomer cement in water has been attributed to two factors: firstly <sup>[2]</sup>, they contain sodium that forms water soluble salts with the matrix forming anions. Secondly <sup>[2]</sup>, free calcium and aluminum ions that are present in the fresh cement can be removed by chemical reactions. In addition, aluminum ions react rather slowly with the matrix forming anions and before they are bound, is vulnerable to early water leaching. As the setting progresses, the cement becomes more and more solid, preventing water penetration and reducing the outward transportation of cations. Finally<sup>4</sup>, the resin modified glass ionomer cement showed the highest solubility which was more than glass ionomer cements. Because they contain a resin HEMA (hydroxy ethylmethacrylate) which is hydrophilic in nature, there is an increased water sorption and subsequent plasticity and hygroscopic expansion. This behavior is

analogous to a synthetic hydrogel. All the four luting agents show a decreased amount of solubility when extending the time between the start of mixing and immersion in artificial saliva. A significant decrease was observed during a 2-8 minute period after commencement of mixing and the loss of substance was greatly reduced at 8 minutes after the commencement of mixing. As regard, the percentage reduction of solubility from 2-8 minutes, we find that the resin modified glass ionomer cement showed the least reduction in solubility which can be explained as mentioned earlier due to the presence of HEMA resin. Although invitro tests have limited clinical significance because it does not give an indication of stability of the set cement in oral environment, they are important for screening the quality of different cement types.

### Conclusion

From the results of this study the following conclusions were obtained. The resin cement showed the least solubility to water at various time intervals of immersion. Zinc phosphate and glass ionomer cement followed this to various time intervals of immersion. The resin modified glass ionomer cement showed the highest solubility. The glass ionomer cement showed a greater percentage of reduction in solubility as the time interval of immersion in water increased when compared to other luting cements. This study shows that the resin modified glass ionomer cement and glass ionomer cements requires protection from moisture in the early period after mixing (8 minutes).

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## Drug Induced - Stevens Johnson Syndrome: A Case Report

### Abstract

SJS is an acute, self-limited disease, Presenting as severe mucosal erosions with widespread erythematous, cutaneous macules or atypical targets. Majority of cases are drug- induced, affecting oral & peri-oral region. We report a case of drug induced SJS in a 16 yr old female which was treated lucratively with steroids. Diagnostic criteria have changed, and more data exist on drugs with an increased risk. Although there is no standardized treatment for all patients with SJS/TEN, options that have been used include cyclosporine, corticosteroids, and intravenous immunoglobulin.

### Key Words

Bleeding, Syndrome, Immunoglobulin, Ulcer

### Introduction

"A new eruptive fever with stomatitis and ophthalmia" was described as a severe variant of erythema multiforme & was termed by Steven and Johnson in 1922. By the 1940's it was commonly called as "Steven Johnson's syndrome (SJS)". The concept of the spectrum of erythema multiforme has been widely accepted since that time<sup>1</sup>. SJS is an acute, self-limited disease, Presenting as severe mucosal erosions with widespread erythematous, cutaneous macules or atypical targets<sup>2</sup>.

Although SJS is rare with an incidence of 0.05 to 2 persons per 1 million populations per year, it has significant impact on the public health in view of its high morbidity and mortality<sup>3</sup>. Majority of cases are drug-induced<sup>4</sup>.

SJS is one such disease which could manifest with extensive oral and peri-oral involvement, where oral physicians come into picture. Hence we are presenting a case of SJS, which has been successfully treated.

### Case Report

16 year old female came to our Department with a complaint of painful ulcers in the mouth & bleeding from lips since a day. She presented with fever a week back for which she was prescribed antibiotics & analgesics after which she developed ulcers in the mouth & bleeding from lips, associated with pain which was sudden in onset, burning type, continuous, localized, and severe in intensity, aggravated on touching, speaking,

eating food & there was no relieving factor. She also had burning micturation & watering of both eyes since 4 days. Her past medical history revealed that she was suffering with fever a week back & was on tab. Ciprofloxacin 500mg tid for 5days & tab Paracetamol 500mg + Diclofenac sodium 50mg tid for 3days for the same. Her past dental & surgical histories were non contributory. Patient had elevated temperature of 100F. Bilateral submandibular lymph nodes were palpable, tender, mobile, firm in consistency. Extra orally there was limited mouth opening & erythematous crusted areas on both upper & lower lip extending upto the vermillion border with fresh bleeding spots, surface appeared rough & scaly, on palpation the periphery of the lesion was hard & tender (figure 1).



Figure 1 - Erythematous Crusted Areas On Both Upper & Lower Lip Extending Upto The Vermilion Border With Fresh Bleeding Spots

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Bleeding was evident on touching with peeling up of overlying skin of lips. There was solitary ulcer seen in conjunctiva bilaterally, associated with watering of eyes & pus discharge (figure 2).



Figure 2 - Solitary Large Ulcer On The Conjunctiva Bilaterally

The vaginal lesion was confirmed with examination in department of Veenerology. Bilateral solitary submandibular lymph nodes were palpable, tender, mobile, firm & measured 1x1 cm. Intra oral examination revealed clusters of ulcers on lower labial mucosa, right & left buccal mucosa (figure 3) & right lateral border of tongue (figure 4) with fresh bleeding spots, each ulcer measured about 1x0.5 cm, surrounded with erythematous halo. Floor of ulcers revealed a whitish slough. Slight provocation initiated bleeding.

& right lateral border of tongue (figure 4) with fresh bleeding spots, each ulcer measured about 1x0.5 cm, surrounded with erythematous halo. Floor of ulcers revealed a whitish slough. Slight provocation initiated bleeding.



Figure 3 - Fresh Bleeding Spot With Ulcers On Right Buccal Mucosa



Figure 4 - Clusters Of Ulcers On Right Lateral Border Of Tongue



Figure 5 - 15 Days After The Treatment Shows Complete Healing Of Ulcers

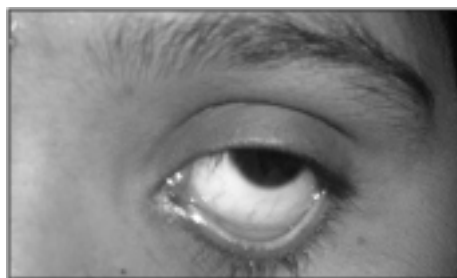


Figure 6 - Eye Lesions Healed

Based on this our clinical diagnosis was Stevens Johnson Syndrome as the lesion noticed in eyes & genitals. Differential diagnosis thought were pemphigus vulgaris & stomatitis medicamentosa. We could subject the patient to only the hematologic investigation as the lesion being acute; the patient was under severe discomfort. Her complete blood picture revealed raised ESR - 50mm/1<sup>st</sup> hr & total leucocyte count was 12000 cells/mm<sup>3</sup>. Rest other findings were within normal range.

We treated her with systemic steroids, tab prednisolone 10mg qid for 7 days, which was gradually tapered to 10mg tid for 7days, 10mg bid for 5days & 10mg once daily for 5days respectively, benzydamine hydrochloride 0.15% oral rinse for oral ulcers. Gention violet application for lip lesions. Clotrimazole cream 1% for vaginal lesion & ofloxacin eye drops 0.3% for eye lesion. Liquid & soft diet was advised. All the lesions healed within 15 days (**figure 5**); there was absence of burning micturation & lacrimation (**figure 6**).

### Discussion

Stevens-Johnson syndrome is a severe, episodic mucocutaneous intolerance reaction described by Hebra<sup>5</sup> in 1866 and Albert Mason Stevens and Frank Chambliss Johnson in 1922. Erythema multiforme (EM) and Stevens-Johnson syndrome are part of a clinical spectrum<sup>6</sup>.

SJS is said to be associated with drugs. More than 100 different medications have been implicated. The syndrome usually begins within 1-14 days of ingestion of the offending agent<sup>7</sup>. In our case the interval was one week. SJS and TEN are considered T cell mediated disorders in which activation of CD8 T lymphocytes lead to destruction and apoptosis of keratinocytes<sup>8</sup>. Drugs can activate T cells by acting as a hapten, as a prohaptent or by direct pharmacologic interaction among the drug, Major Histocompatibility Complex (MHC) molecule and a T cell receptor. It is postulated that drugs can bind with the MHC and T cell receptor causing activation of T cells contributing to SJS. Yap et al<sup>3</sup> determined that the drugs especially anticonvulsants and allopurinol were the major causes of SJS. Jean-Claude Roujeau, et al<sup>9</sup> in 1995 conducted a study on medication use & risk of SJS & TEN, according to whom the commonest drugs causing SJS included most classes of antibiotics, including cephalosporins, quinolones, aminopenicillins, tetracyclines, and imidazole antifungal agents. A recent study by Gokhan Okan, et al<sup>7</sup> in 2008

reported a case of ciprofloxacin induced SJS. This holds well in our case where the patient was on ciprofloxacin for a week. Kristina E, et al<sup>10</sup> stated that among the available NSAIDs, oxcam derivatives have the greatest association with SJS & the risk of SJS or TEN in patients receiving NSAIDs is extremely low; whereas older patients, women, and patients within the first month of treatment initiation have the greatest risk. Mainly drug- induced SJS-TEN Overlap and TEN have high mortality. The reported mortality rate ranges from 5% to 40%<sup>11, 12</sup>. The syndrome may be diagnosed on clinical criteria. Signs and symptoms consist of a non-specific prodrome of malaise, fever, headache, sore throat, cough, chest pain, vomiting, diarrhea or myalgias<sup>6</sup>.

Systemic corticosteroids has unproven benefit in early cases of SJS and TEN and deleterious in the advanced forms<sup>13</sup>. Other treatment includes cyclosporine and intravenous immunoglobulin but new treatments, such as amniotic membrane support for ocular damage, may need to be considered<sup>14</sup>. To conclude drug induced SJS is more common & is considered to have high mortality rate, herewith we presented a case of drug induced SJS which was treated successfully with systemic steroids.

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## Cutaneous Odontogenic Sinus Tract: A Diagnostic Challenge

### Abstract

Cutaneous sinus tracts of dental origin are often initially misdiagnosed and inappropriately treated because of their uncommon occurrence and the absence of symptoms. Misdiagnosis of the lesion can lead to cumbersome treatment planning including multiple surgical excisions and biopsies, systemic antibiotic regimens with eventual recurrence. Variety of lesions i.e. Osteomyelitis, actinomycosis, malignancy etc. mimic such a clinical picture. Case of cutaneous facial sinus tract related to mandibular molar was diagnosed clinically. Nonsurgical endodontic therapy was done as the treatment of choice resulting in successful healing of lesion without any cosmetic treatment. So aim of this report is to present a case report of this common misdiagnosed lesion showing healing of same without any surgical intervention.

### Key Words

Cutaneous Sinus Tract, Mandibular Molar, Management

### INTRODUCTION

Although the most common cause of the intermittently suppurating cutaneous sinus tract in the face and neck area is chronic dental infection, chronic draining sinus tracts of the face and neck continue to be a diagnostic challenge (1). A review of several reported cases reveal that patients have had multiple surgical excisions, radiotherapy, multiple biopsies, and multiple antibiotic regimens, all of which have failed, with recurrence of the cutaneous sinus tract, because the primary dental aetiology was never correctly diagnosed or addressed. Few received cancer-directed therapy before having lesions correctly diagnosed (2, 3). Tidwell et al. 1997 reported a case which takes over 15 years to recognize a dental origin (4). Because these lesions are often diagnosed incorrectly, they are also treated ineffectively.

This report involves a case of cutaneous facial sinus tract of dental origin, its diagnosis and treatment.

### CASE REPORT

A 22-year-old male reported to our institute complaining of sensitivity in relation to

upper right posterior tooth. On examination it was found that there was carious lesion in relation to maxillary right first molar for which composite restoration was advised.

Extraoral examination also revealed erythematous, symmetrical, non tender elevated nodule (1 X 1 cm in size) with crusting and history of periodic drainage along with large skin lesion (**fig 1**) on right face and neck region. He stated that he had felt an induration on his cheek about one year ago and left it untreated because he had no pain.



**Fig 1: Large Skin Lesion On Right Side Of Face And Neck**

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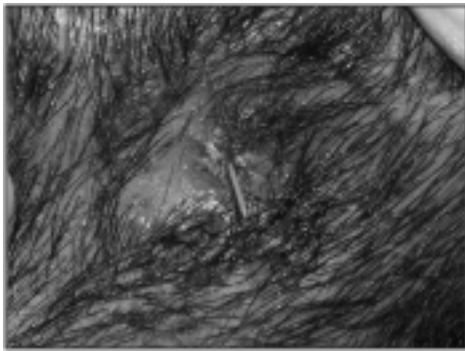
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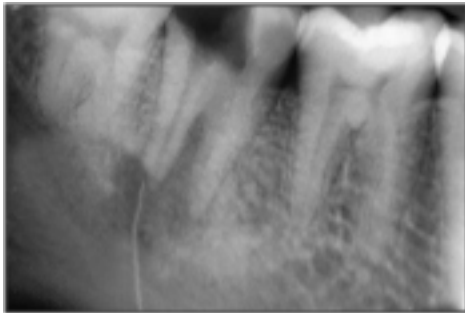
However, as the lesion started to discharge pus during the following months, he then received several treatments from a dermatologist. In spite of taking large number of antibiotics and antifungal medications both orally and topically, the lesion did not heal and the surgeon had recommended surgery now.

On intraoral examination, grossly carious right lower second molar was detected. The tooth was not tender to percussion or painful on biting and did not respond to electrical pulp testing. Upon radiographic examination, periradicular radiolucency in relation to carious tooth was seen. Sinus tract was tracked with a gutta-percha cone (**fig 2**) to the distal root lesion of the first molar tooth as seen in confirmatory radiograph (**Fig 3**).

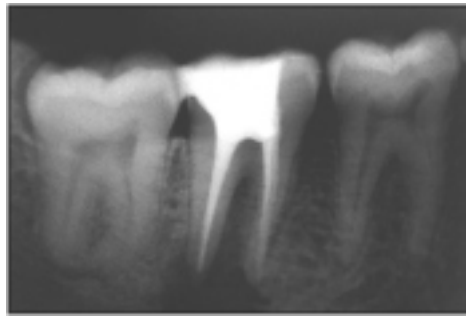
Based on these findings, the patient was diagnosed as having an odontogenic cutaneous sinus tract secondary to chronic periradicular periodontitis of the left mandibular second molar tooth. His consent for endodontic treatment was taken and root canal treatment started. The skin lesion may be the result of accumulation of pus because of patient's beard leading to suprainfection.



**Fig 2: Gutta Percha Passed Through Sinus Present**



**Fig 3: Confirmatory Radiograph Showing Origin Of Sinus From Distal Root Of Molar**



**Fig 4: Post Operative Radiograph**



**Fig 5: Skin Lesion Showing Signs Of Healing**



**Fig 6: Healed Skin Lesion**

Patient was explained the dental etiology of the sinus formation and its possible management. He was even asked to get his beard shaved but patient was not willing for that because of religious reasons.

After local anaesthesia and rubber dam placement, root canal treatment was initiated with pulp chamber access and biomechanical preparation of the root canals was done. Irrigation during instrumentation was carried out with 1% sodium hypochlorite and EDTA. Calcium hydroxide mixed with chlorhexidine paste was used as the intra canal medicament. After 1 week, lesion showed signs of healing. The canal filling with gutta percha and AH plus root canal sealer was performed 2 weeks after the initial appointment (fig 4) and the lesion showed further healing (fig 5).

After 1 month, skin lesion healed (fig 6) and radiographic examination showed the repair of periapical tissues too. As the skin lesion have healed, patient did not turn up for further recall appointments.

But the present case report showed the healing of long standing cutaneous sinus and the large skin lesion (may be caused due to suprainfection from the draining pus) and thus lay stress on need of thorough

knowledge about the possible dental etiology of cutaneous sinus tract in head and neck area.

#### **DISCUSSION**

A sinus tract is an abnormal channel that originates or ends in one opening. An orofacial fistula is a pathologic communication between the cutaneous surface of the face and the oral cavity. Chronic dental periapical infections or dentoalveolar abscesses cause the most common intraoral and extraoral fistulas.

As the lesion develops it is usually disregarded to be of dental origin, patient seeks treatment from a dermatologist or general surgeon and often undergoes multiple antibiotic regimens, surgical excisions, biopsies and even radiotherapy.

Misdiagnosis adds to the chronicity of the lesion and has profound effect on facial esthetics due to unnecessary treatment resulting in cutaneous scarring and dimpling. Only 50% of patients with cutaneous odontogenic sinus tracts have a history of toothache. Most patients are unaware of an associated dental problem (1,5), thus delaying the correct diagnosis of the cutaneous lesion with its primary odontogenic origin. One case was correctly diagnosed only after 32 years (6).

The sites of dentocutaneous fistula are usually anatomically close to the causative tooth. Of reported cases, 80% involved mandibular teeth of which half were anterior teeth, producing sinus tracts in the submental and chin sites (7). Other sites of extra-oral drainage of odontogenic origin are the cheek, canine space, nasolabial fold, nose, upper lip, and inner canthus of the eye (1,3,7).

Mandibular incisors and cuspids typically drain to the chin or submental region, and premolar and molar infections typically drain above the inferior border in the submandibular region of the anterior triangle of the neck (8). Occasionally the opening of the sinus tract may be found at a far distance from the dental infection. Endelman (9) described a patient in whom a sinus from a tooth infection opened on the chest wall and another on the upper one-third of the thigh.

#### **Pathogenesis**

Cariou exposure with bacterial invasion of the tooth pulp leading to a periapical abscess is the most common cause of dentocutaneous sinus tracts. The inflammation destroys the cancellous alveolar bone and proceeds along the periosteum until perforation occurs. An intraoral or extraoral sinus can develop, depending on the path of the inflammation, which is dictated by surrounding muscular attachments and fascial planes. For example, if the bone perforation on the mandible occurs above the muscular attachment, then an intraoral sinus will result. If the perforation occurs below the level of muscular attachment, then a cutaneous sinus will result. The cutaneous lesion may develop as early as a few weeks (10) or as late as 30 years (11).

#### **Diagnosis**

Evaluation of a cutaneous sinus tract must begin with a thorough history and awareness that any cutaneous lesion of the face and neck could be of dental origin.

Dentocutaneous sinus tracts appear as soft,

slightly depressed nodules, often fixed to underlying structures, with a central opening from which fluid can be expressed. Palpation of the surrounding tissue may produce pus, which supports the diagnosis. Intraoral and dental examinations are critical for making the diagnosis. In particular, the examiner should look for dental caries or restorations and periodontal disease. Early radiographs can prevent unnecessary surgeries when the teeth appear clinically normal. A panoramic or periapical radiograph will show a radiolucency at the apex of the infected tooth.

Recognition of a sinus tract origin is the first step in diagnosis. Intraoral periapical radiographs should be taken routinely when such lesions are present, preferably with a gutta-percha cone threaded into the sinus tract. Because of gutta-percha's radiopacity, the source of the infection will be revealed. Any chronic suppurative lesion on the middle or lower portion of the face should be investigated for possible dental cause. If the primary infection site is the pulp of a tooth, the logical diagnosis would be a chronic alveolar abscess, which is defined as a long-standing low grade infection of the periradicular alveolar bone.

Biopsy, if performed, will show nonspecific findings such as pseudoepitheliomatous hyperplasia and chronic inflammation.

Most infections are polymicrobial, and culture often yields growth of anaerobes or facultative anaerobes. Sassone et al (12) performed a microbiologic evaluation of primary endodontic infections in teeth with and without sinus tract. They discovered the greatest prevalence of such bacteria as *Fusobacterium nucleatum* sp. *vincentii*, *Porphyromonas gingivalis*, *Veillonella parvula*, *Enterococcus faecalis*, *Campylobacter gracilis*, and *Neisseria mucosa*. The total bacterial counts were similar between lesions with and without sinus tracts, although *E faecalis*, *Streptococcus anginosus*, *Capnocytophaga sputigena* and *Capnocytophaga gingivalis* had significantly higher counts in those lesions without sinus tracts. Higher levels of *P gingivalis* and *F nucleatum* sp. *nucleatum* were noted in cases with sinus tract.

### Differential Diagnosis

The differential diagnosis (1,10) should include traumatic lesions, fungal and bacterial infections, neoplasms presence of a foreign body, local skin infection (carbuncle and infected epidermoid cyst), pyogenic granuloma, chronic tuberculosis lesion, osteomyelitis, actinomycosis, and

gumma of tertiary syphilis. Rare entities to be included in the differential diagnosis are developmental defects of thyroglossal duct origin or branchial cleft, salivary gland and duct ?stula, dacryocystitis, and suppurative lymphadenitis.

### Treatment

Root canal therapy or surgical extraction is the treatment of choice. Root-canal therapy is done if the tooth is restorable; Extraction is indicated for nonrestorable teeth. Once the primary odontogenic aetiology has been properly eliminated or removed, the sinus tract and cutaneous lesion usually resolve within a few weeks without treatment, Systemic antibiotic administration is neither necessary nor recommended in patients with cutaneous odontogenic sinus tracts who have an intact immune system. Antibiotics may be used as an adjunct to sendodontic therapy in the setting of diabetes, immunosuppression, or systemic signs of infection such as fever. Antibiotic therapy alone will not be effective in these cases because of the absence of adequate circulation in a necrotic pulp system and abscess. If antibiotics are to be used, penicillin V potassium is the first choice. Clindamycin or amoxicillin-clavulanate may be used if the infection is unresponsive. After root canal therapy, the cutaneous lesion usually resolves in 1 to 2 weeks. The patient may be left with a residual umbilication of the skin that can be surgically revised if it is cosmetically unappealing.

### Conclusion:

Chronic, draining dental infection is one of the most common causes of fistulae of the face and neck. An understanding of the pathogenesis of cutaneous fistulae arising from dental infections will lead to proper early diagnosis and treatment without unnecessary surgery.

The case presented here shows that cutaneous odontogenic sinus tracts are still being misdiagnosed and that treatment applied is inappropriate. The case illustrates the need for cooperative diagnostic referrals between physicians and dentists, and highlights the need for thorough diagnostic procedures that should always include a dental examination. The clinician should recognize that a cutaneous sinus tract is a

sequel to pathosis, while the associated nonvital tooth, with its periradicular periodontitis, is the primary cause.

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## Giant Cell Fibroma - A Case Report With Review Of Literature.

### Abstract

Giant cell fibroma (GCF) is a non-neoplastic lesion of fibrous connective tissue origin considered to be a variant of fibroma. In spite of similar histology, several distinctions can be made between a number of fibrous hyperplasias according to characteristics such as age distribution, gender predilection, location and etiology.

Though the GCF is very similar histologically to other fibrous hyperplasias, clinical features may aid in distinguishing it from other lesions. Few cases have been reported about this lesion. We report a case of Giant cell fibroma affecting the oral cavity of a 38 year old male.

### Key Words

Giant Cell Fibroma, Fibrous Hyperplasias, Oral Cavity.

### Introduction

The giant cell fibroma is an interesting non neoplastic lesion of the oral mucosa. It was first described by Weathers and Callihan in 1974. [1] It was named for its characteristically large, stellate-shaped, mononuclear and multinucleated giant cells. [1] The authors examined more than 2,000 specimens in a group of fibrous hyperplasias, and 108 met their criteria for this "new" lesion which they called GCF.

Before Weathers' and Campbells' distinction of GCF, Eversole and Rovin [2] compared and contrasted 279 fibrous hyperplastic gingival lesions, which fell into four categories: pyogenic granuloma, peripheral gingival fibroma, peripheral giant cell granuloma, and peripheral ossifying fibroma. Each has its own diagnostic histopathologic characteristics but exhibit overlap of clinical presentation. Speculations from the study were that all four types of lesions are merely varied histologic responses to common etiologic factors, but similar to one another and to other fibrous hyperplasias.

Fibrous hyperplasias are considered reactive proliferations of fibroblastic tissue rather than neoplastic proliferations. Most are the result of chronic injury or irritation. GCF was at one time hypothesized to be

virus-induced, but that claim was never substantiated; therefore, it is believed to arise as a result of a stimulus, source of which cannot always be determined. [3]

There is no gender predilection for GCF, but it is a lesion of the young, found most commonly in the first three decades of life. [4]

It may be pedunculated or sessile and is found most commonly on the gingiva, with the mandibular gingiva being affected more than the maxillary. It may also be found in extragingival sites, including the tongue, palate, and buccal mucosa. It is typically of normal mucosal color unless traumatized during mastication or oral hygiene procedures. [5]

Microscopic examination usually shows multiple large stellate-shaped and sometimes multinucleated fibroblasts (giant cells) in a loosely arranged vascular fibrous connective tissue. [4]

### Case Report

A 38 year old male reported to the Department of Oral & maxillofacial pathology, (Vinayaka missions Sankarachariyar dental college - Salem, Tamilnadu) with a chief complaint of a small swelling on the left maxillary gingiva since

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2 months. [Fig1]



FIG 1: Smooth exophytic growth on the maxillary gingiva in relation to 23.

The patient was a known smoker since 10 years. No other relevant medical history was found, his vital signs were normal.

On clinical examination a well defined round swelling was seen measuring 1x1 cm in relation to the left maxillary canine. [Fig 2] No surface discharge was seen, the mucosa over the swelling was same as that of the normal mucosa. On palpation the inspeactory findings were confirmed, the swelling was firm and non tender. It was immobile. The mouth opening was normal. Generalized extrinsic stains were seen around the cervical thirds of all the teeth.

Routine blood examination was normal.

An excisional biopsy was performed under local anesthesia and the specimen was subjected to histopathological examination which revealed a dense fibrous stroma, large stellate shaped fibroblasts were seen. [Fig 3], [Fig 4] Multinucleated giant cells were also seen among the large plump and stellate shaped fibroblasts some of which are smudged. [Fig 5]

A final diagnosis of giant cell fibroma was established.



FIG 2: Round and sessile growth, colour is normal as that of the adjacent mucosa.

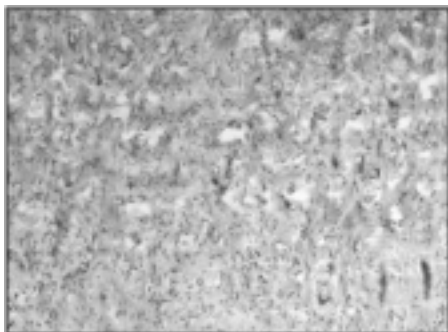


FIG 3: 10 X view H&E stain showing a fibrous connective tissue with few blood vessels and minimal or absent inflammatory cells.

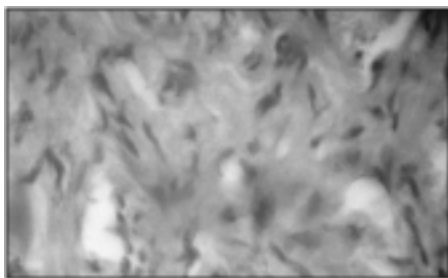


FIG 4: 10 X view H&E stain shows large stellate shaped fibroblasts in a dense stroma, nuclei are enlarged and stellate without hyperchromatism.

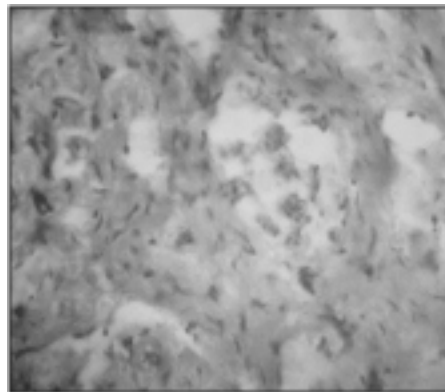


FIG 5: Dense stroma showing stellate shaped fibroblasts and multinucleated giant cells.

### Discussion

The GCF was first described as a separate entity among fibrous hyperplastic soft tissue lesions by Weathers and Callihan in the early 1970s. GCF is a fibrous tumor with distinctive clinicopathology unlike traumatic fibroma; it is not associated with chronic irritation. It represents approximately 2-5% of all oral fibrous proliferations. [3]

After distinguishing GCF among fibrous hyperplasias, Weathers and Callihan further elucidated the structure of the lesion when they studied them under light microscopy. They concluded again that dominant cells in the GCF were indeed unique, and that GCF merited its own classification. [6]

The lesion usually occurs at young age of less than 30 years in about 60% of cases. Most studies show female preponderance. 50% of all cases occur on the gingiva. The mandibular gingiva is affected twice more than the maxillary counterpart. Our case has occurred in a male patient on the mandibular gingiva. Tongue and palate are next preferred sites for GCF in the oral cavity. [7]

It can be seen in other sites, especially the nose, and differs from irritation fibroma in two ways: it contains cells (fibroblasts) with large, angular nuclei, especially near the surface of the fibrous mass, beneath the overlying epithelium; and it has a greater tendency to recur.

The histologic composition of GCF is the consistent diagnostic feature of the lesion. Microscopic examination shows multiple large stellate-shaped and sometimes multinucleated fibroblasts (giant cells) in a loosely arranged vascular fibrous connective tissue. The lesion is characterized by a diffuse, somewhat

immature, rather avascular collagenic stroma with small bipolar and slightly stellate fibroblasts scattered throughout in moderate numbers. Occasional fibroblasts will be quite large and angular, and may have more than one nucleus. These pathognomonic cells are never hyperchromatic, as they would be if they were truly dysplastic fibroblasts, and they often have a smudged appearance. [7]

Differential diagnosis encompasses a wide array of lesions, it differs significantly from routine fibromas in that its stroma contains scattered fibroblasts with very large, usually angular (stellate), but not hyperchromatic nuclei. The clinical diagnosis of ossifying fibroma was a logical inclusion in the differential diagnosis of this lesion, as it can look much like the GCF clinically, ossifying fibromas are typically normal mucosal color like GCFs, but they have islands of osteogenic cells dispersed throughout the lesion.

Unlike GCF, peripheral ossifying fibroma is found only in the gingiva, occurs more in females, and is thought to arise from the periodontal ligament. [8], [9]

Color and vascularity of lesions can also be distinguishing features when diagnosing fibrous hyperplasias. Most irritation fibromas are of normal mucosal color, unless traumatized, in which the lesion could appear reddened, or whitish due to hyperkeratinization, the result of continued irritation after development of the lesion. Pyogenic granuloma, on the other hand, is commonly found on the gingiva (like GCF), but tends to be red and bleeds easily if manipulated. [10]

Savage and Monsour [11] retrospectively reviewed the histologic features of all lesions designated as fibrous or fibroepithelial polyps over a 10-year period. They concluded that the histologic features were not sufficiently unusual or characteristic in normal or pathologic tissues to warrant grouping the lesions as a separate and distinct entity.

This lesion should not be confused with giant cell fibroblastoma, a term often used by general pathologist and dermatologists. This lesion is a true benign neoplasm and has a distinctive subcutaneous/dermal mass of 2-6cm seen mostly in young boys. It is not related to GCF of oral cavity. [12]

The treatment of choice for GCF is



conservative surgical excision GCF seldom recurs, nor does it regress spontaneously because the excess collagen in the lesion is permanent tissue. Periodontal root planing is also suggested during excision to remove possible sources of irritation. There is no risk of transformation to cancer.

Our case is in agreement with the literature on age, pain, location, and presenting signs of the lesion.

### Conclusion

Although most fibrous hyperplasias are relatively innocuous lesions, histologic examination of the tissue is necessary in most cases to rule out the possibility of malignancy. Though they are not considered true tumors, fibrous hyperplasias may continue to increase in size until the stimulus or irritation is removed or the lesion is excised. In our case the patient was a smoker hence early diagnosis was necessary to rule out malignancy.

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## Cemento-Ossifying Fibroma Of The Maxilla : A Case Report

### Abstract

Cemento-ossifying fibroma of the maxilla is an uncommon tumor. It is a benign fibro-osseous lesion that arises from the periodontal membrane. These tumours occur in the third and fourth decades of life, with predilection for women. The mandible is more commonly involved than the maxilla. This article describes a case of cemento-ossifying fibroma of the maxilla in a 40-year-old male patient. The physical examination revealed a maxillary enlargement and an intraoral swelling extending from 11 to 22 obliterating the buccal vestibule. The teeth were agile and displaced. Wide surgical excision of the lesion was subsequently performed and the tissue was sent for histopathological examination. An accurate diagnosis requires careful clinical, radiological and histological correlation in order to make an optimal treatment and an excellent outcome.

### Key Words

Cemento-ossifying fibroma, fibro-osseous lesions, maxilla.

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### Introduction

Cemento-ossifying fibroma (COF) is a fibro-osseous lesion that arises from the periodontal membrane.<sup>1</sup> The periodontal membrane is a layer of fibrous connective tissue surrounding the roots of teeth. It contains multipotential cells that are capable of forming cementum, lamellar bone, and fibrous tissue.<sup>2, 3</sup> Although central COFs of the mandible are common, they are infrequent in the maxilla.<sup>4</sup>

This lesion should be distinguished from fibrous dysplasia of bone and certain other fibro-osseous lesions that do not represent true neoplasia.<sup>5</sup> A close histogenetic relationship exists between the central COF and the central ossifying fibroma. The pathologic differences between central COF and fibrous dysplasia are few and the diagnosis must be made in light of the radiographic findings.<sup>6</sup>

### Case Report

A 40-year-old male patient reported with a chief complaint of a painless swelling in the upper front region for a period of 3 years. Initially, the swelling was small in size and showed a gradual increase to its present dimensions. Extra oral examination showed

a diffuse swelling in the upper front region (Fig 1).



Fig 1: 40-year-old male patient with an enlargement in the maxillary anterior region.

The skin over the swelling was normal, and there was no local rise of temperature. On palpation the swelling had variable consistency. Buccal cortices were expanded. The lesion was smooth, non tender and hard; there was no accompanying cervical lymphadenopathy

The physical examination revealed a maxillary enlargement and an intraoral lesion. The teeth were agile and displaced. The swelling extended from 11 to 22 and it obliterated the buccal vestibule (Fig 2). Oral mucosa was normal. The overlying mucosa

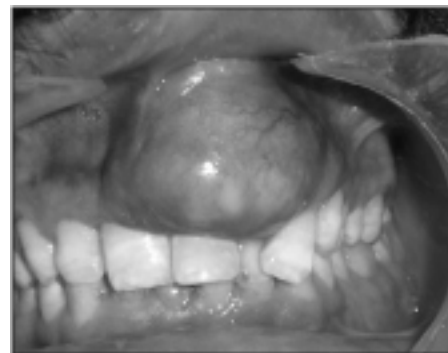


Fig 2: Firm mass of size 4 X 4 cm extending from 11 to 22 which had almost effaced the jugogingival groove. The teeth were agile and displaced.

was reddish pink in color and slightly swollen but there was no ulceration or fistula formation. On palpation, the swelling was bony hard in consistency but no tenderness or paraesthesia. His medical history was not contributory and physical examination disclosed no evidence of any systemic disease. No history of trauma to the maxilla could be elicited.

Radiographically, orthopantomograph, occlusal & intra oral periapical radiograph

(Fig 3, 4, 5) showed a well-defined large multilocular radiolucent lesion (approx 4x4 cm) extending from 11 to 22. The lesion was well demarcated with sclerotic border and heterogeneous in contrast. The mass did not invade the maxillary sinus. No evidence of cortical erosion was noticed. The radiographic differential diagnosis included odontogenic myxoma, COF, fibrous dysplasia (FD), focal cemento-osseous dysplasia (FCOD), desmoplastic ameloblastoma and central giant cell granuloma.

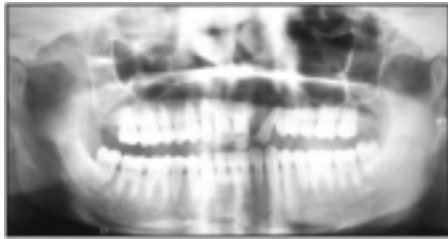


Fig 3: Orthopantomograph showing a well-defined multilocular lesion with radiolucent and radio-opaque foci.

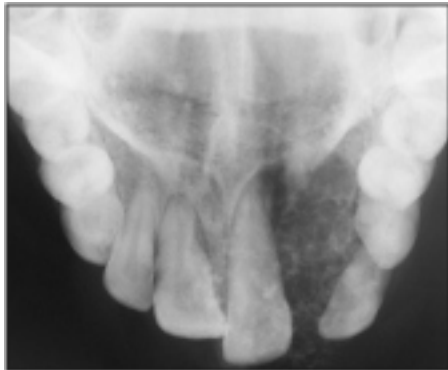


Fig 4: Occlusal radiograph showing the extent of the lesion (approx 4 X 4 cm) that contained small foci of calcification extending from the 11 to 22.



Fig 5: Intraoral periapical radiographs showing the extent of the lesion (approx 4 X 4 cm) that contained small foci of calcification extending from the 11 to 22.

A biopsy was performed under local anaesthesia and the specimen was sent for

histopathology examination. Histopathological examination showed stratified squamous epithelium where deeper areas showed intense fibroblastic proliferation with calcifications of different sizes and shapes. Bony trabeculae rimmed by osteoblasts were seen. The patient's medical history did not reveal any pathological condition. Therefore, surgical excision of the lesion was proposed to the patient.

### Management

The surgical intervention was carried out in the Department of Oral and Maxillofacial Surgery. Wide surgical excision of the lesion was subsequently performed (Fig 6) and the tissue was sent for histopathological examination (Fig 7).

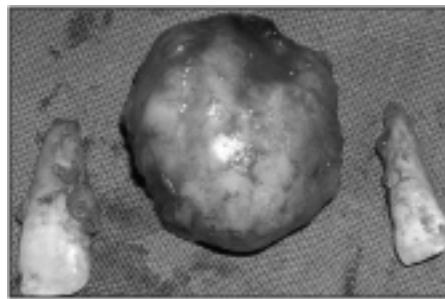


Fig 6: The surgical specimen (gross appearance)

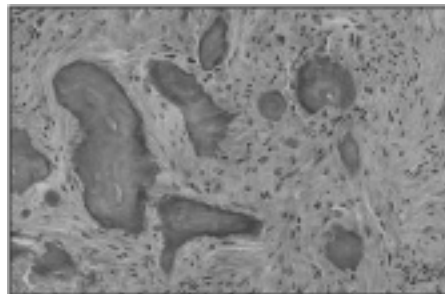


Fig 7: Histopathologically deeper areas showed intense fibroblastic proliferation with calcifications of different sizes and shapes. Bony trabeculae rimmed by osteoblasts were seen.

The clinical, radiographic and histologic findings were consistent with COF. The postoperative course was uncomplicated and there was no lesion recurrence up to one year of follow-up.

### Discussion

COF is generally classified as a type of fibro-osseous lesion of the jaws. The

mandible is more commonly involved than the maxilla, and the premolar-molar region is the most common site. Small lesions are often symptomless. Large lesions result in painless swelling of the involved bone which may cause obvious facial asymmetry.<sup>7</sup> In some cases, initial symptoms are present.<sup>8</sup>

The radiographic appearance depends on the location and the amount of calcified tissue present. Varying degrees of radiopacities and radiolucencies may be present. Central COFs are typically well-defined, solitary radiolucencies with scattered radiopaque foci. They maintain a spherical shape, expand cortical bone without causing perforation, and may cause tooth divergence.<sup>9</sup> The central COF, have a centrifugal growth pattern rather than a linear one. Therefore the lesion grows by expansion equally in all directions and present as round tumor mass.

Generally, COF characterised by a well-defined expansile bony mass and rarely associated with destruction or extraosseous soft tissue components.<sup>10</sup> Unlike the COF, the aggressive cemento-ossifying fibroma (ACOF) grows massively with extensive cortical expansion.<sup>9, 11</sup> There are no histopathologic criteria that are predictive of aggressive behaviour or tendency for recurrence. Nevertheless, Zupi et al. reported two features that may help in distinguishing ACOF from COF. Firstly, clinically, the ACOF occurs at a far lower mean age than the COF. Secondly, the histological pattern of the ACOF seems to be unique in being highly cellular with entrapped osteoblasts. However, considering the age, radiographic appearance and the growth behaviour, our case would clearly fit under the COF category, the non-aggressive type.

COF is a slow-growing lesion composed of cellular fibroblastic tissue containing basophilic masses of cementum-like tissue. In addition, varying amounts of bony trabeculae are interspersed within the lesion, giving it its characteristic features<sup>6, 12</sup> used the presence or absence of woven and lamellar bone in histopathological section to differentiate the COF from the other fibro-osseous lesions. In uncomplicated cases, fibrous dysplasia contains no lamellar bone but, rather, has arrested woven bone. On the other hand COF and ossifying fibroma contain woven bone and are often rimmed by osteoblasts that have laid down layers of lamellar bone. Additionally COF may have

areas of cementum, appearing as psammoma bodies embedded in a benign fibrous stroma.

Large tumors may involve the nasal septum, orbital floor, and infraorbital foramen. The tumor extent guides surgical therapy. Maxillary central COFs are large at the time of presentation, indicating the capacity of the tumor to expand freely within the maxillary sinus. Pathologic examination of the central COF shows a proliferation of irregularly shaped calcifications within a hypercellular fibrous connective tissue stroma. The calcifications are extremely variable in appearance and represent various stages of bone and cementum deposition. The circumscribed nature of the lesion permits complete local enucleation or curettage of small lesions. Large lesions that have destroyed a considerable amount of bone may require segmental resection and reconstruction.

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- Uniformly British English
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## Surgical Derotation - A Case Report

### Abstract

A male child, 7 ½ years old reported to the Dept. of Pedodontics with rotated maxillary left permanent central incisor and an unerupted 'Mesiodens'. The case was treated by surgical removal of the supernumerary tooth along with surgical correction (through intra alveolar traction) of the rotated incisor followed by its immobilization through passive splinting. Post operative clinical and periodic radiographic follow-up reveals favorable prognosis in terms of vitality and stability of the tooth with normal physiological root development.

### Key Words

Derotation , Mesiodens, Acrylic Splint

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### Introduction

Tooth rotation, is defined as observable mesiolingual or distolingual intra-alveolar displacement of the tooth around its longitudinal axis. Rotation of teeth can be caused by number of factors like space availability for tooth alignment, tooth eruption order, and functional influences exerted by the tongue and lips consonant with a multifactorial model in the origin of tooth malpositions.<sup>1,4</sup> Supernumerary tooth can also cause tooth rotation and mesiodens is the commonest among this anomaly. In addition, mesiodens can delay or prevent eruption of central incisors in 26-52% of cases, cause ectopic eruption, displacement or rotation of a central incisor in 28-63% of cases, and labially displace incisors in 82% of cases

Mesiodens frequently causes retention of permanent incisors which erupt spontaneously after the extraction of supernumerary tooth, if it is conserving the eruptive force and there is sufficient space in the dental arch. Other complications involving the permanent incisors include dilacerations of the developing roots, root resorption and loss of tooth vitality<sup>2, 3</sup>. Thus, a significant delay in treatment can create the need for more complex surgical and orthodontic management.

The aim of this case report is to introduce a potentially convenient approach as compared to conventional orthodontic procedure for treatment of rotated maxillary

central incisor.

### Case Report

A 7 ½ -year-old boy was referred to the Department of Pedodontics with rotated left upper permanent central incisor.

The child's dental history was non-contributory for pertinent findings. The clinical examination showed good facial symmetry and competent lips at rest. Intra oral examination revealed Class I malocclusion with severe rotation of left maxillary central incisor. Radiograph revealed the presence of a mesiodens in the premaxillary region and no associated pathology was seen in the root of central incisor. Shift cone technique confirmed its palatal location. (fig 1)

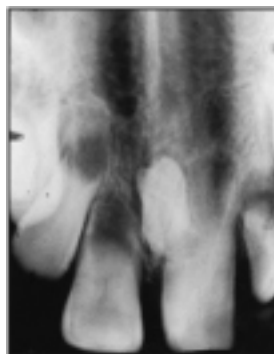


Fig 1 Preoperative Periapical Radiograph



Preoperative Study Model

Decision was taken to remove the mesiodens and correct the rotated tooth by means of surgery. An acrylic splint was fabricated with rotated tooth and that region of 21 was hollowed out so that it can be tried before as well as after surgical derotation procedure. Hence, it confirms the occlusal comfort of the patient with the splint before the intended surgery and can immobilize the derotated tooth in a most passive position.

Before surgery the splint was tried inside the mouth to conform the fit and comfort of the patient (fig 2.3). Then the tooth was extracted by raising a palatal flap and cutting the bone without damaging the roots of adjacent central incisors (fig 2.1). Rotated tooth was held by an ideal extraction forceps along with gauge piece for better grip and to prevent the tooth from coming out of its socket (fig 2.2). The tooth was gently



Fig 2.1 Mesiodens Exposed For Removal



Fig 2.2 Rotating Incisor With Forceps Held With Gauge

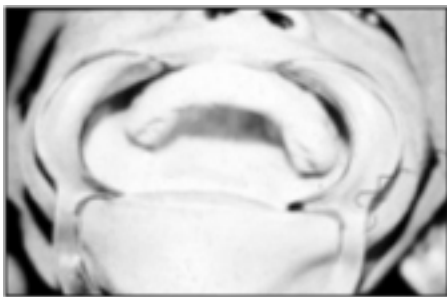


Fig 2.3 Presurgical Trial Of The Splint



Fig 2.4 Postsurgical Placement Of The Splint

luxated within the socket but at the same time, no excess force was given to over rotate. It was turned carefully to the desired position without delivering any pull or push force.

Then splint was cemented and kept for 3 weeks (fig 2.4). Patient was followed for 13



Fig 3.1 Post Operative Radiograph



Fig 3.2 Post Operative Photograph

months. Periapical radiograph showed normal physiological root development with no signs of infection or root resorption and also there was evident reduction in midline diastema. (fig 3.1,3.2).

#### Discussion

Conventional treatment of rotation is generally done by fixed or removable appliance but both these procedures have their inherent disadvantages. If a fixed appliance had to be given in this case, we would have to wait for root completion, and removable appliance may not give the desired result.

#### Disadvantages and potential risks of orthodontic treatment

- 1) Decalcification- The presence of a fixed appliance predisposes to plaque accumulation as tooth cleaning around the components of the appliance is more difficult. Decalcification during treatment with fixed appliances is a real

risk, with a reported prevalence of between 2 and 96 per cent.

- 2) Loss of periodontal support-As a result of reduced access for cleansing, an increase in gingival inflammation is commonly seen following the placement of fixed appliances. Removable appliances may also be associated with gingival inflammation, particularly of the palatal tissues, in the presence of poor oral hygiene.
- 3) Root resorption-It is now accepted that some root resorption is inevitable as a consequence of tooth movement. On an average, during the course of a conventional 2-year fixed-appliance treatment around 1 mm of root length is lost.
- 4) It is usually said, rotations are easy to treat, but very difficult to retain. They have a very high risk of relapse due to stretching of the supra-alveolar and transeptal gingival fibers which readapt very slowly to the new position. Thus long term retention is required to achieve stability of treatment.

#### Advantages of "surgical derotation" are:

- a) Duration of treatment is short
- b) Retention is not required
- c) Patient cooperation is less critical

Reasons for selecting this approach in this case were 1) age of the patient 2) tooth was in erupting stage 3) root was with wide open apex 4) enough space was present for accommodation of derotated tooth and 5) shape of the root of central incisor was round.

Use of the acrylic splint described here offers the following advantages: (1) maximum patient comfort, (2) good occlusion and mastication, (3) ease of insertion, (4) easy readjustment, if needed, and (5) maximum stability<sup>8</sup>.

Even though, during derotation damage to periodontal ligament is inevitable, according to American Academy of Endodontics if tooth is reimplanted within the first 5 min, root surface fibroblasts and precursor cells from the root and alveolar periodontal ligament can live, reproduce, and become functional fibroblasts, capable of producing a united periodontal ligament to protect the root from resorption.<sup>5,6</sup>

A frequent justification for early intervention is that it can reduce the severity and complexity of comprehensive treatment with fixed appliances. The goal of

early treatment is to establish normalcy for further growth and development. This, in turn, allows us to maximize positive growth patterns and to minimize distalization mechanics in treatment.

### Conclusion

Surgical derotation or intentional derotation can be used for treatment of rotated tooth but ideal case selection and judicious surgical approach is mandatory for desired results.

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## Management Of Knife Edge Ridge- A Case Report

### Abstract

Knife edge ridge most commonly occurs in the edentulous mandible. Patient complains of pain while chewing the food because the overlying mucosa is pinched between the denture and the bone. A case with knife edge ridge is managed by using the Differential pressure impression technique is discussed.

### Key Words

knife edge ridge, differential pressure impression technique.

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### Introduction:

A sharp bony ridge is a frequent problem among the edentulous patients and commonly occur in the mandible in the edentulous patient. If present should be identified during the initial assessment by palpation of residual edentulous ridges. When it is conventionally loaded, the overlying mucosa is pinched between the denture base and the bone which leads to pain over the ridge.<sup>1</sup> Effect in the underlying bony structure of the residual ridge may be the cause of chronic pain under dentures especially during mastication.

Knife edge ridge is formed due to rapid resorption of labial and lingual side of the lower anterior ridge. Gingiva overlying it becomes rolled and soft tissue proliferates leaving hypermobile ridge crest tissue.<sup>2</sup>

Acc. to Meyer three types of sharp ridges are:<sup>2</sup>

- 1) Saw tooth ridge
- 2) Razor like ridge and
- 3) Those with discrete spiny projections. However, this classification is academic because all of these type can produce pain under denture

Knife edge ridges are thin, buccolingually sharp but smooth and like a feather edge they are painful under pressure and this type of ridge seen only in mandible<sup>2</sup> X-ray photographs show a thin ridge with a clearly defined outline, the cancellous bone being covered with a cortical layer<sup>3</sup>.

Immediate dentures are often an ultimate cause of sharp ridges. Local destruction of the bone by the periodontal disease before tooth extraction, improper surgical procedures of alveolar bone at the time of extraction of teeth, or lack of follow-up and proper correction of changing tissue conditions may be contributing factors.<sup>4</sup>

A combination of factors contributes to bone resorption, with the amount of resorption and the relative importance of each factors varying with the patients.<sup>4-5</sup>

### The etiologic agents believed to be of significance include,

- 1) nutritional inadequacy of the diet
- 2) endocrine functions
- 3) tissue resistance to stress
- 4) traumatic factors (dentures etc)
- 5) systemic disease and
- 6) disuse.

The influence of genetic factors appears not to have been investigated.

Inadequate dentures do not necessarily cause residual ridge changes in otherwise healthy individuals.<sup>6</sup>

### Alternative treatments for knife edged ridges:

- a) Provision of soft lining-soft lining was not used because of hygiene and maintenance problems associated with these materials.
- b) A controlled pressure impression

technique would decrease occlusal loading over the affected area and distribute forces more to the primary support areas like buccal self<sup>2</sup>

- c) Preprosthetic surgery has been widely advocated for dealing with sharp bony ridges. It was not chosen here for the twin disadvantage of surgical trauma to the patient and destruction of potentially stabilizing bone.
- d) Differential pressure impression technique. Differential pressure technique was chosen as it enables a conservative preservation of ridge height for stability without overloading the crest of the ridge.

### Method

Technique which will distribute loading onto alternative areas over the ridge and relieve the mucosa over the sharp bony ridge producing differential pressure, secondary impression of the mandibular arch with a sharp bony ridge

The aim of this technique is to produce loading onto alternative areas (buccal shelf area) and relieve the mucosa over the sharp bony ridge from the load.

The areas that are capable of bearing the load should be preferentially loaded. Those areas that are incapable of load bearing should have their loads reduced<sup>1</sup>.

### Case Report-1

A 60 yr old female patient reported to the



Department of Prosthodontics with complains of replacement of her missing teeth. On examination it has been found that patient has very thin (knife edge) ridge present in relation to mandibular arch (**fig: 1**) thus complete denture has been advised with differential pressure impression technique.



Fig : 1

Primary impression was made for both upper and lower arch using impression compound and special tray fabricated on the primary cast. A medium bodied silicone impression was used to make a fully muscle trimmed secondary impression. (**fig:2**).



Fig : 2

The impression produced displacement of the mucosa over the sharp bony ridge. If it is used to construct the final denture prosthesis, there is a potential for the denture to cause traumatic pain in this region. The area of the impression over the sharp ridge is cut away using a scalpel blade. The tray is perforated over the sharp ridge. (**fig:3**)



Fig : 3



Fig : 4

It is important to place numerous large perforations in order to ensure low pressure for the next stage of the impression. Complete impression was made using light bodied impression material (**fig: 4**). Jaw relation recorded and trying was done.

#### Case No -2

A 56-year old male complained of soreness under his denture. His denture had been made 5 year back. The tissue on the mandibular ridge were hyperplastic, mobile and tender to palpation. Radiograph revealed multiple bony spines protruding from the mandibular ridge crest. The hyperplastic soft tissue and sharp bone were removed surgically. During healing period the lower denture was worn with a soft relined material . new denture were made. The patient reported comfort, retention, and renewed pleasure in eating.

#### Case No- 3

A 54 year old female patient reported with complained of pain while chewing food. On examination it was found that she had sharp edge ridge in the mandibular arch. She was denture wearer. It was decided that fabricate a new denture for this patient with Differential pressure impression technique. After giving the denture to the patient, she reported one week after and now she don't have any pain on the ridge while chewing the food.

#### Discussion

The complete denture fabricated by this technique has proved successful for this patient. The successful treatment depended on the accurate diagnosis of the cause of the patient's symptoms.

Bolender and Swenson have reported a successful vestibular extension procedures. This surgical technique might be used for patients who lack adequate ridges after removal of sharp projections to recreate ridge conditions favorable to denture stability and retention.<sup>7</sup>

The use of the pressure relief areas is a successful form of treatment. However redistribution of the load by the impression technique, as presented here, is likely to create a more controlled loading of the mucosa. Preprosthetic surgery can also be advocated to dealing with the sharp bony ridge. But it is not chosen here because it may lead to trauma to the patient and destruction of the potentially stabilizing bone. Sharp bony ridge cannot bear load but the height of the ridge does provide resistance to horizontal force (stability). Differential pressure impression technique is a conservative preservation of the ridge height for stability without overloading the underling mucosa. Thus selection of the appropriate impression technique is essential for the success of our prosthesis.

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## Mandibular 2nd Pre Molar With Two Roots And Three Root Canals - A Case Report

### Abstract

Anomalies are commonly occurring phenomenon. For successful completion of the non-surgical root canal treatment, a thorough knowledge of root canal anatomy and its variations is necessary. Normal root and root canal anatomy of mand. 2nd pre-molar is well documented in various text books but there is a great deal of variation in the reporting of the incidence of anomaly. Incidence of two separate roots in this tooth is rare. This paper attempts at explaining the successful management of rare case of mand 2nd pre-molar with three root canals with an overview of type and number of common anatomic forms.

### Key Words

knife edge ridge, differential pressure impression technique.

### Introduction

Knowledge of root canal morphology and possible variations in the anatomy of root canal system is important in the successful management of non-surgical root canal treatment followed by negotiation, cleaning and shaping (Ingle J, 2ND Ed 1976)<sup>1</sup>

Incomplete instrumentation followed by incorrect obturation is most common cause of failure of as reported by Ingle. Mandibular 2nd pre-molar is typically described as a single rooted tooth with root canal system in text books. There are also numerous case reports and anatomic studies that have reported variations.

Incidence of number of roots and number of root canals reported in anatomic studies varies greatly in literature.<sup>2,3</sup>

Vertucci in his series of studies conducted on extracted teeth reported 25% incidence of 2<sup>nd</sup> canal<sup>4</sup>.

Zilich and Dawson reported 11.7% occurrence of two canals and 0.4% of three canals<sup>5,6</sup>.

Case of mand. 2<sup>nd</sup> pre-molar with three canals have been reported by Kaffe I, Kaufmann AY et al 1985, Singh RP, Stamps HF et al 1987, Chan K et al 1992, Fisher 1992, De Moor RJ 2005, and Nallapati 2005. Atypical occurrence of three canals in 2<sup>nd</sup> pre-molars with two orifices distal half of furcation area and one orifice on mesial wall

of pulp chamber has been reported by De Moor et al<sup>7</sup>. Various factors like ethnicity, age and gender that can contribute to the differences observed in various anatomic studies have been reported by Troop M, Tronstad I in 1986<sup>5</sup> and Sert S et al 2004<sup>8</sup>. Apart from morphological studies, frequent case reports have shown unusual root canal variation many of which have been attributed to fusion, germination or concrescence. Present case report is of mandibular 2<sup>nd</sup> pre-molar with three root canals. The discussion has been based on the significance of such a finding.

### Case Report

45 years old male patient reported for the treatment of pain in mandibular right side for last three days. Clinical examination revealed deep disto-occlusal caries with definite pulp involvement. The tooth was tender to percussion. Endodontic treatment was planned for this tooth. Pre-operative radiograph were taken. Careful examination of radiograph showed the presence of two roots and two root canals. Third root canal was not visible because of superimposition. Treatment was started by giving anesthesia using 2% lidocaine with 1:1,00,000 adrenaline. Endodontic access cavity was prepared through occlusal surface and roof of pulp chamber was removed.

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Examination showed pulp chamber wide mesio-distally showing two root canals, one mesial and one distal. Continued careful examination to rule out any possibility of additional canal revealed the presence of third root canal in distal root. All three canals were thoroughly instrumented and shaped and obturated with laterally condensed gutta percha using AH plus root canal sealer. Temporary restoration was placed and radiograph was taken. Patient was called after one week for permanent restoration.

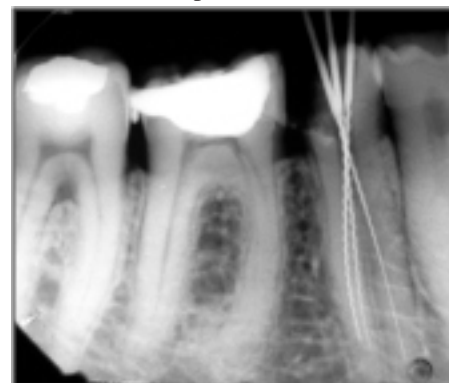


Fig : 1

### Discussion

Thorough mechanical cleaning of entire pulp cavity and complete obturation with inert material is main objective of the successful root canal treatment. This objective can not be achieved without



Fig : 2

thorough knowledge of root canal anatomy , careful interpretation of radiograph and proper modification of access cavity essential for recognition and management of anatomical variations<sup>9</sup>.

Mandibular 2<sup>nd</sup> pre-molar is described as a single rooted tooth with single root canal system. The ovoid shaped root in cross section has developmental grooves or depressions on mesial and distal surfaces. The incidence of two separate roots in this tooth is very rare. Often considered an enigma to endodontist, mand. 2<sup>nd</sup> pre-molar with more than one root and root canals dividing at various levels of the root can generate complex problems.

In the case presented here, two roots with three root canals were identified. Failure to identify 2<sup>nd</sup> and 3<sup>rd</sup> root canal might have resulted in incomplete treatment and failure. Morphological structure in this case is similar to morphological structure studied by Moayedi S , Lata DA and Sanjeev Tyagi et al<sup>10</sup>.

All these cases involved mand. 2<sup>nd</sup> pre-molar with two root canals and identical numbers of distribution of root canals. Such similarity should warrant that internal morphology must be identified precisely to identify supplementary root canals or root canal aberrations to achieve successful treatment.

Pulpal floor anatomy and good quality radiograph at different angles is necessary to accurately diagnose the no. of roots and root canals in 2<sup>nd</sup> pre-molars.

Martinez -Lozano et al<sup>11</sup> have suggested 40<sup>o</sup> mesial angulation of x-ray beam to identify additional canals. Buhrlay L J et al<sup>12</sup> and Sempira et al<sup>13</sup> have demonstrated the use of magnification to improve clinical ability to visualize and access canals.

Pulp chamber that appears to be deviated from normal configuration , either triangular or too large in mesio distal plane should be suspected of having three canals (Bellizi and Hartwell- 1981).

In spite of being difficult to negotiate due to narrowing and curvature , most of the canals can be negotiated and instrumented using current endodontic technique. Failure to recognize the presence of extra root or canals can often lead to acute flare-ups during treatments and subsequent failure.

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## Use Of Biomaterials In Restoring Large Peri-radicular Bone Defects: A Case Report

### Abstract

This case report presents a rare treatment modality employed for treating a large peri-radicular bone defect which had led to Grade-III mobility in relation to mandibular anterior teeth. The treatment involved the use of Mineral Trioxide Aggregate (MTA) biomaterial for a retrograde filling and as well as filling up the peri-radicular bone defects.

A 15-year-old female patient was referred to the endodontic clinic as a result of large periapical swelling in relation to the mandibular central incisors prevailing for over a period of two months. Radiographic examination revealed complete destruction of buccal bone plate. Conventional root canal therapy along with apicoectomy was performed, and a root-end cavity was prepared and restored with MTA as a retro-filling material. Simultaneously the MTA was filled up in the bony defect and the teeth were splinted with a composite splint. Periodic radiographic and clinical examination was carried out which demonstrated considerable healing and the splint was removed after five weeks. Nine months after the periradicular surgery, there were no clinical or radiographic signs suggestive of treatment failure, instead the patient's follow-up has demonstrated that the case management has been successful as indicated by lesion regression and periodontal repair accompanied with no mobility what so ever. MTA was chosen as a result of its ability to provide an excellent marginal seal and due to its capacity to induce cell response which leads to the adherence of osteoblasts to MTA. Literature has reported that MTA facilitates the regeneration of periodontal ligament and formation of bone. On the basis of the review of literature and the clinical-radiographic outcomes of the case presented, it can be concluded that, large bone defects caused by peri-radicular lesions could be filled with a recognizably effective osteo-inductive and osteo-conductive biomaterials such as MTA.

### Key Words

Biomaterials, Mineral trioxide aggregate, peri-radicular surgery

### Introduction:

Periradicular surgery is often indicated as a complementary procedure in cases where the conventional endodontic treatment fails. In addition to elimination of pathologic tissues, peri-radicular surgery usually involves apicoectomy, preparation of root end cavity and its filling with a retrograde filling material. During the past decade, newer technologies and materials have been developed for retrograde restorations.. Historically gold foil and amalgam have been used. Subsequently the usage of zinc oxide eugenol, Glass ionomer cement, EBA and Super EBA have been reported in literature.<sup>1</sup> Though none of these materials have been proved to provide any osteoinductive and osteoconductive properties.

**Mineral trioxide aggregate (MTA)** is a powder aggregate containing mineral oxides with a good biological action. MTA when used is able to induce bone regeneration and may facilitate in the

regeneration of the periodontal ligament and formation of bone. In addition to these characteristics, MTA presents good physical properties and excellent biocompatibility. As published in literature, it has been hypothesized that MTA may exhibit anti-recurrence properties against the pathological lesions. For a clinical point of view, it has been suggested that MTA can be applied to induce bone formation and inhibit recurrence of the pathology.<sup>2</sup>

This article reports of a case in which biomaterial such as MTA have been used as a root-end filling material and also to pack the bony defect to induce bone formation.

### Case Report:

A 15-year-old female patient was referred to the *Department of Conservative Dentistry and Endodontics at Maharishi Markandeshwar College of Dental Sciences and Research, Mullana (Ambala)* with the complaint of large swelling in relation to the mandibular central incisors prevailing for over a period of two months. Clinically both

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the central incisors were tender on percussion and demonstrated Grade-III mobility. In the review of medical history, the patient did not mention any kind of health problems and denied a history of allergies to any pharmaceutical compounds. In dental history review, she stated that she had not suffered any kind of dental trauma or underwent any orthodontic treatment. The patient stated that initially the swelling was small but increased considerably within a span of two months. The radiographic picture presented complete destruction of buccal bone plate and it appeared as if the teeth were "floating" with-in the bone defect. The treatment approach started with the improvement of the periodontal conditions in the surroundings by means of plaque removal, scaling and root planing.

In the next stage, conventional root canal treatment was carried out. Care was taken while performing biomechanical preparation by grasping and supporting the affected teeth between the index finger and

the thumb. The root canal was instrumented by hand instruments and obturated according to the technique as explained by Schilder.<sup>3</sup> The periradicular surgery was performed immediately after the completion of the endodontic therapy.

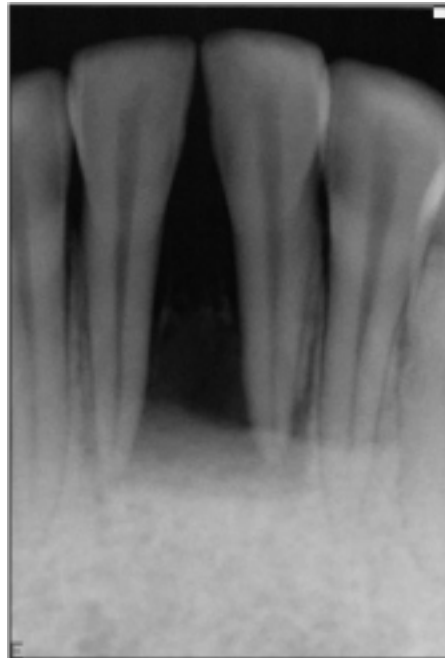
The peri-radicular surgery was performed in two phases. The first phase consisted of an apicoectomy with the removal of apical 3mm of root end and preparation of root end cavity by using a bur. Curettage of the lesion was done and haemostasis in the bony cavity was achieved prior to the placement of **Mineral Trioxide Aggregate/ MTA (ProRoot MTA, Denstply, Tulsa)**. Following all of the aforementioned procedures, MTA was placed in the root end cavity and compacted. Subsequently the entire bony defect was filled up with MTA and the mucoperiosteal flap was repositioned and sutures were placed. To impart immobility and stability to the affected teeth, a composite splint on the facial surface of teeth was placed by achieving support from adjacent teeth. The patient was prescribed appropriate medication including an anti-inflammatory drug and antibiotics. The sutures were removed 7 days post-operatively. Periodic radiographic and clinical examination was carried out which demonstrated considerable healing and the splint was removed after five weeks. Nine months after the peri-radicular surgery, there were no clinical or radiographic signs suggestive of treatment failure, instead the patient's follow-up has demonstrated that the case management has been successful as demonstrated by lesion regression and periodontal repair accompanied with no mobility what so ever.



Pre-operative Clinical:



Large Peri-radicular bone defect



Pre-operative Radiographic  
(Teeth appear to be "floating"  
with-in the bone defect)



Post-operative Clinical  
(After complete healing)



Postoperative Radiographic  
(MTA has been filled up in the bone defect)

#### Discussion:

This case report suggests the successful outcome of periradicular surgery after use of MTA as an effective bone replacing material during regenerative tissue procedures. In the case reported in this article MTA was considered as a material of choice because of its characteristics of promoting excellent marginal sealing and stimulating osteoblastic adherence to the retrofilling material surface.<sup>4</sup>

There were no clinical and radiographical signs suggestive of failure but instead the patients follow up has demonstrated that the case management has been successful as indicated by lesion regression and periodontal repair.

The MTA patent stated that MTA consists of 50-75% (wt) calcium oxide and 15-25% silicon dioxide. These two components together comprise 70-95% of the cement.<sup>5</sup> MTA is a powder aggregate containing mineral oxides with a good biological action and may potentiate the regeneration of periodontal ligament and formation of bone.<sup>6</sup> Studies have demonstrated that in the presence of MTA, cells grow faster and produce more mineralized gene expression in osteoblasts. Qin H et al have hypothesized that MTA has anti-recurrence properties and inhibit recurrence of such large periradicular defects.<sup>2</sup> The most characteristic tissue reaction that MTA exhibits is the presence of

connective tissue after the first post operative week.<sup>7</sup>

The use of biomaterials in this case was necessary because of large destruction of buccal bone plate circum-adjacent to apex of mandibular incisors as chronic lesion associated with affected teeth. It has been reported that MTA promotes the growth of cementum on its surface and reattachment of periodontal ligament so that the contact of extruded MTA with the periapical tissue is not an obstacle to healing.<sup>8</sup>

#### **Conclusion:**

On the basis of the findings of studies addressed in literature review and the clinical and radiographic outcome in this case MTA can be used to induce bone formation and inhibit recurrence of such cases with large periradicular defects.

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## Diode laser Applications in Periodontics

### Abstract

Periodontics extensively deals with soft tissue surgeries. However, pain, trauma, bleeding, post-operative edema and scarring are often associated with conventional methods of surgery which are problematic for both the patient and the clinician. Hence, to overcome these drawbacks, 940nm Diode laser was used to perform various surgical procedures including frenectomy, gingivectomy, vestibuloplasty, depigmentation and second stage implant surgery. The intra-operative and post-operative advantages i.e. lack of swelling, bleeding, pain or scar tissue formation, and good wound healing were observed in all the cases, verifying diode laser as an appropriate and beneficial device for soft tissue surgeries.

### Key Words

Depigmentation, Diode Laser 940nm, Frenectomy, Gingivectomy, Implant Recovery, Vestibular Deepening

### Introduction:

A laser is a device that emits light (electromagnetic radiation) through a process of optical amplification based on the stimulated emission of photons. The term "laser" was first introduced to the public in Gould's 1959 conference paper "The LASER, Light Amplification by Stimulated Emission of Radiation".<sup>1</sup>

Lasers have been classified traditionally based on the active medium e.g., gas, liquid, solid state, or semiconductor diode. Whereas, clinically lasers can be classified into two types: soft and hard lasers. The soft tissue lasers available are carbon dioxide lasers, Nd:YAG lasers, argon lasers, Er:YAG lasers, Er,Cr:YSGG lasers and diode lasers. The first laser diode was demonstrated by Robert N. Hall in 1962.<sup>2</sup>

The diode basically does not interact with dental hard tissues, this makes it an excellent soft tissue surgical laser, indicated for cutting and coagulating gingiva and oral mucosa, and for soft tissue curettage or sulcular debridement.<sup>3</sup> A diode laser is a solid-state semiconductor laser that typically uses a combination of Gallium (Ga), Arsenide (Ar), and other elements, such as Aluminium (Al) and Indium (In), to change electrical energy into light energy.<sup>4</sup> It is usually operated in contact mode using a flexible fiber optic delivery system, and emits laser in continuous- wave or gated-pulsed modes.<sup>3</sup> The power output for dental

use is generally around 2 to 10 watts.<sup>4</sup> Tissues can respond to laser light in four different ways: scatter, transmit, reflect, and absorb. Absorption is the most desired laser/tissue interaction in dental use which in turn depends on three factors i.e. wavelength, tissue composition and tissue's water content. Laser-tissue interaction is the use of light energy that is absorbed by the tissue to produce a photobiological effect which can be manifested as photodisruption, plasma induced-ablation, photoablation, thermal, and photochemical.<sup>5</sup> The mechanisms of diode laser that lead to ablation or decomposition of biological materials are photochemical, thermal or plasma mediated.<sup>3</sup>

The diode laser exhibits thermal effects using the "hot-tip" effect caused by heat accumulation at the end of the fiber, and produces a relatively thick coagulation layer on the treated surface. Tissue penetration of a diode laser is less while the rate of heat generation is higher than that of the Nd:YAG laser. Since, the diode laser causes minimal damage to the periosteum and bone under the gingiva being treated as well as exhibits the unique property of being able to remove a thin layer of epithelium cleanly,<sup>4</sup> it can be used for a variety of soft tissue procedures without impacting the neighboring tissues. Diode lasers can be used for a multitude of dental procedures which are predominantly soft tissue procedures and include soft tissue surgery, periodontal pocket therapy, peri-

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implantitis, but can also be used for certain applications involving hard tissue (teeth), i.e. endodontics - root canal disinfection and laser-assisted tooth whitening. The advantages of diode lasers over the other lasers are the smaller size of the units as well as the lower financial costs.<sup>4</sup>

Regarding advantages of lasers over surgical procedures these include- dry and bloodless surgery, instant sterilization of the surgical site, reduced bacteremia, reduced mechanical trauma, minimal postoperative swelling and scarring and minimal postoperative pain.

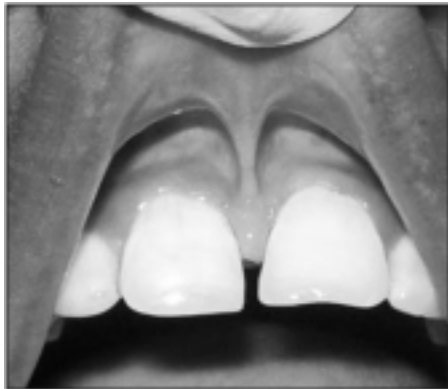
These case reports describe few of the various soft tissue procedures that were performed with ezlase™ 940 nm Diode laser.

### Case Reports:

#### Case 1

A 21 year old female patient reported to the Department of Periodontics, Babu Banarasi Das College Of Dental Sciences, Lucknow, with the chief complaint of spacing in the upper front tooth region. The patient reported no significant medical history. Presence of a high maxillary frenal attachment was identified as the cause of midline diastema (**Fig 1**). Therefore the patient had to be treated orthodontically and a frenectomy procedure with diode laser to excise the aberrant frenum was planned. The problem was explained to the patient and a written consent was signed. The frenum was excised with a diode laser in a pulsed mode

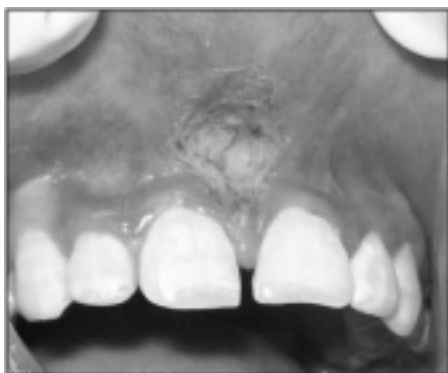
at a setting of 5 watt, 1 ms pulse interval (**Fig 2**). The procedure was completed within 10 minutes and caused no discomfort to the patient. The surgical field was clear and dry without bleeding and caused no pain to the patient. No local anaesthesia or suturing was required for the patient. The postoperative area was left to heal by secondary intention (**Fig 3**). Healing was uneventful and no scarring was seen at 2 weeks (**Fig 4**).



(fig.1) High Maxillary Labial Frenal Attachment



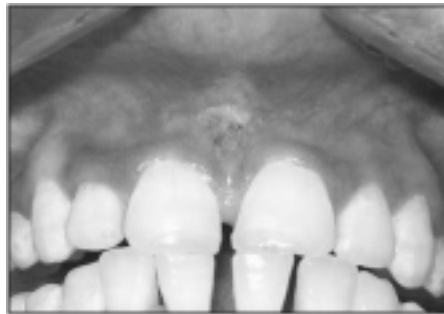
(fig 2) Frenectomy With Diode Laser



(fig 3) Postoperative Area

**Case 2:**

A 35 year old male patient reported to the Department of Periodontics, Babu Banarasi Das College Of Dental Sciences, Lucknow,



(fig 4) Healing After One Week

3 months after the placement of 2 two- stage implants, for the second stage surgery. The implants were placed to replace missing mandibular left second premolar and first molar. Radiograph was taken to ensure complete osseointegration.



(fig 5) Preoperative Record (first Stage Implant Surgery- Implant Insertion)



(fig 6) Preoperative Record (two Weeks After First Stage Implant Surgery)

Based on the first stage implant placement surgery records of the patient (**Fig 5, 6**), position of implants were determined and located with the help of trans-gingival probing under topical anesthesia. A written consent was taken from the patient. Diode laser was used at a setting of 2 watt,



(fig 7) Second Stage Implant Surgery With Laser



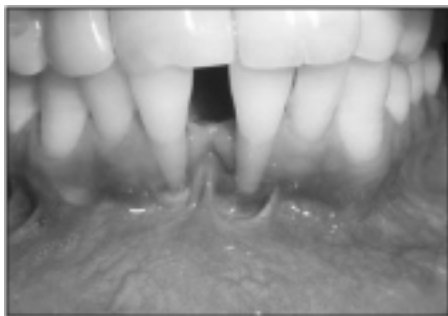
(fig 8) Healing Abutment Placed



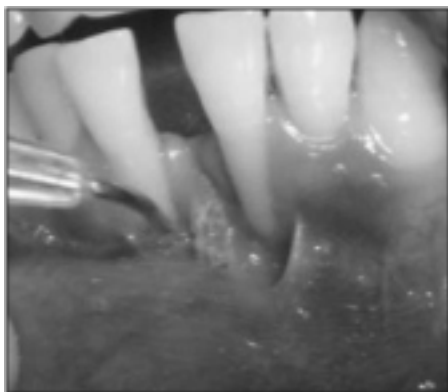
pulsed mode with 0.2 ms pulse interval to excise a circular piece of tissue covering each implant (Fig 7). No anesthesia was required. Cover screws were removed and replaced with healing abutments (Fig 8). Patient reported no discomfort. Gingival margins adapted well and formed a collar around the healing abutments with no shrinkage seen at 1 week.

**Case 3:**

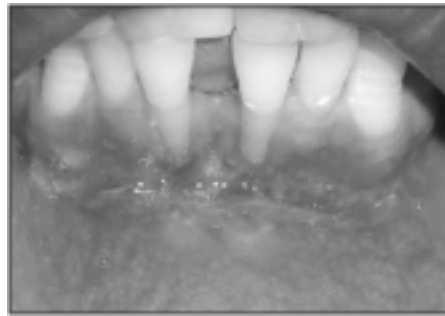
A 20 year old female patient reported to the Department of Periodontics, Babu Banarasi Das College Of Dental Sciences, Lucknow, with the chief complaint of unaesthetic exposure of roots of the lower front teeth, which started 2 years back (Fig 9). A staged approach was planned to treat gingival recession. In the first stage vestibular deepening was done along with frenotomy to increase the width of attached gingiva apical to the recession and to eliminate tension due to mandibular labial frenum on the gingival margins. Recession coverage was planned to be done in the second stage. A written informed consent was taken from the patient. Diode laser at a pulsed mode, 2 watt & 1.0 ms pulse interval was used (Fig 10). The procedure was performed with no patient discomfort or pain. Anesthesia was not required. The healing was uneventful and a gain in the width of attached gingiva could be appreciated after vestibular deepening (Fig 11).



(fig 9) Recession In 31, 41 With Shallow Vestibule



(fig 10) Vestibular Deepening With Laser



(fig 11) One Week Postoperative

**Case 4:**

A 19 year old female patient reported to the Department of Periodontics, Babu Banarasi Das College Of Dental Sciences, Lucknow with a chief complaint of gum enlargement in the lower front lower region since 1 month (Fig 12). The patient was undergoing orthodontic treatment since 6 months. The patient reported no medical history and was not under any medication. On intra oral examination gingival enlargement covering half of the crown of the mandibular anterior teeth was observed. Oral prophylaxis was performed, but the enlargement failed to resolve. Therefore a gingivectomy with laser was planned. An informed consent in written was taken from the patient. Diode laser in a pulsed mode at 5 watt and 0.20 ms pulse interval was used (Fig 13). The surgical field was with minimal bleeding. Minimal local anesthesia was injected, and the patient complained of no discomfort or postoperative pain. Healing was uneventful and the gingival contour and size achieved was remarkable (Fig 14).



(fig 12) Gingival Enlargement In Mandibular Anterior Region



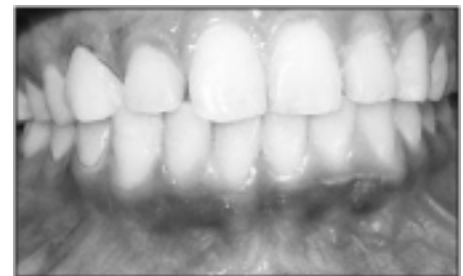
(fig 14) One Week Postoperative



(fig 13) Gingivectomy With Laser

**Case 5:**

A 20 year old male patient reported to the Department of Periodontics, Babu Banarasi Das College Of Dental Sciences, Lucknow with a chief complaint of unaesthetic brownish color of gums (Fig 15). On intra oral examination score-4 gingival pigmentation (Dummett-Gupta Oral Pigmentation Index scoring criteria given by Dummett C.O. in 1964) of the maxillary and mandibular gingiva was observed. The patient was provided with various gingival depigmentation treatment options including conventional scalpel blade, electrocautery and laser. The patient gave consent in written for laser depigmentation. Diode laser in a pulsed mode at 2 watt and 1.00 ms pulse interval was used to treat maxillary gingival hyperpigmentation and 2 weeks later mandibular gingival hyperpigmentation (Fig 16). There was no bleeding, discomfort and the patient was fully satisfied with the results (Fig 17). Even after 3 years of follow-up there were no signs of repigmentation (Fig 18).



(fig 15) Gingival Hyperpigmentation



(fig 18) After 3 Years



(fig 16) Laser Depigmentation



(fig 17) Post Operative Region

#### Discussion:

For many intraoral soft tissue surgical procedures, the laser is a viable alternative to the conventional techniques. The commercially available dental instruments have emission wavelengths ranging from 488 nm to 10,600 nm and are all nonionizing radiation. This is to avoid any mutations in the cellular DNA components which ionizing radiations are known to cause.

Different wavelengths have different absorption coefficients based on the varied composition of human tissue. In order to maximize the thermal reaction, there should be a close match between the laser wavelength and the chromophore(s) present in the target tissue. During the thermal ablation as the temperature increases at the surgical site, the soft tissues are subjected to warming (37 to 60°C), protein denaturation, coagulation (> 60°C), welding (70 to 90°C), vaporization (100 to 150°C), and carbonization (> 200°C). The primary chromophores for intraoral soft tissue ablation are hemoglobin, water, and melanin.<sup>5, 6</sup> Diode lasers (810-980 nm range) emit laser light in the near infra-red spectrum of the electromagnetic radiation which are highly absorbed in hemoglobin and other pigments. One of the main benefits of using diode lasers is the ability to selectively and precisely interact with diseased tissues. Lasers also allow the

clinician to reduce the amount of bacteria and other pathogens in the surgical field, and, in the case of soft-tissue procedures, achieve good hemostasis with the reduced need for sutures. The purported advantages of lasers versus conventional surgery include increased coagulation that yields a dry surgical field and better visualization; the ability to negotiate curvatures and folds within tissue contours; tissue surface sterilization and, therefore, reduction in bacteremia; decreased swelling, edema, and scarring; decreased pain; faster healing response; and increased patient acceptance. When laser cutting is in progress, small blood and lymphatic vessels are sealed due to the generated heat, thereby reducing or eliminating bleeding and edema. Denatured proteins within tissue and plasma are the source of the layer termed "coagulum", which is formed because of laser action and serves to protect the wound from bacterial or frictional action.<sup>7</sup> Also the diode laser did not produce any deleterious effect on the root surface. Therefore, diode laser surgery can be performed safely in close proximity to dental hard tissue. All these above mentioned advantages were evidently experienced in the above cases. During procedure, there was no bleeding. Also, postoperatively, no pain was experienced by the patient and no swelling or any other signs of infection were noticed, whereas other alternative procedures have to be accompanied by administration of antibiotics and analgesics to minimize postoperative infection and pain.

In the gingival enlargement case (case 4) reported above, as the patient was wearing fixed orthodontic braces and wires, electro cautery was avoided and surgery with scalpel would have been cumbersome, however treatment with 3mm laser tip provided an indispensable benefit of accessibility and precision.

Using soft tissue lasers is not only beneficial for the patient but for the clinician as well, as in the case of second stage implant surgery with laser, the impression could be taken immediately after implant exposure with little blood contamination in the field due to hemostatic effect of the laser. Also, there is minimal tissue shrinkage after laser surgery, therefore tissue margins remain at the same level after healing as they are immediately

after surgery. Different types of dental lasers including diode laser have been used for second stage implant surgery and have demonstrated safety, ease of use, faster recovery and accelerated start of the restorative phase.<sup>8</sup>

The soft tissue procedures described in the current article validate the advantages associated with diode laser. The risk of eye injury is minimal but must be considered, especially for high-output lasers in the invisible range. Protective goggles, specific for the wavelength, must be used for the patient and the therapist. The future of diode lasers as soft tissue lasers is promising and can be successfully integrated into the everyday dental practice.

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## A Rare Case Of Recurrent Fibrous Dysplasia In An Elderly Patient, With A Brief Review Of Literature Of Monostotic Fibrous Dysplasia Of Maxilla

### Abstract

**Aim :** The aim of this case report is to discuss this rare case of Monostotic fibrous dysplasia of maxilla in an elderly patient and its management.

**Summary :** Fibrous dysplasia accounts to around 2% of all bone tumours. This disease is characterized by replacement of healthy bone by fibrous tissue with different grades of metaplasia. Maxillary monostotic fibrous dysplasia is more common in comparison to polyostotic fibrous dysplasia in maxillofacial skeleton. It accounts to 80 to 85% of all fibrous dysplasias. Jaws are commonly affected site. The treatment of monostotic fibrous dysplasia ranges from conservative recontouring of the lesions to radical excision, followed by autogenous bone grafting. Monostotic fibrous dysplasia is a disease which most commonly occurs in children and young adults. Here, we present a rare case of recurrent fibrous dysplasia of maxilla in a 63 year old patient, its diagnosis and management with a brief review of literature.

### Key Words

Depigmentation, Diode Laser 940nm, Frenectomy, Gingivectomy, Implant Recovery, Vestibular Deepening

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### Introduction.

Fibrous dysplasia is a rare bone condition characterized by the replacement of healthy bone by fibrous tissue and different grades of bone metaplasia.<sup>1</sup> It accounts for approximately 2% of bone tumours.<sup>2</sup> If only one bony is involved, it is termed monostotic fibrous dysplasia. If more than one bone is involved, it is termed polyostotic fibrous dysplasia. Monostotic fibrous dysplasia is less serious than polyostotic form.<sup>3</sup>

### Clinical presentation.

A 63 year old male patient reported to department of oral and maxillofacial surgery with complaint of swelling in left cheek region. The swelling had attained the current size after a gradual and slow growth since past 15 years. Patient had undergone the surgery for the same, 15 years back, but soon the lesion recurred. Patient also complained of an opening on the face with pus discharge in the region of the swelling. The swelling was painful but the severity of the pain increased 2 months before he reported to us. On examination, a 3.5 inch by 2.5 inch large swelling was seen on left cheek region. The swelling was hard, non tender and well demarcated from surrounding bone (**Figure 1**).

On intra oral examination, the swelling was seen involving left maxillary alveolar ridge and hard palate with a dimension of 2 inch by 2 inch. (**Figure 2**)

The intraoral swelling was in continuation with extraoral swelling. There was a sinus opening in the left cheek region with pus discharge.



Figure 1: Pre Operative Frontal Photograph.

On attempted aspiration with an 18 gauge needle, the needle failed to penetrate the



Figure 2: Pre Operative Intra Oral Photograph

lesion. The clinical findings were suggestive of a benign tumour of the left maxilla. Infection control and pain control was achieved with antibiotics and analgesic therapy. Further radiological investigations were undertaken to establish the diagnosis. Orthopantomograph and Paranasal sinus view radiographs revealed a mixed radiopacity and radiolucency, giving a ground glass appearance involving whole of left maxillary sinus till the orbital floor.

Computed tomography scan of the lesion revealed increased density with enlarged maxillary alveolus, marked deformity with bony expansion and mixed pattern ranging from cystic through ground glass to heavily mineralized tissue. The central area predominantly along the inferior aspect was showing typical "cotton wool appearance".(Figure 3)

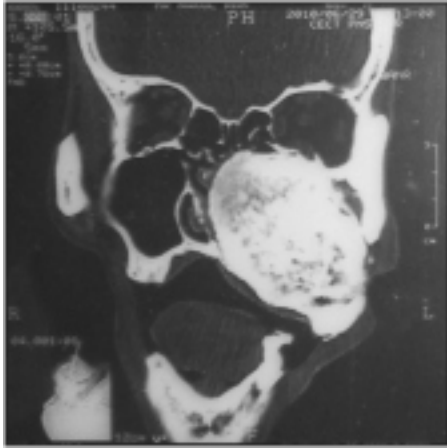


Figure 3: C.T. Showing Space Occupying Lesion In Left Maxillary Region.

The extent of the lesion was as follows:

**Superior:**

The lesion had caused deformity of orbital floor, which was pushed up with no evidence of infiltration of extraconal space.

**Inferior:**

Convex bulge at roof of oral cavity with erosion and expansion of hard palate.

**Medial:**

The lesion was encroaching ipsilateral nasal cavity. The nasal turbinates were eroded with bowing of nasal septum towards right.

**Posterior:**

The lesion was obviating pterygomaxillary fissure. The pterygoid plates were preserved.

**Anterior:**

There was contour bulge with thickening of the overlying soft tissue.

This large expansile bony lesion arising from alveolar process of left maxilla was having clinical and radiological presentation of fibrous lesion and Paget's disease.

**Differential diagnosis**

The clinical and radiological appearance of this maxillary swelling mimics a number of clinical entities. Metabolic bone diseases such as hyperparathyroidism produces similar pattern, but bone lesions in hyperparathyroidism are most likely to be polyostotic, bilateral and does not cause bone expansion. In our case, biochemical values, suggestive of hyperparathyroidism, such as serum calcium level, parathormone level were within normal limits, so, hyperparathyroidism was ruled out. Paget's disease was other consideration for this clinical and radiological presentation. Paget's disease is most commonly seen in elderly patients and maxilla is most common site of occurrence, as in seen in our case. Ground glass appearance or frosted glass appearance was seen in radiographs, which gives the radiological picture of fibrous dysplasia. Serum alkaline phosphatase was within normal limits, which is usually raised in Paget's disease.

**Diagnosis.**

Incisional biopsy was planned and performed under local anaesthesia. Haematoxylin and eosin section revealed bony trabeculae evenly placed in fibrillar connective tissue. Chinese letter pattern was seen in the bony trabeculae. Collagen fibres of trabeculae were seen extending into the fibrous tissue. (Figure 4) A Correlating clinical, radiological and histopathological finding, diagnosis of recurrent monostotic fibrous dysplasia of maxilla was established.

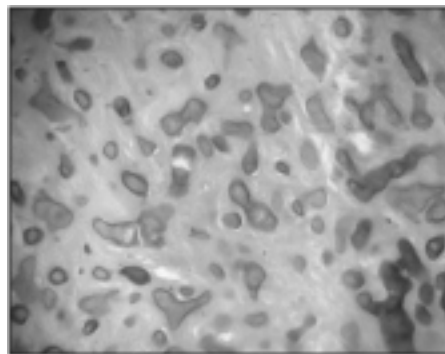


Figure 4: High Power Magnification Showing Chinese Letter Pattern.

**Management.**

Hemimaxillectomy of left maxilla was planned under general anaesthesia. Weber fergusson incision was placed and flap was raised. The lesion was exposed and it was

seen to be well demarcated from surrounding normal bone, which was an unlikely finding of fibrous dysplasia. The osteotomy cuts were placed to separate the maxilla from the surrounding maxillofacial skeleton. The maxilla was separated by deepening the cut with chisel. The defect was lined with collagen sheets (biological dressing) and sutured. Surgical stent was placed. An intermediate obturator was fabricated after 14 days. Further prosthodontic rehabilitation was done with permanent obturator after 2 months of surgery. (Figure 5)



Figure 5: Post Operative Photograph

**Discussion.**

Monostotic fibrous dysplasia accounts to 80-85% of all fibrous dysplasias and jaws are most commonly affected sites.<sup>4</sup> Monostotic fibrous dysplasia may occur at any age, but are most common in children and young adults.<sup>5</sup>

Surgery is the main stay of treatment for fibrous dysplasia, but the technique of surgery is controversial. The different modalities of treatment could be conservative recontouring of the lesion or radical excision of the lesion followed by autogenous grafting. In a review of treatment for fibrous dysplasia, success rate of conservative surgery was 74% initially and up to 86% after successive surgery.<sup>2</sup> In another retrospective study of 12 cases of fibrous dysplasia of the maxillofacial bones, no relapse was found in any cases treated with radical excision, whereas three of the seven cases treated with conservative excision relapsed after few years.<sup>6</sup>

A clinicoradiological analysis of symptomatic craniofacial fibro-osseous lesions was done. The objective was to

outline the clinical and radiological aspects of symptomatic craniofacial fibro-osseous lesions and to study the appropriate surgical management. It was concluded that treatment of craniofacial fibro-osseous lesion is highly individualized. A conservative approach may not be able to treat all cases of craniofacial fibro-osseous lesions. A more radical approach that includes a craniofacial resection or a total maxillectomy may be warranted in few cases.<sup>7</sup>, especially tumours invading the vital structures as in our case; it was invading the orbital rim and orbital floor.

In another retrospective study on 68 patients of craniomaxillary fibrous dysplasia, no disease recurrence was observed in cases treated with complete excision. Recurrence was seen in cases treated with conservative remodelling. In another case of remodelling, infection was seen, which resolved on antibiotic therapy. Palatal fistula was seen in two cases. This author prefers conservative approach only in polyostotic cases and McCune Albright syndrome and in most cases of monostotic or monofocal fibrous dysplasia, aggressive but definitive treatment was recommended.<sup>8</sup>

In another review regarding the management of aggressive midface and orbital fibrous dysplasia, aggressive resection and various degrees of reconstruction to optimize function was recommended. While fibrous dysplasia is classified as a benign process, local expansion can cause significant functional and aesthetic deformities. Each lesion should be thoroughly evaluated and, vital structures are involved or threatened, total of subtotal resection should be considered.<sup>9</sup>

In another description of 28 craniomaxillofacial fibrous dysplasia, patients were treated as early as the symptoms occurred. The principles of surgical treatment were based on zones of involvement.

**Zone 1 :**

Fronto-orbital, zygoma and upper maxillary region

**Zone 2 :**

Hair bearing skull

**Zone 3 :**

Central cranial base

**Zone 4 :**

Tooth bearing zone.

Radical surgeries were performed in

**Zone 1**

and conservative reshaping in

**Zone 2,**

**Zone 3 and Zone 4.**<sup>10</sup>

**Conclusion and summary.**

In a debate between, radical and conservative approach for the treatment of fibrous dysplasia of maxilla, a new dimension emerges, which can be termed curative. Curing the lesion is the prime concern for the surgeon, for which any customized approach tailored to the individual patient is adopted.

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## Intraoral Technique For The Extension Of Posterior Palatal Seal - A Review And Case Report

### Abstract

Seldom, complete dentures are deficient in postpalatal seal. The deficiency may be in length, depth or in both. Present article deals a review and an intraoral technique for the extension of posterior palatal seal (PPS). Case report outlines the associated problems of stability and retention that is faced in Class III soft palate. Reported patient was referred by a private practitioner. The article enumerates the chair side registration and transferring of additional postpalatal seal area in trial maxillary denture, keeping in mind for gagging reflex. The recommended posterior palatal seal area laid a little beyond from the fovea palatini and centrally around the mid line. The steps are performed with auto polymerizing resin. Integration of the used an additional area for the PPS increases the significant retention and stability in aforesaid patient. Suggested PPS is replaced with light polymerized dual cure denture relines resin material in final prosthesis by the intraoral method.

### Key Words

Additional posterior palatal seal, Gentian violet, light- polymerized dual cure relines resin

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## INTRODUCTION

Postpalatal seal (PPS), also known as the the posterior palatal seal area or the post dam area, is a valve seal area present at the posterior border of the maxillary removable dental prosthesis. The PPS area is defined as the soft tissue area at or beyond the junction of the hard and soft palates on which pressure, within physiologic limits, can be applied by a complete denture to aid in its retention [1].

The first Anatomical land mark of the PPS [2] extends medially from one tuberosity to another. This landmark travels laterally across the hamular notch and anteriolaterally up to a distance of 3.0 to 4.0 mm, to end in the muco-gingival junction of the posterior part of maxillary ridge known as the Pterygo-maxillary seal. At the bony level, the PPS area encompasses horizontal plate of the palatine bone, the maxillary tuberosity and the hamular process of the medial pterygoid plate. The Second land mark contains the two types of imaginary "vibrating lines" across the posterior part of the palate that divide the immovable and the

movable tissue of the hard and soft palate. The Anterior vibrating line lay between immovable hard palate tissue and movable the soft palate tissue. It is generally cupid bow-shaped. Posterior vibrating line is located at the junction of the aponeurotic part of the soft palate that shows limited and marked movement. It is usually straight, with a slight curvature anteriorly [2, 3]. The third land mark is fovea palatini. They are two indentations, oval to round in shape, being unique to human race and in 50% cases are located anterior to the anterior vibrating line [4] at a distance of about 1.3 mm. In rest 50% cases, fovea palatini are located either on or behind the anterior vibrating line [5]. Fovea palatine can be used only as a guide for the placement of posterior border of maxillary denture. The PPS lies between anterior and posterior vibrating line. The preferred Choice of PPS [2, 6, 7, 8, 9] can be a butterfly shaped and continued upto 3.0 to 4.0 mm anteriolareral to the tuberosity, approximating mucogingival junction. The depth of PPS ranges from 1.0 to 1.5 mm. but it should be 0.5 to 1.0 mm at median raphe. Silverman

[10] advocated that complete denture could be extended up to an average of 8.2 mm dorsally over to the vibrating flexion line. The relationship between soft palate and hard palate is called palatal throat form [8]. Terrel (**Figure 1**), [11] advocated a peculiar form of PPS which extends on either side from the posterior palatine area in those soft tissues between the hard palate and base of the alveolar ridge. Terrel referred it, as additional seal palatal seal. Present article highlights a literature of review and case report onto the posterior palatal seal. This article is linked to the retention and the stability of the maxillary denture which deals with an additional seal.

## CASE REPORT

About a few months back, a fifty-year-old female patient was referred to the deptt. of Prosthodontics, by a private practitioner. Patient had a complaint of retention and stability with maxillary complete denture. The Patient suffered edentulism from the last six months. On intraoral examination, she had a U-shaped, medium vaulted and

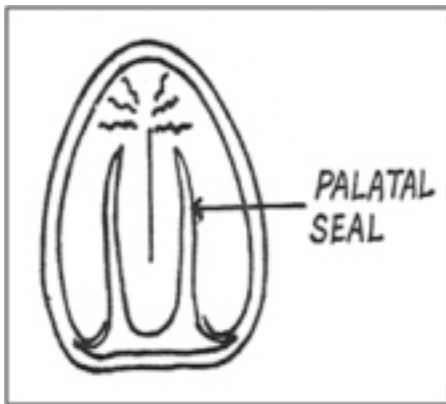


Figure 1: Additional PPS As Palatal Seal Suggested By Terrel

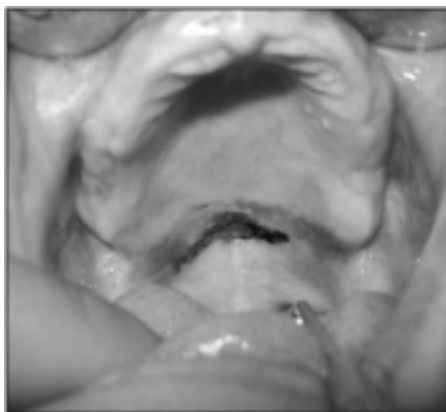


Figure 2: Primary PPS And Additional Reverse Cupid Bow-shaped PPS As A Pink And Violet Band, Respectively

long enough antero-posterior hard palate and a Class III soft palate with a 70° angle to the hard palate (**Figure 2**). A Class II palatal throat form was also reported [8]. Authors suggested a short clinical trial as a chair side procedure to enhance the seal area. This was accomplished by an additional reverse palatal seal in the mid line of posterior denture border region.

#### INTRAORAL TECHNIQUE

1. The initial steps for registering the reverse PPS was done through the marking of a band of Gention violet 1% w/v [12] (**Figure 2**) over the soft palate beyond the fovea palatini, after drying the mucosa. This area of advocated PPS was performed by asking "ah" in a vigorous manner unless patient felt

and initiated gagging reflex. This gave an extended area of PPS. Again, a primary butterfly-shaped PPS was marked by indelible pencil as a pink band.

2. The posterior border of the denture was roughened and prepares a 45-degree bevel joint [13] along with retentive keys. The sticky staged auto polymerizing resin was applied on the bevel joint. Auto polymerizing resin of the dough stage was added centrally and posteriorly to the bevel joint on the posterior border near about a width of a 5.0 to 6.0 mm. The prosthesis was inserted in the patient mouth and the patient asked to perform normal respiratory movements to inhale and to exhale until the material was cured. A light messaging pressure from the first finger was also applied.
3. Polished trial maxillary denture prosthesis had a width up to 2.0 to 5.0 mm which was suggested PPS. It is replica of the Gention violet band (**Figure 3**). The patient was examined and reviewed. The result was much satisfactory (**Figure 4**). Authors gave the prosthesis to the patient and advised for revisit the department after one week for the final replacement of material in the prosthesis. Extended PPS was replaced with light polymerized dual cure denture reline material, intra orally [14].

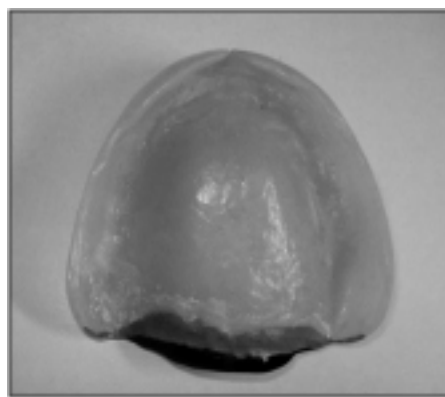


Figure 3: Reverse PPS Over To Complete Denture



Figure 4: Upper Maxillary Denture Insertion With Reverse PPS.

#### DISCUSSION

Trial prosthesis was advised whether the extended PPS would be tolerated or not. The causes of disappointing retention in PPS region can be depend on the two factors. First factor was the involuntarily movements between the sot tissue of the hard and soft palate, at the time of primary PPS recording [3]. That recorded PPS gave unacceptable result in processed denture. That is not in clinician hand but the physiological reflexes of patient decide. Second factor was the polymerization shrinkage of the polymers [15]. The displacement of the soft tissue in the glandular area is a critical factor in the effectiveness of PPS [2, 5]. The clinically suggested compressible area was present to some extent beyond the fovea palatini and centrally around the mid line of Class III soft palate near posterior border of the maxillary denture. This area could not be registered, at the time of initial stages of a PPS registration because of the unwillingly movements between the hard and soft palate. The area exists just away from the primary palatal seal. This glandular area provides an additional reverse cupid bow- shape PPS to a trial maxillary denture. The marking of advocated PPS band was done by the Gention violet (crystal violet, Methyl Violet 10B, hexamethyl pararosaniline chloride) is a bactericide and an agent. The Gention violet was used by surgeons for the skin marking before suegery. The use of dough staged auto polymerizing resin in comparison of light cure denture resin is more economical for the trial prosthesis.

## CONCLUSION

Precision is achieved, not when there is nothing more to add but when there is nothing left to take away. Extension of PPS in complete denture had been made with both intra and extra oral methods. In this case report, incorporation of the additional PPS has been done intra orally in trial maxillary denture with the auto polymerizing resin. It has increased the retention in the current, different configured palate. Extended PPS does not initiate the gagging reflex. Used area for the addition is delineated with Gentian violet dye. Authors replace additional seal with the light polymerized relined resin in final prosthesis. Recommended area is significant to the aforesaid palatal classification. It offers a high quality of maxillary denture. Authors validate their finding and recommend further studies involving significant number of the patients.

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## An Overview Of Maxillary Canine Impaction

### Abstract

Disturbances in the eruption of canine is a frequently encountered clinical problem in orthodontics. Early detection and timely interception results in successful management of the malocclusion. Although the overall prevalence of impacted maxillary canine is low, it is second only to the impacted mandibular third molar in its frequency of occurrence. In selected cases, extraction of impacted canine is indicated to minimize the risk and facilitate treatment. Since canine is a key tooth for the integrity of the arch and to maintain stability of the treatment, canine extraction can compromise esthetics, function and occlusion of the finished case. The most common treatment procedure for the impacted canine is surgical exposure of the canine followed by treatment with orthodontic mechanotherapy. This article presents an overview of the incidence, etiology, unfavourable sequelae, diagnosis and management of impacted maxillary canine.

### Key Words

Impaction, Maxillary Canine, Etiology, Diagnosis & Management.

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### Introduction:

In most individuals, permanent teeth will erupt uneventfully and replace their primary successors. However, in some these unerupted teeth are diverted or angulated aberrantly and lose their potential to erupt. According to Shafer, Hine and Levy, impacted teeth are those which are prevented from erupting by some physical barrier in the eruption path. The permanent maxillary canine is second only to the mandibular third molar in its frequency of impaction. The ectopic eruption and impaction of maxillary permanent canine is a frequently encountered problem in orthodontics. An overview of the incidence, etiology and sequelae as well as the surgical and orthodontic considerations in the management of impacted canines is presented here.

### Incidence:

Incidence of maxillary canine impactions vary from 0.92% - 1.7%.<sup>1,2</sup> Impactions are twice as common in females(1.17%) than males(0.51%). Impacted canines are found palatally in 85% of the cases, with labial position in 15% of cases.<sup>3,4</sup>

### Developmental Considerations:

Moss states that canine remains in maxilla just above the root of lateral incisors until the crown is calcified. It then erupts along the distal aspect of lateral incisors resulting in closure of the physiological diastema if present and the correction of the so called "ugly duckling stage".<sup>5</sup>

Movements of maxillary canine in three dimensions using lateral and postero-anterior cephalometric radiographs from the Belfast growth study taken annually between 5 and 15 years of age was studied. It was shown that the canine travels almost 22 mm during that time.<sup>6</sup> Also according to Dewel, maxillary canines have the longest period of development, as well as longest and most tortuous course to travel from point of formation lateral to piriform fossa, until it reaches the final destination in full occlusion.<sup>7</sup>

### Etiology:

Etiology of impacted maxillary canine is obscure and most likely it is multifactorial. In general, the causes for impacted canine may be generalized or localized.<sup>8, 9, 10</sup>

The most common causes for canine

impactions are usually localized and might be the result of any of the combinations. (a) Tooth size-arch length discrepancies (b) Prolonged retention or early loss of deciduous canine (c) Abnormal position of the tooth bud (d) The presence of an alveolar cleft (e) Ankylosis (f) Cystic or neoplastic formation (h) idiopathic condition with no apparent cause.

Other suggested cause of palatal impaction is trauma to the maxillary anterior region at an early stage of development.<sup>11</sup> Also studies have shown that the presence of lateral incisor root with the right length, formed at the right time is an important variable to guide the mesially erupting canine in a more favourable distal and incisal direction. An increase of 2.4 times in the incidence of palatally impacted canines adjacent to missing lateral incisors as compared with the general population was noted.<sup>12</sup>

A genetic predisposition was shown in some studies; the relatives of patients with palatal canines are likely to exhibit palatally displaced canines and anomalous lateral incisors.<sup>13</sup> Peck et al concluded that palatally displaced canines appear to be a product of polygenic multifactorial inheritance.<sup>14</sup> Also

Prinin et al found that palatally impacted canines are genetic and related to incisor premolar hypodontia and peg shaped lateral incisors.<sup>15</sup>

### **Sequelae Of Canine Impaction:**

Internal or external root resorption of teeth adjacent to canine is the most common sequelae. It is estimated that 0.7% of the children in the 10 to 13 year old age group have permanent incisors resorbed, as a result of canine ectopia. Resorption of lateral incisor root is more common than the central incisor. Lateral incisors are more commonly resorbed palatally and at the midroot level than at the cervical or apical regions.<sup>16</sup> Late resorption of the unerupted canine itself can occur. Loss of vitality and cystic degeneration is an uncommon sequelae and the prevalence is not known. Orthodontic treatment is not without risks which include root resorption, decalcification, periodontal damage and failure to complete treatment. Surgical risks include damage to adjacent teeth and need for re-exposure sometimes.

### **Treatment Planning Considerations:**

The ectopic or impacted canine often requires a multidisciplinary treatment involving oral surgeons and orthodontists. Localization of the impacted canine and prognosis for alignment is important when deciding the management options for patients.

### **Localization of maxillary canine:**

Localization of the unerupted canine involves inspection, palpation and radiographic evaluation. The position of the crown of the lateral incisor can give a clue as to the position of the unerupted canine; that is the crown of the lateral incisor may be proclined if the canine is lying on the labial aspect of the lateral incisor root.<sup>17</sup>

Often the crown of the unerupted canine can be palpated either in buccal position or in palatal position. There is a possibility of ectopic or impacted canine, if the canine is not palpable in the buccal sulcus by the age of 10- 11 years or if the palpation indicates an asymmetrical eruption pattern. Ericson and Kuroi recommend inspection and palpation in canine region annually from 8 years for early identification of impacted canine.<sup>3</sup>

In selected cases, computerized tomograms are helpful in accurately assessing the location and identifying root resorption of adjacent teeth however this method is rarely used because of the high cost of the equipment.

### **Radiographic Evaluation:**

Although various radiographic exposures, including occlusal films, panoramic views and lateral cephalograms, can help in evaluating the position of the canines, in most cases periapical films are uniquely reliable for that purpose. Periapical films evaluate the position of canines with sufficient accuracy in 92% of cases.<sup>16</sup> A single periapical film provides two dimensional representation of the dentition. To evaluate the position of the canine buccolingually a second periapical film should be obtained by using tube-shift technique or Clarke's rule. Occlusal film also helps in evaluating the buccolingual position of impacted canine in conjunction with periapical films.

Panoramic films are also used to localize impacted teeth in all planes of space. Buccolingual position of impacted tooth is determined based on the impacted tooth size relative to contralateral side. If the tooth is farther from the film, it will appear larger e.g. Palatally impacted tooth appears larger than the contralateral normal tooth.

Proper localization of the impacted tooth plays a crucial role in determining proper access for the surgical approach and proper direction for the application of orthodontic forces.

### **Management Options:**

After the comprehensive assessment of malocclusion to localize the canine, decision on its prognosis for alignment should be made. Factors affecting prognosis include patient co-operation, age, general oral health, position of the canine in three planes of space, angulation of the canine to midline, distance from midline and relation of canine to adjacent lateral incisors.

The treatment alternatives include:

1. No treatment except monitoring.
2. Interceptive removal of primary canine.

3. Surgical removal of impacted canine.
4. Surgical exposure with orthodontic alignment.
5. Autotransplantation of the canine.

### **No treatment with periodic radiographic evaluation:**

No treatment is recommended if the canine is in good position and without contact with the lateral incisor and first premolar. But the patient has to be monitored periodically with respect to cystic degeneration, root resorption and other possible complications.

### **Interceptive treatment by extraction of deciduous canine:**

Extraction of primary canine is recommended in uncrowded arches if the patient is between 10-13 years, the maxillary canine is not palpable, and localization confirms a palatal position. In 78% of cases, palatally erupting canine's eruption path normalize within 12 months after extraction of deciduous canine.<sup>18</sup> However, extraction of the primary canine does not guarantee correction in all cases. If there is no radiographic evidence of improvement within one year after interceptive treatment, more aggressive method such as surgical exposure and orthodontic eruption is indicated.

The success of early interceptive treatment for impacted maxillary canine is influenced by the degree of impaction and age at diagnosis. If the maxillary canine crown is distal to the midline of the lateral incisor root, the success rate is proposed to be 91%. Whereas the success rate decreases to 64% if the crown is mesial to the midline of the lateral -incisor root.<sup>18</sup> Other factors which influence the prognosis include canine angulation and crowding. If the vertical angulation exceeds 31%, the chance of normal eruption after extraction significantly decreases.<sup>19</sup>

### **Surgical removal and prosthetic replacement:**

Surgical removal of impacted canines is indicated when there is poor patient co-operation or poor position for orthodontic alignment.

The following are the conditions in which

removal of ectopic canines is recommended.<sup>8</sup>

1. The degree of malposition is too great (canine is oblique or horizontal).
2. Evidence of early resorption of adjacent teeth.
3. Patient is too old for interception.
4. Good contact between lateral incisor and first premolar.
5. If it is ankylosed and cannot be transplanted.

Later the canine can be replaced by a prosthodontic restoration. Also it is possible to use the first premolar as an adequate replacement for the canine by mesiopalatal rotation and introduction of buccal root torque along with grinding of the first premolar palatal cusp.

#### **Surgical exposure:**

There are three basic methods for the surgical exposure and alignment of the impacted canine.<sup>20</sup>

1. Open surgical exposure and spontaneous eruption.
2. Open surgical exposure and packing with subsequent bonding of an auxiliary.
3. Closed surgical exposure and bonding of attachment intra-operatively.

If the canine has correct axial inclination, then open surgical exposure to allow spontaneous eruption is the treatment of choice. Excision of the gingiva over the canine with bone removal is sufficient to allow eruption of canine.<sup>21</sup>

If the canine is impacted labially or in the middle of the alveolus, three techniques can be employed to uncover the tooth. The vertical location of the tooth and the amount of the gingiva will determine the appropriate technique.<sup>22</sup> The three techniques employed are (a)Gingivectomy (b)Apically positioned flap (c)Flap or closed eruption technique.

If the tip of the labially impacted canine is coronal to the CEJ of adjacent lateral incisor and has a wide zone of gingiva, then

gingivectomy is the treatment of choice.

If the tip of the canine is apical to CEJ of adjacent lateral incisor and there is lack of adequate amount of attached gingival around the canine, then apically positioned flap should be performed. If the canine is impacted in the middle of the alveolus or high in the vestibule near the nasal spine, the closed eruption technique may be the treatment of choice.

Appropriate surgical technique should be chosen so that it exposes the canine within a zone of keratinized mucosa and without the exposure of CEJ.<sup>8</sup>

#### **Application of orthodontic traction:**

Different devices can be applied to the crown of an impacted canine, including a wire, pins, crown formers and orthodontic brackets. For many years, cervical neck wires (lasso) were a popular technique to secure a tooth, but such wires injured the root of the tooth. Securing pins into the tip of the canine damaged the crown of impacted tooth. Crown forms snapped or cemented over the crown of an impacted tooth was also popular for many years. The crown forms act as a foreign body, causing erosion of overlying tissue with ultimate exposure of the impacted tooth.

The device of choice is an orthodontic bracket. Once the orthodontic attachment has been placed on impacted canine, orthodontic traction is applied to move the canine into proper alignment. Various methods have been described for applying traction, these usually include the use of fixed appliances with a transpalatal bar and or headgear to control vertical anchorage. The maintenance of adequate space in the canine area is essential prior to application of traction.

Application of force can be in the form of elastic or wire traction. "The ballista spring" system for impacted teeth has been described by Harry Jacoby. It employs a wire loop constructed using a 0.014", 0.016" or 0.018" round wire.<sup>23</sup>

Robert Harry and Harridane described a sectional approach to maxillary canine using transpalatal arch for anchorage. They

used a 0.017" x 0.025" TMA sectional archwire from first molar to canine providing low force over a long range.<sup>24</sup>

Cantilever mechanics for treatment of impacted canines has been described by Fischer et al.<sup>25</sup> Australian helical archwire for assisting eruption of impacted canine was described by Hauser et al.<sup>26</sup> It comprises of three helices bent in 0.016" special plus Australian wire. The Australian wire is bent with helices that serve as stops against the brackets of adjacent teeth to maintain space for erupting canine. An additional incisal helix increases the resilience of the system and anchors the stainless steel ligature running to the canine attachment. K-9 spring for alignment of impacted canines was described by Varun Kalra, it comprises of a spring made of 0.017 x 0.025 inch TMA wire.<sup>27</sup>

Bowman and Carano designed monkey hook as well as kilroy spring for guiding the eruption of impacted tooth.<sup>28, 29</sup> They described two types of kilroy springs. Kilroy I applies lateral and vertically directed forces to direct the impacted tooth. Kilroy II spring was designed to produce more vertical eruptive forces for eruption of buccally impacted tooth. Magnetic forces have also been advocated by some authors to align impacted tooth. Regardless of the method of traction used, the direction of applied force should initially move the impacted tooth away from roots of the neighbouring teeth. In addition, Bishara recommends - a) use of light force (< 60gms) to move the impacted tooth b) creation and maintenance of sufficient space within the arch c) the use of base archwire of sufficient stiffness (0.018"x0.022") to resist deformation by the tractional forces applied.<sup>8</sup>

#### **Conclusion:**

A disturbance in the eruption of permanent maxillary canine is a commonly encountered clinical problem. Canines play a vital role in facial appearance, dental aesthetics, arch development and functional occlusion. Therefore orthodontists have proposed various techniques to guide the eruption of impacted teeth into proper position within the arch. Successful completion of the procedures depends on the expertise of the orthodontist as well as oral surgeon. If signs of ectopic eruption are detected early, every effort should be made

to prevent impaction and its consequences. Early intervention eliminates the need for surgical intervention and complex orthodontic treatment.

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## Orthodontic Management Of The Maxillary Impacted Canines- A Review

### Abstract

The aims of the present review study was to see the contribution of the maxillary permanent canine to the upper face and sense it's importance. Study the etiology behind its impaction, incidence, functional importance of canine, problems encountered during orthodontic tooth movements, risks of impacted tooth movement, and various traction techniques employed. The study also included, how to radiographically evaluate the impacted teeth and classify the impaction, and hence forth formulate a proper treatment plan for it's dis-impaction.

### Key Words

Impaction, Disarticulation, Lateral excursion, Panoramic radiograph, Lateral oblique radiograph, Ankylosis, Soft tissue dehiscence, Attached gingival, Trajectory, Maxillary hypoplasia, Facial stenosis, Pseudopognathism, Ectopic follicle, Root resorption, Cysts and tumors, Periodontal membrane's integrity, Cementoenamel junction.

### Introduction:

One must look at the contribution of the maxillary permanent canine to the upper face to sense its importance. It stands at the corner of the dental arch, forming the canine eminence for support of the alar base and upper lip. Functionally, It supports the dentition, contributing to it's disarticulation in lateral excursion.

Its root length, and particularly its volume, makes it one of the most outstanding abutments for prosthetic replacement of other maxillary teeth.

The impaction of teeth can be any tooth in the oral cavity with the possible exception of the mandibular incisors and the first molars. Third molars 98%, Maxillary cuspids 1.3%, Mandibular first premolars 0.22%, Mandibular second premolars 0.11%.

### Risks Of Impacted Tooth Movement

1. Infection
2. Ankylosis
3. Soft tissue dehiscence
4. Lack of attached gingiva
5. Possibility of extrusion of impacted tooth due to high force application.

### Aetiology

**A) Path of eruption :** The length of travel of the canine from its developmental bed to its eruption is the longest. If on its course, subtle skeletal, dental or functional influences affect its trajectory, impaction is likely to occur.

**B) Diminished skeletal growth of the**

**maxilla :** Extreme maxillary hypoplasia, such as facial stenosis or any of the facial clefts, obviously affects skeletal size of the maxilla. In these cases pseudopognathism of the mandible results as well as impaction of the maxillary canine.

**C) Ectopic follicle :** The ectopic follicle is affected by many other factors as well as strong hereditary predisposition.

**D) Arch length shortage :** The maxillary arch size-tooth mass discrepancy is most likely to affect the maxillary canine, because the canine erupts as the final tooth with in the arch.

**E) Faulty root resorption :** There is tremendous variability of the angle of incidence b/w permanent canine cusp tip and the root end of the primary canine. If the primary-permanent rendezvous is not proper, faulty root resorption and deflection of permanent canine can occur.

**F) Decrease in the length of the dental arch by attrition as the patient matures.**

**G) Low correlation between maxillofacial skeletal growth and impacted tooth maturation.**

**H) Large tooth size.**

**I) Cysts and tumors.**

**J) Persistent deciduous teeth.**

**K) Supernumerary tooth.**

**L) Bone diseases.**

**M) Crowding.**

**Various Classifications Of Canine Impaction**

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### 1.The canine angulation to the mid line.

- The mid line is located and second line made through the canine root apex tip. The angle b/w the two lines is graded:
- Grade 1: 0-15 degree.
- Grade 2: 16-30 degree.
- Grade 3: greater than 31 degree

### 2.Vertical height of canine crown

- Grade 1: Below the level of the CEJ
- Grade 2: Above the CEJ
- Grade 3: More than half way up the root, but less than the full root length.
- Grade 4: Above the full length of the root.

### 3.Canine overlap the adjacent incisor root.

- Regarding the adjacent incisor root.
- Grade 1: No horizontal overlap.
- Grade 2: Less than half the root width.
- Grade 3: More than half, but less than the entire root width.
- Grade 4: Complete overlap of the root width or more.

### Radiographic Evaluation Of Impacted Teeth.

- The radiograph must have the following to be a diagnostic radiograph:
- 1) The entire outline of impacted tooth or teeth.
- 2) Must show the vital structures that are in close proximity to the impacted tooth.
- 3) At least 2mm should show around the impacted tooth.

**The type of radiographs that can be used to identify impaction**

1. Periapical radiograph.
2. Occlusal radiograph.
3. Panoramic radiograph.
4. Lateral oblique radiograph.
5. Lateral cephalometric radiograph.
6. CT scan

### Types Of Traction Techniques

**1. Cementation of a metal or plastic crown. :** Crown cementation on the exposed tooth requires removal of considerable amounts of bone and soft tissue, and its placement may be difficult due to the position of the tooth.

**2. Eyelets in amalgam. :** Early forms of traction included eyelets inserted into amalgam fillings of the impacted tooth, or pins were embedded in the tooth. Threaded pins required drilling through the enamel and an ultimate restoration. This is deemed to be an unacceptable procedure in most of the cases.

**3. Lasso technique. :** In this technique ligation of a wire around the cervical region of the tooth is done at the time of surgery. This approach requires channeling and removal of a large amount of bone, and may be damaging to adjacent tooth and tissues. Moreover this can result in severe resorption at the cemento-enamel junction.

**4. Magnetic traction. :** Here the magnetized canine is erupted after surgery, without patient discomfort and with satisfactory healing of the surrounding tissues.

The attached magnets are then removed, a button or bracket is bonded to the buccal surface of the canine, and the tooth is moved into the arch using a conventional preadjusted edgewise appliance

**5. Bonding. :** Currently the most common procedure is bonding of an attachment directly to the enamel surface of the impacted tooth at the time of surgery.

A curved base bracket is used, with a soft wire ligated to the attachment before bonding. The wire protrudes through the palatal tissue with a pig tail hook for attachment of the elastic.

The oral surgeon should expose enough of the canine to prevent the infiltration of the granulation tissue, but the position of the canine will determine whether the orthodontist can isolate, etch, and bond with a conventional composite resin. Most of the tough impactions are up far enough, that bonding is rendered rather difficult by the proximity of the adjacent tissues and the lack of really good moisture control.

There are a number of things to cope up with this problem e.g. bone wax, local hemostats

and short term hot air application to the area.

### The Treatment Plan Should Be As Follows:

1. Extract the upper central incisor.
2. Start forced eruption of the canine into this extraction space.
3. Level both the arches.
4. Build up the ectopic canine to resemble central incisor.
5. Retention with Hawleys plate.

When considering canines as replacements for upper central incisor the following criteria should be evaluated:

- 1) Angulation and torque of this canine.
- 2) Gingival contour, color, and morphology of the canine.
- 3) Possibility of acceptable recontouring of the canine to avoid premature contact with the opposing teeth and for esthetic reasons.

### Discussion

Palatally erupting maxillary ectopic canines often require orthodontic traction to assist their eruption into functional occlusion. A correct diagnosis of the impacted tooth's location angulation along with its surrounding teeth and obstacles, is necessary to determine the optimal treatment. In most orthodontic techniques used to move impacted canines into the arch, the force usually comes from the archwire and is directed labially. After removal of the fixed appliance some gingival recession could be seen around the canine, probably due to the heavy elastic traction. When a labially impacted or unerupted cuspid has its crown surgically exposed, there will be a tendency for that tooth to eventually have a longer clinical crown.

### The length of the clinical crown is due to the following conditions:

- A) First and foremost is the condition of the attachment on the unerupted tooth. Many of these impacted teeth have very large follicles which extend below the normal clinical crown, hence there is never "normal" attachment to begin with.
- B) Secondly, the surgical exposure itself must be generous, but at the same time observing the periodontal membrane's

integrity. If this is not observed longer clinical crown length will result.

- C) Last but not the least, the type of attachment that is placed on the crown has a lot to do with periodontal status.

This is why many orthodontists oppose to the use of wiring the tooth cervically, which is certainly a potential for stripping periodontal attachment.

### Conclusion

- The impacted canine is not to be regarded lightly and yet, not to be feared.
- Accurate diagnosis is important; adequate uncovering and mechanical assistance to eruption is critical.
- Proper finishing and retention is more critical than in our other orthodontic cases as a whole.
- By proper execution of treatment planning, the orthodontist can save many months of frustration and anxiety.

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## Nanotechnology-the Era Of Molecular Dentistry

### Abstract

Dentistry has seen many era of revolution in past, making it more reliable and comfortable for the patients. It is undergoing yet another change in helping mankind, this time with the help of nanotechnology combined with Nonomaterial's, Biotechnology and Nanorobotics. Nanodentistry will make possible the maintenance of comprehensive oral health by employing nanotissue devices which will allow precisely controlled oral analgesia, dentine replacement therapy, permanent hypersensitivity cure, complete orthodontic realignment etc, all in single office visit.

### Key Words

Nanodentistry, Nanomaterials, Nanorobots, Tissue Engineering

### Introduction

"Greatness does not come from size. Surprises come in small packages." The word nano is derived from Greek word "dwarf". The term nanotechnology was coined by Prof Keric E Dexler a lecturer, researcher and writer of nanotechnology. Nanotechnology is the manipulation of matter on the molecular and atomic levels. It is measured in the billionths of meters or nanometer, roughly the size of two or three atoms. Nanomaterials are the materials with components less than 100 nm in at least one dimension, including clusters of atoms, grains less than 100 nm in size, fibres less than 100 nm diameter, films less than 100 nm in thickness, nanoholes and composites that are a combination of these.

### History

In 1959, the late Nobel Prize winning physicist Richard P. Feynman presented a talk entitled "There's plenty of room at the bottom" at the annual meeting of the American physical society. Feynman proposed using machine tools to make smaller machine tools, which, in turn, would be used to make still smaller machine tools, and so on all the way down to the molecular level. He suggested that such nanomachines, nanorobots and nanodevices ultimately could be used to develop a wide range of atomically precise microscopic instrumentation and manufacturing tools. Feynman argued that these tools could be applied to produce vast quantities of ultra

small computers and various micro scale and nanoscale robots. He concluded that this is "a development which I think cannot be avoided," and the vision of nanotechnology was born.<sup>1</sup>

Nanotechnology aims to manipulate and control particles to create novel structure with unique properties and promises advances in medicine and dentistry. Nanodentistry will make possible the near perfect oral health through the use of Nanomaterials, Biotechnology including Tissue engineering and Nanorobotics.

**Nanomaterials:** Nanomaterials are those materials with components less than 100 nm in at least one dimension, including clusters of atoms, grains, fibres, films, nanoholes, and composites that are a combination of these

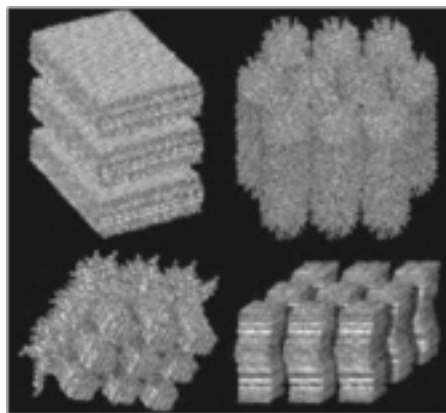


Figure 1: Nanoparticles In Various Shapes Sheets, Rods, Grains, Etc.

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These nanomaterials if present in one dimension are called as sheets, if in two dimensions are nanowires and nanotubes, if present in three dimensions are called as quantum dots.

The various nanostructures are <sup>2</sup>

- Nanopores
- Nanotubes
- Quantum dots
- Nanoshells
- Dendrimers

These various nanostructures (nanodiagnostic aids) have an ability to diagnose a disease in early phase of development. These nanodevices also decipher the encoded information from the bases making up genetic codes underlying the pathogenesis of cancer.

### Application of nanodentistry in Oral Diagnosis and Therapeutics

#### 1. Photosensitizer and carriers:

Quantum dots can be used as a photosensitizer and carriers. They can bind the antibody to surface of target cell and when stimulated by ultraviolet light, they give rise to reactive oxygen species which are lethal to target cells.<sup>3</sup>

#### 2. Nanotherapeutics:

These are the highly specific and targeted drug delivery systems. Nanotechnology in field of therapeutics will help to solve the solubility problems, reduce the drug dosages and

minimise the side effects.<sup>3-5</sup> They will be effective in treatment of brain disorders, Alzheimer's disease, Parkinson's disease etc.

### 3. Treatment of oral cancer:

Nanotechnology in field of cancer therapeutics has offered highly specific tools in the form of multifunctional Dendrimers and Nanoshells. The unique property of Dendrimers such as their high degree of branching, multi valence, globular structure and well defined molecular weight make them promising in cancer therapeutics.<sup>6,7</sup>

Nanoshells are miniscule beads with metallic outer layers designed to produce intense heat by absorbing specific wavelengths of radiations that can be used for selective destruction of cancer cells leaving aside intact, adjacent normal cells.<sup>6,7</sup>

### Application of nanodentistry in clinical dentistry<sup>8,9</sup>:

**1. Nanocomposites:** Composite with nanofillers has two types of nanofillers- nanomeric and nanocluster type. **Trade name:** Filtek Supreme universal restorative pure nano

#### Advantages

- High filler loading
- Desirable handling characteristics
- Superior physical properties like modulus of elasticity and flexural strength etc.
- High polish retention because of nanosize fillers which even if get plucked away by tooth brush abrasion, leave the surface with defects smaller than the wavelength of light.
- Higher translucency giving it more lifelike appearance
- 50% reduction in curing shrinkage

**2. Nanoadhesives:** They are nanosolutions which produce unique and dispersible nanoparticles which prevent agglomerations.

#### Advantages:

- Higher dentine and enamel bond strength
- High stress absorption
- Longer shelf life
- Durable marginal seal
- No separate etching required
- Fluoride release

### 3. Nanoimpression materials:

Nanoimpressions are available with

nanofillers integrated in the polyvinyl siloxane producing a unique addition siloxane impression materials. (Nano Tech Elite H-D+).

#### Advantages:

- Better flow
- Improved hydrophilic properties and hence few voids at margins and better model pouring

**4. Dentifrices:** They are nanosized hydroxyapatite crystals. These Dentifrices form a protective coating on tooth enamel and even restore the surfaces of damaged teeth. Dentifrices like Microbrite has microhydrin which consists of molecular cages, 1-5 nanometer in diameter and degrade the organic food particles.

### 5. Materials to induce bone growth:

Calcium sulphate is used to fill small voids such as those found in post extraction sockets and periodontal bone defects and as adjunct to the longer lasting bone graft materials. Dr Ricci has formulated new calcium sulphate based composite. Bone Gen -TR which resorbs more slowly and regenerates bone more consistently.

**6. Orthodontic wires:** Sandirk Nanoflex is a new stainless steel which allows ultra-high strength combined with good deformability, corrosion resistance and a good surface finish.

### 7. New electrochemical process for coating implants:

Prof Noam Eliaz is behind this innovation and he found that the new implant improves function and longevity. In this process there is electrochemical deposition of synthetic hydroxyapatite over the implant surface. These new implants are more acceptable to human body as these are able to enhance the integration of the nanocoatings to the human tissues. These nanocoatings very much resemble with the biological materials.

### 8. Bone replacement materials :

Hydroxyapatite nanoparticles used to treat bone defects are-

- Ostim<sup>®</sup> (Osartis GmbH, Germany) HA,
- VITOSSO (Orthovita, Inc, USA)
- HA +TCP NanOSS<sup>™</sup> (Angstrom Medica, USA) HA

### 9. Nano sterilizing solution: Gandy Enterprises Inc Florida

has introduced a new disinfectant based on super science of nanoemulsion technology. It uses nanosized

emulsifier droplets of oil that bombard the pathogens. e.g. **Eco Tru Disinfectant.**

#### Advantages:

- Broad spectrum
- Hypoallergic
- Noncorroding
- Does not stain fabric
- Require no protective clothing
- Environment friendly
- Compatible with various impression materials

### Applications of nanorobotics to dentistry<sup>10</sup>:

Around 10-20 years from today. Dental Nanorobots will be constructed. Nanorobots might use specific motility mechanism to crawl and swim through human tissues with navigational precision. These nanorobots will acquire energy, sense and manipulate their surroundings and pass through the odontoblastic process without disrupting the cells.

Nanorobotic function may be controlled by onboard computers that execute pre-programmed instructions in response to local sensor stimuli. Dentist may issue instructions by transmitting orders directly to in-vivo nanorobots via acoustic signals.



Nanorobots

### Applications of Nanorobotics to Dentistry

#### 1. Inducing local anaesthesia:

To induce local anaesthesia in the era of nanodentistry, colloidal suspension containing millions of active analgesics micron size dental nanorobots will be installed on the patient's gingiva which will crawl through mucosa, lamina propria and dentine painlessly reaching the pulp in



around 100s sec. Upon reaching the pulp these tiny machines will establish control over nerves impulse traffic which in turn will be controlled by the dentist on board. When the dentist presses the icon for the desired tooth on the hand held controller display, the selected tooth will numb immediately. After the oral procedures are complete, the dentist orders the nanorobots to restore all sensations, to egress from the tooth by similar pathways used for ingress.

#### Advantages:

- Greater patient comfort
- No anxiety, no needles
- Greater control of analgesia
- Fast and completely reversible
- No side effects and complications

#### 2. Dentin Hypersensitivity:

It is a pathological phenomenon. It is caused by pressure transmitted hydrodynamically to the pulp. Main hypersensitive tooth has dentinal tubules with surface densities will be eight times higher than those of nonsensitive teeth. Dental nanorobots can selectively and precisely occlude the specific tubules within a minute offering patients a quick and permanent cure.

#### 3. Orthodontic Robots:

Orthodontic robots can directly manipulate the periodontal tissues, including gingivae, periodontal ligament, cemental and alveolar tissues allowing rapid repair and painless tooth straightening, rotating and vertical repositioning within minutes to hours.

#### 4. Nanorobotic dentrifices :

Nanorobotic dentrifices delivered by mouthwash or tooth paste can cover all subgingival surfaces, metabolizing trapped organic matter into harmless and odourless vapors. Properly configured dentifrorobots can identify and destroy pathogenic bacteria existing in the plaque and elsewhere. They will also provide a barrier to halitosis. **Nanoneedles;** Suture needles incorporating nano-sized stainless steel crystals have been developed. Nanotweezers are also under development which will make cell-surgery possible in the near future. **Trade name:** Sandvik Bionline, RK 91TM needles [AB Sandvik, Sweden].

#### Nano Tissue Engineering

We are not far away when we will be able to generate whole new tooth with the principles of genetic engineering, tissue engineering and tissue regeneration by manipulating cellular and mineral components at nanoscale. Chen et al by

using nanorods like calcium hydroxyapatite crystals which were oriented roughly parallel to each other, were able to simulate the natural bio mineralization process and create hardest tissue in human body, i.e., dental enamel

#### Tooth Repair:

Major tooth repair will be possible through the combination of nanotechnology, genetic engineering and tissue engineering and later on whole tooth will be grown in vitro and installed in oral cavity. So complete dentition replacement therapy should become possible to understand within the time and economic constraints of an ordinary office visit, using an affordable desktop manufacturing facility in the dentist office.

#### Conclusions :

Naodentistry still faces many significant challenges in realizing its tremendous potential. There are larger social issues of public acceptance, ethics, regulations and human safety that must be addressed before molecular nanotechnology can enter the modern medical armamentarium. However there are equally powerful motivations to surmount these various challenges, such as the possibility of providing high quality dental care to the large amount of world population. Time, specific advances, financial and scientific resources and human need will determine which of the applications described in this article are realized first.

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## Comperative Evaluation Of MTA, Calcium Hydroxide And Portland Cement As A Root End Filling Materials : A Comprehensive Review

### Abstract

In advanced restorative dentistry there is need for surgical intervention to the infected root apex. Once access to the root end is achieved, the root apex is resected and filled with a dental restorative material. The materials currently in use are not satisfactory due to inadequate biocompatibility and failure to achieve desirable properties in an aqueous environment.

An ideal orthograde or retrograde filling material should seal the pathways of communication between the root canal system and its surrounding tissues. It should also be nontoxic, noncarcinogenic, nongenotoxic, biocompatible, insoluble in tissue fluids, and dimensionally stable. Mineral trioxide aggregate (MTA) was developed and recommended initially because existing root-end filling materials did not have these "ideal" characteristics. MTA has also been recommended for pulp capping, pulpotomy, apical barrier formation in teeth with open apexes, repair of root perforations, and root canal filling.

With the introduction of a new material, essentially Portland cement used in the building industry, these desirable properties have been achieved. This paper reviews the properties of MTA, calcium hydroxide and Portland cement used in restorative dentistry, both as a retrograde and orthograde filling material.

### Key Words

Mineral Trioxide, Calcium Hydroxide, Retrograde, Orthograde

### Introduction

In restorative dentistry materials are mainly utilized to replace dental tissue lost through dental caries and tooth preparation procedures. When a significant amount of tooth tissue is lost the dental pulp may be adversely affected. This may necessitate advanced conservative procedures involving extirpation of the dental pulp and obliteration of the space with gutta-percha and root canal sealers. Access for these procedures is through the tooth crown. Should this be unsuccessful, surgical Endodontics is necessary to allow cleaning and sealing of the root end to prevent further infection.<sup>1</sup>

Most endodontic failures occur as a result of leakage of irritants into the periapical tissues<sup>2,3</sup>. An ideal orthograde or retrograde filling material should seal the pathways of communication between the root canal system and its surrounding tissues. It should also be nontoxic, noncarcinogenic, nongenotoxic, biocompatible with the host tissues, insoluble in tissue fluids, and dimensionally stable<sup>4,5</sup>. Furthermore, the presence of moisture should not affect its sealing ability; it should be easy to use and

be radiopaque for recognition on radiographs<sup>4</sup>. Because existing restorative materials used in Endodontics did not possess these "ideal" characteristics<sup>4</sup>, mineral trioxide aggregate (MTA) was developed and recommended initially as a root-end filling material and subsequently has been used for pulp capping, pulpotomy, apexogenesis, apical barrier formation in teeth with open apexes, repair of root perforations, and as a root canal filling material. MTA has been recognized as a bioactive material<sup>6</sup> that is hard tissue conductive<sup>7</sup>, hard tissue inductive, and biocompatible.

An extensive search of the endodontic literature was made to identify publications related to calcium hydroxide-based root canal sealers. The articles were assessed for the outcome of laboratory and clinical studies on their biological properties and physical characteristics. Comparative studies with other sealers were also considered. Several studies were evaluated covering different properties of calcium hydroxide-based sealers. Calcium Hydroxide based root canal sealers have a variety of physical and biological

properties.

### Brief Introduction Of Materials

MTA:

In the 1990s a new material, mineral trioxide aggregate (MTA) was developed at Loma Linda University as a root-end filling material. The first publication on the use of the material to seal root perforations was published in 1993. It is commercially available as ProRoot MTA (Tulsa Dental Products, Tulsa, OK, USA). The use of MTA as a root-end filling material was identified due to the fact that the material is hydraulic cement i.e. it sets in the presence of water. Mineral trioxide aggregate (MTA) is now used extensively in Endodontics.

Two commercial forms of MTA are available (ProRoot MTA); namely the grey and the white MTA both with similar chemical and physical properties. MTA is essentially Portland cement (used in the building industry as a binder in concrete) with 4:1 proportions of bismuth oxide added for radiopacity. The material was originally reported to be composed of calcium and phosphate and its biocompatibility was

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attributed to its similarity to dental hard tissues. However Camilleri and co-workers<sup>4</sup> have shown that MTA is composed primarily of tricalcium and dicalcium silicate, the main constituent elements of Portland cement, which on hydration produce a silicate hydrate gel and calcium hydroxide, not calcium phosphate as claimed by Torabinejad.<sup>8</sup>

### PORTLAND CEMENT:

It is a fine powder produced by grinding cement clinker. It is classified as hydraulic cement, which normally is composed of lime, silica, alumina and ferric oxide. Lime is composed of calcium and magnesium oxides. PC is produced by grinding clay and lime bearing materials in the correct proportions and then heating the mixture to 1400°. This process called calcinations produces physical and chemical changes in the raw materials. The resulting clinker is ground to a fine powder and a small amount of gypsum is added to retard the setting process.<sup>9</sup>

*Typical constituents of Portland clinker plus Gypsum Cement chemists notation under CCN.*

Clinker	CCN	Mass %
Tricalcium Silicate (CaO)3.SiO2	C3S	45-75%
Dicalcium Silicate (CaO)2.SiO2	C2S	7-32%
Tricalcium Aluminate (CaO)3.Al2O3	C3A	0-13%
Tetracalcium Aluminoferrite (CaO)4.Al2O3.Fe2O3	C4AF	0-18%
Gypsum CaSO4.2 H2O		2-10%

*Typical constituents of Portland cement Cement chemists notation under CCN.*

Cement	CCN	Mass %
Calcium oxide, CaO	C	61-67%
Silicon oxide, SiO2	S	19-23%
Aluminum oxide, Al2O3	A	2.5-6%
Ferric oxide, Fe2O3	F	0-6%
Sulfate	S	1.5-4.5%

### CALCIUM HYDROXIDE:

The first clinical use of calcium hydroxide as a root canal-filling material was probably by Rhoner in 1940.<sup>10</sup> It took another 20 years for calcium hydroxide to become popular for apexification, the sealing of

perforations, and management of resorption.<sup>11</sup> A "miracle" material Biocalex (Laboratoire SPAD, Dijon, France), developed by French researchers, was believed to make radical changes to endodontic instrumentation methods.<sup>12</sup> The calcium hydroxide containing a pulp-capping agent, Dycal (Dentsply-Caulk, Milford, DE), also became popular as a sealer among some clinicians in late 1970s.<sup>13</sup>

The two most important reasons for using calcium hydroxide as a root-filling material are stimulation of the periapical tissues in order to maintain health or promote healing and secondly for its antimicrobial effects. The exact mechanisms are unknown, but the following mechanisms of actions have been proposed:

1. Calcium hydroxide is antibacterial depending on the availability of free hydroxyl ions<sup>14, 15</sup>. It has a very high pH (hydroxyl group) that encourages repair and active calcification. There is an initial degenerative response in the immediate vicinity followed rapidly by a mineralization and ossification response<sup>16</sup>.
2. The alkaline pH of calcium hydroxide neutralizes lactic acid from osteoclasts and prevents dissolution of mineralized components of teeth. This pH also activates alkaline phosphatase that plays an important role in hard tissue formation<sup>17</sup>.
3. Calcium hydroxide denatures proteins found in the root canal and makes them less toxic.
4. Calcium hydroxide activates the calcium-dependent adenosine triphosphatase reaction associated with hard tissue formation<sup>17, 18</sup>.
5. Calcium hydroxide diffuses through dentinal tubules and may communicate with the periodontal ligament space to arrest external root resorption and accelerate healing<sup>16, 19</sup>.

### EVALUATION OF PROPERTIES

#### 1. PARTICLE SIZE:

The physical properties of cement might be influenced by crystal size. Smaller particles increase surface contact with the mixing liquid and lead to greater early strength as well as ease of handling. A recent study reported that some particles of MTA are as small as 1.5 μm, which is smaller than the diameter of some dentinal tubules<sup>20</sup>. The authors hypothesized that this might play an important role in the sealing ability of MTA

after hydration and production of a hydraulic seal. This hypothesis might not be clinically relevant, because the dentinal tubules after root canal instrumentation or root-end cavity preparation are not open unless the operator removes the smear layer by acid-etching these surfaces.

The particle size of MTA is reported in many articles. Lee et al<sup>21</sup> reported particle sizes ranging from 1-10 μm for GMTA powder, whereas Camilleri<sup>22</sup> reported that the WMTA powder has particles less than 1 to approximately 30 μm before hydration.

The handling characteristic of PC is dependent on its particle size and shape. Many investigations evaluated particle size and shape of MTA20. WMTA has finer particles than 2 types of PC<sup>23</sup>.

#### 2. CHEMICAL PROPERTIES:

The MTA patent<sup>25</sup> shows that it contains calcium oxide (CaO) and silicon (SiO). Several investigations have reported that the main elemental components of MTA are calcium and silica, as well as bismuth oxide<sup>26, 27</sup>. MTA is currently marketed in 2 forms: gray (GMTA) and white (WMTA). MTA was introduced in gray, but because of the discoloration potential of GMTA, WMTA was developed<sup>24</sup>. Investigations showed that lower amounts of iron, aluminium, and magnesium are present in WMTA than in GMTA<sup>24</sup>.

The primary differences between both types of MTA and PC are a lack of potassium and the presence of bismuth oxide<sup>24</sup>. An investigation evaluated the dry powder of GMTA and WMTA, as well as ordinary and white Portland cement (PC), finding that all tested materials have similar major constituents: tricalcium silicate, tricalcium aluminate, calcium silicate, and tetracalcium aluminoferrite.

An investigation confirmed the similarity of PC and MTA, except for the presence of potassium and lack of bismuth oxide<sup>24</sup>. Another study showed lower amounts of aluminium and sulphur in WMTA compared with WPC<sup>22</sup>.

#### 3. SETTING TIME:

MTA is prepared by mixing its powder with sterile water in a 3:1 powder-to-liquid ratio<sup>39</sup>. The mean setting time of MTA is 165\_5 minutes, which is longer than amalgam, Super EBA, and intermediate restorative material (IRM). GMTA exhibits

significantly higher initial and final setting times than WMTA<sup>29, 30</sup>. The longer setting time of WMTA in comparison with PC is attributed to the lower levels of sulphur and tricalcium aluminate in WMTA<sup>23</sup>.

In an attempt to use MTA for 1-visit perforation repair, a study placed glass ionomer cement (GIC) over WMTA. The authors reported that placing GIC 45 minutes after WMTA placement did not affect the formation of calcium salts in the interface of the 2 materials. In addition, placement of GIC over WMTA did not affect setting of this material<sup>31</sup>. A separate study by the same authors confirmed that the GIC setting was not disrupted by the presence of WMTA<sup>32</sup>.

Dycal has a very short setting time, and in its use as a root canal sealer users recommended first introducing the catalyst paste into the canal with a lentulospiral followed by a gutta-percha cone coated with the base paste<sup>13</sup>. The setting reactions of calcium hydroxide-containing sealers are complex. Even though the sealer surface becomes hard, the inner mass may remain soft for an extended period. Apexit was reported to have a setting time of less than 2 hours at 100% relative humidity<sup>33</sup>. CRCS sets within 3 days in both dry and humid environments. Sealapex sets in 2 to 3 weeks in 100% relative humidity and does not set in a dry environment<sup>34</sup>. Many of its properties support its use alone as a root canal-filling/sealing material, although its placement in canals may be challenging.

#### 4. FLOWABILITY

The setting time of Portland cement and MTA could be reduced by removing the gypsum from the manufacturing process without affecting its other prop-erties. Superplasticizer was used to obtain a homogeneous flowable mix and control setting time ranging from 5 to 12 minutes. Although this material can be applied for dental usage, there are no studies to date concerning the effect of superplasticizer concentrations and liquid-to-powder ratios on properties of the cement.

The mean flows of AWPC plus 1.8% and 2.4% polycarboxylate superplasticizer groups were significantly increased ( $p < 0.001$ ) at all liquid-to-powder ratios when compared with control groups. Significant differences between AWPC plus 1.2% polycarboxylate superplasticizer group and the control groups were observed only in a 0.33 liquid-to-powder ratio ( $p < 0.001$ ).

An acceptable flow within the working time is important for any root canal sealer in order to reach and seal the apical foramen and lateral dentinal wall irregularities. Flow depends on particle size, shear rate, temperature, and time from mixing. It can be measured with either a rheometer or from the diameter of the film of sealer between two glass plates under load<sup>37</sup>. Pitt Ford et al<sup>36</sup> reported significant differences in flow between Apexit and Tubliseal EWT, the former being superior in a rheometer test and the latter with the traditional method. In another study, the flow of Apexit was comparable to AH Plus and Tubliseal EWT<sup>33</sup>.

#### 5. SETTING EXPANSION:

There are conflicting results regarding the setting expansion of various types of MTA<sup>29, 30</sup>. Two investigations showed that WMTA expands slightly more than GMTA<sup>29,30</sup>.

Excessive expansion that might result in a cracked root is an undesirable property when a material is used as a root-end filling substance<sup>30</sup>. The setting expansion of PC is a matter of controversy in the literature. One investigation reported that both types of WPC and OPC show greater expansion than GMTA and WMTA<sup>30</sup>. In contrast, another experiment showed that the setting expansion of PC is less than GMTA and more than WMTA<sup>38</sup>. This might be attributed to the differences of chemical composition among various types of PC.

Biocallex in the presence of moisture in the canal expands by up to 280%. This has the potential to create severe postoperative pain and vertical root fractures. Apexit also has exhibited high water sorption but along with its equally high solubility gives rise to minor overall dimensional change<sup>33</sup>. CRCS was quite stable with volumetric changes in water for 21 days. Sealapex displayed significant sorption in a 100% humid atmosphere with volumetric expansion.

#### 6. SOLUBILITY:

The degree of solubility of MTA is a matter of debate among investigators<sup>8, 30</sup>. Most investigations reported low or no solubility for MTA<sup>8, 30</sup>. However, increased solubility is reported in a long-term study. When comparing the physical properties of WMTA with those of GMTA, the former material demonstrates significantly more solubility<sup>30</sup>. Varying results are reported when comparing PC with WMTA<sup>30</sup>. One

study reported that both ordinary and white PC (WPC) exhibits significantly less solubility than WMTA<sup>30</sup>. These findings are in contrast with another study that shows WMTA is less soluble than 2 different types of PC. The differences are attributed to the type of PC used in these investigations.

In addition, the powder-to-water ratio might influence the amount of solubility. In fact, higher water-to-powder ratios increased MTA porosity and solubility<sup>42</sup>. The authors reported that using more water would increase calcium release from MTA. The addition of bismuth oxide to MTA, which is insoluble in water, is another cause for MTA insolubility. In an experiment on the hydration of MTA, Camilleri<sup>22</sup> confirmed the reaction of bismuth oxide with both calcium and silicate contents of MTA.

The solubility in water and 37% phosphoric acid, and compressive strength of four brands of hard-setting calcium hydroxide base materials were studied. Results were highly variable among brands and no correlations appeared to exist between properties studied. One product was significantly different from the others with regard to acid solubility and compressive strength<sup>39</sup>.

#### 7. COMPRESSIVE STRENGTH:

There are conflicting results regarding the compressive strength of WMTA and GMTA<sup>30</sup>. One study reported that compressive strength of WMTA at 3 and 28 days after mixing is significantly less than that of GMTA<sup>30</sup>. In contrast, 2 other investigations comparing the compressive strength of GMTA and WMTA reported more compressive strength for WMTA<sup>30</sup>. In general, MTA's compressive strength is not significantly affected by condensation pressure<sup>42</sup>. Another recent experiment revealed that keeping WMTA in dry conditions decreases its compressive strength<sup>41</sup>. Even the samples kept moist after mixing show variations in compressive strength, de-pending on the amount of time elapsed between mixing and examination. The samples that were kept for 2-7 days in moisture exhibited greater compressive strength than the 4-hour samples. A recent investigation reported significantly lower compressive strength for WMTA when the material was etched by phosphoric acid (37%). The investigators suggested that restoration with acid-etch composite after MTA placement should be postponed for at least 96 hours<sup>44</sup>.

The compressive strength of some types of OPC and WPC is significantly lower than WMTA and GMTA 28 days after hydration<sup>30</sup>. Attaining adequate compressive strength is important for some of the clinical applications of MTA such as repairing perforations and pulp capping. These procedures require materials with adequate compressive strength to be stable against occlusal pressure.

The strength of a brittle material depends upon the toughness of the material itself and the degree of perfection with which it can be placed. This study shows that both the compressive and tensile strength of calcium hydroxide lining materials is dependent on the fracture toughness at unstable crack propagation, KIC, and the size, number and distribution of pores (which are the defects that nucleate fracture). Of the products tested here, Dycal possesses the greatest actual strength due to a higher than average KIC value and relatively few isolated small pores<sup>40</sup>.

#### 8. FLEXURE STRENGTH:

On the basis of limited literature, it appears that placing a moist cotton pellet over MTA for the first 24 hours increases its flexural strength.

#### 9. PUSH-OUT STRENGTH:

The push-out strength of perforation repair materials is an important factor because shortly after perforation repair, tooth function might dislodge the material. MTA has lower push-out strength in comparison with IRM or Super EBA after immersion in walking bleach materials. On the basis of available data, it appears that MTA gains optimal physical properties such as flexural strength, compressive strength, and push-out strength when it receives enough moisture after being placed in an operation site.

#### 10. pH:

The pH value of MTA is 10.2 after mixing. This value rises to 12.5 at 3 hours<sup>8</sup>. Comparing pH values of GMTA with WMTA, the latter material displays a significantly higher pH value 60 minutes after mixing<sup>29,30</sup>. MTA kept its high pH value throughout the course of a long-term study; the authors attributed the high pH value to the constant release of calcium from MTA and the formation of CH. Comparing pH values at different periods of time, both WMTA and GMTA exhibit significantly higher pH values than 2 types of PC immediately after mixing<sup>30</sup>. However, 30

minutes after mixing, no statistical difference can be found among the tested materials. At 60 minutes, GMTA has a significantly lower pH value than WMTA and both types of PC<sup>30</sup>. Available data show that mixing MTA with water results in the formation of CH and a high pH environment.

The pH of calcium hydroxide paste has been shown to be as high as 12.5 when used for intracanal medicament purposes<sup>15</sup>. In an experimental study, the pH of distilled water in contact with Sealapex reached 11.5 during 30 days, most of which was gained in the first 1 hour, followed by CRCS (10.5), Apexit (10.5), and Sealer 26 (9.5)<sup>45</sup>. In another experiment, the maximum pH of Sealapex and CRCS in a 1-week study did not exceed 9.1 and 7.8, respectively<sup>46</sup>. Further research on Sealapex showed a slow and gradual rise in pH (not exceeding 9.57) in bidistilled water in the first hour, after which the sample disintegrated in solution, whereas CRCS did not cross the 7.65 mark<sup>47</sup>.

#### 11. RADIOPACITY:

The mean radiopacity for MTA has been reported at 7.17 mm of an equivalent thickness of aluminum<sup>8</sup>. This value is higher than that reported for Super EBA or IRM in a separate investigation. Another study compared the same materials and reported more radiopacity for Super EBA and IRM than MTA. The difference can be due to the use of different methods to evaluate the radiopacity of test materials. Comparing the radiopacity of WMTA with that of GMTA, 2 separate studies reported more radiopacity for WMTA<sup>29,30</sup>. Because a similar amount of bismuth oxide is used to produce radiopacity in both materials, the presence of other substances in WMTA might be the reason for this difference between the two.

The mixtures of Portland cement with bismuth oxide and lead oxide presented the highest radiopacity values and differed significantly from the other materials ( $p < 0.05$ ), whereas Portland cement/zinc oxide presented the lowest radiopacity values of all mixtures ( $p < 0.05$ ). Portland cement/bismuth subnitrate and Portland cement/iodoform presented statistically similar radiopacity values ( $p > 0.05$ ), and both materials were more radiopaque than Portland cement associated with zirconium oxide, bismuth carbonate, barium sulfate, calcium tungstate, and zinc oxide ( $p < 0.05$ )<sup>48</sup>.

According to ISO 6876/2001 standards, the recommended radiopacity of the root canal sealer should be at least that of a 3-mm thick aluminium wedge. Radiographs of samples

of Sealapex showed large voids in their structure, and they were less radiopaque than CRCS for 3 weeks, after which the voids disappeared and there was an increase in radiopacity for Sealapex<sup>49</sup>.

#### 12. POROSITY:

Many studies have evaluated MTA porosity. The amount of porosity in mixed cement is related to the amount of water added to make a cement paste, entrapment of air bubbles during the mixing procedure, or the environmental acidic pH value<sup>28</sup>.

#### 13. MICROHARDNESS:

The microhardness of MTA can be influenced by several factors such as the pH value of the environment, the thickness of the material, the condensation pressure, the amount of entrapped air in the mixture, humidity, acid etching of the material, and temperature<sup>23,28,42,44</sup>. An acidic environment has an adverse effect on the microhardness of both GMTA and WMTA.

The microhardness of 2-mm and 5-mm thicknesses of GMTA and WMTA was investigated when the materials were used as an apical barrier. Regardless of the formulation of MTA or placement technique used, a 5-mm thickness is significantly harder than a 2-mm thickness. An investigation compared the microhardness of WMTA with 2 types of PC. WMTA showed significantly more microhardness than both types of PC<sup>49</sup>, which can be attributed to the different chemical and physical properties of the tested materials<sup>23,24</sup>. A recent study confirmed a trend of less microhardness after using more pressure during MTA condensation<sup>42</sup>. Two separate investigations reported that EDTA and acid-etch procedure significantly reduce MTA microhardness<sup>44</sup>.

#### 14. BIOCOMPATIBILITY:

Both MTA and Portland cement are bioactive materials. The biocompatibility of the materials had originally been attributed to the chemical similarity to tooth hard tissues namely calcium phosphate. However this has been shown not to be the case. MTA produces calcium hydroxide as a by product of the hydration reaction. The similarity of action of both MTA and Portland cement to calcium hydroxide had been postulated.

Calcium hydroxide is used extensively in dentistry. When using SEM to study the biocompatibility of dental materials it is imperative to ensure there is no reaction between the material and the reagents used in the experimental procedure. Scanning

electron microscopy thus is contraindicated to evaluate cell growth and expression over materials based on Portland cement. Other methods of assessing biocompatibility are thus preferred<sup>1</sup>.

#### 15. ANTIBACTERIAL PROPERTIES:

In an antimicrobial study on MTA and PC against *Staphylococcus aureus*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Candida albicans*, a wild fungus, and a mixture of these bacterial and fungal species, both materials exhibited diffusion in agar without inhibition of microbial growth<sup>50</sup>. Some investigations showed that GMTA<sup>51,52,53</sup> and WMTA<sup>52</sup> have an antifungal effect. In contrast, others showed that GMTA has limited or no antifungal effect<sup>50</sup>. One experiment showed that freshly mixed and 24-hour set GMTA have an antifungal effect on *C. Albicans*<sup>51</sup>. The antifungal effect of MTA might be due to its high pH or to substances that are released from MTA into the media. In contrast, a study comparing the effect of MTA and PC on *C. albicans*, *S. aureus*, and *Escherichia coli* showed no antimicrobial effect for either of the tested materials<sup>54</sup>. Another investigation reported antimicrobial activity of GMTA, WPC, and OPC on *Micrococcus luteus*, *S. aureus*, *E. coli*, *P. aeruginosa*, *C. albicans*, and *Enterococcus faecalis*<sup>53</sup>.

The literature shows that MTA has an antibacterial and antifungal effect. Lowering the powder-to-liquid ratio might adversely affect the antibacterial and antifungal properties of MTA.

The incorporation of antibacterial components in root canal sealers may be an important factor in preventing the regrowth of residual bacteria and controlling bacterial re-entry into the root canal system. The antibacterial effect of calcium hydroxide is based on its ability to release hydroxyl ions and to raise pH.

#### Conclusion

Both MTA and Portland cement are a bioactive material that influences its surrounding environment. There are many published reports regarding the chemical, physical, and anti-bacterial properties of MTA. This article showed that MTA is composed of calcium, silica, and bismuth. It has a long setting time, high pH, and low compressive strength. It possesses some antibacterial and antifungal properties, depending on its powder-to-liquid ratio. In spite of its advantages it has a disadvantage of high cost and poor handling.

PC is manufactured widely all around the world, and it is impossible to control the quality, composition, and biocompatibility of these materials. The higher solubility of some types of PC is also a matter of concern. The compressive strength of some types of OPC and WPC is significantly lower than WMTA and GMTA 28 days after hydration. Excessive expansion that might result in a cracked root is an undesirable property when a material is used as a root-end filling material. Despite some similarities between PC and MTA, it is not safe to use PC, which has not been formulated for human use, in place of a bioactive medical material such as MTA.

Calcium hydroxide-based root canal sealers have a variety of physical and biological properties. Comparative studies reveal their mild cytotoxicity, but their antibacterial effects are variable. Further research is required to establish the tissue healing properties of calcium hydroxide in root canal sealers. Calcium hydroxide is used extensively in dentistry. When using SEM to study the biocompatibility of dental materials it is imperative to ensure there is no reaction between the material and the reagents used in the experimental procedure.

Further studies are required to assess properties of these materials for their use as root end filling materials.

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## Tooth Wear - An Overview With Special Emphasis On Dental Erosion

### Abstract

Non-cariou tooth surface loss is a normal physiological process occurring throughout life, but accelerated tooth wear can become a problem affecting function, aesthetics or longevity of dentition. Tooth wear is a complex multifactorial problem and there is difficulty identifying a single etiological factor. Erosive tooth wear is a condition of growing concern to the clinician and the subject of extensive research - a view supported by the literature and a point for deliberations across various professional platforms over recent decades. There is good deal of evidence that dental erosion is growing steadily and its presence synergistically aggravates tooth wear by other mechanisms. Early recognition of dental erosion is important to prevent serious irreversible damage to the dentition. This overview is aimed to discuss various types of tooth wear in brief and provide an insight into diagnosis, risk factors, and management of dental erosion.

### Key Words

Tooth wear, Tooth erosion, diagnosis, prevention, GORD, diet, eating disorders.

### Introduction

The hard dental tissues including enamel, dentin and cementum, are critical to the integrity of the dentition. Loss of these tissues can have significant consequences for the patient. Tooth wear refers to gradual loss of dental hard tissues by a disease process other than dental caries. Attempts have been made to distinguish between pathological and physiological loss of tooth tissues (1, 2). Tooth wear can be regarded as pathological if the teeth become so worn that they do not function effectively or seriously mar the appearance before they are lost for other causes. Tooth wear is mostly result of three processes: abrasion, attrition and erosion. A further process (abfraction) might potentiate wear by abrasion and/or erosion. Tooth wear in an individual is likely to be multifactorial as individual wear mechanisms rarely act alone but interact with each other. However, in recent years the contribution of erosion to tooth wear is increasing due to change in lifestyle and eating habits (1). Epidemiological data, and studies in vitro and in situ, suggest that, of the three individual wear processes, erosion is the most common threat for tooth surface loss (2,3,4).

### Multifaceted nature of tooth tissue loss in non carious conditions

There are various forms of non-caries destructive processes leading to a loss of tooth structure. These include abrasion, demastication, attrition, erosion, abfraction, and resorption. Non-caries tooth structure loss is almost never caused by any one of the above processes alone. A brief overview of these will help in further understanding-

**Abrasion:** Term 'abrasion' is derived from the Latin verb abrader, abrasi, abrasum (to scrape off) and describes the wearing of a substance or structure through mechanical processes, such as grinding, rubbing and scraping (5). Dental abrasion is a pathological wearing of teeth resulting from abnormal mechanical processes involving foreign objects or substances repeatedly introduced in the mouth and contacting the teeth. The main etiological factors are oral hygiene procedures.

1. Brushing: aggressive horizontal brushing, use of hard bristles, force and time spent on brushing, tooth brush design, length, number, and diameter of tufts.
2. Dentifrices: type of dentifrice ie powder or paste, size and hardness of the

particle, ph and amount of dentifrice used.

3. Use of excessive dental floss, tooth picks or interdental brushes causes proximal abrasion.

Other factors include occupational habits like placement of pins or nails between teeth or holding pipe stem between teeth. Tooth brush abrasion is most common form of abrasion and is usually seen as a sharp, V-shaped notch in the cervical third of the facial aspect of teeth.

**Demastication:** A special form of abrasion is demastication describes the wearing away of tooth substance during the mastication of food with the bolus intervening between opposing teeth (5). Abrasion is mainly on the occlusal side and is influenced by the individual food. Most of the wear is physiological but become pathological if patient is habitual of eating very hard substances like beetle nut.

**Attrition:** Term 'attrition' is derived from the Latin verb atterere, attrivi, attritium, describing the action of rubbing against something (5). Attrition in dentistry is physical wear of teeth as a result of contact

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of teeth with each other with no foreign substance intervening. Although physiological as teeth come in contact with each other during function but becomes abnormal if patients have parafunctional movements like bruxism. Normal physiological attrition is usually present on occlusal surfaces with a characteristic feature of antagonistic plane facets and sharp margins, enamel and dentin usually wear at same rate (6). Attrition also includes proximal surface wear at the contact area because of physiological tooth movement.

**Abfraction:** Term 'abrasion' is derived from the Latin verb frangere, fregi, fraction (to break) is used to describe a special form of wedge shaped defects at the cemento-enamel junction of a tooth (5). Abfraction is a loss of tooth surface at the cervical areas of teeth caused by tensile and compressive forces during tooth flexure. These forces are focussed on the CEJ where they provoke microfracture in enamel and dentin. The weakened cervical region would then be susceptible to abrasion and erosion (7, 8). Abfraction usually involve single tooth with excessive interferences or eccentric occlusal loads and appear as wedge shaped defects having sharp rims at CEJ.

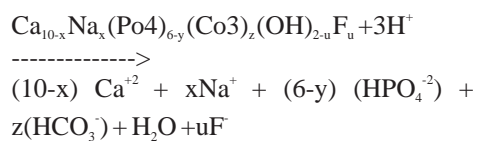
**Erosion:** Term 'erosion', is derived from the Latin verb erodere, erosi, erosum (to gnaw, to corrode), describes the process of gradual destruction of the surface of something usually by electrolytic or chemical processes (5). Dental erosion is defined as the progressive, irreversible loss of hard dental tissues due to a chemical process not involving bacteria (9, 10). The acids responsible for erosion are not products of the intraoral flora; they stem from dietary, occupational or intrinsic sources.

**Resorption:** Resorption is the process of biological degradation and assimilation of substances or structures previously produced by the body. In dental terms, it refers to the biological removal of dental hard tissue by cementoclastic, dentinoclastic and ameloclastic activity. This can be either a physiological process, as in the case of root absorption of deciduous teeth, or a pathological process such as resorption owing to trauma, cysts or

neoplasms. Resorption is of no relevance in the context of erosion which occurs at the surface of a tooth, but in the context of differential diagnosis it cannot be omitted from the list of non-carious destructive processes.

**Mechanism:**

Tooth erosion is a multifactorial condition and has a complex aetiology. Every factor plays a role in inducing or preventing erosion. Over time, the interaction of all these factors may lead to either progression or protection of the surface. Dental hard tissues are largely composed of mineral crystals of hydroxyapatite with the formula  $Ca_{10}(PO_4)_6(OH)_2$ . Dental hydroxyapatite (HAP) is often described as "calcium deficient" and "carbonated" because some calcium ions may be substituted by sodium, magnesium and potassium, and some phosphates ( $PO_4$ ) by carbonates ( $CO_3$ ) (11). Because of these substitutions the mineral in enamel and dentin is much more acid soluble than HAP which in turn is much more soluble than fluorapatite (FAP) which has the formula  $Ca_{10}(PO_4)_6F_2$  (12). Dentin and enamel have similar mineral compositions, although the carbonate content of enamel is approximately 3% while in dentine it is 5-6%, making dentin mineral even more acid soluble (11). Chemical erosion of the teeth occurs either by the hydrogen ion derived from strong/weak acids, or by anions which can bind or complex calcium (chelators). The hydrogen ions,  $H^+$ , are derived from acids as they dissociate in water and  $H^+$  ion itself can attack the tooth mineral crystals and directly dissolve by combining with either the carbonate ion or the phosphate ion, as shown in equation (11).



The effect of direct attack by the hydrogen ion is to combine with the carbonate and/or phosphate releasing all of the ions from that region of the crystal surface leading to direct surface etching.

Depending on the pH and duration of

exposure of chemicals having acidic pH there can be either direct removal of hard tissue by complete dissolution or creation of a thin softened layer few millimetres below the surface: a process known as softening (1,13). This softened layer is vulnerable to subsequent mechanical wear or further progress in softening causes its complete dissolution (14). In dentin exposed to acid there is first dissolution at the junction of the peritubular and intertubular dentin, then loss of the peritubular dentine and widening of the tubule lumina (15) and finally formation of a superficial layer of demineralised collagenous matrix (16). While it persists, this layer might mechanically protect the underlying residual dentin and might also affect chemical reactions between the latter and the oral fluids, but it is itself vulnerable to mechanical and proteolytic damage and will ultimately be lost (1,17). Normal tooth brushing scarcely abrade the normal enamel but it becomes vulnerable to tooth brush abrasion and even friction of tongue after acidic attack (18,19,20,21). Similarly softened dentin is also susceptible to mechanical wear (18, 22). Thus acid attack to enamel and dentin make them more vulnerable and other tooth wear process like attrition and abrasion become more severe.

**Types of erosion :** Tooth erosion can be extrinsic, intrinsic, or idiopathic.

**Extrinsic erosion:** Extrinsic erosion is the result of exogenous acids. Dietary acids, however, are the principal causative factor for extrinsic tooth erosion (5,10,18). Other important factors include oral administration of some medicines-such vitamin C preparations, acid used to dissolve small renal calculi and iron tonics. Occupational exposure due to industries, swimming pools, wine tasters etc (5).

The most frequently consumed erosive acids are fruit acids and phosphoric acid contained in fresh fruits, fruit juices and soft drinks (5,6). Most fruits and fruit juices have a very low pH (high acidity) as shown in table (23, 24).

This finding is of concern, particularly since children and adolescents are the primary

**Table 1. Common Beverages and Juices pH (23,24).**

Coke	2.7	Apple Juice	3.4
Pepsi	2.7	Orange Juice	3.4
7-up	3.2-3.5	Grapefruit Juice	3.2
Sprite	2.6	Cranberry Juice	2.3-2.5
Mountain Dew	3.2	Pineapple Juice	3.4
Fanta Orange	2.9	Kiwi Juice	3.6
Red Bull	3.4	Grape Juice	3.4
Beers	4.0-5.0	Carrot Juice	4.2
Wines	2.3-3.8	Iced Tea	3.0
Root Beer	3.0-4.0	Coffee	2.4-3.3
Milk	7.0	Tea (Black)	4.2

**Table 2. Common Food Stuffs and Their pH (23,24)**

Apples	2.9-3.5	Relish	3.0
Apricots	3.2-4.0	Tomatoes	3.7-4.7
Grapes	3.3-4.5	Pickles	2.5-3.0
Peaches	3.1-4.2	Fermented Vegetables	3.9-5.1
Pears	3.4-4.7	Mayonnaise	3.8-4.0
Plums	2.8-4.6	Fruit Jam/Jellies	3.0-4.0
Grapefruit	3.0-3.5	Mustard	3.6
Lemons/Limes	1.8-2.4	Cranberry Sauce	2.3
Oranges	2.8-4.0	Vinegar	2.4-3.4
Pineapple	3.3-4.1	Ketchup	3.7
Blueberries	3.2-3.6	Italian Salad Dressing	3.3
Cherries	3.2-4.7	Sour Cream	4.4
Strawberries	3.0-4.2	Sauerkraut	3.1-3.7
Raspberries	2.9-3.7	Yogurt	3.8-4.2

consumers of these drinks (25,26). The erosive potential of beverages does not depend on pH alone (27, 28) and pH is not a direct indicator of erosive potential, as other chemicals accompanying the strong acid in a particular exogenous product may modify the erosive potential. Yoghurt is one of the products with pH around 4.0 but no evidence of causing erosion for most people. This is likely to be because of the high concentration of calcium and phosphate ions present, inhibiting the erosive demineralisation of apatite through the 'common ion effect'. So other components of

beverages, such as calcium, phosphates, and fluoride, may lessen erosive potential. Also, factors such as frequency and method of intake of acidic beverages as well as proximity of tooth brushing after intake may influence susceptibility to erosion. For example, drinking through a straw lessens the contact time of the beverage with the teeth compared to drinking from a cup.

**Intrinsic erosion:** Intrinsic erosion is the result of endogenous acid, or gastric acid contacting the teeth during recurrent vomiting, regurgitation or reflux. Unlike dietary acids, the pH and titratability of gastric juice is significantly greater and so the level of destruction is normally more severe (29). The pH of gastric acid is around 1.2, and the pH of exogenous acids vary between 2.5 - 4.0. Eating disorders of psychosomatic origin such as nervous vomiting, anorexia nervosa or bulimia are often the cause of regurgitation or vomiting, which in these cases is self-induced. Causes of somatic origin include pregnancy, alcoholism, Disulfiram treatment for alcoholics and gastrointestinal disorders such as gastric dysfunction, chronic constipation (a condition of extreme and persistent constipation caused by obstruction in the intestinal system), hiatus hernia, duodenal and peptic ulcer and gastro-oesophageal reflux disease (GORD or GERD).

Due to its profound effect on erosion Gastro-oesophageal reflux disease (GORD) warrants additional mention. GORD is a common condition, estimated to affect 7% of the adult population on a daily basis and 36% at least one time a month (30). Reflux is the passive or effortless movement of regurgitated acid into the mouth. This is caused by increased abdominal pressure, inappropriate relaxation of the lower esophageal sphincter or increased acid production by the stomach (31). Signs and symptoms associated with reflux are heartburn, retrosternal discomfort, epigastric pain and dysphasia. However, symptoms are not reliable indicators of the presence or absence of GORD. Patients may be symptom free despite continuation of reflux and are described as silent refluxers

(32) and dental erosion may be the only clinical sign that reflux is occurring. Excessive intake of alcohol, carbonated drinks and certain foods such as spicy food, and fatty food can provoke GORD. Alcohol can result in gastritis and provoke GORD. Alcoholics also have poor diet control and tend to eat more acidic foods and drinks. Neurologically impaired children have significantly higher levels of gastric reflux than healthy children with over 70% of children with cerebral palsy having abnormal reflux activity (33).

**Idiopathic erosion** is the result of unknown origin, i.e. an erosion-like pathology where neither tests nor anamnesis are capable of providing an etiologic explanation.

**Factors involved on progression or arrest of erosion:** Biological factors and behavioural factors have major influences on the progress or arrest of erosion. Biologic factors includes saliva, tooth composition and structure, dental anatomy, occlusion and the anatomy of soft tissues in relation to the teeth, physiological soft tissue movements such as swallowing pattern.

**Saliva:** Salivary function is an important factor in the etiology of erosion. The erosive effects of acids are exacerbated by decreased salivary gland function. Saliva is a significant factor in the prevention of dental erosion since it helps to directly neutralize and clear acids, as well as forming a protective coat over the teeth and promoting remineralization. Buffering capacity of saliva refers to its ability to resist a change in pH when an acid is added to it. This property is largely due to the bicarbonate content of the saliva which is in turn dependent on salivary flow rate. Patients with erosion were found to have lower salivary buffer capacity when compared with controls in several studies (34,35,36,37) The pellicle is derived from specific salivary proteins and lipids that bind to the surface of the tooth (38, 39). Pellicle forms a diffusion barrier, similar to a lipid/protein membrane, and protects the very outer surface against direct acid attack. The plaque bacteria build upon the pellicle, forming a further diffusion barrier. On smooth accessible surfaces there is often

little or no plaque leaving only the pellicle as the first barrier to acid erosion. At the gingival margin there is almost always plaque and crevicular fluid access thereby protecting a narrow band from erosion.

**Tooth composition and structure:** The composition of human teeth is known to be highly variable with respect to trace element concentrations and clinical studies have shown marked differences in the response of various human teeth to acidic beverages.

Dental anatomy, occlusion and the anatomy of soft tissues in relation to the teeth: The shape and contour of teeth and their prominence in the mouth relative to drinking identified as factors that may modify the erosion process. Acid-eroded enamel is considered more susceptible to attrition, and thus, dental occlusion is likely to play an important role in the manifestation of erosion-induced tooth wear patterns. Conversely, tooth wear, primarily caused by parafunctional habits such as bruxism, will be greatly accelerated in the presence of an erosive challenge to the teeth.

**Anatomy of the soft tissues and physiological soft tissue movement:** The anatomy of oral soft tissues in relation to the teeth and physiological soft tissue movements will influence the tooth sites that acidic substances will contact and will influence the clearance pattern of acidic substances from the mouth. Friction from the tongue even can cause erosion.

**Behavioural factors:** Behaviour can be strongly influenced by socio-economic status. Some studies have indicated that people involved in strenuous exercise may be at risk of dental erosion because of their more frequent ingestion of acidic sports drinks, fruit juices and other acidic beverages. Ironically, healthier diets including the consumption of more fruits and vegetables may be an important factor in the aetiology of dental erosion. As a matter of fact lactovegetarian diet has been associated with a higher prevalence of dental erosion. Further, individuals with eating disorders such as anorexia nervosa and bulimia may compound their erosion risk from regurgitation with the

consumption of large quantities of fruits, juices and carbonated soft drinks in addition to wilfully purging ingested food.

#### **Diagnosis of erosion**

Detailed familiarity with the current understanding of dental erosion etiology and a differential diagnosis are critical before any dietary or behavioral pattern can be associated with the observation of tooth structure loss.

Medical history must include information regarding any systemic conditions that influence the salivary flow, use of any chronic medication, gastric reflux, heartburn, acid mouth taste frequent vomiting and so forth. A thorough case history may involve consultation with the patient's physician.

Since high intake of acidic foods and beverages have been strongly associated with erosion. Therefore a thorough diet record of each and every patient must be noted down. Detailed information regarding oral hygiene practices must be noted including method, types and frequency.

Dental history regarding jaw parafunction and bruxism should also be taken. Patient's occupation and recreational habits must also be recorded in the history. Intraoral photographs for documentation and study models to monitor progression are equally necessary. Salivary tests including unstimulated and stimulated flow rate as well as buffering capacity should be performed. A thorough case history will also undoubtedly involve consultation with the patient's physician

#### **Clinical appearance**

Erosive lesions can appear on any surface depending on the area of tooth that comes directly under the acidic attack. For example patient suffering from GORD, palatal surface of upper anterior teeth is most commonly involved, sucking a lemon against anterior teeth will involve facial surfaces.

Dental erosion must be distinguished from other forms of wear, as it contribute to general tissue loss by surface softening, thus enhancing physical wear processes. Loss of

shine or luster of enamel and appearance of glazed surface are early signs of erosion. Further attack leads to flattening of convexities of teeth, cusps become more rounded and overall appearance of teeth becomes more flattened. Edges of restorations may appear to rise above the level of the adjacent tooth surfaces. Appearance of concavities on the smooth surfaces, grooving or cupping occur on incisal/occlusal surfaces with discrete areas of exposed dentine, which increase in area as the erosion progresses. There may also be incisal chipping and teeth may appear darker as dentine is exposed and increase in enamel translucency at incisal edges. In severe cases, the whole tooth morphology disappears and the vertical crown height can be significantly reduced. Depending on severity hypersensitivity appear as first symptom to patients, further tooth loss can even cause pulp exposures.

The concavities must be differentiated from the wedge shaped defects caused by abrasion which have sharp margins and cuts at right angle into the enamel and their depth clearly exceeds the width while concavities of erosive lesions are more wide compared to their depth with indulating borders. A typical appearance of erosive lesion is appearance of chamfered enamel margin coronal to CEJ ie presence of intact enamel along the ingival margin. The preserved enamel margin may be due to presence of plaque which act as diffusion barrier and also the neutralization of acid by sulcular fluid having ph between 7.5-8.0.

**Management of erosion:** A complete clinical management involves the identification of cause for erosion, preventive management and restorative management. Identification of the etiology is important as a first step in management of erosion. A detailed questionnaire should be asked to patient to identify the etiologic factors. Refer patients or advise them to seek appropriate medical attention when intrinsic causes ie GORD, vomiting, or salivary dysfunction are involved. If excessive dietary intake of acidic foods or beverages is discovered, patient education and counseling are important.

Since erosion, attrition and abrasion often occur simultaneously all causative components must be taken into consideration when planning preventive strategies. Preventive programmes comprise of dietary advice, fluoride regimes, stimulation of salivary flow rate, use of buffering medicaments and correct use of oral hygiene products.

Dietary advice include identification of acidic food in patient diet, their amount and frequency. Acidic drinks should be drunk quickly rather than sipped and use of straw is beneficial and should not be held or swished in mouth.

Toothbrushing should be delayed for at least 20 minutes after an erosive attack and possibly up to 60 minutes because of the increased risk of abrasive wear on the softened/eroded surface (40,41) Instead use of fluoride mouth rinse, baking soda solution or simply rinsing with water is better.

Avoidance of acidic food and drink between meals, at bedtime and during the night is highly recommended. Milk related products have pH close to normal and should be preferred compared to soft drinks. Finishing a meal with milk or cheese is also useful as this will help bring the oral environment back to a neutral pH (42) Patient should be instructed to use appropriate oral hygiene techniques like use of a soft toothbrush and low abrasion fluoride containing toothpaste as high abrasive toothpastes may destroy the pellicle (43). Toothpastes or mouthwashes with a too low pH should be avoided. Fluoride mouth rinses, varnishes and desensitising agents aids in remineralisation and decrease sensitivity (44, 45). Fluoride application 2-4 times by dentist and use of topical fluoride at home by patient is recommended. The application of concentrated topical fluoride gels and varnishes before the erosive challenge is likely to take place was found experimentally to provide some inhibition of demineralisation of both roots and crowns (46). Recent laboratory and clinical studies have shown that toothpaste containing 5000 ppm fluoride was significantly more effective than one

containing 1450 ppm fluoride in reducing enamel loss caused by orange juice (47,48).

Saliva provides buffering capacity that resists acid attacks. This buffering capacity increases with salivary flow rate. Saliva is also supersaturated with calcium and phosphorus, which inhibits demineralization of tooth structure. Stimulation of salivary flow by use of a sugarless lozenge, candy or gum is recommended. The use of a non-acidic sugar-free lozenge may be more advisable, since gum chewing may have an abrasive effect on softened tooth structure. Neutralize acids in the mouth by dissolving sugar-free antacid tablets 5 times a day, particularly after an intrinsic or extrinsic acid challenge. Consider application of composites and direct bonding where appropriate to protect exposed dentin (49).

Use of protective devices. Insertion of a close fitting occlusal guard at high risk times such as during sleeping (for GORD patients), swimming in poorly maintained swimming pool (for professional swimmers) or voluntary vomiting (for anorexia/bulimia patients) may be considered.

#### **Restorative management**

The longevity of dental restorations depends on the durability of the material per se and its wear resistance (8), the durability of the interface between tooth substance and restoration, the level of tooth destruction, its location and load.

Under acidic conditions all dental restorative materials show a degradation over time (surface roughness, decrease of surface hardness, substance loss). However, it seems that ceramic and composite materials show a good durability. Conventional glass-ionomer cements are not recommended as permanent restorations because of their disintegration in acidic conditions (38).

In past the severely eroded dentition was usually rehabilitated by the provision of extensive crown and bridge work or removable overdentures. However due to improvements in composite restorative

materials, and in adhesive techniques, it has become possible to rehabilitate mild and moderate eroded dentitions in a less invasive manner and the use of modern direct restorative materials can provide excellent longevity, even in load-bearing situations (52,53). The advantage of direct composite restorations is that they are adaptable to the defect and repair is straightforward. Several case reports demonstrate the successful rehabilitation of (erosive) worn dentitions using adhesive techniques (54-56). The restorative treatment plan should be adapted to the degree of tooth substance loss e.g. loss of vertical dimension. These options also include cast alloy restorations for palatal and occlusal erosion, sandblasted nickel-chromium alloys or heat treated gold are usually used where aesthetics is not important. The castings can be cemented with a resin based material that can bond to both metal oxide and tooth surface.

Initially, erosive tooth wear limited to the enamel can be restored with direct composites or in more advanced cases, porcelain veneers can be considered as treatment of choice. Restorations inserted in this stages not only fulfil the esthetic needs but also prevent further progression of erosive lesions and take care of any hypersensitivity present.

However cases of advanced erosion poses a problem for their reconstruction as there is not enough space for the restorative material on the occlusal side. As long as there is only a loss of 1-2mm of interocclusal space, the teeth can be reconstructed directly with composite materials (57). Patients tolerate such a small increase in the vertical dimension usually without any problem. However further loss of interocclusal space may require more extensive treatment however to prevent an invasive, full mouth rehabilitation, it can be convenient to gain interocclusal space with orthodontic measures, especially if mainly groups of teeth (e.g. all teeth in the anterior region) are involved in erosive tooth wear. The orthodontic treatment can be achieved with fixed or removable appliances, such as the Dahl appliance (57,58). Following orthodontic treatment, the eroded teeth can

then be reconstructed (57, 59).

However if extensive tooth tissue loss is present, occlusal reconstruction may be necessary, particularly for older patients. Endodontic and periodontic therapy, surgical crown lengthening, placement of foundations, and orthodontic repositioning of the teeth may be required before crowns and other prostheses can be constructed. An acrylic full arch maxillary splint or nightguard may be needed to limit the adverse effects of concomitant tooth grinding once restorative treatment is complete.

#### Recall and maintenance care

Failure to monitor the patient may result to relapse of condition, therefore it is essential that a recall care regime matched to the patient's requirements should be established, to check patient compliance, monitor wear, reinforce advice, and for encourage to maintain changed behaviour. it is important to combine active treatment with preventive measures and recall at regular intervals to ensure the long-term success.

#### Conclusion

Tooth wear and erosion are modern day problems for dentistry. Early diagnosis and accurate detection of possible risk factors including their interplay are essential to halt the process of tooth wear. Long-term success is only possible when the cause is eliminated. An incorrect diagnosis regarding the contributions of abrasion, attrition, abfraction and erosion to specific lesions will result in inappropriate or ineffective treatment. Due to its major impact on tooth wear, management of erosion is becoming increasingly significant in the long-term maintenance of the dentition. Such management indeed is complex and may require interdisciplinary long-term strategy including liaison with physicians.

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## Tooth Whitening - A Review

### Abstract

Aesthetics by definition is the science of beauty that particulates detail of an animate or inanimate object that makes it appealing to eye. In this modern civilized cosmetically conscious world, well contoured and well aligned "white teeth" set standard for beauty. Such white teeth are not only attractive but also indicative of nutritional health, self-esteem, hygiene practice and cosmetic status. Tooth whitening has become a multi-million dollar industry, and there are literally hundreds of competing products to whiten teeth, be they in-office procedures or take-home systems. This review article provide information on various tooth whitening materials and their effects.

### Key Words

Microabrasion, Macroabrasion, Lasers, Root Resorption, Microhardness.

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## INTRODUCTION

Dentists have been perplexed by the problem of tooth discoloration for the last 200 years and have tried numerous chemicals and methods to remove the various types of discoloration. The process and outcome of whitening depends upon the cause and type of discoloration. Treatment modalities include micro abrasion, macroabrasion, veneering and placement of porcelain crowns, but they all require cutting of tooth structure. There are increasing numbers of patients who do not want their teeth to be "cut down" for crowns and prefer an alternative, conservative approach of tooth bleaching.

American Dental Association defined bleaching as the treatment, usually involving an oxidative chemical that alters the light absorbing and/or light reflecting nature of the material /structure thereby increasing its value (whiteness)<sup>1</sup>. The pioneer in the field of bleaching was Macintosh (1799) who invented chloride of lime and named it as "Bleaching Powder". However, from 1860's one of the most effective early techniques for bleaching non- vital teeth was introduced by Truman J.<sup>2</sup> using "Labarague's solution". Since then, several agents were used directly or indirectly to act upon tooth. Considering efficacy, advantages and disadvantages of different materials, most commonly used

materials are hydrogen peroxide, carbamide peroxide and sodium perborate

## BLEACHING MATERIALS

**HYDROGEN PEROXIDE (H<sub>2</sub>O<sub>2</sub>)** - It is a clear colorless odorless liquid stored in light- proof amber bottles. Various concentrations of this agent are available such as 5.5%, 7.5%, 8%, 10% but 30-35% stabilized aqueous solutions are the most common. Hydrogen peroxide is capable of generating a hydroxyl radical, an oxygen-derived free radical. Hydroxyl radicals are extremely reactive and have been shown to degrade components of connective tissue, particularly collagen and hyaluronic acid. Hydrogen peroxide is caustic and burns tissues on contact, releasing toxic free radicals, perhydroxyl anions, or both. The pH value plays an important role in the rate of reaction in the bleaching process. Ionization of buffered hydrogen peroxide in the pH range of 9.5 to 11.8 produces more perhydroxyl free radicals. The result is a 50% greater bleaching effect in the same time than other pH levels. The average pH value found in various strengths of hydrogen peroxide is approximately 4. This acidity provides hydrogen peroxide a long shelf life. However to achieve efficacy standards, hydrogen peroxide must be buffered to a much higher pH value with a salt of an alkaline base (sodium hydroxide) before being used as a bleaching agent.

Various delivery systems for hydrogen peroxide are:

- Syringe form
- Bottle form
- Strip form- Whitestrips premium- 10% hydrogen peroxide
- Wrap form- Whitening wrap- 8% hydrogen peroxide
- Tray -with or without reservoirs.

## CARBAMIDE PEROXIDE (CH<sub>6</sub>N<sub>2</sub>O<sub>3</sub>)

This agent also known as urea hydrogen peroxide and is available in the concentration range of 3 to 45%. Solutions of 10% carbamide peroxide break down into urea, ammonia, carbon dioxide and approximately 3.5% hydrogen peroxide. Popular commercial preparations contain about 10% carbamide peroxide, with a mean pH of 5 to 6.5. A 35% solution yields 10% hydrogen peroxide. The 15% and a 20% solution of carbamide peroxide are also available for the dentist supervised home bleaching procedure. The 15% carbamide peroxide solution yields 5.4% hydrogen peroxide and the 20% one yields 7% hydrogen peroxide.

A 35% solution of carbamide peroxide is available as to be used by the dentist as in an In Office procedure prior to the patient using the home kit.

It was found that carbamide peroxide has a slower rate of reaction than hydrogen

peroxide, especially at room temperature and oral temperatures. Hydrogen peroxide releases oxygen within the first few seconds of contacting surfaces, whereas carbamide peroxide remains active for 40-90 minutes after tissue contact. Oxygen combines with stain molecules in enamel to make stains more soluble and are dissolved into the saliva or an oral rinse.

#### **SODIUM PERBORATE - Na<sub>2</sub>[H<sub>2</sub>(O<sub>2</sub>)<sub>2</sub>(OH)<sub>4</sub>]**

Various types of sodium perborate preparations are available: monohydrate, trihydrate, and tetrahydrate:

- Sodium perborate monohydrate - active oxygen is 16%
- Sodium perborate trihydrate - active oxygen is 11.8%
- Sodium perborate tetrahydrate - active oxygen is 10.4%

This oxidizing agent is available in a powdered form or as various commercial preparations. Sodium perborate is stable when dry but, in the presence of acid, warm air or water, decomposes to form sodium metaborate, hydrogen peroxide and nascent oxygen.

#### **MECHANISM OF ACTION OF BLEACHING AGENT:**

The whitening mechanism of bleaching is believed to be linked to the degradation of high molecular weight and complex organic molecules that reflect a specific wavelength of light which is responsible for the color of the stain. The resulting degradation products are of lower molecular weight and composed of less complex molecules that reflect less light, resulting in a reduction or elimination of discoloration. Darkly pigmented organic material responsible for enamel discoloration is composed of carbon ring structures with unsaturated double bond.

With further oxidation these products are modified to hydrophilic non-pigmented carbon structures with saturated carbon bonds. Ideally this is the point at which whitening should be terminated. If the degradation process continues, there is further decomposition of organic matrix, which can lead to complete oxidation with generation of carbon dioxide and water, resulting in a total loss of enamel matrix protein.

#### **BLEACHING TECHNIQUES**

These can be classified according to the vitality of the tooth:

- 1) **Non-vital tooth bleaching-**  
Walking bleach technique  
In-office bleaching  
Inside/outside bleaching
- 2) **Vital tooth bleaching-**  
Dentist-administered bleaching  
Dentist-supervised bleaching  
Dentist-provided bleaching/night guard vital bleaching/matrix bleaching  
Over the counter products (OTC)

#### **NON-VITAL TOOTH BLEACHING**

**Intracoronary bleaching** is a conservative alternative to the more invasive esthetic treatment of non-vital discolored teeth. **American Assoc. of Endo.<sup>1</sup> (1998)** suggested that it involves the use of chemical agents placed within the coronal portion of an endodontically treated tooth to remove tooth discoloration. This intracoronary bleaching technique requires the application of at least 2 mm thick layer of protective cement such as zinc polycarboxylate, zinc phosphate, glass ionomer cement, IRM or endodontic obturation.

#### **WALKING BLEACH TECHNIQUE**

It is probably the most popular option for bleaching non-vital teeth. Both hydrogen peroxide and sodium perborate have been used for walking bleach technique and various heat sources have been applied to speed up the reaction and improve the bleaching effect. **Spasser H.F.<sup>3</sup>** and **Holmstrup G., et al.<sup>4</sup>** pioneered the combination of sodium perborate and water or **Nutting E.B. and Poe G.S.<sup>5</sup>** gave the concept of sodium perborate mixed with hydrogen peroxide i.e. Modified walking bleaching technique.

The medicament is placed into the pulp chamber, sealed, left for 3-7 days and is thereafter replaced regularly until acceptable lightening has been achieved. If the tooth has not responded satisfactorily after 2-3 treatments, then Walking bleach technique can be supplemented with an in-office bleaching technique,<sup>6</sup> acid etching of dentin internally would open the dentinal tubules to allow better penetration of bleaching agents.<sup>7</sup> Various advantages of this technique are that it requires less chair side time, is safer and more comfortable for the patient<sup>4</sup>.

#### **THERMO/ PHOTO CATALYTIC BLEACHING**

A cotton pellet soaked with 30 - 35% hydrogen peroxide solution is placed in the

pulp chamber after placing 2mm thick barrier. Heat is applied with a heat or light source with a temperature range of 46-51°C<sup>4</sup>. Bleaching should be limited to separate 5- minute's periods rather than a long continuous period<sup>8</sup>. Light application by specially designed lamps can be used either alone or in combination with heat.

#### **INSIDE/ OUTSIDE BLEACHING TECHNIQUE**

**Settembrini L., et al.<sup>9</sup>** gave a modification of walking bleaching technique. This technique lead to reduction in the number of in-office appointments<sup>10</sup> In this technique, access to the pulp chamber is gained by the removal of coronal restoration and coronal portion of 2-3 mm of root filling. The remaining root filling is sealed with 2 mm thick glass ionomer cement. The patient places bleaching material, usually 10% carbamide peroxide, intracoronally at regular intervals and covers the lingual aspect of the tooth with a plastic splint (tray). The pulp chamber is left unsealed during the weeks of treatment. The advantage of this method is that it saves chair-side time as bleaching takes place both internally and externally simultaneously<sup>11</sup>

#### **VITAL TOOTH BLEACHING**

##### **DENTIST ADMINISTERED BLEACHING**

It requires the use of a high concentration of hydrogen peroxide (30 - 35%) or carbamide peroxide (35-40%). This is often supplemented by a heat or a light source to enhance the action of peroxide<sup>12</sup>. The technique is accomplished without the anesthesia to determine the patient's pain threshold for the heat level. The main advantages of this technique are that, although it uses caustic chemicals, it is under the complete control of the dentist and the soft tissue is protected from the procedure. The disadvantages of this technique are the cost, the unpredictable nature of the result, chances of pulpal injury and the unknown duration of the treatment.

##### **DENTIST SUPERVISED BLEACHING**

It is done by means of a bleaching tray loaded with high concentrations of carbamide peroxide (35-40%) that is placed in the patient's mouth for 30 minutes to 2 hours while the patient is in the dental office.

##### **DENTIST- PROVIDED BLEACHING (Night-guard vital bleaching/Matrix**



### Brand Professional In-Office Bleaching Products

Company		Type	Percent	Time
Ultradent Products	Opalescence Xtra	Hydrogen Peroxide	35%	As needed
	Opalescence Xtra Boost	Hydrogen Peroxide	38% + activator	As needed
Discus Dental	White Speed	Hydrogen & Carbamide Peroxide	18% H2O2 + 22% H2O2 and carbamide per	30 minutes
	ZOOM!	Hydrogen Peroxide	25%	3 - 20 min sessions
Densply	Illumine'	Hydrogen Peroxide	30%	15-60 min
BriteSmile		Hydrogen Peroxide	15%	60+ min

Brand	Light Activation	Heat Activation	Mixing
Opalescence Xtra	Yes	Yes	
Opalescence Xtra Boost	No	No	Syringe to syringe mixing, 7.0 pH
White Speed	No	No	Custom Trays, equivalent to 13.2% H2O2
ZOOM!	Whitening Lamp	Yes	
Illumine'	No	No	Syringe to syringe mixing, Custom trays
BriteSmile	Yes	Yes	7.0 pH

### Few Professional Take Home Bleaching Products

Company	Brand	Type	Percent	Time	Misc
Ultradent	Opalescence	Carbamide Peroxide	10%	8-10 hrs at night	Reg, mint, or melon
	Opalescence F	Carbamide Peroxide	15 or 20%	8-10 hrs at night	Reg, mint or melon
	Opalescence PF	Carbamide Peroxide	15 or 20%	8-10 hrs at night	Potassium nitrate & Fl
Discus Dental	Nite White Excel 2	Carbamide Peroxide	10, 16, or 22%	10-overnight	Regular or Cherry
				16-4hrs	
				22-1hr	
	Nite White Excel 3	Carbamide Peroxide	Same	Same	Hydrogen Peroxide 1%
	Day White Excel 2	Hydrogen Peroxide	7.5 or 9.5%	30 min 2xday	
Premier Dental	Perfecta Bravo	Hydrogen Peroxide	9%	30 min 1xday	
Densply	Nupro Gold	Carbamide Peroxide	10% or 15% with Fl		
Procter & Gamble	Crest White Strips	Hydrogen Peroxide	6.50%	30 min 2xday	3 week supply

bleaching/Dentist prescribed home - applied bleaching) - This recently introduced bleaching technique has created a resurgence in the field of bleaching primarily because of its relative ease of application, safety of the materials used, the low cost, its general availability to all socio-economic classes of the patients and the high percentage of successful treatment.

It is administered by the patient using 5-22% solution of carbamide peroxide in a custom made tray. Results are generally seen in 2-3 weeks, and the final treatment outcome is complete in 5-6 weeks. However the treatment times may vary extensively and much depends on the amount of time per day

the patient chooses or is able to apply the technique. Recently, solutions of hydrogen peroxide that range from 1% to 16% and carbamide peroxide that are either 10% or 15% in concentration have been used.

### OVER THE COUNTER PRODUCTS-

These are often based on carbamide peroxide or hydrogen peroxide of various concentrations and placed in a prefabricated tray.

1. Acid - Rinse: This is usually citric or phosphoric acid which may be harmful to the dentition, as continued rinsing may cause tooth erosion. The potential for misuse may be considerable. The PH

of this rinse is between 1 and 2.

2. Bleaching Gel: This gel, applied for two minutes, has an acidic PH of 2-3.
3. Post Bleach 'polishing cream' - This is tooth paste containing titanium di-oxide which may give a temporary painted white appearance.

Whitening strips has been used recently.<sup>13</sup>

### POWER BLEACHING AND IN-OFFICE BLEACHING:

Some dentists and patients prefer in-office or power bleaching. A high concentration of hydrogen peroxide (generally 35%) is administered to the teeth with an activating or promoting method (e.g. heat, light, laser) to expedite the whitening effect. The treatment is in complete control of the operator. But it has certain disadvantages. It takes more clinical time and may be more expensive. Longer and more frequent appointments may be needed. Teeth are dehydrated initially which can lead to false evaluation of actual shade change. There are serious safety conditions. The bleach is normally a stronger, caustic concentration and so is more dangerous.

### COMPRESSIVE BLEACHING TECHNIQUE

It was suggested that the power bleaching technique could be made more effective by compressing the bleaching material on the tooth. He recommends using 35% hydrogen peroxide in a bleaching tray, seating the tray edges with light cured resin to prevent damages to the soft tissue. The benefit of this method is that it influences the penetration of oxygen ions into the tooth enamel, which improves tooth shade significantly<sup>14</sup>.

### DUAL - ACTIVATED TECHNIQUE-

This bleaching system is formulated for both light and chemical activation. Dye indicators have also been incorporated in these bleaching systems.

### LASER-ACTIVATED BLEACHING -

Reyto R.<sup>15</sup> introduced lasers for extracoronal bleaching. The whitening effect with the use of laser is achieved by a chemical oxidation process. Laser bleaching has the advantage that it acts as a jump- start for difficult cases by helping to remove difficult stains such as tetracycline and flourosis.

### EFFICACY OF THE BLEACHING TECHNIQUES

### INTRINSIC TOOTH BLEACHING

There are various methods and materials

available for bleaching non- vital teeth. 90%-95% success with the thermocatalytic bleaching or Walking bleach method has been observed.

Earlier authors reported that the bleaching efficacy of sodium perborate is enhanced by the addition of 30% hydrogen peroxide<sup>16, 5</sup>, but later on it was found that there was no difference in the shade of teeth bleached with sodium perborate in 30% hydrogen peroxide, sodium perborate in 3% hydrogen peroxide or sodium perborate in water.<sup>8</sup> Some authors suggested that though bleaching efficacy of sodium perborate is enhanced by the addition of 30% hydrogen peroxide, but 30% hydrogen peroxide has been associated with external root resorption when used intracoronally. So, it is recommended that sodium perborate mixed with water rather than 30% hydrogen peroxide or heat should be used in walking bleach method to prevent the occurrence of external root resorption.<sup>17</sup>

### EXTRINSIC TOOTH BLEACHING

Vital tooth bleaching can be performed with a high rate of success as a more conservative measure than restorative treatment, such as porcelain veneers, crowns or composite bonding. It was advocated that most teeth are susceptible to bleaching, provided that the treatment is carried out for a sufficient long time<sup>18, 19</sup>. The first subjective change in tooth color can be observed after 2-4 nights of tooth bleaching using night guard vital bleaching with 10% carbamide peroxide.<sup>20</sup> **Matis B.A., et al.**<sup>21</sup> compared the efficacy and safety of 10% carbamide peroxide to the placebo gel as a home bleaching gel and found that 66% patients had clinically observable color change. **Swift E.J. Jr., et al.**<sup>22</sup> in his study examined the use of 10% carbamide peroxide nightly for 2 weeks and found that the teeth were 8 shade units lighter on Vita shade guide. **Ritter A.V., et al.**<sup>23</sup>, from the follow up of 30 patients whose teeth were bleached with 10% carbamide peroxide revealed that 43% patients perceived their tooth color as stable 10 years after bleaching.

**Shethri S. Al., et al.**<sup>24</sup> evaluated two in-office bleaching products (35% and 38% hydrogen peroxide) and found no statistical difference during all active treatment periods and follow - up visits.

**Zekonis R., et al.**<sup>25</sup> compared the efficacy of 10% carbamide peroxide (at- home for 14 days) and 35% hydrogen peroxide (in-office; 60 minutes) and found that 10%

carbamide peroxide produced significantly lighter teeth than 35% hydrogen peroxide during all active treatments and follow- up visits. **Dietschi D., et al.**<sup>26</sup> supported this result by his study in which home bleaching using 10%, 15%, 16% and 20% carbamide peroxide was compared to in- office 15% and 30% hydrogen peroxide bleaching and found that home bleaching regime proved more efficient than in- office technique. However the use of higher concentration of carbamide peroxide (15, 16, and 20%) did not prove significantly more effective than 10% carbamide peroxide.

Some studies when compared the bleaching strips (6.5% hydrogen peroxide) and the bleaching tray(10% Carbamide peroxide) and found that bleaching strips were more or equally efficient.<sup>27,28,29</sup>

### ADVERSE EFFECTS

**Tooth sensitivity-** Tooth sensitivity was found to be the most common side- effect of external tooth bleaching<sup>30</sup>. It has shown that there is concentration dependent peroxide penetration in the enamel and dentin that entered the pulp chamber<sup>31,32</sup> and penetration of the restored tooth was higher than that of intact tooth.<sup>33</sup> Also it was found that where heat was used to accelerate the bleaching process and the exposure was 30 minutes thrice, 78% patients suffered sensitivity to cold and intermittent spontaneous pain lasting up to 1 day after treatment<sup>34</sup>. **Gonzalez Ochoa J.G.** histologically evaluated human pulp after bleaching over night with 10% carbamide peroxide and revealed inflammatory changes in 4 out of 12 teeth after 4 and 14 days' treatment but there was no inflammation in teeth that were bleached with carbamide peroxide for 14 days followed by the recovery phase of 14 days.<sup>35</sup> Tooth sensitivity normally persists for up to 4 days after the cessation of bleaching treatment

**Cervical root resorption** is an inflammatory - mediated external resorption which can be seen after trauma and following intra- coronal bleaching. It was presumed that the irritating chemical diffuses via unprotected dentinal tubules and cementum defects<sup>36</sup>. Diffusion of hydrogen ions from intra coronal bleaching agents may provide an acidic environment that is optimal for osteoclastic activity and bone resorption. Also the difference in the osteoclastic activity of hydrogen peroxide, carbamide peroxide and sodium perborate is due to the difference in the pH of 35% hydrogen peroxide (3.7), 35% carbamide

peroxide (6.5) and sodium perborate (9.9).<sup>37</sup>

**Alterations in the tooth** - Several studies on the adverse effects of non- vital bleaching show alterations in the structure and microhardness in the enamel, dentin and cementum. Some studies found that hydrogen peroxide causes denaturation of dentin which may then act as a foreign body and become susceptible to resorption.<sup>38</sup> others demonstrated that 35% hydrogen peroxide cause morphological and structural changes in dentin and enamel. These changes are time -dependant and affected directly by pre- treatment with acid etchants. **Rotstein I., et al.**<sup>40</sup> found that 30% hydrogen peroxide reduces the organic component of dentin and cementum, making them more susceptible to degradation while 2% sodium perborate in water did not cause any change in the percentage of inorganic composition of dentin and cementum. They found that dentin and cementum became 10- 12- fold less soluble when sodium perborate mixed with 3% hydrogen peroxide was used instead of 30% hydrogen peroxide.

**Alterations in microhardness of enamel and dentin-** Despite the widespread use of tooth whitening products, their effects on the physical properties of tooth is still a matter of concern. It was reported that enamel surface developed varying degree of surface porosity and alteration due to bleaching with 10% carbamide peroxide after pretreatment with 37% phosphoric acid<sup>41</sup>. It was found that the total mineral content of enamel was reduced from 90.39 to 86.01 following bleaching with 10% carbamide peroxide gel. Also the calcium - phosphate ratio decreased from 2.10 to 2.07.<sup>42</sup> Also bleaching enamel with 10% and 20% carbamide peroxide could significantly reduce its ultimate tensile strength within 14- day treatment<sup>43</sup>

To compensate the altered microhardness of enamel, it was assumed that microstructural alterations in bleached enamel may be reversed due to repair mechanism by salivary components. Increase in enamel microhardness could be observed if fluoride, potassium nitrate or sodium citrate is present in the bleaching agent. It was suggested that fluoride treatment following bleaching reduces the demineralization of enamel caused by hydrogen peroxide and carbamide peroxide.<sup>44</sup>

**Effect on restorations-** Various studies found that that despite the utilization of

modern dentin adhesive systems, non-vital tooth bleaching has shown to adversely affect the sealing ability of resin composites when bonding is performed<sup>45,46,47</sup> immediately following bleaching.

A number of studies have examined the reason for reduced bond strength of resin composite to tooth and suggested that the poor bonding surfaces are created by changes in enamel structure resulting from loss of calcium, increased porosity, decrease in microhardness and alterations in the organic substance, manifesting itself with an over-etched appearance and loss of prismatic form.<sup>45</sup> Another suggested reason could be the residual peroxide from the bleaching agent which interferes with resin attachment and inhibits resin polymerization.<sup>48</sup>

To compensate the problem of compromised bond strength of resin composites, different treatment options have been investigated. Some authors recommended delays in restorative procedures to avoid clinical problems associated with compromised bond strength following bleaching.<sup>49</sup> Others suggested that the removal of superficial enamel after bleaching restores the bond strength of resin composite to the tooth to the normal level. Also use of alcohol-based bonding agents and treatment of access cavities and pulp chambers with 10% sodium ascorbate for 3 hours following bleaching has been recommended<sup>50</sup> It was also suggested that 1-week delay in the restorative procedures after bleaching improved the reduced sealing ability of resin composite, but did not reverse it entirely. They found that placement of a calcium hydroxide base and glass ionomer cement over the root canal filling is an important step to seal the root canal from the bleaching agent.

Various studies documented increase in amount of mercury released varied with the type of amalgam and the type of the bleaching agent. It ranged from 4 times to 30 times higher than the saline controls<sup>51</sup>

It was also found that bleaching may increase the solubility, surface degradation and fluoride release of glass ionomer cement and other cements.<sup>52</sup> Also it significantly reduces the microhardness of composites and poly acid modified composites<sup>67</sup>.

**Mucosal irritation-** A high concentration of hydrogen peroxide (30-35%) is caustic to the mucous membrane and may cause burns.

### Genotoxicity and carcinogenicity of bleaching agents

A dose dependant increased incidence of duodenal hyperplasia where 0.1% and 0.4% hydrogen peroxide was administered to mice via drinking water for 100 days. Benign and malignant lesions in the stomach and duodenum after 90 days exposure were also found.<sup>53</sup> However I.A.R.C.<sup>54</sup> (the international agency for research on cancer) concluded that there is limited evidence in experimental animals and inadequate in humans for the carcinogenicity of hydrogen peroxide.

### Toxicity Of Hydrogen Peroxide And Carbamide Peroxide

The acute effects of hydrogen peroxide ingestion are dependent on the amount ingested and the concentration of the hydrogen peroxide solution. Accidental ingestion of 35% hydrogen peroxide has resulted in several fatal or near-fatal poisonings<sup>55</sup>. These individuals vomited, were cyanotic, and experienced convulsions and respiratory failure. Young children are at high risk for accidental ingestion. One syringe (3.5 g) of 18% carbamide peroxide yields 210 mg of hydrogen peroxide. Fatal poisoning is therefore not likely even if one ingests one syringe of bleaching agent. Ulceration of the oral mucosa and esophagus, nausea, vomiting, and sore throat have been reported for other hydrogen peroxide-containing preparations. It is therefore important to keep syringes with bleaching agents out of the reach of children, to prevent any possible accident.

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## Halitosis - Revisited

### Abstract

Oral malodor is a common problem among general population and evidences reveal that it forms about 85% of all bad breath. Bad breath can have a distressing effect that may become a social handicap and the affected person may avoid socializing. The condition is multifactorial in etiology and may involve both oral and non-oral conditions. Volatile sulphur compounds (VSC), namely hydrogen sulphide (H<sub>2</sub>S) and methyl mercaptan (CH<sub>3</sub>SH) are the main cause of oral malodor. These substances are by-products of the action of bacteria on proteins. Gram-positive bacteria produce little or no malodor; most Gram-negative bacteria are potent producers of odoriferous compounds. Treatments corresponding to the causes of oral malodor include mechanical or chemical tongue cleaning, periodontal disease treatment, oral hygiene instruction and mouth rinses or mouthwashes.

### Key Words

malodor, volatile sulphur, hydrogen sulphide, gram-negative

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Bad breath as they say is better than no breath at all. And as "George Orwell" said, "the road to wigan pier". You can have affection for a murderer, but you cannot have affection for a man/woman whose breath stinks.

Yet, halitosis is a common and universal problem that can lead to a significant amount of social disharmony and embarrassment<sup>1</sup>. Halitosis term originates from the Latin "halitus" means "breath" and the Greek "osis" means "abnormal" or "diseased".

In simple words also known as "Bad Breath, Foul Odor, Fetur ex ore, Fetur oris"

### Introduction

Halitosis, breath malodor or colloquially known as "bad breath" can be subdivided as real halitosis, pseudohalitosis and halitophobia<sup>2</sup>.

### True halitosis<sup>3</sup>

Real halitosis can be further subdivided into physiological and pathological halitosis. Physiologic halitosis includes halitosis caused by dietary components, deleterious

habits, morning breath, secondary to xerostomia caused by physiologic factors. Pathologic halitosis occurs secondary to pathologic conditions or oral tissues like gingival and periodontal diseases like periodontitis, acute necrotizing ulcerative gingivitis, residual post-operative blood, debris under dental appliances, ulcerative lesions of the oral cavity, Halitosis may be associated with coated tongue, may occur due to xerostomia secondary to salivary gland diseases, tonsilloliths.

### Pseudohalitosis<sup>3</sup>

Patients who suffer from pseudohalitosis complain of the existence of halitosis though it is not perceived by others. This condition can be managed effectively by counseling (using literature support, education and explanation of examination results) and simple oral hygiene measures.

### Halitophobia<sup>3</sup>

Some individuals continue to insist that they have halitosis even after they have been treated for genuine or pseudo-halitosis. Such individuals are categorized as halitophobic. Halitophobia may be considered when no physical or social evidence exists to suggest that halitosis is

present.

### Psychogenic Halitosis<sup>3,4</sup>

Psychogenic Halitosis is the one which is imagined. In this a person believes that his breath smells bad when it actually does not. This problem may occur in people who tend to exaggerate normal body sensations. Sometimes this is caused by a serious mental disorder such as schizophrenia. A person with obsessional thoughts may have an overwhelmed sense of feeling dirty. A person who is paranoid may have the delusion that his organs are rotting. Both these persons feel their breath smells bad. Such people may be helped by having a doctor or dentist assures them that they do not have bad breath. If the problem continues, person benefit from seeing a psychotherapist.

The term oral malodor characterizes malodor that has its origin in the oral cavity. Clinical surveys have shown that over 90% of all breath malodor originates in the mouth<sup>5</sup> (Delanghe et al 1997, van Steenberghe 1997).

### History

The references of oral malodour have been

found in scripts of Eber papyrus as early as 1550 B.C., and in the Talmud (a book containing ancient Jewish civil and religious law). Hippocrates (460-400 B.C.) had developed a mouthwash of unadulterated wine, anise, dill seed and myrtle. Maccius Platus (254-184 B.C.) a Roman dramatist who was sufficiently offended by his wife's halitosis to find it just cause for infidelity.<sup>5</sup> In 19th century Joseph Howe, a physician, introduced his well-written and informative book. He believed that halitosis was the result of sulphuretted hydrogen, which is found in great abundance in the intestinal canal as well as in decayed teeth, dead teeth and inflamed gums. He also postulated that stress, in the form of fear, excitement or tension may sufficiently alter the body systems to produce a disagreeable breath odor.<sup>6</sup>

### Epidemiology

Information regarding the prevalence of oral halitosis is scarce due to lack of epidemiological studies. An early study from The Netherlands among 11625 individuals revealed a prevalence of approximately 25% in subjects older than 60 years of age (de Witt 1966). In subjects under 20 years, the prevalence of oral halitosis was 10%, indicating that the prevalence of this condition increases with age. Several studies in industrialized countries report an incidence as high as 50%, with a various degree of intensity. In China the incidence of oral halitosis was surveyed in a sample of 2000 individuals aged 15-64 years. Oral halitosis was measured in 27.5% of the subjects with organoleptic measurements (Liu et al 2006).<sup>7</sup> Bornstein et al. 2009 reported 20% prevalence of detected chronic halitosis among 626 male army recruits of Switzerland. Yokoyama et al (2010) reported 42% prevalence of halitosis experience (anxiety or consciousness of the problem at least once) and 39.6% prevalence of clinically detectable malodour in 474 senior high school students of Japan.<sup>8</sup>

### Fact file

Breath smells only when certain aromatic compounds are found dissolved in it. These include methyl mercaptan, hydrogen sulphide, cadaverine, putrescine, skatole and isovaleric acid<sup>9</sup>.

Some of these may be absorbed from the bowel in the bloodstream and then circulated around the body until they are excreted via the lungs in the breath. In the

same way garlic rubbed into the soles of feet can later be detected in trace amounts in the breath. Spicy foods also create recognizable odor in some people's pungent exhalations.

### Etiology

*Temporary halitosis:* It results from hot/spicy food, certain drinks, alcoholic beverages, coffee and most common from garlic, onion, salty foods, spices, curries, cured foods like salamis and cooked food such as kippers<sup>10</sup>. Tobacco consumption causes mouldy odor and Hyposalivation/Xerostomia (dry mouth) also leads to bad breath<sup>11</sup>.

*Morning breath:* Everybody has a degree of halitosis, first thing in the morning. There is a physiological reason for this. During sleep, the flow of saliva is reduced drastically and tongue and cheek move very little. This allows food residues to stagnate in the mouth and dead cells that are normally shed from the surface of tongue and gums and from the inside of cheek to accumulate. As bacteria starts to work on them and digest them, an unpleasant smell is generated. This process is biologically known as putrefaction/rotting.

Although normal, anyone suffering from nasal congestion whose mouth breathes is more likely to suffer from these actions to a greater extent. Luckily, this morning breath generally disappears after breakfast and after brushing the teeth because saliva starts to flow again and any left over residues are washed away and swallowed<sup>12</sup>.

*Smoking (cigarettes/cigars):* Breath smells like ash tray. Smoking also reduces the flow of saliva and therefore further exacerbates the problem<sup>13</sup>.

*Crash dieting/fasting:* When the body is no longer supplied with energy giving carbohydrates it first breaks down glucose stored in the muscles and liver in the form of glycogen. But this does not last long. After a few hours, the body begins to breakdown its fat stores and the waste product of their metabolism, ketones, endows the breath with a distinctive sweet and sickly smell. This can be seen in those who has vigorously worked out and exercised and not taken sufficient carbohydrates before or after. People on a strict caveman or high protein diet experience the same effect for similar reasons.

### Oral Malodor

Bad breath is usually caused by bacteria that

live in person's mouth. Bacteria, just like humans, go through their lives consuming food and excreting waste. The waste products produced by some oral bacteria are sulfur compounds. These odoriferous waste products usually lie at the root of person's bad breath problem.

The stench associated with rotten eggs is caused by hydrogen sulfide. The stinky smell emanating from feed lots and barnyards is one produced by methyl mercaptan and odor associated with ocean is that of dimethyl sulfide. Each of this is excreted as a waste product by bacteria that live in our mouths. Together dentist refer to them as *Volatile Sulfur Compounds* (VSC'S). Term volatile simply describes the fact that these compounds evaporate readily even at normal temperatures. The extreme volatility of these compounds explains how they have the ability to offend around us instantly.

### Production of VSC's

The unpleasant smell of breath mainly originates from VSC's which comprise of hydrogen sulfide (H<sub>2</sub>S), methyl mercaptan (CH<sub>3</sub>SH), dimethyl sulfide (CH<sub>3</sub>)<sub>2</sub>SH, dimethyl disulfide (CH<sub>3</sub>)<sub>2</sub>S<sub>2</sub>, as first discovered by Tonzetich. They all are thiols; containing a characteristic -SH group which is formed when the oxygen atom in hydroxyl group is replaced by sulfur. Oral thiols are toxic byproducts of gram negative anaerobic bacterial metabolism of sulfur containing amino acids (cystine, cysteine and methionine) that reside in saliva, GCF, the gingival and periodontal pocket and tongue surface. This bacterial metabolism is of putrefactive nature and leads to oxygen depletion<sup>14</sup>.

Volatile fatty acids such as valerate, butyrate and propionate are all malodorous. When hormonal, gastro-intestinal, renal, or metabolic pathologies are the cause, additional malodorous molecules can be produced; these circulate in the blood and are expressed through the expired air or GCF.

### Other waste products are

*Cadaverine:* Smell associated with corpses

*Putrescine:* Produced by decaying meat;

*Skatole:* Human faecal matter;

*Isovaleric acid:* Sweaty feet.

The above wonderful mixture of compounds emanates from mouth of human and no one is exception. Everyone has some level of these unpleasant compounds in their

breath. Fortunately however, low levels of these compounds cannot be detected by human nose. It is only when the levels become elevated, others nose can detect them.

Bad breath is caused by waste products of anaerobic oral bacteria (more specifically gram negative anaerobic bacteria<sup>15</sup> e.g.: prevotella intermedia, porphyromonas gingivalis etc.). Term anaerobic describes that they best grow in environments devoid of oxygen. Person's mouth is a home for hundreds of different species of bacteria and on going in our mouth is a constant battle for living space between type of bacteria which do create waste products that causes bad breath and those that don't and it's the precise balance between the relative number of these type of bacteria that determine the quality of person's breath.

Plaque accumulation (the whitish film that is formed above and below gum line and also on tongue) can tip the scales in favor of odor causing bacteria. A layer of plaque as thin as 0.1-0.2 mm becomes depleted to oxygen, precisely in which anaerobic bacteria flourish. So, as more and more plaque builds up, bacteria causing bad breath gain available living space and proliferate, thus increasing the level of odor. Solis-Gaffar et al. examined eight prominent Gram-positive and four Gram-negative bacteria for their ability to produce volatile sulfur compounds. All of the Gram-negatives and none of the Gram-positives produced H<sub>2</sub>S, CH<sub>3</sub>SH, and (CH<sub>3</sub>)<sub>2</sub>S<sup>6</sup>. Tonzetich and McBride examined strains of B. melaninogenicus for their ability to produce volatile sulfur metabolites and found collagenase and protease positive strains (asaccharolyticus) produced more of these cell and tissue destructive compounds than strains (var. melaninogenicus) that did not have collagenase and protease activities. F. nucleatum, an anaerobic Gram-negative rod, is another prominent organism in the microflora of the crevices of humans especially those with gingivitis/periodontitis that can metabolize cysteine and methionine and produce the sulfur volatiles that contribute to malodor.<sup>9</sup>

**What is the food source for anaerobic bacteria that cause bad breath?**

Most of the odoriferous compounds that cause bad breath are waste products created by anaerobic bacteria, as they digest proteins. This means that as we consume food items such as meat and fish, bacteria living in our mouth also get meal and waste

products from their meals are precisely the compounds that cause bad breath. There is always naturally occurring protein food sources floating around in our mouth such as dead skin cells or protein compounds found in the saliva. And then also especially for those who are not diligent with brushing and flossing, there is always the left over food debris from yesterdays meal and the meal before that.....and the one before that.....

High protein foods include meat, fish, sea food and eggs; dairy foods such as milk, cheese, yoghurt; cereal grains and products; desserts especially cakes and pies.

**Where do the bacteria that cause bad breath live?**

For most of us bad breath causing bacteria live on the surface of tongue. Secondary locations can be at or below person's gum line<sup>16</sup>.

*Bacteria that live on person's tongue*

Most common odor producing region of the tongue is its posterior region. covered by a whitish layer, dental plaque and its chocked full of anaerobic bacteria that cause bad breath. The precise surface texture found on individual's tongue will influence the amount of coating that tends to accumulate. Fissured tongue, grooved tongue, and lingua plicata have more potential to accumulate bacteria laden coating than those with smoother tongue surface.

Refer **table 1** for classification of severity and extent of tongue coating (Van Steenberghe, 2004). There is a direct correlation between the amount of coating that exists on persons tongue and total number of anaerobic bacteria<sup>17</sup>.

**Table 1 - Classification of severity and extent of tongue coating (van Steenberghe, 2004)**

Degree 0	No visible coating
Degree 1	< 1/3 covered by easily removable coating
Degree 2	< 2/3 covered by easily removable coating and < 1/3 covered by not easily removable coating
Degree 3	> 2/3 covered by easily removable coating
Degree 4	> 2/3 covered by not easily removable plaque

*Bacteria that live at and below person's gum line*

When we floss the teeth, at times we are dredged up with foul taste or odor. This odor is more noticeable in the posterior part of the mouth, as the bacteria that cause bad breath often find a cozy home here.

Even in a relatively healthy mouth, anaerobic environment both around and in between the teeth and underneath the gum line can be found. This anaerobic environment is more in people who suffer from gum diseases such as gingivitis and periodontitis (Periodontal Disease). In periodontal disease the deep recesses of the periodontal pockets are difficult to clean. This creates the ideal anaerobic environment for the bacteria that causes bad breath.

Other reasons for oral malodor are Candidiasis, deep carious lesions (particularly after food impaction), exposed pulps and open root canals, extraction wounds, interdental food impaction, necrotizing ulcerative gingivitis (NUG), necrotizing ulcerative periodontitis (NUP), acrylic prosthesis and Vincent's angina.

Yoneda M et al have reported a case of oral malodor associated with internal resorption.<sup>18</sup>

**Association of oral malodor with periodontitis**

A correlation has been found between VSC concentration in mouth air and increased pocket depth in periodontitis patients.<sup>19,20</sup> The uptake of volatile sulphurs by epithelial cells may play an important role in the pathogenesis of periodontal disease: it has been proposed that volatile sulphurs may alter the permeability of affected cells and facilitate the access of toxic metabolites into the underlying connective tissue thereby contributing to collagen degradation. There is also general agreement that the VSC content of exhaled mouth air and the concentration of VSC precursors increases with the severity of periodontal disease.<sup>21</sup>

*Source of VSC production in periodontitis patients<sup>12</sup>*

In 1998, Yaegaki et al carried out a study aimed to investigate the VSC production of tongue coating in relation to the severity of periodontal disease. They analyzed the VSCs in mouth air using gas chromatography before and after removing the tongue coating. They concluded the tongue coating might be a main site of oral malodor production in slight or moderate periodontal disease, whereas, the periodontal pocket would be the main origin of VSCs only in severe periodontal disease.

*Role of VSCs in the pathogenesis of destructive periodontitis*

In addition to being a major contributor to oral malodor, VSCs have been implicated in

the disruption of oral mucosa and may contribute to the progression of periodontal disease. Some studies suggest that the production of VSCs by these microorganisms may contribute to the progression of periodontal disease via breakdown of the oral mucosa leading to bacterial invasion. **Ng and Tonzetich** found that the permeability of porcine sublingual mucosa increased 75 percent and 103 percent following exposure to hydrogen sulfide and methyl mercaptan, respectively. This finding suggests that the VSCs of oral malodor could contribute to the pathogenesis periodontitis.<sup>22</sup>

VSCs are highly toxic to tissues even at extremely low concentrations and, therefore, may play a role in the pathogenesis of inflammatory conditions affecting the periodontium, such as periodontitis. They also alter the metabolism of fibronectin and interfere in the enzymatic and immunological reactions leading to tissue destruction while showing an increase in the release of Interleukin-1 (IL-1) and PGE2.<sup>12</sup>

Some studies have failed to demonstrate positive correlations between periodontitis severity and halitosis. **Rosenberg M et al (1991)**<sup>23</sup> found a weak correlation between presence of pockets greater than 7 mm and sulphide measurements. **Bosy et al in 1994** did not find a relationship between periodontal disease and the prevalence or severity of halitosis. In addition to the lack of presence/absence of periodontal disease, the intensity of halitosis based on VSC concentration was 19% less in periodontally healthy subjects (mean 111 ppb) than in subjects with periodontitis (mean=136 ppb).<sup>21</sup>

**Malodor of Extraoral Origin**<sup>3,4,24</sup>

In only 10% of cases, cause can be traced back to an internal (Lang and Filippi, 2005a) or ENT problem (Tonzetich, 1978)

Refer **table 2** for the possible causes. Certain breath odors are of diagnostic significance for the physician. For example, the acetone odor of diabetic ketoacidosis, the ammonia smell of uremia and the rotten egg smell of liver failure is due to the inability of the liver to break down diethyl sulfide, which is released due to bacterial action. This is excreted through the lungs.

*Halitosis of Upper Respiratory Tract:* It may be because of chronic sinusitis, nasal obstruction, nasopharyngeal abscess and

carcinoma of the larynx.

*Halitosis of Lower Respiratory Tract:* It may be because of bronchitis, bronchiectasis, pneumonia, pulmonary abscess and carcinoma of the lungs (Attia and Marshall 1982, Lu 1982, Durham et al 1993, McDowell and Kassebaum 1993)

*Gastrointestinal tract:*

Unpleasant odor from the lower gastrointestinal tract is only detectable during belching or vomiting, because the esophagus is normally collapsed (Attia and Marshall 1982). The stomach is therefore not considered to be contributory to the halitosis, except in rare circumstances (Rosenberg 1996). The following pathologies might be responsible for less than 1% of malodor cases:

**Zenker's Diverticulum:**

It is hernia in esophageal wall, allowing accumulation of food and debris and thus putrefaction. It can cause a significant breath odor because it is not separated from oral cavity by any sphincter.

**Gastric hernia:**

Fundus of stomach protrudes through diaphragm with relative sphincter insufficiency allowing gases to escape and contents to flow back to the esophagus can cause reflex of the gastric contents up to the oropharynx. This is sometimes combined with ructus, where air from stomach suddenly regurgitates.

**Gastric Reflux:**

It is a common cause of morning halitosis. In this, there is reflux of gastric juice, bacteria and digested food into the pharynx.

**Intestinal gas production:**

**Others:**

Extraoral halitosis might also be a manifestation of a serious systemic disease, such as hiatus hernia, hepatic cirrhosis or diabetes mellitus (Tangermann 2002). **Tangerman A, Winkel EG (2007)** provided evidence that the VSC, CH<sub>3</sub>SH and to a lesser extent H<sub>2</sub>S are the main contributors to intra-oral halitosis and that CH<sub>3</sub>SCH<sub>3</sub> is

**Table 2 – Possible causes of Halitosis**

Specialty	Cause / Basic Disease	
Dentist	- Coating of the tongue - Sub and / or supragingival biofilm - Gingivitis - Periodontitis - Candidiasis - Untended prosthesis - Abscesses	- Open root canals - Overhanging restoration margins - Pemphigus - Morbus Behcet - Erythema exudativum multiforme - Ulcerating and decomposing tumors
ENT	- Tonsillitis - Sinusitis - Pharyngitis - Diphtheria - Pfeiffer's Disease - Angina Plaut Vincent	- Debris - Abscesses - Lues III - Chronic rhinitis - Postnasal drip - Ulcerating and decomposing tumors
Internal Medicine	- Putrid bronchitis - Pneumonia - Abscesses (lung) - Xenoliths - Gangrene of the lung - Wagner's granulomatosis - Gastric and intestinal diseases. - Precomatose condition and coma (uremia, coma hepaticum)	- Diabetes mellitus - Oesophagitis - Yellow fever - Pharmaceuticals - Trimethylaminuria - Ulcerating and decomposing tumors - Diverticle



the main contributor to extra-oral or blood-borne halitosis, due to a hitherto unknown metabolic disorder.<sup>25</sup>

Rosenberg M et al (2007)<sup>26</sup> identified predictive factors for bad breath in the general adult population, by a 38-question self administered questionnaire, along with objective odor judge and instrumental measurements and results suggested that that alcohol intake and body mass index may be factors that help predict oral malodor.

### Medications:

Some drugs, such as metronidazole, can cause breath malodor. Metronidazole, an antimicrobial, also leads to the patient's perception of metallic taste, which is often confused with breath odor. Eucalyptus containing medications impart a melon like odor. Arsenic smells of rotten onions. Amitriptyline (a tricyclic anti-depressant), certain anti-hypertensives, sedatives, hypnotics, anti-allergic drugs which dry up saliva as a side effect, also add to the problem.

### Do You Have Bad Breath?

At some point each of us had bad breath. For any individual, the exact status of their breath is difficult to ascertain, reason for this is that the oral cavity, the source of our breath, is connected to our nose by way of an opening which lies in the back of our mouth (back in the region of soft palate). Since noses tend to filter out and ignore background odors, it filters out and ignores our own bad breath. This means it is quite possible for a person to have bad breath, yet not be aware of it.

### Diagnosis

#### Patient's History

- Patient should be asked to describe the type of smell that is being noticed. Depending on the origin, different smells may be distinguished. (Refer table 3)

- Who noticed the bad breath- patient himself (halitophobia / pseudohalitosis) or others?
- Under which circumstances was the bad breath experienced? Only in the morning (temporary bad breath), after meals (due to certain foods or spices), or after lying down. Halitosis after meals or lying down may be indicative of regurgitation oesophagitis (Van Steenberghe, 2004).
- The clinician should ask about the frequency (e.g., every month), time of appearance with in the day (e.g., after meals can indicate a stomach hernia) etc. One of the major challenges in judging halitosis is that self reported halitosis is quite subjective. Thus, it may be helpful if the patient is accompanied by candidate who is able to give more objective picture. For example, a spouse, friend or family members.

### Is there a way a person can test their own breath<sup>24</sup>?

There are indirect routes to test your own breath.

#### Experiment 1:

Lick your wrist, wait about five seconds while the saliva dries somewhat and then smell it. This experiment tells us about the smell of the anterior portion of the tongue.

#### Experiment 2:

Take a spoon. Turn it upside down and use it to scrap the very back portion of the tongue. Take the look at the material that has been scraped off, usually a thick whitish material. Now take a whiff of it. This experiment tells us about the smell of posterior portion of the tongue. This smell is probably the way your breath smells to others.

#### Experiment 3:

Take a toothpick and introduce into the

interdental area (area between teeth) and smell it.

### Experiment 4:

Spit saliva in a small cup or spoon. Allow it to dry for a few seconds (so that putrefaction odors can escape from the liquid) and then smell it.

### How Academic Researchers Test for Bad Breath?

Before a dental researcher can evaluate various cures for bad breath, they must measure its severity both initially and after the cure.

### Organoleptic Testing<sup>4,24</sup>

Gold standard for measuring halitosis is organoleptic testing. In this testing, the researchers are using their senses of smell i.e. their nose as the means for making the determination. Historically, this method has been a frequent choice among dental researchers. Noses are readily available, inexpensive to obtain and operate and to their credit, noses can detect up to 10,000 different smells. One of the problems associated with using this method is that it is not totally objective. Another is that factors other than just breath odors can and do influence organoleptic evaluations. Factors such as hunger, menstrual cycle, head position and the degree of attentiveness and expectation can each influence a judge's interpretation of what they smell.

To assess halitosis, examiner should be trained and calibrated. To assess examiners differentiation abilities, test kits with different scents may be used (*smell identification test*). Further, these kits containing different dilutions of specific scents are available to assess and train differentiation strength of scents (Lang and Filippi, 2005b). Sometimes, the examiner's smell may be impaired due to ones own halitosis, or temporary deterioration of smelling (example rhinitis).

*Prerequisites:* Going to the dentist to classify the halitosis can be quite embarrassing, so high level of privacy has to be maintained. Patient and examiner have to abstain from substances that cause temporary malodor, 12 hours before the examination. Substances that mask halitosis may have to be avoided (e.g. shampoo, perfume, mouth rinses). Classify it in four degrees of severity (**Refer table 4**). Further the clinical examination should follow a certain sequence in order to distinguish the origin of malodor (**Table 5**).

**Table 3 - Different types of breath malodor according to their most likely origin (Preti et al, 1992; van Steenberghe, 2004)**

Type of Odor	Origin
Like rotten eggs	Indicates volatile sulfur compounds (VSC), which in most cases are associated with periodontitis or coated tongue.
Sweet (like dead mice)	Cirrhosis of the liver: besides VSC, aliphatic acids (butyric, propionic acid), methylmercaptan, ethanethiol, dimethyl sulphide accumulate.
Like rotten apples	Not well controlled insulin-dependant diabetes: accumulation of ketones
Like Fish	Kidney insufficiency or trimethylaminuria (very rare metabolic disease): uremia and accumulation of di- and trimethylamine

**Table 4 - Classification of Subjectivity perceived Halitosis (Seemann, 2002)**

Degree 0	From approximately 10 cm distance, have the patient say "A". No unpleasant smell is perceived.
Degree 1	From approximately 10 cm distance, have the patient say "A". An unpleasant smell is perceived.
Degree 2	From approximately 30 cm distance, an unpleasant smell is perceived during a conversation.
Degree 3	From approximately 1m distance, i.e. during the anamnesis talk, an obvious bad breath is perceived.

**Table 5- Sequence of the clinical examination**

Smelling	Perceived air Originates From
- the air or the oral cavity while the patient holds his breath	- the oral cavity
- the air expected through the mouth	- the mouth or the lungs
- the air when a patient forms a forced expiration	- the bronchi and / or the lungs
- the air while the patient counts from 1 to 20	- (most likely) the oral cavity; counting leads to drying of the mucosa setting free VSC that are solved in the saliva
- the anterior 2/3 of the tongue; patient licks his wrist at which the examiner smells after a while of drying	- the anterior part of the tongue
- the coating from the posterior 1/3 of the tongue, that was scrapped by the scrapper, periodontal probe or spoon	- the posterior part of the tongue
- the plaque and debris removed from some interdental spaces by a tooth pick, interdental brush or a periodontal probe	- the interproximal spaces
- saliva spat into a small cup	- the saliva
- the air expelled by the nose	- the nose or the sinuses
- the air from one and then the other nostril	- just the nose or sinus of one side

Demerits: Each judge participating won't be able to make equivalent comparison. And when we are repeatedly exposed to a bad odor our sense of smell acclimates to the odor and therefore loses much of its sensitivity. Bad breath that was exceedingly objectionable at the beginning, may seem quite less as the evaluation continues.

#### Instrument assessment<sup>24</sup>

It has been used by dentist to study bad breath and definitely quantify the precise level of specific compound present in someone's breath. This device can analyze air, (incubated) saliva, or crevicular fluid for any component.

*Use:* Primarily for scientific purpose.

*Demerits:* Relatively expensive, requires personnel with special training to operate them, not portable equipment and time consuming.

Recently a small, portable gas chromatograph (Oral Chroma, Abilit, Henderson, Nevada) has been introduced, which makes this technique available for periodontal clinics. It has the capacity to measure the concentration of three key sulfides separately.

#### Halimeter<sup>4,24</sup>

It is a specialized type of sulfide monitor and it produces a mean by which tester can quantify degrees of bad breath in parts per billion (ppb). These machines first introduced in 1991, measure the level of sulfide gas found in persons breath i.e. VSC'S. Halimeters showing high levels of sulfide suggest a correlating high levels of VSC although doesn't test for individual type of VSC's specifically.

The examination should preferably be done after at least 4 hours of fasting and after keeping the mouth closed for 3 minutes. The mouth air is aspirated by inserting a drinking straw fixed on the flexible tube of the instrument. This straw is kept about 2cm behind the lips, without touching any surface and while the subject keeps the mouth slightly open and breathes normally.

Absence of breath malodor leads to readings of 100 ppb or lower. Patients with elevated levels of VSC's easily reach 300-400 ppb.

*Disadvantages:* It test for a fewer no. of compounds (sulfides only) than gas chromatographs and in fact tests for no individual compounds at all but just sulfide as a class. Additionally compounds such as ethanol (alcohol) and essential oils (both of which are found in mouthwashes) interfere

with halimeters ability to make a measurement.

*Advantages:* It requires no special training to use, is portable, measurements can be made quickly and apparatus is comparatively inexpensive.

*Uses:* For follow ups, psychological support during treatment and many patients trust the result of a device more than dentists nose (Seeman 2002).

Rosenberg M et al (1991)<sup>23</sup> elucidated that although assessment of steady-state sulphide levels by the sulphide monitor does not constitute a direct measure of oral malodor, its relation to organoleptic measurement, superior reproducibility, objectivity, and sensitivity support the use of the sulphide monitor in clinical studies. Based on the superior reproducibility and sensitivity of the sulphide measurements compared with organoleptic measurements, the sulphide monitor may be a valuable tool for assessment of oral malodor. The sulphide monitor also presents other advantages such as: (i) no need for skilled personnel; (ii) non-invasive; (iii) low likelihood of cross-infection; (iv) portability; (v) relatively inexpensive; and (vi) rapid turnaround time of one to two min between measurements. However, it lacks the specificity of gas chromatography, since it cannot distinguish between the proportions and species of different VSC's.

#### The BANA Test

Bacteria that produce bad breath can be detected by performing BANA test. Bacteria, in question have the characteristic of being able to produce an enzyme that degrades the compound BANA (benzoyl-D, L-arginine-naphthylamide). When sample of patient's saliva that contains these bacteria is placed in the BANA testing compound, they cause it to break down. As a result, the testing compound changes color. The results of a study by **Kozlovsky A et al (1994)** suggested that the BANA test, a simple, adjunct assay together with volatile sulphide determination which provides additional quantitative data contributing to the overall association with odor judge estimation.<sup>27</sup>

#### Utilizing Chemiluminescence

One of the most recent methods for detecting the compounds associated with bad breath. Method was introduced in 1999. When a sample containing sulfur compound is mixed with the tests mercury compound, the resulting reaction causes fluorescence.

*Advantage:* It provides better selectivity and sensitivity when measuring low levels of sulfur compounds as compared to halimeters.

### *Zinc oxide and Nitrogen chemiluminescence detectors*

These chemiluminescence detectors permit the precise measurement of nitrogen compounds such as indole & cadaverine in organic matrices. This helps to determine whether these nitrogen compounds are present in mouth air.<sup>28</sup>

### **Electronic Noses**

Also called as Artificial Noses, are supposed to provide quantification and classification of exact smells (Shimura et al, 1997). Originally it was developed for quantitative assessment of smells in food or beverage. However, an application to diagnosis of halitosis appears reasonable.

### **Dark Field or Phase- Contrast Microscopy**<sup>24</sup>

Gingivitis and periodontitis are typically associated with a higher incidence of motile organisms and spirochetes. These can be seen directly with the help of microscope. Advantage: patients become aware of the bacteria present in the plaque, tongue coating and saliva.

### **How do you cure bad breath?**

The most important step a person can take towards improving the quality of breath is to clean their mouth in a manner which helps to minimize the amount of food available for anaerobic bacteria, minimize the total number of these bacteria that exist, minimize the availability of type of environment in which these bacteria prefer to live, make any environment in which these bacteria do live less hospitable. On a second front, a person can use products that neutralize the odor causing volatile sulfur compounds.

### *Minimizing the food supply for bacteria that causes bad breath*

When anaerobic bacteria digest proteins, volatile sulfur compounds are created as waste products that cause bad breath. The person who maintains a vegetarian diet mostly of fruits and vegetable has fewer chronic breath problems than those who consume protein rich food such as meat. It is important for a person to clean one's mouth thoroughly especially after eating protein rich food. This is because even after we have finished a meal minute particles of food still remain in our mouth. Much of this food debris ends up lodged between our teeth and incorporated into the coating found on the posterior part of our tongue. Since these are precisely the same locations in which the anaerobic bacteria that cause bad breath live, if a person does not clean their mouth

thoroughly a food supply is provided for these bacteria over an extended period of time.

### **How cleaning your teeth and gums can help to cure bad breath?**

As already explained the bacteria that causes bad breath live in dental plaque that accumulates on and around person's teeth, both at or below gum line. So a thorough brushing and flossing technique is needed in order to remove this plaque and any food debris.

### **Make an appointment with your dentist**

If bad breath problem persists, even after a period of following all of the tips and suggestions, then one should schedule an examination and cleaning appointment with the dentist so that one can discuss their problems with them. During this visit the following can be accomplished:

- 1.) Sometimes effective brushing and flossing technique can be difficult to learn. After examining, dentist can provide with instructions, tips, and pointers that will be helpful in specific situation.
- 2.) Tartar (dental calculus) accumulation can interfere with effective brushing and flossing. Scaling and root planing will remove this debris from teeth. *In a study by Saito Mitsuhiro et al (2000) halitosis parameters as measured by the Halimeter, and the organoleptic examination were improved, and the total amount of plaque was decreased. These results suggest that improved gingival inflammation with periodontal treatment improves halitosis.*<sup>29</sup>
- 3.) Periodontal evaluation: Periodontal pockets are often impossible for us to clean for bacteria to live. So, if periodontal condition is evaluated, dentist can outline the treatment required to control this condition.
- 4.) Dentist will check if there are any untreated dental conditions that could be causing or exaggerating breath problems.
- 5.) Dentist will help you to determine whether its oral or medical evaluation is indicated.

### **Bad Breath Cures by Tongue Scrapers or Tongue Brushes**<sup>1</sup>

Most people overlook cleaning their tongue, however, starting to do so on a regular basis, can be the single most beneficial treatment for bad breath that a person can institute. The anterior portion of a person's tongue is usually less offensive than the smell found emanating from the posterior part. The reason for this is related to the fact that the anterior portion of the tongue is somewhat

self-cleansing and more exposed to outside environment, thus getting a better oxygenation and therefore less likely to harbor large numbers of odor producing bacteria. Many tongue functions require that the anterior portion of the tongue touches firmly against the hard palate. This friction produces a cleansing action, therefore preventing any significant bacterial accumulation.

The posterior portion of the tongue in comparison only rubs up against the palate (soft palate) relatively gently during tongue movements. This soft palate contact does not provide enough friction to produce any significant cleansing. For this reason it is typically the posterior aspect of the tongue that is found to harbor the bacteria that cause a person's bad breath, and thus the posterior tongue is the most important area to clean.

### *By Tooth Brush:*

To do so, start as far back as possible and then make brush strokes outward, toward the front of mouth. One needs to use some pressure but of course not enough to cause irritation to tongue. As a way of improving the effectiveness of tongue brushing efforts, one can use toothpaste.

### *By Tongue Scraper:*

Some people believe this is more effective method and produces less gagging. To do so, place a tongue scraper on the posterior part of tongue. Be thorough and gentle and don't scrap so hard or vigorously that it irritates the tongue. Faveri M et al (2006) suggested that tongue scraping appears to be the most important hygienic procedure to reduce morning bad breath in periodontally healthy subjects.<sup>30</sup>

A Cochrane review (2008)<sup>31</sup> conducted to provide reliable evidence regarding the effectiveness of tongue scraping versus other interventions (including mouthwashes) to control halitosis concluded that there is weak and unreliable evidence to show that there is a small but statistically significant difference in reduction of VSC levels when tongue scrapers or cleaners rather than toothbrushes are used to reduce halitosis in adults. They found no high level evidence comparing mechanical with other forms of tongue cleaning. Tongue scrapers or cleaners are slightly more effective than toothbrushes as a means of controlling halitosis in adults. This review, which included 2 trials (40 participants) found that, although the use of tongue scrapers was generally well accepted, the effects of tongue cleaning using scrapers or brushes appeared to be very short lived and there was some limited evidence of tongue trauma which occurred

with prolonged use of one tongue scraper.

A study by Casemiro LA et al (2008)<sup>32</sup> compared the effectiveness of a new manual toothbrush that has a tongue scraper on the back of its head and a commercial tongue scraper in improving breath odor and reducing the aerobic and anaerobic microbiota of tongue surface. They demonstrate that the adoption of methods for tongue cleaning associated to toothbrushing minimizes halitosis and reduces bacterial counts on tongue surface. The evaluated methods (toothbrush with a tongue scraper on the back of its head and conventional tongue scraper) were equally effective in the improving breath odor and reducing the facultative aerobic and anaerobic microbiota on tongue surface of the studied population.

### Bad Breath Cure by Chemicals<sup>24</sup>

Mouthwashes, when used in conjunction with a regimen of effective tongue cleaning, tooth brushing, and flossing, can play a role in the treatment of bad breath. Carvalho MD et al (2004)<sup>33</sup> demonstrated the beneficial impact of mouthrinses on morning breath even in the absence of mechanical plaque control. In a cross-over trial conducted by them on college students, the VSC formation was inhibited in descending order, 0.2% chlorhexidine, 0.12% chlorhexidine, triclosan and essential oils and cetylpyridinium chloride. The effectiveness of a particular mouthwash will be founded on its possessing one or both of the following characteristics:

#### A) Antibacterial mouthwashes

If a mouthwash has the ability to kill bacteria, so reduces anaerobic bacteria that produce VSC's and hence bad breath.

#### B) Mouthwash that neutralizes VSC's

The ingredients found in some mouthwashes have the capability to neutralize VSC's and/or the compounds from which they are formed.

Some of the different types of over-the-counter mouthwashes have been employed in the treatment of bad breath (Table 6). Following are the compounds which offer a great help to reduce the oral malodor:

1. **Chlorhexidine:** it is most effective anti-plaque and anti-gingivitis agent. Its antibacterial action can be explained by disruption of the bacterial cell membrane by the chlorhexidine molecules, increasing its permeability and resulting in cell lysis and death.

Rosenberg et al showed that a 0.2% chlorhexidine rinse provides 43% reduction in VSC levels and a greater than 50% reduction in organoleptic mouth odor ratings.

2. **Halita**, a new solution containing 0.05% chlorhexidine, 0.05% CPC, 0.14% zinc lactate and no alcohol, has been found even more effective than chlorhexidine alone, suggesting that the other compounds are also important. This is explained by the synergistic action of chlorhexidine and CPC on one hand and by the zinc ions on the other hand.

3. **Essential oils** containing mouthwash present in market is Listerine. It has been found only relatively effective against oral malodor (25% reduction vs. 10% for placebo). In a study by Pitts G et al an essential oil mouthrinse was able to reduce the offensive gases present in morning bad breath as measured by a sulfide monitor, a result that is in agreement with those of a previous short-term study, in which the results indicated a reduction of the organoleptic scores by essential oils, which caused a sustained reduction in the plaque odorogenic bacteria, unlike the placebo.<sup>34</sup> An argument was made that the re-odorization was important to the overall activity of the product only for about 30 min after treatment and, at post-treatment times of 60-180 min, the anti-odor activity of the product was due to its anti-microbial action. That conclusion became the basis for the premise that anti-VSC agents would succeed if they had an antimicrobial component.<sup>35</sup>

4. **Chlorine Dioxide** it is a powerful oxidizing agent that can eliminate bad breath by oxidation of hydrogen sulfide, methylmercaptan and the amino acids methionine and cysteine. Shinada K et al (2010)<sup>36</sup> showed that a mouthwash containing ClO<sub>2</sub> improved morning bad breath measured with the organoleptic measurement and reduced the concentrations of H<sub>2</sub>S, CH<sub>3</sub>SH and (CH<sub>3</sub>)<sub>2</sub>S measured by gas chromatography in healthy subjects. Moreover ClO<sub>2</sub> mouthwash used over a 7-day period was effective in reducing plaque, tongue coating accumulation and the counts of Fusobacterium nucleatum in saliva.

5. **Two-Phase Oil-Water Rinse** Rosenberg et al designed a two-phase oil-water rinse containing CPC that was shown to result in daylong reduction in oral malodor. The efficacy of this formulation is thought to result from the

adhesion of a high proportion of oral microorganisms to the oil droplets, which is further enhanced by the CPC. These reductions were almost comparable to chlorhexidine, superior to Listerine and significantly superior to a placebo.

6. **Triclosan** a broad spectrum antibacterial agent has been found to be effective against most oral bacteria and has a good compatibility with other compounds used for oral home care. The anti-VSC effect depends strongly on its solubilizing properties. In the Carvalho et al. (2004)<sup>33</sup> investigation, plaque formation was not always directly associated with VSC measurements, since the triclosan and CPC mouthrinses were more effective in reducing bad breath than in reducing supragingival plaque accumulation. Therefore, it could be postulated that the superior reducing effect of these specific mouthrinses on bad breath may be related primarily to their efficacy in reducing the load of VSC-related microorganisms and oral debris in the whole mouth niches rather than only in supragingival plaque reduction.<sup>35</sup>

#### 7. Amine fluoride/Stannous Fluoride

#### 8. Hydrogen peroxide 3%

Quirynen M et al (2002)<sup>37</sup> demonstrated that morning halitosis can be successfully reduced by the sole twice daily use of 0.2% chlorhexidine (CHX)-alcohol mouthrinse, 0.05% CHX +0.05% cetylpyridinium chloride (CPC) + 0.14% zinc lactate mouthrinse, an amine fluoride/stannous (AmF/SnF<sub>2</sub>) fluoride (125ppm F-/125ppm F-) containing mouthrinse, which all significantly reduced the bacterial load in the saliva and retarded the de novo plaque formation. The subjective ratings of the subjects were in general more in favour of CHX-CPC-Zn or AmF/SnF<sub>2</sub> solutions.

Cochrane review investigating the effects of mouthrinses in controlling halitosis which included five trials (293 participants), found that there is some evidence that mouthrinses containing antibacterial agents such as chlorhexidine and cetylpyridinium chloride or those containing chlorine dioxide and zinc can to some extent reduce the unpleasant odour but the use of mouthrinses containing chlorhexidine resulted in noticeable but temporary staining of the tongue and teeth.<sup>38</sup>

### Herbal remedies

Many natural products like yogurt, lemon

water, mint leaves, vinegar, cardamom seeds are beneficial in curing bad breath.

Lodhia P et al (2008)<sup>39</sup> have shown significant effectiveness of green tea in reducing oral malodor because of its disinfectant and deodorant activities, although effect was maintained for a very short duration. Green tea was found even more effective than sugarless chewing gum and mint in reducing volatile sulphur compounds.

Epigallocatechin gallate (EGCg), the main antimicrobial tea catechin, has been reported to inhibit growth and virulence factors of oral pathogens *in vitro*. Although the mechanism is unclear, the potential of EGCg in reducing halitosis caused by volatile sulfur compounds (VSCs) has been suggested. Xu X (2010)<sup>40</sup> study tested the hypothesis that EGCg reduces VSCs by suppressing *mgl*, the gene encoding L-methionine- $\alpha$ -deaminase-mercaptomethanelyase, responsible for methyl mercaptan (CH<sub>3</sub>SH) production by oral anaerobes. They concluded that EGCg may represent a natural and alternative agent to the antimicrobial chemicals.

### Can breath mints, lozenges, drops, sprays, and chewing gum help to cure bad breath?

These products when used alone are not as effective as when used in conjunction with tongue cleanser, toothbrushes and flossing, especially when they contain agents that have the ability to neutralize VSC's. As an added benefit, the use of mints, lozenges and chewing gums will stimulate the flow of saliva in person's mouth and saliva has cleansing and diluting effect on the bacteria and bacterial waste products that are found in person's mouth and therefore, helps to minimize person's problems.

### Role of dentifrices

Feng X et al (2010)<sup>41</sup> conducted four randomized and controlled clinical trials and; meta-analysis evaluating the collective outcomes of four independent trials furnish evidence of significant short-term, overnight and cumulative breath malodor reduction after brushing with a stannous-containing sodium fluoride dentifrice that simultaneously provides additional cosmetic and therapeutic oral health benefits.

Peruzzo DC et al (2007)<sup>42</sup> evaluate the effect of the flavoring agents present in a dentifrice

on the formation of VSCs in the morning breath of healthy individuals and suggested that a flavor containing dentifrice seems to prevent VSCs formation in morning bad breath regardless of the amount of TC in periodontally healthy subjects.

### How to clean dentures to reduce the menace?

Dentist should provide with specific instructions regarding the cleaning of dentures since dental plaque forms on dentures just like it does on teeth, gums and tongue. So, usually a dentist's recommendations will include instructions about thoroughly scrubbing your dentures with a toothbrush or specialized denture brush, both inside and out. After scrubbing, they might be placed in antiseptic solution.

### For ENT and Medical Problems

For infections in nose, paranasal sinuses and pharynx: Appropriate antibiotic therapy.  
For Gastric Reflux: Antacids, H<sup>2</sup> blockers and appropriate changes in dietary habits.

A simple classification with corresponding treatment needs was reported by Miyazaki et al.<sup>2,35</sup> **Ken Yaegaki, Jeffrey M. Coil, (2000)**<sup>2</sup> suggested that treatment of physiologic halitosis (TN-1), oral pathologic halitosis (TN-1 and TN-2) and pseudo-halitosis (TN-1 and TN-4) would be the responsibility of dental practitioners. Oral pathologic halitosis is caused mainly by periodontal disease, a condition managed by periodontal treatment. Additionally, dental treatment may be necessary to correct faulty restorations that might contribute to poor oral health (TN-2). Furthermore, patients with genuine halitosis who undergo successful reduction of halitosis by TN-2 or TN-3 yet still believe that they have the condition should also be referred to a psychological specialist (TN-5).

Halitophobic patients usually refuse to visit a psychological specialist, because they cannot recognize their condition as psychosomatic. They never doubt that they have offensive oral malodour. Hence, they are unhappy with the dental clinician who tells them they do not have the condition. Some clinicians may hesitate to refer such patients to a specialist, and the patients may then start "doctor shopping." It is important, therefore, to provide TN-4 counselling to these patients.

Pseudohalitosis almost always requires referral for clinical psychologist management. In extreme instances, patients

become socially isolated, may have their teeth extracted and occasionally commit suicide. However, patients often refuse to acknowledge that they may have a psychological problem. Therefore, the involvement of a third party (e.g. a confidant such as a close family member or a trusted friend) in the management may provide the patient with additional psychological support to consider the problem in a more objective manner<sup>2</sup>

### General points to remember as Bad Breath Remedies

- Drink plenty of water.
- Rinse your mouth with water often.
- Stimulate your mouth's flow of saliva.
- Clean your mouth well especially after eating high protein content food.

### Conclusion

Oral malodor (halitosis or bad breath) is an offensive odor of oral cavity and may disturb interpersonal communication and social activities. The oral region is the most frequent origin of halitosis. Factors associated with oral malodor were oral hygiene, periodontal disease and oral dryness. Hence health education and preventive intervention; such as tooth brushing instruction, and treatment regimens targeting periodontal disease as well as tongue cleaning should be incorporated to reduce levels of these compounds in mouth air and are satisfactory for cosmetic treatment.

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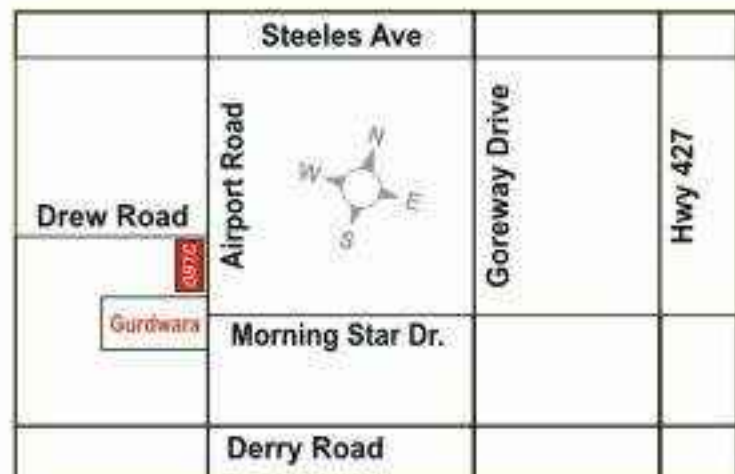
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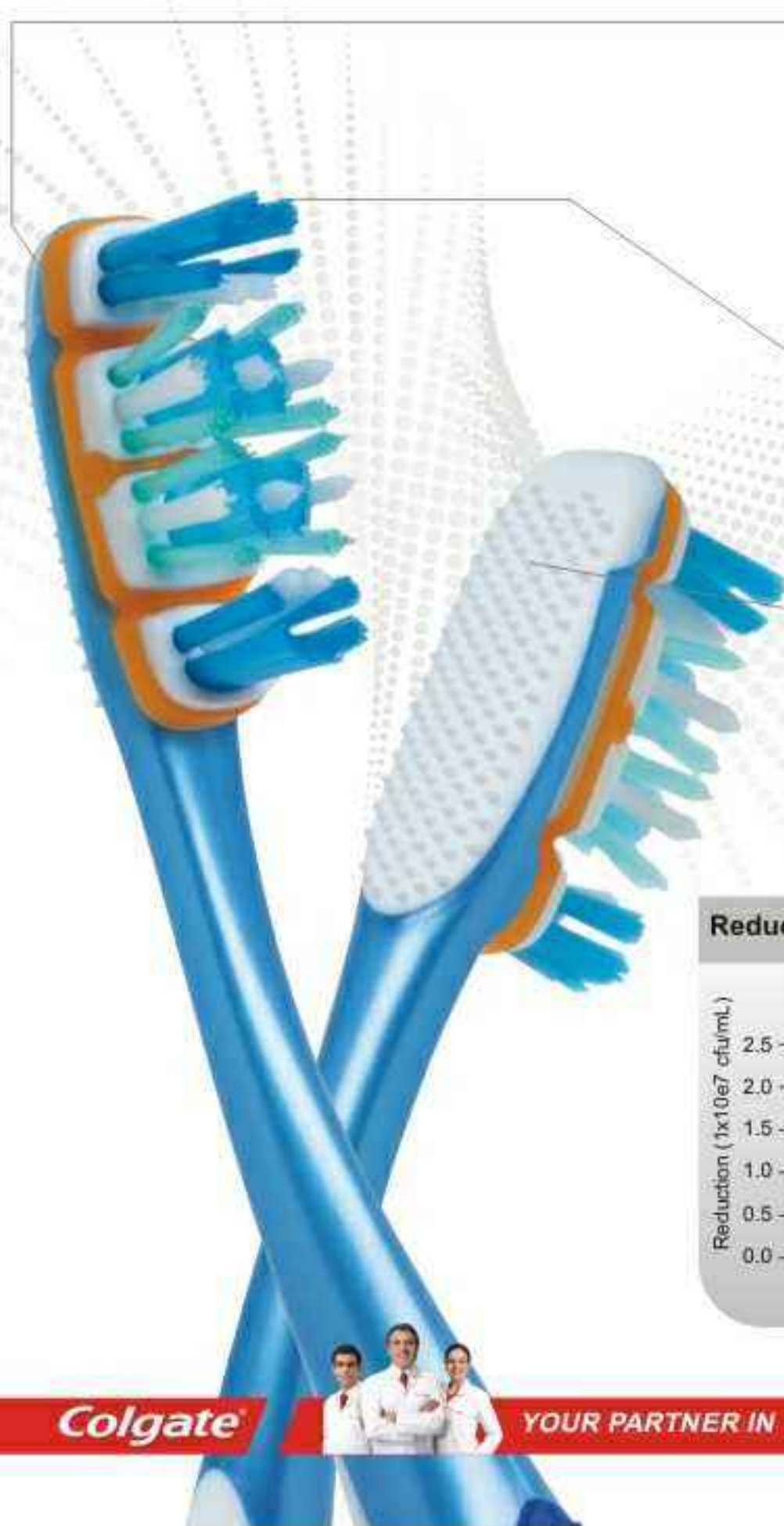
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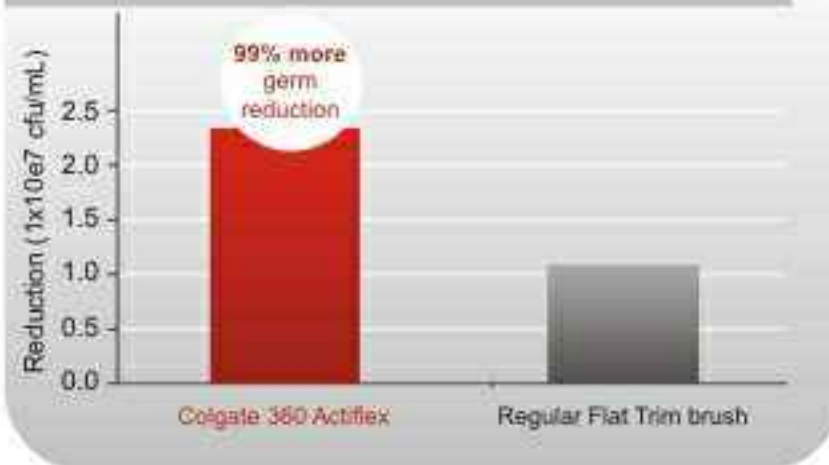
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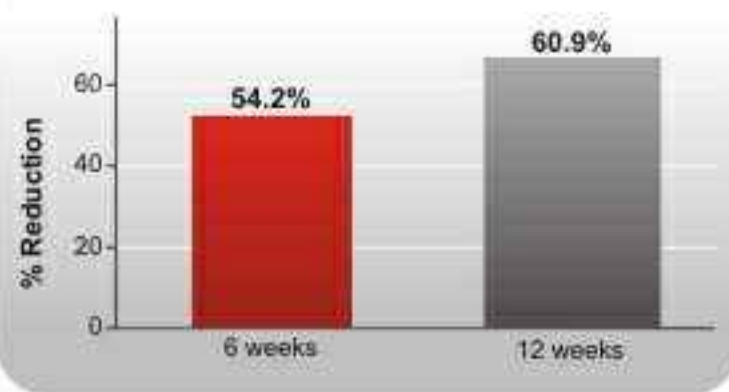


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