# **RGUHS** Journal of Dental Sciences

## (An Official Publication of RGUHS)



## Rajiv Gandhi University of Health Sciences, Karnataka

4<sup>th</sup> 'T' Block, Jayanagar, Bengaluru 560 041, Karnataka Phone No: 080-26961934, 26961935 E-mail: registrar@rguhs.ac.in Website: www.rguhs.ac.in

# **RGUHS** Journal of Dental Sciences

#### **ADVISORY BOARD**

#### Dr. S. Ramananda Shetty

Vice Chancellor RGUHS, Bangalore, Karnataka

### Dr. D. Prem Kumar

Registrar RGUHS, Bangalore, Karnataka

### Dr. Mahesh Verma

I/C President Dental Council of India, New Delhi

#### EXECUTIVE DIRECTOR

#### Dr. R. Rama Raj Urs

University Librarian RGUHS, Bangalore, Karnataka

#### **EDITORIAL BOARD**

### Editor-in-Chief

### Dr. K S Nagesh

Dean, Faculty of Dentistry, RGUHS and Principal, D.A.P.M.R.V Dental College, Bangalore and Member of Syndicate

Editors

### Dr. C. K. Chandrashekar

Chairman, Board of Studies, UG Board RGUHS, Karnataka

#### Dr. Mohamed Faizuddin

Professor & Head, Department of Periodontics, M. R. Ambedkar Dental College & Hospital, Bangalore

Assistant Editor

#### Dr. Suma S

Reader, Department of Oral and Maxillofacial Pathology, D A P M R V Dental College, Bangalore

#### MEMBERS

Dr. Ikramuddhin Aukhil, USA

Dr. Jayanth Kumar, USA

#### Dr. Roopa Nadig

Director, PG Studies Dayanand Sagar College of Dental Sciences, Bangalore

#### Dr. Priya Subramanyam

Professor & Head, Department of Pedodontics The Oxford Dental College, Bangalore

#### Dr. Girish Galagali

Professor and Head, Department of Prosthodontics Navodaya Dental College, Raichur and Member of Senate RGUHS, Karnataka

#### Dr. Rajkumar Alle

Professor and Head, Department of Orthodontics Rajarajeshwari Dental College and Hospital Bangalore and Member of Senate, RRGUHS, Karnataka

#### Dr. Shreenivas S. Vanaki

Professor & Head, Department of Oral Pathology P M N M Dental College & Hospital, Bagalkot

#### Dr. Sateesh Babu

Professor & Head, Department of Prosthodontics V. S. Dental College and Hospital, Bangalore,

#### Dr. S E Shekar

Principal KLE Institute of Dental Sciences, Bangalore

# **RGUHS** Journal of Dental Sciences

# Contents

In	struction to Authors
Ec	litorial 2
Oı	iginal Articles
1.	Comparison of shear bond strength of Orthodontic Brackets using three different curing lights - An In Vitro study Dr M R Balasubramanian Dr K Ravi Dr R Krishna Rai Dr S Dilin Dr K Arul Prakash
2.	Influence of smoking on Fibroblast Apoptosis in Chronic Periodontitis Dr. Sachin S Shivanaikar, Dr. Mohamed Faizuddin, Dr. Kishore G Bhat
3.	A comparative evaluation of the apical sealing ability of a glass ionomer based root canal sealer and epoxy resin root canal sealer -in vitro study Dr.Karthik.J, Dr.S.Jagdish
Ca	ise Report
4.	Prosthodontic Rehabilitation of an Acquired Surgical Mandibular Defect – A Case Report Dr. Muralidhar G, Dr. Ravishankar K, Dr. Reyazulla M A
5.	<b>Dental management of congenital scoliosis - A case report</b> Dr. Priya Subramaniam, Dr. Megha Gupta
6.	Esthetic Management of Gingival Hyperpigmentation By Three Different Surgical Techniques - Case Report Dr Shivanand Aspalli, Dr Siddhant Jajoo, Dr V Sudhir Shetty, Dr Asif
Re	eviews
7.	Zirconia Ceramics and its Applications in fixed Prosthodontics – A Review Dr. Krishna Prasad D, Dr. Chetan Hegde, Dr. Meghashri K, Dr. Manoj Shetty
8.	Oral Antimicrobial Peptides – Protectors of the Oral Cavity Dr. Shweta Somasundara Y, Dr. Jayakumar H L
9.	<b>Mechanism of Disocclusion – A Review</b> Dr. Sanjana J Rao, Dr. Manoj Shetty, Dr. Krishna Prasad, Dr. Chetan Hegde
10	<b>. One piece implants versus two piece implants – A clinical</b> review Dr. Sudhindra S Mahoorkar, Dr. Girish P Galagali
Сс	lumn
11	. Dentistry: The Time of Yore (Part IV – The Dentifrice Tale) Dr. Suma S

#### **INSTRUCTION TO AUTHORS**

The RGUHS Journal of Dental Sciences is an official publication of the Rajiv Gandhi University of Health Sciences, Karnataka. The journal publishes original articles, case reports, reviews, scientific abstracts and short communications pertaining to all disciplines of dentistry.

#### Submission of manuscripts

Manuscripts should be sent to:

#### **RGUHS Journal of Dental Sciences**

Editor-in-Chief Dr. K.S.Nagesh

Principal

R.V. Dental College

No.CA 37, 24th Main,

I Phase, J.P. Nagar,

Bangalore-560078

Two copies of the manuscripts with two sets of figures should be submitted, along with a copy on a compact disc. Any further queries can be sent to rvdc@vsnl.com

The author is responsible for all statements made in his work, including the changes made by the copy editor. Authors submitting a paper do so on the understanding that the work has not been published before, is not being considered for publication elsewhere and has been read and approved by all of the authors.

#### **Manuscript format:**

The paper should be in UK English with double spacing and the pages should have a 1-inch margin. The manuscript should preferably be no longer than 10 double-spaced pages (roughly 3000 words), and the pages should be numbered.

The first page: should contain

1) Title- must be concise but informative and should not contain more than 50 characters.

- 2) The authors' names
- 3) The Department/Institution
- 4) An address for each author

5) The name, address, telephone number, fax and Email address of the author responsible for correspondence.

#### The second page: should contain the

- 1) Abstract, which should not exceed 200 words.
- 2) Keywords, upto 10

*The Main Text:* The format of the main text is as follows

**1)** For Original Articles: Introduction, materials and methods, results, discussion, acknowledgements and references.

- **a**) Introduction: should be brief and clearly state the purpose of the article
- **b)** Materials and methods: an outline of the essential steps and the materials/equipments should be given.
- c) Results: should be presented in a logical sequence in the text, tables and illustrations
- **d)** Discussion: should emphasize the new and important aspects of the study, implications of the results and the conclusions that follow. The observations should be related to other relevant studies. The discussion should end with a brief conclusion.
- **e)** Acknowledgements: to those persons who have made substantive contributions to the study.
- **f)** References: must follow the Vancouver system and numbered consecutively in the order in which they appear in the text. Examples:

*Journal:* Buchner A, Sciubba JJ. Peripheral epithelial odontogenic tumours: a review. Oral Surg Oral Med Oral Pathol 1987; 63:688-97

*Book:* Ten Cate AR. Oral histology: Development, structure and function, 5<sup>th</sup> edition, Missouri: Mosby-Year Book, Inc, 1998: 50-66

**2) For Case Reports**: Introduction, description of case, discussion, acknowledgement and references.

**3)** For **Reviews:** Introduction, body, conclusion and referencesa. Systematic reviews are preferred over narrative reviews. However, narrative reviews on novel subjects with substantial material and adequate references will be considered.

*Illustrations:* should be minimum and should clarify the text. They should be of good resolution and planned to fit the proportions of the page. Each illustration should be accompanied by a legend (in capitals only). The illustrations should be in JPEG/TIFF format and should be included in the soft copy along with the word document. In addition, a printout of the illustrations with their accompanying legends should be sent along with hard copy of the manuscript.

*Tables:* should be labeled consecutively in Arabic numerals.

*Abbreviations and symbols:* only standard abbreviations must be used.

#### **EDITORIAL**



**Dr. K S Nagesh, MDS** Editor-in-Chief RGUHS Journal of Dental Sciences Principal, R.V. Dental College No. CA 37, 24<sup>th</sup> Main, I Phase J.P.Nagar, Bangalore-560078

In Karnataka, during the last decade, there has been an outpouring of students graduating with a BDS (Bachelor of Dental Surgery degree). Yet, only 20% of these graduates can enter a MDS (Master of Dental Surgery) course, thus leaving no auxiliary options for the rest of them. This has created an imperative need for the introduction of short term courses in dentistry for BDS graduates. I am glad that the Rajiv Gandhi University of Health Sciences, Karnataka, has taken a lead in this regard and started certificate courses in Implantology and Aesthetic Dentistry. The courses are conducted across the state, in various teaching and non-teaching institutions which fulfill the norms laid down by the university. I hope this is a boon to the fresh graduates and crafts an ascending curve in their careers.

With Regards,

(Dr. KS Nagesh)

### Comparison of shear bond strength of Orthodontic Brackets using three different curing lights - An *In Vitro* Study

Dr. M.R. Balasubramanian MDS<sup>1</sup>, Dr. K. Ravi MDS<sup>2</sup>, Dr. R. Krishna Raj MDS<sup>3</sup>, Dr. S. Dilip MDS<sup>4</sup> and Dr. K. Arul prakash MDS<sup>5</sup>

<sup>1</sup>Dean, <sup>2</sup>Vice Principal, <sup>3</sup>Professor, <sup>4</sup>Professor, <sup>5</sup>Postgraduate Student SRM Dental College, Chennai, Tamil Nadu, India.

#### Abs rac

The introduction of bonding has revolutioni ed orthodontics. Halogen lamp used for curing initially had several disadvantages like quick overheating of filament, ability to convert less than 1% of electrical energy to light energy and a short life span. Light emitting diode (LED) which was introduced later for curing had little loss of power during its application, improved life span and improved rate of polymeri ation. Xenon plasma are curing light is a relatively new development which is said to deliver a high intensity output and reduced curing time. The curing time of 20-40s with halogen lamps is said to be dramatically reduced to 4-6s with plasma are curing. This study was undertaken to determine the shear bond strength of orthodontic brackets using three different curing lights. Ninety premolars were divided into three groups. The teeth were bonded with stainless steel premolar brackets. Lloyd's instron machine was used to determine the shear bond strength of 10.02 Mpa  $\pm$  0.68Mpa. Plasma light curing unit recorded mean bond strength of 9.99 Mpa  $\pm$  0.37Mpa. LED light curing unit recorded mean bond strength of 9.99Mpa  $\pm$  0.41 Mpa. The results of the present study show there is no significant difference in the bond strength of the bonded brackets on the tooth surface using different light curing units. The results of the ARI scores revealed no difference between the groups. Plasma are curing can provide acceptable bond strength with decreased curing time there by reducing the chair time.

Ke words: Bond strength, c ring light, halogen lamps, light emitting diode, plasma arc.

#### INTRODUCTION

One of the most significant advances in orthodontics in the past four decades is in the use of composite resin as a bonding material which was introduced by Newman in 1965<sup>1</sup>. In contemporary fixed appliance treatment a principal requirement is correct bracket positioning .The advent of light cure adhesives has become popular since their introduction in 1979 by Tavas and Watts<sup>2</sup>, as they provided increased working time and aid correct bracket positioning. A disadvantage of the light cure approach is the time it takes to expose each bonded bracket to the light.

Halogen lamps were the first to be introduced as the source of light. Though it was a boon for the clinical achievements for the dental practice in the initial stages it had many demerits. Quick over heating of the

Author for Correspondence:

DR. R. KRISHNA RAJ, ProfessorDepartment of Orthodontics, SRM Dental College, Bharathi Salai, Ramapuram Po,Chennai-600089, Tamil Nadu, India.

Email: srmorthodontics@gmail.com

filament of the halogen bulbs made its use restricted for lengthy procedures, especially in orthodontics. It was able to covert just 1% of the electricity energy to light energy. The life span of the bulb was only100 hours after which the efficiency decreased.

Mills<sup>3</sup> presented the solid state light emitting diode (LED) in 1995. Since then LED has attracted increasing attention as a new source for light-activated polymerization. The LED curing light uses the junction of doped semiconductors instead of a halogen light bulb to produce light. There is little loss of power during its application, and the light source may last for 10,000 hours. The system does not require a bulb light filter; the light is acceptably resistant to shock and vibration, and is activated with a small amount of energy. The LED curing light increases the rate of polymerization using a wavelength ranging from 420 to 480 nm, which is the most efficient wavelength.

Developments in light-curing units have LED to the introduction of a plasma-arc light-curing unit that delivers high intensity output and exhibits accelerated light-curing times of 2-3 seconds per site. The xenon plasma arc curing light was first used in the 1990s; it dramatically decreases the time needed to cure an orthodontic resin from 20 to 40 seconds needed to polymerize the resin by halogen lights to 4 to 6 seconds. The xenon plasma arc curing light increases polymerization efficiency activating a photo initiator within a narrow wavelength range of 470 to 480 nm, which decreases the polymerization time needed. This rapid curing feature saves considerable chair side time when compared with conventional light-curing units. Its size, cost and limited mobility are some of its disadvantages.

#### **AIMS AND OBJECTIVES**

To compare the shear bond strength of orthodontic brackets cured by using halogen, LED and plasma arc curing units.

#### **MATERIALS AND METHODS**

Ninety freshly extracted teeth for orthodontic purpose (maxillary and mandibular premolars) were collected. They had undamaged Buccal enamel with no caries and no pre-treatment by any chemicals. Following extraction, residue on the teeth was removed and washed away with tap water. They were then stored in normal saline at room temperature to prevent dehydration and bacterial growth. The teeth were mounted on an acrylic blocks such that the roots were completely embedded into the acrylic up to the cemento-enamel junction leaving the crown exposed. The teeth were randomly divided into three groups. The blocks were colour coded for easy identification (Fig 1).

Maxillary and mandibular premolar SS brackets American Orthodontics® was used in this study, they had an average base area of 10.5mm<sup>2</sup>.Etchant used was 37% Phosphoric acid gel (3M Unitek) ® and the adhesive used was Transbond XT light cure adhesive (3M Unitek) ®.The light sources used were

▲ A 3M ESPE, Elipar<sup>™</sup> 2500-Halogen -curing unit (Fig 2)

Fig. 1 : Colour Coded Samples





- ▲ A 3M ESPE, Elipar<sup>TM</sup> Light emitting diodecuring unit (Fig 3)
- ▲ A PLASMA STAR<sup>™</sup> Plasma arc-curing unit (Fig 4)

For each type of light source 30 teeth from group I, II, III were bonded using the following protocol: Enamel surface were polished with oil and fluoride free fine pumice with a slow speed micro motor hand piece and brush. Washed and dried using 3 way syringe, etched with 37 % phosphoric acid gel for 30 seconds, washed and dried using 3 way syringe .A thin coat of primer was applied to acid-etched enamel and to the bracket base. Bracket was placed at long axis point on buccal surface of tooth and excess adhesive around the bracket base was removed with a curved probe. Light sources were used according to the manufacturer's instruction for each group

- ▲ GROUP I cured with halogen light curing unit for 40 sec
- GROUP II cured with LED light curing unit for 20 sec
- ▲ GROUP III cured with plasma arc light curing unit for 6 sec









#### **Bond Strength Testing**

Shear bond strength was measured with universal testing machine (Lloyd Universal testing machine-Model No. L.R 100K)(Fig 5). The specimen mounted in its acrylic block was secured to the lower grip of the machine. To maintain a consistent de-bonding force a ligature wire embedded on to an acrylic block was fixed in the movable head. The ligature wire was positioned in such a way that it touches the bracket.

A cross-head speed of 1 mm/min was used. The computer recorded the force to de-bond the bracket in Newtons (N) and converted into mega pascals (MPa) as a ratio of the force to de-bond to the surface area of the bracket.

Bond strength MPa = Force (Newton)/ Surface area of bracket (mm2)

#### RESULTS

The mean of the shear bond strength of each group and the standard deviation were found out (Table 1). One way analysis of variance was done using ANOVA. It is a statistical technique specially designed to test whether the mean of more than two quantitative populations are equal. The results were tabulated. (Fig 6)

The brackets bonded with *HALOGEN LIGHT* curing unit recorded mean bond strength of 9.99 Mpa and the standard deviation was 0.37Mpa.The brackets bonded with *LED LIGHT* curing unit recorded mean bond strength of 10.02 Mpa and the standard deviation was 0.68Mpa.The brackets bonded with *PLASMA ARC LIGHT* curing unit recorded mean bond

Table1: Comparison of Shear Bond Strengths					
Groups			ar Bond S	trength(MP	a)
Halogen Light			9.99±	0.37	
LED light			10.02	±0.68	
Plasma Ai	rc Light		9.99±	0.41	
Table.2 Ari Scores Obtained for the T			for the Thi	ee Groups	
	Score				
Groups	0	1	2	3	
I	5	15	10	0	
II	5	20	5	0	
	9	9	10	2	

strength of 9.99 Mpa and the standard deviation was 0.41Mpa.There is no significant difference in mean bond strength between Group I, Group II and Group III.

The debonded specimens' bond failure was assessed, and scoring was graded according to the Adhesive Remnant Index or ARI (Artun and Bergland, 1984)<sup>1</sup> after debonding the teeth and bracket were examined under a 10X magnification to evaluate the amount of resin remaining on the tooth.

The A.R.I score has a range between 0 and 3 as follows:

- 0- No adhesive remained on the tooth.
- 1- Less than half of the enamel bonding site was covered with adhesive.
- 2- More than half of the enamel bonding site was covered with adhesive.
- 3- the enamel bonding site was covered entirely with adhesive.

# Comparison of mean adhesive remnant index scores between the three groups:

The mean Adhesive remnant index scores were compared between the three groups (Fig 7)

- ▲ Group I- Halogen, had a mean A.R.I. score of 1.170.69
- ▲ Group II- LED, had a mean A.R.I score of 1.160.59
- ▲ Group III- Plasma arc had a mean A.R.I score of 1.170.95.

There was no significant difference in mean A.R.I scores between Group I, Group II and Group III (table 2)





#### DISCUSSION

Direct bonding of orthodontic brackets to the teeth has become a routine clinical procedure in fixed appliance therapy. Choosing of a bonding system has become challenging for a clinician due to rapid-fire development of many new products; which was pioneered over the decades by, Buonocore<sup>5</sup> (1955), Newman<sup>1</sup>(1965), Wilson & Kent<sup>6</sup>(1971) who; by their visionary work paved the way for advances in the area of bonding. In 1979, Tavas and Watts<sup>2</sup> introduced the use of light-cured adhesives in orthodontics. The various drawbacks associated with the bonding of teeth have forced the orthodontists into a continuous search for ideal orthodontic adhesives. The two main criteria considered are adequate bond strength and very little or no enamel damage on removal.

The light-cured adhesives were polymerized by using different light sources like visible light, halogen. Developments in light-curing units have led to the introduction of a plasma-arc light-curing unit in orthodontics by Cacciafesta<sup>7,8</sup> in 1990s, that delivers high-intensity output and exhibits accelerated light-curing times of 3 seconds per site. This rapid curing feature saves considerable chair side time when compared with conventional light-curing units. In 1995, Mills et al<sup>3</sup> proposed solid-state light-emitting diode (LED) technology for the polymerization of light activated dental materials to overcome the shortcomings of other light–curing units.

The present study was to compare the shear bond strength of orthodontic brackets generated by using three different sources of lights namely halogen, LED and plasma arc, and shows that there was no significant difference in the bond strength among halogen, LED,

RGUHS J Dent. Sciences, June 2011 / Vol 3 / Issue 2

plasma arc .There was no significant difference in mean bond strength between Group I, Group II and Group III. The shear bond strengths obtained for three light sources are more than recommended by Reynolds(1976)<sup>9,10</sup>, a minimum bond strength of 5.9 to 7.8 MPa was found adequate for most clinical orthodontic needs. Furthermore, the shear bond strength recommended for successful clinical bonding was estimated to be 7 MPa by Lopez<sup>11</sup> (1980).

The halogen curing light is the least expensive of the three units tested. It is relatively easy to use and produces clinically acceptable bond strength at its maximum setting, but it takes longest time to cure. The plasma arc is the most expensive, is fairly easy to use, produces bond strengths equal to that of other units and takes the least time to cure. The LED costs slightly more than the halogen light and significantly less than the plasma arc, it takes half the time of the halogen light to cure and it is cordless. This also produces acceptable bond strengths, making it a more suitable device for current orthodontics practices although plasma arc carries a distinct advantage when multiple bondings are needed routinely.

#### CONCLUSION

There is no significant difference in the bond strength of the bonded brackets on the tooth surface using different light curing units. The results of the ARI scores revealed no difference between the groups. This study shows that, both LED and plasma arc provide adequate bond strength and can be used for orthodontic purposes.

#### REFERENCES

- Newman.G.V. Epoxy adhesives for orthodontic attachments. Progress report: Am J Orthod Dentofac Orthop 1965;51:901-912.
- Tavas, Watts. A visible light activated direct bonding material. An in vitro comparative study: Br. J. Orthod. 1984; 33-37.
- 3. Mills. Blue Light emitting diode-an alternative method of curing light. Br. Dent. J; 1995;169-178.
- 4. Artun J Sven Bergland, Clinical trials with crystal growth conditioning as an alternative to acid-etch enamel pretreatment. Am.J.Orthod; 1984;333-340.

- Michael G.Buonocore, M.S, Rochester Simple method of increasing the adhesion of acrylic filling material to enamel surface. J Dent Res1955; 34;849-853.
- 6. Wilson, A.D. and Kent, B.E. A new translucent cement for dentistry, Brit.Dent.J.1972;132;133-135,
- Vittorio Cacciafesta, Maria Francesca Sfondrini, and Andrea Scribante. Plasma arc versus halogen lightcuring of adhesive-precoated orthodontic brackets: A 12-month clinical study of bond failures. Am J Orthod Dentofac Orthop; 2004;126:194-99.
- Vittorio Cacciafestaa, Maria Francesca Sfondrinib, Andrea Scribantec ,Andreas Boehmed; Paul-Georg Jost-Brinkmanne. Effect of Light-tip Distance on the Shear Bond Strengths of Composite Resin. Angle Orthod2005;75:386–391.

- ReynoldsIR. A review of direct orthodontic bonding. Br.J.Orthod.1975:171-178.
- Reynolds IR, von Fraunhofer. Direct bonding of orthodontic attachments to teeth. The relations of adhesive bond strength to gauze mesh size. Br J Orthod1976;3:91-5.
- 11. Lopez. Retentive shear strengths of various bonding attachment bases Am. J. Ortho. Jun 1980; 669–678.

## Influence of smoking on Fibroblast Apoptosis in Chronic Periodontitis

Dr. Sachin.S.Shivanaikar MDS<sup>1</sup>, Dr. Mohamed Faizuddin MDS<sup>2</sup> and Dr. Kishore G. Bhat Md<sup>3</sup>

<sup>1</sup>Senior Lecturer, Maratha Mandal's NGH Institute of Dental Sciences, Belgaum, Karnataka.

<sup>2</sup>Dr.Mohamed Faizuddin, Professor and Head, Department of Periodontics, M.R.Ambedkar Dental College, Bangalore, Karnataka.

<sup>3</sup>Dr.Kishore G Bhat, Professor and Head, Department of Microbiology and Molecular Biology, Maratha Mandal's NGH Institute of Dental Sciences, Belgaum, Karnataka.

#### This article has been republished in this issue due to a printing error in the previous issue of the journal. The editorial board regrets the same

#### Abstract

Periodontal disease is a chronic inflammatory condition initiated by microorganisms inhabiting the gingival crevice, leading to destruction of tooth supporting tissues. There are various risk factors for the disease and smoking is one of the important risk factors. The maintenance of equilibrium between the host defence and microorganism in the sulcus is essential to preserve health. Apoptosis or programmed cell death is a very important phenomenon in regulating homeostasis and disturbance in this is often associated with disease. Fibroblasts are the important component of the connective tissue which is responsible to maintain homeostasis. The aim of this investigation was to study the influence of smoking on apoptosis of fibroblasts by quantifying them in the gingival connective tissue of smoking and non-smoking subjects suffering from chronic periodontitis. 30 Gingival biopsies were harvested from smokers (n=15) and non-smokers (n=15) who suffered from chronic periodontitis. The apoptosis of fibroblasts was assessed and quantified using p53 monoclonal mouse antihuman antibody. The mean ages of the smokers was 47.20 $\pm$ 0.70 and non-smokers was 44.40 $\pm$ 13.40.There was no significant difference in plaque and bleeding index and in probing depth in two groups, but clinical attachment loss showed a significant increase in smokers with p value of 0.036<sup>\*</sup>. There was an increase in apoptosis of fibroblasts among smokers than non-smoking subjects suffering from periodontitis.

Key Words: Apoptosis, Smoking, Fibroblasts

#### **INTRODUCTION**

Periodontal disease is caused by constant exposure of periodontal tissue to bacteria finally leading to destruction of the tooth-supporting tissues and loss of teeth. It is a chronic condition characterized by periods of active tissue destruction at specific sites followed by healing. To preserve a healthy periodontal tissue, it is important for the host to maintain a balance between invader and defender.<sup>1</sup> Cell death, together with cell division, generates the correct number and types of cells, and maintains the balance between various cell populations in an organism<sup>2</sup>.

Apoptosis is a highly regulated form of programmed cell death defined by distinct morphological and biochemical features<sup>3</sup>. Perhaps the greatest irony in

RGUHS J Dent. Sciences, June 2011 / Vol 3 / Issue 2

biology is that life depends on death for tissue homeostasis and maintenance of health in a multicellular organism<sup>4</sup>. The term apoptosis had been coined by Kerr and associates in 1972<sup>5</sup> in order to describe the morphological processes leading to controlled cellular self-destruction. The apoptotic mode of cell death is an active and defined process which plays an important role in the development of multicellular organisms and in the regulation and maintenance of the cell populations in the tissues upon physiological and pathological conditions.<sup>6</sup>

Altered apoptosis has been reported in chronic inflammatory diseases and in neurodegenerative diseases such as Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis, ischemic myocardial infarction, stroke and perfusion. Apoptosis is also altered in autoimmune diseases such as hepatitis and graft versus host disease. Decreased or inhibited apoptosis is also a feature of many malignancies, autoimmune disorders, and viral infections<sup>7</sup>.

Author for Correspondence:

Dr. Sachin.S.Shivanaikar, Senior Lecturer, Maratha Mandal's Nathajirao G. Halgekar Institute of Dental Sciences & Research Centre. # 47 A/2, Near KSRP Ground, Bauxite Road, Belgaum-10, Karnataka, INDIA. E-mail:drsachinshivanaikar@vahoo.co.in

The process of apoptosis can be modulated by various stimuli including hormones, cytokines, growth factors, bacterial or viral infections, and immune responses. Among other factors, the products of two genes that encode proteins Bcl-2 and p53 have been shown to play a fundamental regulatory role in apoptosis. Bcl-2 is a member of a family of anti-apoptotic proteins that can prevent or reduce cell death induced by a variety of stimuli. p53 is the protein product of a tumor-suppressor gene, and expression of p53 can induce apoptosis. This protein is also implicated in the regulation of tissue dynamics, and is specifically thought to induce apoptosis in terminally differentiated cells, including inflammatory cells.<sup>8</sup>

Human gingival fibroblasts are an important component of connective tissue. They play an important role in synthesis and degradation of collagen and components of extracellular ground substance and have an important role in healing of periodontal tissues. Alteration in the normal behaviour of the fibroblasts in response to pro inflammatory cytokines is reported to have an adverse effect on tissue homeostasis. It has been reported that the elimination of fibroblasts by early apoptosis is involved in tissue destruction in periodontal disease<sup>9</sup>.

There are various risk factors for the periodontal disease and smoking is confirmed as one of them in both longitudinal and cross sectional studies<sup>10</sup>. It is reported that there is decrease in inflammation and increase in the destruction of the tooth supporting bone among smokers, but the exact mechanism of this tissue destruction is not clear. Since there are reports of smoking altering apoptosis of various cells in system, alteration of fibroblasts apoptosis in the gingival tissue may be responsible for the breakdown of periodontium, Hence, the aim of this investigation was to study the influence of smoking on apoptosis of fibroblasts in subjects suffering from chronic periodontitis and to quantify the apoptosis of fibroblasts in the gingival connective tissue in smoking and non-smoking subjects by immunohistochemical method.

#### **MATERIALS AND METHOD**

The Study population consisted of 30 male subjects

suffering from chronic periodontitis who were divided into two groups according to their smoking habits. Persons who never smoked (n=15) and subjects who smoked one or more packs of cigarettes daily for at least 2 years (n=15). The nature and purpose of the study was explained to the subjects and written informed consent was taken. Approval from the Ethical Committee of M.R Ambedkar Dental College and Hospital, Bangalore was obtained. The study was carried out from March 2009 to May 2009. Prior to specimen collection periodontal parameters like Bleeding index (Ainomo and Bay), Plaque index (Silness and Loe), Probing depth and Attachment loss was recorded using UNCA periodontal probe. Gingival biopsy samples were harvested with the following clinical criteria, Subjects having inflammatory changes in the gingival tissue, presence of bleeding on probing, pocket depth of 5mm and presence of clinical attachment loss of 3mm. The gingival tissue was harvested from either buccal or lingual site and the biopsies were fixed in 4% buffered formalin and were transported to the laboratory where the specimens were embedded in paraffin wax and sectioned (Fig 1). The apoptosis of fibroblasts in connective tissue was detected by Immunohistochemistry by using p53 monoclonal mouse antihuman antibody as described by F.Jarnbring et al<sup>3</sup>.

#### Quantification of cells

Quantification of apoptotic fibroblasts was done as per the method suggested by Sule Bulut et al<sup>11</sup>. Stained slides were first screened and the area for examination were determined by the observers, using a light microscope\* equipped with a digital video camera .Each section was analysed for the p53 positive stained cells in the connective tissue (Fig 2). The areas chosen for the quantification was captured through the CCD camera, transferred to the computer. All the fibroblasts were manually counted in every area sampled and the number of positively stained fibroblasts were divided by the total number of cells present .The level of expression of p53 were graded in semi quantitative fashion using a 0 to 3+ Scale,

 $\bigstar$  Scale 0 : no staining;



Fig 2: Photomicrographs of gingival tissues stained with p53 monoclonal mouse antihuman antibody. Magnification (x 40); arrow showing fibroblast apoptosis



- ▲ Scale 1+ : stained cells comprising 10% of the cells;
- ▲ Scale 2+ : stained cells comprising 10% 30% of the cells and
- Scale 3+ : stained cells comprising >30% of the cells.

The calculations were performed at x 40 magnification. All slides were evaluated blindly by two independent observers.

#### **Statistical analysis**

Descriptive statistical analysis was carried out. Results on continuous measurements are \*presented on Mean SD (Min-Max) and results on categorical measurements are presented in Percentage. Significance is assessed at 5 % level of significance. Analysis of variance (ANOVA) has been used to find the significance of study parameters

#### RESULTS

The mean ages of the smokers and non-smokers were  $47.20\pm0.70$  and  $44.40\pm13.40$  which is depicted in **table 1**.

The mean Plaque index (PI) among smokers and nonsmokers was  $1.32\pm0.18$  and  $1.42\pm0.35$  and there was no statistical significant difference between two groups, The mean Bleeding index (BI) among smokers and non-smokers was  $73.27\pm8.40$  and  $71.61\pm7.21$  which showed no statistical significant difference between the two groups which is depicted in **table 2**.

The mean Probing pocket depth (PPD) among smokers and non-smokers was  $5.57\pm1.54$  and  $4.59\pm1.22$  respectively which showed no statistical difference among the groups. The mean Clinical Attachment level (CAL) among smokers and non-smokers was  $6.13\pm0.81$  and  $5.46\pm0.84$  which showed a statistical significant difference with P value of 0.036\* and is depicted in **table 3**.

Grade 0 fibroblasts apoptosis among smokers and nonsmokers was 0 and 2, Grade 1 was 6 and 11, Grade 2 was 9 and 2 respectively, and there was no grade 3 fibroblasts apoptosis in both the groups This showed that there was increase in the fibroblast apoptosis among smokers compared to non-smokers with a statistical significant difference at p value of 0.010\* which is depicted in **Table 4** and **Graph 1**.

Table 1: The age distribution of the subjects				
Age in years	Smokers	%	Non smokers	%
11-20	-	-	0	0.00
21-30	2	13.3	3	20.00
31-40	4	26.7	4	26.67
41-50	3	20.0	4	26.67
51-60	3	20.0	1	6.67
61-70	3	20.0	3	20.00
Total	15	100.0	15	100.00
	47.20±0.70		44.40±13.40	

#### Influence of smoking on Fibroblast Apoptosis in Chronic Periodontitis

Table 2: Mean comparison of periodontal parameters					
Clinical parameters	Smokers	Non smokers	P value		
Plaque Index	1.32±0.18	1.42±0.35	0.331		
Bleeding Index	73.27±8.40	71.61±7.21	0.566		
Table3: Mean comparison of periodontal parameters					
Clinical parameters Smokers Non smokers P valu					
Pocket depth	5.57±1.54	4.59±1.22	0.062*		
CAL	6.13±0.81	5.46±0.84	0.036*		

Table4: Fibroblast apoptosis in Smokers and Non-smokers				
Fibroblasts Apoptosis	Smokers	Non Smokers		
GRADE 0	0	2(13.3%)		
GRADE I	6(40.0%)	11(73.3%)		
GRADE II	9(60.0%)	2(13.3%)		
Grade III	0	0		
TOTAL	15(100.0%)	15(100.0%)		
Inferences Incidence of Grade II Fibroblasts are		Fibroblasts are		

significantly more in Smokers (60.0% vs. 13.3%) when compared to non- smokers with P=0.010\*



#### DISCUSSION

Periodontitis is initiated by microorganisms and various risk factors are responsible for progression of the disease. Smoking is considered as one of the major risk factor for periodontal destruction and is confirmed from both longitudinal and cross sectional studies<sup>12</sup>.Direct correlation between tobacco use and increased attachment loss, pocket depth and reduced bone height have been reported<sup>13,14</sup>. Although the correlation between smoking and periodontal disease

is firmly established the role of smoking in the pathogenesis of periodontal disease is not very clear. Alteration in immune responses to periodontal pathogens is believed to be one of the potential mechanism<sup>13,14,15</sup>. Several investigations have suggested that smoking affects many types of cells including the gingival fibroblasts<sup>16</sup>. It has been reported that increased oxidative stress due to smoking causes DNA damage and apoptosis in lung fibroblasts of smokers<sup>17</sup>.

Fibroblasts are the major constituent of the gingival connective tissues. They synthesize collagen and elastic fibers as well as glycoproteins and glycosaminoglycans. They also regulate collagen degradation through phagocytosis and secretion of collagenases. They play a central role in pathogenesis, healing and homeostasis. Increased apoptosis of fibroblasts has been reported during gingival inflammation. However there is paucity of literature about the effect of smoking on gingival fibroblasts and their apoptosis, Hence this investigation is carried out to quantify fibroblasts apoptosis in the gingival biopsies of smokers and nonsmokers suffering from chronic periodontitis in order to understand the effect of smoking on gingival fibroblasts apoptosis.

The result of the present investigation showed that the significant higher grade II fibroblasts apoptosis occurred in the gingival tissue of smokers suffering from chronic periodontitis than non-smokers, these findings suggests that the increased apoptosis of fibroblasts might be responsible for increased clinical attachment loss and marginal bone loss.

To our knowledge there is no other histopathological investigation which has dealt with effect of smoking on fibroblasts apoptosis among smokers suffering from periodontitis, however the cell culture studies conducted by Gabriella Argentin et al suggest that there is antiapoptotic and genotoxic effect of smoking on human gingival fibroblasts which are contrary with our observation<sup>18</sup>. A cell culture study with human lung fibroblasts conducted by Stefano et al has shown that smoking produces increased oxidative stress, DNA damage and apoptosis in the fibroblasts and speculated that this could contribute to the development of pulmonary emphysema<sup>17</sup>. These findings indirectly

endorse the findings of present investigation. In the absence of other investigations involving gingival fibroblasts and conflicting reports of cell culture studies caution is warranted in drawing conclusion about the effect of smoking on apoptosis of gingival fibroblasts in chronic periodontitis.

We consider the possibility that p53 could be involved in apoptosis observed in Periodontitis. Certain activators of apoptosis require the presence of a functional p53 protein.p53 is a tumor suppressor protein which, when active, induces genes related to cell cycle regulation, DNA repair mechanism, and the induction of apoptosis.<sup>19</sup> Although p53 is present in normal tissues and cells, its short half-life make its expression almost undetectable in healthy normal tissues.<sup>20</sup> Upon activation, p53 is stabilized so that its expression can be detected with anti p53 antibodies using immunohistochemical techniques. Our data show the presence of p53- positive cells in gingival biopsies of smokers suffering from periodontitis that could support a p53 dependent apoptosis mechanism which is to be clearly defined.

The limitations of our study includes

1. Sample size of our study is small.

2. We have used only p53 monoclonal mouse antihuman antibody for detection of apoptotic cells. Others studies have used more than one method to be more authentic in their findings, some have used TUNEL technique which is more sensitive than p53.

It is recommended that further research using larger sample size, sensitive staining techniques and better ways to overcome systematic errors may be undertaken to better understand the role of apoptosis among smokers and non-smokers in patients suffering from periodontal disease.

Based on the results of present study it could be concluded that the smoking might influence fibroblasts apoptosis in presence of chronic periodontitis. There is increase apoptosis of fibroblasts among smokers than non-smokers. This might be the reason for increase periodontal destruction among smokers suffering from chronic periodontitis compared to non-smokers. However further research is warranted to understand the role of fibroblasts apoptosis in increased periodontal destruction among smokers.

#### ACKNOWLEDGEMENT

We Thank Dr. Ramadan Kayak, Principal, Professor and Head, Department of Oral Pathology and Dr. Safari Sent, professor, Department of Pathology, Maratha Mandal's Nathajirao Halgekar Institute of Dental sciences and research Centre, Belgaum, for their help and cooperation in conducting the Immunohistochemical analysis

#### REFERENCES

- GenCorp, R. J. Host responses in periodontal diseases: current concepts. Journal of Periodontology, 1992,63: 338–355.
- Chen, Y. & Zychlinsky, A. Apoptosis induced by bacterial pathogens. Microbial Pathogenesis,1994, 17:203–212.
- F. Jarnberg, E. Somogyi, J. Dalton, A. Gustafsson and B. Klinge .Quantitative assessment of apoptotic and proliferative gingival keratinocytes in oral and sulcular epithelium in patients with gingivitis and periodontitis. J Clin Periodontol, 2002, 29: 1065-1071.
- Deepak raj, Douglas E Brash, Douglas Grossman. Keratinocyte Apoptosis in Epidermal Development and Disease. J Invest Dermatol, 2006, 126: 243-257.
- Kerr, JF, Wyllie,AH and Currie, AR, Apoptosis: a basic biological phenomenon with wide-ranging implications in tissue kinetics. Br J Cancer, 1972, 26: 239-257.
- Leist,M and Jaattela,M. Four deaths and a funeral: from caspases to alternative mechanisms .Nat. Rev.Mol. Cell Biol. 2001,2: 589-598.
- Andrew G Renehan, Catherine Booth, Christopher S Potten, What is apoptosis, and why is it important? BMJ, 2001, 322:1536-1540.
- Sule Bulut, Hilal Uslu, B handan and Omer Engin Bulut. Expression of caspase-3,p53 and Bcl-2 in generalized aggressive Periodontitis. Head and Face Medicine,2006,2:17
- Arce, Roger Mauricio, Tamayo,, Oscar and Cortes, Armando, Abstract . Apoptosis of gingival fibroblasts in periodontitis. Revista Colombia Medica, 2007, 8

:197-209.

- Beck JD, Koch GG, Rozier RG, Tudor GE. Prevalence and risk indicators of periodontal attachment loss in a population of older community dwelling blacks and whites. J Periodontol, 1990,61:521-528.
- Sule Bulut, B handan, E.E Alaaddinoglu,F. B Oduncuoglu, O.E Bulut, B.Demirhans .Effect of cyclosporin A on apoptosis and expression of p53 and bcl-2 proteins in the gingiva of renal transplant patients. J Periodontol, 2005, 76:691-695.
- M.A Mariggio, L.Guida, A. Laforgia, R. Santacroce, E. Curci, P. Montemurro et al .Nicotine effects on polymorphonuclear cell apoptosis and lipopolysaccharide-induced monocyte functions. A possible role in periodontal disease? J Periodont Res, 2001,36:32-39.
- 13. Bergstrom J, Preber H .Tobacco use as a risk factor. J periodontol, 1994, 65:545-550
- 14. Haber J, Kent RL. Cigarette smoking in periodontal practice. J Periodontol, 1992 63:100-106.
- 15. Tuder, R. M., K. Wood, L. Tarasevicine, S. C. Flores, and N. F. Voelkel. . Cigarette smoke extract decreases

the expression of vascular endothelial growth factor by cultured cells and triggers apoptosis of pulmonary endothelial cells. Chest , 2000,117:241S–242S. (Abstract)

- 16. Massimo T, Paola Poggi, Renata Boretta .Human Gingival fibroblasts cytoskeleton is a target for volatile smoke components. J Periodontol: 2001, 72:709-713.
- Stefano Carnevali, Stefano P, Biancamaria I, Renato v, Roberto B, Monica C et al. Cigarette smoke extract induces oxidative stress and apoptosis in human lung fibroblasts. Am J Physiol Lung Cell Mol Physiol ,284:L955-L963.
- Gabriella A and Rosadele C Genotoxic and antiapoptotic effects of nicotine on human gingival fibroblasts. Toxicological science, 2004, 79:75-81.
- 19. Ko LJ, Prives C. p53:puzzle and paradigm.Genes Dev.1996;10:1054-1072.
- J Gamonal, A Bascones, A Acevedo, E Blanco and A Silva. Apoptosis in chronic Adult Periodontitis Analysed by In Situ DNA Breaks, Electron Microscopy, and Immunohistochemistry. J Periodontol,2001;72:517-525.

### A Comparative Evaluation of the Apical Sealing Ability of a Glass Ionomer Based Root Canal Sealer and Epoxy Resin Root Canal Sealer *-In Vitro* Study

**Dr. Karthik.**  $J^1$  MDS, **Dr. S.Jagdish**<sup>2</sup> MDS

<sup>1</sup>Senior Lecturer, Department of Conservative Dentistry & Endodontics, Dayananda Sagar College of Dental Sciences, Bangalore, Karnataka, India

<sup>2</sup>Formerly Professor & Head, Department of Conservative Dentistry & Endodontics, D.A.P.M.R.V.Dental College and Hospital, Bangalore, Karnataka, India

#### Abstract

The objective of this *in vitro* study was to determine the apical seal of a glass ionomer based sealer (Ketac-Endo) and epoxy resin root canal sealer (AH-Plus) and the other objective was to check whether the use of dentin conditioner (10% polyacrylic acid) improved the seal in glass ionomer based root canal sealer. Using a stereomicroscope and the values were subjected to statistical analysis. Results of the study showed that AH-plus sealed better than Ketac-Endo sealer showing lower levels of dye penetration, being statistically significant. Another observation made was that the use of dentin conditioner improved the adhesion of Glass ionomer sealer to the root canal wall.

Keywords: 2% Methylene Blue, Gates Glidden drills, crown down technique, Ketac-Endo sealer, AH Plus sealer, 10%Polyacrylic acid.

#### **INTRODUCTION**

The three dimensional obturation of the entire root canal system including lateral canals, fins, cul-de-sacs that are present with a biocompatible material so as to obtain a fluid impervious apical and lateral seal has been the main objective of obturation. It has been demonstrated that incompletely obturated root canal system accounts for approximately sixty percent of endodontic failures. <sup>1</sup>. Lack of apical seal leads to microleakage and eventually failure of the root canal treatment. On account of this many improvements in the techniques of cleaning and shaping and root canal obturation have been made.

Use of a sealer during root canal obturation is essential for the success, since it enhances a possible attainment of impervious seal and serves as filler for canal irregularities and minor discrepancies between the root canal walls and the core filling material. Of the various root canal sealers available today, resin sealers (AH Plus) have been used successfully to fill the root canal system. Percolation of fluids in apical portion is a

Author for Correspondence:

Dr. Karthik. J, No.1141, 18<sup>th</sup> cross, 30<sup>th</sup> Main, Banashankari II stageBangalore-560070 Email: tiku78@gmail.com major concern with many sealers. The lack of good adhesion between the gutta percha, sealer and the canal wall often leads to microleakage. In order to improve the sealing ability constant improvements are being made for improving the quality of obturation resulting in development of new sealers with better physical, chemical & biological characteristics. This has focused on the use of glass ionomers and other dentin bonded resins. Glass polyalkenoate (glass ionomer) developed in 1960 by McLean and Wilson, has come a long way ever since they were introduced as an efficient luting and restorative material. Further developments have resulted in considerable improvements in their properties and handling characteristics.

Glass ionomers are used in dentistry because of their long term excellent adhesion to dentin. It is this property that prompted the development and introduction of a root canal sealer based on glass polyalkenoate cement, which is marketed as Ketac-Endo (3M-ESPE). It claims to have favorable properties like biocompatibility, good adhesion to dentin and optimum flow characteristics. It has been reported that the physical properties and ease of manipulation of various experimental samples of glass ionomer root canal sealers were equal, or superior, to A Comparative Evaluation of the Apical Sealing Ability of a Glass Ionomer Based Root Canal Sealer and Epoxy Resin Root Canal Sealer -*In Vitro* Study

those of a zinc oxide-eugenol based sealer made according to Grossman's formulation.<sup>2</sup> In one study it was demonstrated that the obturation of canals in conjunction with glass ionomer based root canal sealer significantly 'strengthened the roots' when compared with roots obturated with gutta percha and zinc oxide-eugenol based sealer.<sup>3.</sup> The aim of this in vitro study is to perform a comparative evaluation of the apical sealing ability of a glass ionomer based root canal sealer and epoxy resin root canal sealer using stereomicroscopic examination, following dye penetration method.

#### METHODOLOGY

#### Source of samples:

Fifty extracted permanent single rooted maxillary anterior teeth were collected from the Department of Oral Surgery, R.V.Dental College and Hospital Bangalore.

#### Armamentarium

a) 5.25% Sodium hypochlorite.

- b) 17% EDTA
- c) Gates Glidden drill.

d) K-Files.

e) Spreaders.

f) Gutta Percha cones.

g) Ketac-Endo root canal sealer (3M-ESPE)

h) AH-Plus root canal sealer (DENTSPLY)

i) Nail varnish.

j) 2% Methylene Blue dye.

k) Distilled water.

l) Cavit.(3M ESPE)

#### Method of collection of samples:

Collection of fifty extracted permanent single rooted maxillary anterior teeth from the Department of Oral Surgery, R.V.Dental College, Bangalore, which are indicated for extraction.

#### Inclusion criteria for samples:

Non carious teeth

Teeth with completed root formation

#### **Exclusion criteria for samples:**

1) Teeth with open apices.

2) Calcified canals.

3) Variations in the radicular anatomy.

#### **PROCEDURE:**

Fifty human maxillary anterior teeth with a single root canal were selected for use in this study. The selected teeth were stored in a 5.25% sodium hypochlorite (NaOCl) solution for one day to remove any organic debris and thereafter stored in normal saline solution. The crowns were removed from the teeth with a low speed diamond disc at the cemento-enamel junction and any residual pulp tissue was removed from the root canals with a barbed broach. Each canal was negotiated with a size 15 K file until the tip of the file was seen at the apical foramen and each canal's working length was calculated to be 0.5 mm less than the length obtained with this initial file. Crown down technique of canal preparation was employed in all the specimens in the study using Gates Glidden no.3,2,1 followed by K-files no.40,35,30,25 size till the working length. The master apical file (MAF) used was size 25 K.file. The canals were irrigated copiously with 5.25 % solution of NaOCl .On completion of the canal preparation, the teeth were randomly divided into five experimental groups of 10 teeth each.

GROUP-A: Prepared canals were obturated using AH-Plus as the root canal sealer and gutta percha by the lateral condensation technique.

GROUP-B: Prepared canals were obturated using Ketac-Endo as the root canal sealer and gutta percha by the lateral condensation technique..

GROUP-C: Prepared canals were conditioned with Poly acrylic acid (10%) prior to obturation with Ketac-Endo as the root canal sealer and gutta percha by the lateral condensation technique.

GROUP-D: Prepared canals without any root fillings were coated all over with nail varnish, including the coronal end, except the 2mm of the apical end (Positive control).

GROUP-E: Prepared canals without any root fillings were sealed apically and coronally with Cavit and

A Comparative Evaluation of the Apical Sealing Ability of a Glass Ionomer Based Root Canal Sealer and Epoxy Resin Root Canal Sealer -*In Vitro* Study

coated with nail varnish on the entire external root surface. (Negative control) The root canals of the teeth in Groups A.B and C were dried with paper points and standardized size No:25 gutta percha points were selected as master points. Each point was tested visually in the root canal to ensure placement to the full working length and tug back appreciated. The sealers were mixed according to the manufacturers' directions and were introduced into the canals using spiral root filler. The master gutta percha point was then coated with sealer and inserted into the canal to the full working length. The remainder of the canal was filled by lateral condensation technique. The tooth roots were then coated with two layers of colored nail varnish except for the sectioned surface of the coronal root face and the apical 2 mm of the root.. The experimental and control teeth roots were each placed in numbered containers which were filled to identical levels with 2% Methylene blue dye and then placed in containers immersed in the dye for a further two days. The tooth roots were grooved buccally and lingually with a diamond disc, ensuring that the root canal filling was not penetrated. The linear extent of dve penetration in the apical third root ends was measured using a stereomicroscope (20 x magnifications).

Duncan test was used in this study which is a multiple comparison procedure developed by Duncan in 1955, which

	Table 1: Duncan test results				
	LEAKAGE-DUNCAN TEST				
CDOUDS	Subsets of alpha = 0.05				
GROUPS	N	1	2	3	
Group a	10	.9790			
Group b	10		1.4900		
Group c	10			1.6820	
Sig.		1.000	1.000	1.000	

Table 2: ANOVA test results					
			ANOVA TEST	-	
	Sum of	df	Mean	F	Sig
	Squares		Square		-
Between	2.641	2	1.320		.000
groups				257.857	
Within	.138	27	5.120E-03		
groups					
Total	2.779	29			

is based on multiple comparison procedures that use the range statistic *alpha*, to compare sets of means.

ANOVA( Analysis of Variance) test between the groups showed that there was statistically significant difference between the groups. The difference in the p-value between the AH Plus and Ketac Endo was p<0.01, which was statistically significant. The values between Ketac Endo with and without conditioning were not statistically significant. The inference drawn from the above test are highlighted below as follows.

Group A (AH- Plus) showed the least level of dye penetration of 0.9mm. The mean value of dye penetration was 0.9790 for this group .

Group B (Ketac-Endo with conditioning) showed dye penetration levels of 1.49.mm. This was statistically significant less than that of Group B, but more than Group A.

Group C (Ketac-Endo without conditioning) showed the highest levels of dye penetration of 1.79 mm. The mean value of dye penetration for this group was 1.682 mm.

#### DISCUSSION

The fluid impervious seal of the root canal system, a major objective in root canal obturation, can be evaluated using leakage tests. Numerous investigations have compared the sealing capacity of various root canal sealers showing conflicting results. The present study, an in vitro evaluation of apical leakage of two root canal sealers namely, AH-Plus and Ketac-Endo showed that AH-Plus used as a sealer in conjunction with lateral condensation significantly decreased apical leakage. In the present study the canal was enlarged to apical size 25 using a crown down technique. This technique was employed so as to have sufficient amount of flaring (telescopic preparation) which would allow more amount of sealer placement. Also, crown down technique is the currently the technique of choice of root canal preparation, which would allow better reach of the irrigating solution, ease of sealer placement and bulk for obturating material. Although the canal could have been enlarged to a larger size, the purpose of maintaining the apical size 25 was to have bulk of root canal sealer around the guttapercha .In vitro studies have proved that more amount of sealer in the canal renders the tooth stronger and also the chemical bond to the dentinal wall is relatively high. The study also showed that combination of conditioning dentin with 10% polyacrylic acid and the use of glass ionomer sealer helped to reduce leakage when compared to the same sealer used without conditioning.4 However the apical leakage is significantly less in AH-Plus when compared to any of the glass ionomer based root canal sealer. The statistically significant difference found between AH-Plus and Ketac-Endo (p<0.01) underlies the fact that resin based sealer performed better than glass ionomer based root sealer.<sup>5</sup> In the present study the lateral condensation was the method of obturation utilized, as it provides a standard for all the three groups and also a widely practiced clinical procedure.<sup>6</sup> It would seem possible that the glass ionomer sealer can get disturbed during placement of the spreader during obturation, resulting in voids. Further while withdrawing the spreader the root canal may be deprived of some amount of glass ionomer sealer, as it tenaciously adheres to the spreader. A relative demerit of glass ionomer sealer is its short working time unlike epoxy resin sealer, which gives ample time for the placement of additional cones without interfering the setting reaction and also the flexibility of placing more cones in a short span of time. It may be interesting to study the apical leakage experience of single gutta percha cone technique while using Ketac-Endo. The advent of cones such as Protaper GP Points matching with similar files can throw light on better obturation since the sealer is not disturbed as in lateral condensation. Ketac-Endo does not appear to have lubricating property like AH Plus. It has only 7 minutes of working time while AH-Plus has a good reasonable working time of 30 minutes. This is a pronounced clinical advantage since should there be a correction required, it would be easy to rectify any gutta percha in AH Plus rather than glass ionomer sealer. There is no solvent to dissolve glass ionomer sealer. Thus the lack of working time is always a concern with Ketac- Endo sealer.

It is possible that Ketac-Endo depends on circumferential chemical bonding to prevent leakage, whereas AH-Plus sealer does not have any bonding but still resists leakage because of close adaptation and effective lateral condensation of gutta percha, thus ensuring a three dimensional obturation of the root canal system.<sup>7</sup> An in vitro study in reported that the apical and coronal leakage of laterally condensed Ketac-Endo and AH-26 root canal sealer to have comparable apical seal.<sup>8</sup> They have further speculated that the strength of setting contraction of large mass of Ketac-Endo is greater than the strength of the bond between sealer and the dentin, thus leading to leakage in such areas. They suggest that Ketac-Endo is not suitable for single cone technique or for retrograde filling due to greater mass of sealer and possible setting contraction. However with the advent of protaper gutta percha points which match the corresponding protaper instruments, there is hardly any room for increased thickness of sealer thus negating the contraction factor. Most of these protaper gutta percha points snugly fit the prepared canals which require minimum amount of application of sealer. Although they have reported that Ketac-Endo gave similar apical and coronal seal to that obtained with AH-26 when used in conjunction with lateral condensation of gutta percha, they have observed that physical property of Ketac-Endo sealer does not subscribe as an ideal root canal sealer in its current form and further investigations of these properties are suggested.<sup>9</sup>

In the present study an attempt has been made to use the Ketac-Endo after conditioning the dentin of the root canal with polyacrylic acid.<sup>10,11</sup> this was done in the light on knowledge of conventional use of dentin conditioners prior to any glass ionomer restoration during restorative procedures. This procedure of conditioning with polyacrylic acid has indeed helped to obtain better adaptation as evidenced in the lower leakage compared to no conditioning.<sup>12</sup> However the values are not statistically significant but the advantage appears marginal. The leakage experience in both groups of Ketac-Endo does not match the AH-Plus values in that the AH-Plus group has definitely performed better and also the values are statistically significant (p<0.01)

Ketac-endo also renders the tooth strong by bonding and increases the strength of the tooth which was stated in an in vitro study. This is beneficial to the tooth root treated indirectly since the monoblock effect rendered will make the tooth stronger. The increased leakage experience in Ketac-Endo groups could also be due to repeated placement of spreader during lateral condensation of gutta percha. At this stage two things can happen, one is the chemical bonding that is taking place between unset glass ionomer and dentin gets mechanically disturbed by the insertion of spreader between guttapercha and canal wall.<sup>13</sup> Secondly, some cement may inadvertently be removed as it adheres to the spreader (stainless steel instrument). There is always a disturbance throughout in the in the initial stages when it is prime time for chemical bonding. Thus the seal may not be perfect and can lead to voids in the glass ionomer which could have contributed to the increased leakage. An in vitro study investigated the use of vacuuming technique prior to immersion of the tooth in the dye.<sup>14</sup> According to manufacture, the glass ionomer must not be dried once it sets and it requires moisture to maintain its integrity and any loss of moisture by way of evaporation or drying it becomes weak, chalky, and brittle and gets easily debonded. Keeping these properties in view, in the present study was designed not to use the vacuum prior to the exposure of the dye thus A Comparative Evaluation of the Apical Sealing Ability of a Glass Ionomer Based Root Canal Sealer and Epoxy Resin Root Canal Sealer -*In Vitro* Study



exploiting the chemical situation. The AH-Plus specimens showed leakage between sealer and dentin wall while the Ketac-Endo specimen showed leakage between gutta percha and sealer. This substantiates that the glass ionomer has better bonding to the dentin than the gutta percha while the sealer in case of AH-Plus appear to be adhering to gutta percha than dentin. In a study done in 1979, the sealing qualities of Ketac-Endo and Roth 801- zinc oxide based sealer were compared.<sup>15</sup> However, one study reported that Ketac-Endo showed significantly more leakage than zinc oxide based sealer.<sup>16</sup> Thus there are conflicting reports about the sealing ability of Ketac-endo. This may be due to many variables such as preparation of the specimens, vacuuming, and change in the cement due to external factors. But the results of an in vitro study indicate that the use of polyacrylic acid conditioner does not improve the sealing ability of Ketac-Endo. There have been conflicting reports with respect to the sealing ability of Ketac-Endo. According to a study done to compare the apical sealing ability of Ketac-Endo with zinc oxide sealer which showed no statistically significant difference in the apical sealing of two sealers. Many attempts have been done by several workers to try to improve the apical seal. The results of the present study has demonstrated that Ketac-Endo has shown higher leakage while AH-Plus has given better results with lesser micro leakage. The original preparation (AH-26) although in market in some countries, has been replaced by AH-Plus, as silver in AH-26 may lead to tooth discoloration due to silver sulfide. Preparations are available without silver. Newly developed preparation AH-Plus is also based on epoxy resin Bisphenol-a-diglycidiether (BADGE) but contains a different catalyst.

One of the drawbacks of AH-26 apart from slow setting is due to the release of formaldehyde during polymerization. Now there are indications that new AH Plus does not release formaldehyde as stated in a study in 1993. The other benefits of AH-Plus over AH-26 sealer are it does not contain silver, higher radiopacity (ranks the first followed by Ketac-Endo), longer working time and setting time (8 hours at 37 degree Centigrade), and biocompatible with no mutagenic effect post operatively. Interesting to study will be the addition of calcium to the gutta percha which may enhance its adhesion to glass ionomer sealers, as its chemical bonding to tooth structure is a known fact. Search goes on to develop an inert biological sealer which will bridge and bond comprehensively with gutta percha and the surrounding dentinal walls thus creating a hermetic seal.

#### CONCLUSION

1. AH-Plus sealer demonstrated lower apical leakage levels

and performed better than Ketac-Endo with and without dentin conditioner.

2. Ketac-Endo although has the ability to bond dentin, failed to seal as effectively as AH-Plus thus exhibiting higher apical leakage levels.

3. The use of dentin conditioner in the Ketac-Endo group marginally improved its apical seal showing less leakage values.

4. Ketac-Endo needs to be improved as far as its viscosity, flow and working time, in order to be considered on par with the existing root canal sealers.

5. Further clinical studies are required to be carried out to substantiate the results of the present study and also to study the cytotoxicity and mutagenicity of AH-Plus root canal sealer.

#### REFERENCES

- 1. Dow PR, Ingle JI. Isotope determination of root canal failure. Oral Surg Oral Med Oral Pathol 1955; 8:1100-4.
- Ray H, Seltzer S. A new glass ionomer root canal sealer. J Endod 1991; 17:598-603.
- Trope M, Ray HL. Resistance to fracture of endodontically treated roots. Oral Surg Oral Med Oral Pathol 1992; 73:99-102.
- Hewlett ER, Caputo AA, Wrobel DC. Glass ionomer bond strength and treatment of dentin with polyacrylic acid. J Prosthet Dent. 1991; 66(6):767-72.
- Saunders WP, Saunders EM. Influence of smear layer on the coronal leakage of Thermafil and laterally condensed guttapercha root fillings with a glass ionomer Sealer.J Endod. 1994; 20(4):155-8.
- Tidswell HE, Saunders EM, Saunders WP. Assessment of coronal leakage in teeth root filled with gutta-percha and a glass of ionomer root canal sealer. Int Endod J.1994; 27(4): 208-12
- Goldberg F, Artaza LP, De Silvio A. Apical sealing ability of a new glass ionomer root canal sealer. J Endod. 1995; 21(10):498-500
- Christopher MO, Paul VA. An in vitro study of apical and coronal microleakge of laterally condensed gutta percha with Ketac-Endo and AH-26. Aus Den J 1998; 43(4):262-8.
- Dilek HK, Simon T. Apical sealing ability between a glass ionomer sealer and epoxy resin sealer. J.Endod 1998; 32(5): 334-8.
- Timpawat S, Sripanaratanakul S. Apical sealing ability of glass ionomer sealer with and without smear layer. J Endod. 1998; 24(5):343-5.

A Comparative Evaluation of the Apical Sealing Ability of a Glass Ionomer Based Root Canal Sealer and Epoxy Resin Root Canal Sealer -*In Vitro* Study

- Timpawat S, Harnirattisai C, Senawongs P. Adhesion of a glass-ionomer root canal sealer to the root canal wall. J.Endod. 1998; 27(7):445-9.
- Saleh IM, Ruyter IE, Haapasalo M, Orstavik D. The effects of dentine pretreatment on the adhesion of root-canal sealers. Scandinavian Institute of Dental Materials, Haslum, Norway. 2002.
- Najar AL, Saquy PC, Vansan LP, Sousa-Neto MD.Adhesion of a glass- ionomer root canal sealer to human dentine. Aust Endod J. 2003; 29(1):20-2.

- Sevimay & a. Kalayci. Evaluation of apical sealing ability and adaptation to dentine of two resin-based sealers. Journal of Oral Rehabilitation 2005 32; 105–110.
- Brown RC, Jackson R, Skidmore AE. An evaluation of apical leakage of a glass ionomer root canal sealer. J Endod 1998; 20:288-91.
- 16. Pitt Ford TR. The leakage of root fillings using glass ionomer cement and other materials. Br Dent J 1979; 146:273-8

### Prosthodontic Rehabilitation of an Acquired Surgical Mandibular Defect- A Case Report

### Dr. G. Muralidhar<sup>1</sup> MDS, Dr. K. Ravishankar<sup>2</sup> MDS and Dr. M. A Reyazulla<sup>3</sup> MDS

<sup>1</sup>Senior Lecturer, <sup>2</sup>Associate Professor, Department of Prosthodontics, Krishnadevaraya College of Dental Sciences and Hospital, Bangalore.

Department of Prosthodontics, Krishnadevaraya College of Dental Sciences and Hospital, Bangalore.

<sup>3</sup>Reader, Department of Oral Surgery, V S Dental College and Hospital, Bangalore.

#### Abstract

Prosthetic rehabilitation of an acquired surgical mandibular defect presents the prosthodontist with a unique challenging experience of providing a strong psychological mind frame for an otherwise socially isolated and depressed patient to lead a reasonably active socioeconomic life through a mandibular prosthesis which satisfactorily restores both functional and esthetic demands of that particular patient.

This article aims to unleash the problems and difficulties encountered in rehabilitating a type IV mandibular defect according to Cantor and Curtis classification and the methods to overcome them.

KEYWORDS: prosthodontic rehabilitation, surgical defect, type IV mandibular defect

#### INTRODUCTION

One of the most consistently challenging areas of maxillofacial rehabilitation is the treatment of patients who have had partial or total mandibulectomy. These procedures involve extensive loss of tissues and associated functions. The prosthetic prognosis is rarely good, and reconstructive surgical procedures even when indicated, usually do not significantly improve the prosthetic potential especially in total mandibulectomy cases<sup>1</sup>. But it is generally accepted that there are fewer problems with the rehabilitation of partially edentulous patients than with those who are completely edentulous<sup>2</sup>.

#### **Evaluation and treatment planning:**

Any Prosthodontic procedure begins with a thorough evaluation and treatment planning which follows a particular pattern.

Author for Correspondence: Dr. Muralidhar G, Senior Lecturer, Department of Prosthodontics, Krishnadevaraya College of Dental Sciences and Hospital, Hunasamaranahalli, Via Yelahanka Bangalore-562157, Karnataka, India.

Email: prosthodontistmurali@gmail.com

A thorough dental examination, radiographs, and impressions are completed routinely. A good oral hygiene protocol is mandatory for dentulous patients. Preservation and restoration of teeth in strategic location may provide a much better support for the prosthesis. Effective communication between the surgeon and the maxillofacial prosthodontist is essential in determining the extent of resection and in the initial design of the surgical prosthesis and for developing a realistic treatment or rehabilitation of patients undergoing mandibular resection.

Preoperative consultations allow the prosthodontist to make recommendations to the surgeon to achieve better prosthetic results. Preservation of the preoperative occlusal alignment of the remaining mandibular structure is a logical goal for the rehabilitation of these patients<sup>2</sup>. The major goal of cancer therapy is not only to eradicate the disease but also to restore patients to a reasonably normal quality of life. The team concept, in which head and neck surgeon, speech pathologist, radiation oncologist, maxillofacial prosthodontist, and other members of the health profession function together in planning the rehabilitation and primary modes of therapy, ensures the patient's early and successful rehabilitation<sup>3</sup>.

Partial mandibular resections fall into two main categories, marginal resections and segmental resections, as classified by Cantor and Curtis<sup>1</sup>. The marginal resection (Type I) preserves the inferior border of the mandible and its continuity, thereby sustaining the potential for normal function<sup>2</sup>. Whereas when a complete segment of mandible from the alveolar crest through the inferior border is removed (segmental resection) discontinuity results and function of the remaining mandibular segment is severely compromised <sup>2</sup>. In contrast to segmental resection marginal resection does not result in malocclusion<sup>2</sup>.

For Prosthodontic rehabilitation to be possible, it is imperative that the functional movements of the remaining residual mandible are understood <sup>4</sup>. The best method of rehabilitation is to restore the continuity of the mandible either by autogenous bone graft or by use of alloplastic material which will facilitate intraoral prosthetic reconstruction<sup>5</sup>.

#### **CASE REPORT**

A 20 year old female patient visited to V.S. Dental College and Hospital, Bangalore with a chief complaint of swelling in the lower left quadrant with loose teeth in that region. She was referred to the oral and maxillofacial department where a thorough diagnosis was performed.

The swelling was diffuse and was not translucent upon illumination. The patient had dull throbbing pain and the swelling had eroded the bone surrounding it which appeared as a huge radiolucent defect. An external biopsy of the swelling was made and sent for further investigation. The preliminary investigation revealed that the swelling had features of osteosarcoma. However when investigations for its metastasis was carried out it revealed that there was no metastasis. Thus the swelling was subjected to another biopsy and this time the results were indicative of a granular type of ameloblastoma. After the final diagnosis, the patient was subjected to hemimandibulectomy surgical procedure with the resection site involving the complete left half of the mandible without crossing the midline (fig 1). After the surgical procedure stainless steel plates were fixed. After six months of surgery the patient came back with broken plates. Then it was replaced with an autogenous rib graft (fig 2).

After two months the patient was referred to the Prosthodontic department for rehabilitation of the defect (fig 3). A primary impression was made with sectional tray using impression compound and relining it with alginate on the defect site (fig 4). Primary cast and custom tray were fabricated and final impression was made with elastomeric impression material. Master cast was obtained from the final impression and an interim mandibular prosthesis was fabricated using heat polymerized acrylic resin with Adams clasp for retention and the teeth were arranged on buccal side and out of occlusion (fig 5).

The patient was periodically recalled for about 3 months and was observed for the response of bone graft to the interim prosthesis. As the graft tissue did not demonstrate any significant resorption, a definitive prosthesis in the form of cast removable partial denture was planned. Final impression was made with elastomeric material. The prosthesis was designed with multiple circlet clasp design on the dentulous side with a lingual plate major connector as the depth of the lingual sulcus was less than 8 mm.

The frame work was tried in the patient's mouth (fig 6,7) and the prosthetic teeth were arranged and denture base was extended bucally to compensate for the inward position of the cheek on the affected side. The patient was asked to make lateral and protrusive movements in order to ascertain that there were no contact of the artificial teeth with opposing dentition as it would place undue stress upon the graft area. The patient was informed that the prosthesis was meant to serve only the esthetics and not for masticatory purpose.

The patient was observed for around three weeks after the prosthesis was delivered to ascertain the effect of prosthesis upon the graft area. Except for a few impinging areas there was no significant resorptive changes of the graft area and there was a significant improvement in esthetics as the extended denture base provided the necessary check support (fig 8).

#### Prosthodontic Rehabilitation of an Acquired Surgical Mandibular Defect - A Case Report

#### et al Dr. Muralidhar G



Fig.2: Harvested rib graft placed and tightened with titanium screws



Fig.3: Condition of the graft when the patient visited Prosthodontic department



Fig.4: Primary impression made with compound which was relined with alginate on defect side



RGUHS J Dent. Sciences, June 2011 / Vol 3 / Issue 2



Fig.6: Try-in of the framework in the patients mouth



Fig.7: Intra-oral view of the framework







#### DISCUSSION

In a type IV mandibular resection, where a posterior and anterior tooth are missing on the defect side with graft placement, but does not include temporomandibular joint reconstructions on the surgical side, the remaining teeth on the intact side of the arch often present a straight line configuration enabling the prosthesis to move along multiple axis of rotation along both horizontal and sagittal fulcrums. The axis depends upon the point of load application<sup>6</sup>.

Moreover these patients tend to use the dentate side for mastication. If these rotations are not controlled it can lead to accelerated resorption of the graft site with devastating effects due to abnormally directed forces upon this site.

This can be effectively managed by employing Embrasure clasps and multiple circlet clasps on the posterior teeth with an infrabulge retainer on the anterior abutment. In some situations, rotational path design may be used to engage the natural undercuts on the mesial proximal surfaces of the anterior abutments.

Lingual retention with buccal reciprocation on the remaining posterior teeth should also be considered. The longitudinal axis of rotation in this design should be considered to be a straight line through the remaining teeth. Depression of the prosthesis on the edentulous side will have less chance to dislodge the prosthesis if retention is on the lingual surfaces than if on the buccal. Physiologic relief of minor connectors is always recommended<sup>6,7</sup>.

A mandibular guidance flange was not employed in this prosthesis design as this appliance is used in dentulous patients with non-reconstructed lateral discontinuity defects who have severe deviation of the mandible toward the surgical side and who are unable to achieve unassisted intercuspation on the nonsurgical sides<sup>2</sup>.

Head position is of extreme importance during registration of jaw relation records. If the patient is in a semi recumbent or supine position in the dental chair during the recording procedure, the mandible may be retracted and deviated toward the surgical side <sup>8</sup>. To minimize this problem the recording should be made with the patient seated in a normal upright postural position.

#### CONCLUSION

Preoperative evaluation of the maxillofacial patient provides for optimal preparation of the patient and planning of the treatment. This can greatly enhance the patients' post-surgical adjustment to the prosthesis. The type of tumor often dictates the prosthetic prognosis and therefore the approach to prosthetic rehabilitation. The extent of surgical treatment is directly related to tumor size, extension, and type. Immediate or delayed prosthetic treatment depends not only on the timing of healing of the defect site but also on the knowledge that the tumor has been completely eradicated.

#### REFERENCES

- Cantor R, Curtis TA. Prosthetic management of edentulous mandibulectomy patients. I. Anatomic, physiologic, and psychologic considerations. J Prosthet Dent. Apr 1971;25:446-57.
- Aramany MA, Myers EN. Intermaxillary fixation following mandibular resection. J Prosthet Dent. Apr 1977;37:437-44
- 3. Dale J Misiek. Oral and maxillofacial reconstruction.

Journal of Oral and Maxillofacial Surgery 1993; 51(1) suppl1:56-61

- Cantor R, Curtis TA. Prosthetic management of edentulous mandibulectomy patients. 3. Clinical evaluation. J Prosthet Dent. Jun 1971;25:670-8
- Aramany ,MA. Replacement of missing or defective organs, in sassouni.V, Sotereanos G. Diagnosis and treatment of dentofacial abnormalities. Springfield, 1974, Charles C Thomas Publisher.
- Mc Cracken. Removable partial Prosthodontics. 9<sup>th</sup> Ed. St Louis, Mosby 1995 Pg 447
- Beumer J, III, Curtis TA, Marunick MT. Maxillofacial rehabilitation: prosthodontic and surgical considerations. St Louis: Ishiyaku EuroAmerica Inc; 1996.
- Jack W Martin, Ronald J Shupe, Rhonda F Jacob, Gordan E King. Mandibular positioning prosthesis for the partially resected mandibulectomy patient. J Prosthet Dent. May 1985;53:678-680.

### **Dental Management of Congenital Scoliosis - A Case Report**

Dr. Priya Subramaniam $^1\,{\rm MDS},$  Dr. Megha Gupta $^2\,{\rm MDS}$ 

1: Professor and Head, 2: Former Postgraduate student, Department of Pedodontics, The Oxford Dental College, Hospital and Research Centre, Bangalore, Karnataka, India

#### Abstract

This paper reports on the dental management of a 14 year old child with spinal deformity. The patient had congenital scoliosis with hemivertebrae. Oral examination revealed dental caries, hypoplasia and delayed eruption. Complete oral rehabilitation was done on the dental chair, keeping appointments short and using fourhanded dentistry. The patient is currently on a semi-annual periodic recall since one and a half years and continues to show satisfactory oral health.

*Keywords :* Congenital scoliosis; Special Child; Special Health Care Dentistry; Spinal deformity; Root Canal Treatment; Four–handed dentistry; Enamel hypoplasia.

#### INTRODUCTION

Individuals with Special Health Care Needs encompasses a wide variety of physical, developmental, mental, sensory, behavioral, cognitive, and emotional impairments that require medical management, health care interventions, and/or use of specialized services or programs. Children with special health care needs are those who have or are at increased risk for a chronic physical, developmental, behavioral or emotional condition and who also require health and related services of a type or amount beyond that required by children generally.<sup>1</sup>

These children present a special challenge to the dental health care team. It is generally acknowledged that majority of disabled children have been dentally neglected. Despite the recognition that dental professionals can play an important role in the rehabilitation of these children, many dentists are reluctant to treat these children. This reluctance may arise due to various reasons like lack of knowledge, fear and anxiety regarding these children and unfamiliarity with the techniques required for their dental care.<sup>2</sup>

Abnormalities of vertebral development during the first trimester of pregnancy often result in the structural deformity of the spine that are evident at

Author for Correspondence:

birth or become obvious in early childhood. Congenital vertebral anomalies are a collection of malformations of the spine. Most of them are not clinically significant, but can cause compression of the spinal cord by deforming the vertebral canal or causing instability.

Congenital scoliosis or kyphotic deformity results in a missing portion, partial formation, or lack of separation of the vertebrae. Failure of formation usually presents as a hemiverterbra (portion of a vertebra) which results in an imbalance in the spinal column forcing the spine to curve as the child grows.

Congenital scoliosis can be classified as: Partial or complete failure of vertebrae formation (wedge vertebrae or hemivertebrae), partial or complete failure of segmentation (unsegmented bars), and mixed.<sup>3</sup> The prevalence of scoliosis in India ranges from  $0.2 \%^4$  to  $0.3\%^5$ .

Congenital scoliosis may occur as an isolated deformity or in combination with other organ system malformations. The spine and major organs develop between three and six weeks in utero. Therefore, it is common to see other congenital malformations such as heart problems, kidney or bladder problems, and spinal cord malformations in patients with congenital scoliosis.<sup>6</sup>

Other general abnormalities seen in patient's with congenital scoliosis include Sprengel's deformity, Klippel-Feil syndrome, cutaneous abnormalities, caféau-lait spots, ligamentous laxity, hypertrichosis, flat

**Dr. Priya Subramaniam**, Professor and Head, The Oxford Dental College, Hospital and Research Centre, Bommanahalli, Hosur Road, Bangalore-560068, Karnataka, India *Email: drpriyapedo@yahoo.com* 

foot, multiple contractures and neurofibromatosis. Oral findings include high arched palate, facial hypoplasia and defective dental occlusion.<sup>7</sup>

Risk of progression of spinal deformity in a child with congenital scoliosis depends on the growth potential of the malformed vertebrae. Progressive congenital kyphosis is a serious problem since paraplegia may develop as a result of compression of the spinal cord against the apex of the deformity.<sup>6</sup>

Each patient is unique and a treatment plan is made based on the risk of curve progression during growth. The goals of treatment are to allow the child to reach the end of growth with a reasonably straight, balanced spine, and to allow the spine to grow as much as possible. Necessary surgical intervention is best if performed before significant deformity has developed.

Similarly, Klippel Feil syndrome is a disorder characterized by failure of normal segmentation of any two of the seven cervical vertebrae. It is also known as Congenital Cervical Synostosis or Cervical Vertebral Fusion. Klippel and Feil first described it in 1912 as a classic triad comprising of a short neck, low posterior hairline and a painless limitation of head movement.8 It is associated with several defects such as deafness, congenital heart defects, mental deficiency, rib defects and scoliosis. 6 It presents with a high frequency of cleft lip and/or palate and occasional oligodontia in the primary and permanent dentition, craniofacial asymmetry, maxillary constriction and velopharyngeal insufficiency. Abnormal bony mass in the ramus and zygomatic region has been reported. Additional anomalies are hemifacial microsomia and prominent nasal bridge.9

Cephalometric analysis in an 8 year old girl with Klippel-Feil syndrome revealed a Class I dentoskeletal pattern with an excessive mandibular plane angle and fused cervical vertebrae. Panoramic radiogram showed congenitally missing lower second premolars and right central incisor.<sup>10</sup>

Oral findings recorded in an 8 year old boy with Klippel –Feil syndrome were multiple dental carious lesions, Class I malocclusion with severe crowding, vertical open bite, deep palate, mouth breathing and poor oral hygiene. Complete oral rehabilitation was done keeping short appointments which included preventive treatment, pulp therapy for carious molars, transpalatal and lingual arch space maintainers to prevent further space loss and close monitoring for future orthodontic treatment.<sup>11</sup>

Thus, these children with structural disabilities exhibit malocclusion, poor oral hygiene and have multiple untreated carious lesions. These do not seek routine dental care. Parents may find it difficult and probably expensive to transport a non – ambulatory child. These deformed children may also have a psychosocial stigma. The oral disease along with the physical disability puts these individuals in the high-risk category; hence they need treatment regimens tailored to individual needs.

#### **CASE REPORT**

A 14-year old male patient presented to the department of Pedodontics and Preventive Dentistry, The Oxford Dental College, Hospital and Research Centre, Bangalore, with a chief complaint of dental decay and severe, spontaneous pain in the lower left posterior region. The patient also expressed difficulty in mastication.

Medical history and records revealed patient to have congenital kyphoscoliosis with hemivertebrae. All the development milestones were delayed in the child. The parents had a consanguineous marriage. The patient was poorly built, of height 120 cm, weighed 38 Kg and walked with a limping gait. The right shoulder was raised by approximately 3 inches (compared to the left shoulder when patient stood upright). The backbone showed a convex deformity (figure 1). The A-P and lateral view of cervical spine showed C5 and C6 to be hemivertebrae which caused the bending of cervical vertebral column towards the right side in both lateral and antero-posterior direction (figure 2). The A-P view of pelvic region showed that the ileum is not fused with the ischium and pubis bilaterally. Both the femoral epiphyseal ends have not fused with metaphysis. On the right side, the angulation of the neck of the femur with its shaft is increased. (figure 3).

The A-P view of vertebral column revealed left half of the vertebral body of T9 fused with the left half of vertebral body of T10, causing no growth on he left side of the vertebrae and asymmetric growth on the right side. As a result, there is bending of vertebral column towards left with convexity on the right side (figure 4).

Intraoral examination revealed deep dentinal caries with pulp exposure of mandibular left first permanent molar (figure 6). The tooth was tender on percussion. The left submandibular lymph nodes were palpable and tender. Patient also had dental caries in the mandibular right first permanent molar. Root stump was seen in the mandibular left deciduous second molar (figure 6). The deciduous maxillary molars showed dental caries and enamel hypoplasia (figure 5). Thus, the patient had a deftscore of 5 and DMFT score of 2. The permanent maxillary and mandibular canine, premolars and second molars had not yet erupted.

Intra - oral periapical radiograph of mandibular left first permanent molar showed deep dentinal caries involving the pulp, along with widening of periodontal ligament space, loss of the continuity of lamina dura and periapical radiolucency associated with the mesial root (figure 7). Hence, mandibular left first permanent molar presented with an acute exacerbation of chronic irreversible pulpitis. Deep dentinal caries with root resorption was seen with respect to maxillary left first deciduous molar. Delayed eruption of the permanent dentition was revealed by the intra-oral periapical radiographs of the posterior teeth in all four quadrants; that showed the presence of the unerupted permanent teeth. Lateral cephalogram was taken to assess the craniofacial measurements. Cephalometric analysis showed that all linear and angular measurements were within the normal range of values.

Pediatric medical referral did not show the patient to have any other associated systemic disease.

Prior to dental treatment, consent was obtained from pediatric orthopaedician to treat the patient on the dental chair and to use local anesthesia.

Since the patient expressed discomfort in sitting on the dental chair for a long duration, each treatment session was scheduled for duration of less than 30 minutes. The patient was made comfortable on the dental chair by placing cushions along the backrest so as to simulate a dental restraint –'Bean bag insert' and four handed dentistry was practiced.

Root canal treatment of the mandibular left first permanent molar was done. The tooth was restored with a preformed stainless steel (SS) crown (3M ESPE) since the final occlusion was not yet established (figure 8). Extraction of root stump of mandibular left deciduous 2<sup>nd</sup> molar and maxillary left first deciduous molar was carried out. Glass-ionomer cement was used to restore the maxillary second deciduous molars. The mandibular right first permanent molar was restored with composite resin. Pit and fissure sealants were also given for the premolars and permanent molars (figures 9 & 10). Proper oral hygiene instructions and brushing techniques appropriate for his age were also demonstrated. Fluoride varnish {Fluor Protector (Ivoclar Vivadent )}was applied topically as a caries preventive measure.

The patient was recalled after one month for evaluation and is presently under a periodic follow up.

#### DISCUSSION

Differently abled individuals may suffer not only from physical disability, but also mental deficits, behavioral problems and disorders involving different organ systems. Each disabled condition has dental needs that require immediate attention; any delay in the treatment increases the severity of the handicap and makes the condition much more difficult to bear.<sup>2</sup> Timely intervention and preventive dental care is of prime importance in differently abled individuals. It would be prudent to review the literature on the oral conditions of few such individuals.

Mental disability is a general term used when an individual's intellectual development is significantly lower than average and his or her ability to adapt to the environment is consequently limited.<sup>12</sup> Mental retardation occurs in 2-3% of Indian population. Prevalence of minor mental retardation is seven-ten times more than severe mental retardation.<sup>13</sup> Factors that contribute to increased dental caries, poorer periodontal conditions, & additional oral health problems in these individuals include long term medications, unusual / faddy eating habits, damaging oral health habits, poor manual dexterity and inability

Fig.1: The lateral view of the patient shows convex deformity of the backbone.



Fig.2: The A-P and lateral view of cervical spine showed C5 and C6 to be hemivertebrae which caused the bending of cervical vertebral column towards the right side in both lateral and antero-posterior direction.



Fig. 3:The A-P view of pelvic region showed that the ileum is not fused with the ischium and pubis bilaterally. Both the femoral epiphyseal ends have not fused with metaphysis. On the right side, the angulation of the neck of the femur with its shaft is increased.



Fig. 4: The A-P view of vertebral column revealed left half of the vertebral body of T9 fused with the left half of vertebral body of T10, causing no growth on the left side of the vertebrae and asymmetric growth on the right side. As a result, there is bending of vertebral column towards left with convexity on the right side.



Fig. 5: PRE-OPERATIVE: Maxillary arch showing dental caries w.r.t left and right deciduous molars. Enamel hypoplasia of the deciduous molars is also seen.



Fig. 6: PRE- OPERATIVE: Mandibular arch showing deep dentinal caries w.r.t mandibular left first permanent molar, root stump w.r.t left deciduous second molar and dental caries w.r.t right mandibular first permanent molar



Fig. 7: Pre-operative: Intra-oral periapical radiograph of mandibular left posterior region shows deep dentinal caries involving the pulp, along with widening of periodontal ligament space, loss of the continuity of lamina dura and periapical radiolucency associated with the mesial root w.r.t permanent first molar. Root stump w.r.t deciduous mandibular second molar present.



FIGURE 8: Post- operative: Intra–oral periapical radiograph showing root canal treatment followed by stainless steel crown on mandibular left first permanent molar. Root stump w.r.t deciduous second molar has been extracted, and second premolar is seen.



Fig.9: Recall following one and a half years– Maxillary arch: Restoration of left deciduous molar and pit and fissure sealants placed on premolars and first permanent molars.



Fig.10: Recall following one and a half years – Mandibular arch: Root canal treatment of left first permanent molar and restored with SS crown. Right first permanent molar restored with composite resin and pit and fissure sealants placed on premolars.



to comply with carer for oral hygiene.<sup>12,14</sup>

In a study conducted on the 3-14 year old handicapped children of Calcutta, it was found that dental caries experience was highest in mentally retarded children followed by cerebral palsied, blind, epileptic, physically handicapped, children with Down's syndrome and deaf and dumb. The caries prevalence of handicapped children was higher than the normal children.<sup>15</sup> Similarly, Rao et al<sup>16</sup> reported caries prevalence of 71.56% in 524 handicapped children in South Kanara district, Karnataka. The decayed component constituted the majority of the dental caries index. Mitsea et al <sup>14</sup> evaluated the oral health status of 6-15 year old Greek children and teenagers with disabilities. They concluded that the treatment needs regarding both the dentitions are extremely high in all groups of individuals. The oral hygiene status was poor in individuals with mental retardation. Highest rate of malocclusion was found in children with cerebral palsy.

Oral findings in individuals with Down syndrome include open bite, fissured lips and tongue, macroglossia, missing and malformed teeth, oligodontia, microdontia, taurodontism, underdeveloped maxilla, high-arched palate, damaging oral habits such as bruxism and mouth breathing, increased gag reflex and enlarged adenoids.<sup>12</sup>

Another disability affecting the world population at a dramatic rate is autism. Autism is a complex neurodevelopmental disorder characterized by qualitative impairments in social interaction and communication, with restricted, repetitive, stereotyped patterns of behavior, interests and activities.<sup>17</sup> Most autistic children have problems with their day to day activities such as eating, drinking, sleeping, bathing and tooth brushing. All these factors could make them more prone to oral disease. Children with autism also commonly have damaging oral habits such as bruxism, tongue thrusting, pricking at the gingiva, lip biting, and pica.<sup>18</sup>

A short attention span, restlessness, hyperactivity and erratic emotional behavior may characterize patients with mental disability undergoing dental care. Treating such patients requires adjusting to social, intellectual & emotional delays. The family should be given a brief tour of the office before attempting treatment. The dentist should be repetitive, speak slowly & in simple terms and give only one instruction at a time. The parent should be invited into the operatory for assistance and to aid in communication with the patient. The appointments should be kept short, scheduled early in the day.<sup>12</sup>

Besides, physical and mental disability, individuals may also be medically compromised which may involve one or more organ systems. The estimated incidence of end – stage renal failure (ESRF) in childhood, either due to a congenital or acquired condition, is 10 to 12 per 1 million children, with a prevalence varying between 39 to 56 million children in the United States.<sup>19</sup>

Oral manifestations of children with renal diseases include ammonia-like odor, dysgeusia (impaired taste), stomatitis, xerostomia, parotitis, decreased salivary flow, gingival enlargement secondary to drug therapy. Enamel opacities may be seen due to disturbed calcium and phosphate metabolism. The prevalence of dental caries is observed to be low in these children.<sup>20</sup>

However, there is paucity in literature with regard to the oral conditions of children with kyphoscoliosis. Since the patient was unable to sit for a prolonged period in a semi – supine position on the dental chair, short appointments of 25-30 minutes duration were maintained and cushions placed along the backrest to simulate a restraint 'beanbag dental chair restraint'. The beanbag dental chair insert is used for persons who need more support and less immobilization in a dental environment. It is reusable and washable, and one size fits most people. Many patients with physical disabilities relax more in this setting.<sup>12</sup>

Children with disabilities may present challenges that require special preparation before the dentist and office staff can provide acceptable care. The children with disabilities are best managed by a multidisciplinary team in which the dental team effectively carries out the treatment for the child. Hence, fourhanded dentistry was mandatory to treat the patient. In four-handed dentistry, a dental assistant is required to carry out the treatment effectively. A dental assistant can be a major asset in behavior control during restorative dentistry. There are advantages to involving the dental assistant early in the appointment. It is time saving, and gives the child better understanding of the situation. This approach also establishes the opportunity for the dental assistant to develop rapport with child patient.<sup>21</sup>

Since the child's behavior was rated as positive, according to the Frankl's behavior rating scale, the treatment was carried out in dental operatory itself using local anaesthesia when required.

Congenital scoliosis develops due to disturbances during the first trimester of pregnancy. The first evidence of calcification of primary teeth starts 3 to 4 months in utero and is completed within one year after birth.<sup>22</sup> Enamel hypoplasia of the primary dentition could be due to disturbances during enamel formation and mineralization. The enamel hypoplasia makes the tooth more vulnerable to decay.<sup>23</sup>

Apart from treatment procedures, and restorations the preventive protocol for this patient included diet counseling, placement of sealants and topical fluoride varnish applications. Assessment of dietary habits is crucial for an understanding of the actual caries situation, for predicting the caries risk in the individual and also for designing treatment plans and prophylactic programs. Dietary choices affect oral health as well as general health and well being. So, dietary advice should be tailored to the needs of the individual patient and should form part of a comprehensive preventive programme.

Topical fluoride varnish on a semi-annual basis was placed for its caries effectiveness. By the use of fluoride varnish, the fluoride ion remains in intimate contact with the enamel surface for a longer period of time compared to fluoride solutions, hence there is increased cariostatic action.<sup>24</sup>

Patient was educated and motivated to follow regular oral hygiene measures at home. He was advised to use fluoridated toothpaste, follow Fones technique <sup>25</sup> of tooth brushing, change his tooth-brush once in 3 months and floss regularly.

A holistic approach in the management of differently abled children not only alleviates pain but also gives them a sense of well being. This would require effective treatment planning and motivation combined with communication between various pediatric specialties.

### REFERENCES

- 1. Crall JJ. Improving oral health for individuals with Special Health Care Needs. Pediatr Dent 2007; 29:2: 98-104.
- Tandon S, Sudha P. Dental care of Disabled children A pilot study. J Indian Soc Pedo Prev Dent 1986; 4: 1: 25-31.
- 3. The Terminology Committee, Scoliosis Research Society. Aglossary of scoliosis terms. Spine 1976;1:57.
- Saikia KC, Duggal A, Bhattacharya PK, Borgohain M. Scoliosis. An epidemiological study of school children in lower Assam. Indian Journal of Orthopedics, 2002 Oct; 36:(4): 243-5.
- Taneja DK, Sahi S. Epidemiological study of scoliosis in school children in Rewa. Indian Journal of Orthopedics, 1990 Jan; 24:(1):78-81.
- Behrman, Kliegman, Jenen. Nelson Textbook of Pediatrics. 17<sup>th</sup> edition; Saunders Publication, Philadelphia, Pennsylvania, 2004. pp 2280-2289.
- S Mohanty, N Kumar. Patterns of presentation of congenital scoliosis. Journal of Orthopedic Surgery 2000; 8(2): 33-37
- Nagib MG, Maxwell RE, Chou SN. Identification and management of high-risk patients with Klippel-Feil syndrome. J Neurosurg 1984; 61(3):523-30
- Barbosa V, Maganzini AL, Nieberg LG. Dento skeletal implications of Klippel – Feil syndrome – A case report. N Y State Dent J 2005; 71(1): 48-51.
- 10. Ozdiler E, Akcam MO, Sayin MO. Craniofacial characteristics of Klippel-Feil syndrome in an eight year old female. J Clin Pediatr Dent 2000; 24(3):249-54.
- 11. Lagravere MO, Barriga MI, Valdizan C, Saldarriaga A, Pardo JF, Flores M. The Klippel – Feil syndrome: a case report. J Can Dent Assoc 2004; 70 (10):685-8.
- 12. McDonald RE, Avery DR, Dean JA. Dentistry for the Child and Adolescent. Mosby, St. Louis, 2004; 524-556.

- 13. Kabra M, Gulati S. Mental retardation. Indian J Pediatr 2003; 70(2):153-8.
- Mitsea AG, Karidis AG, Donta Bakoyianni C, Spyropoulos ND. Oral health status in Greek children and teenagers with disabilities. J Clin Pediatr Dent 2001 Fall; 26(1): 111-8.
- Gupta DP, Chowdhury R, Sarkar S. Prevalence of dental caries in the handicapped children of Calcutta. J Indian Soc Pedod Prev Dent 1993; 11(1):23-7.
- Rao DB, Hegde AM, Munshi AK. Caries prevalence among handicapped children of South Kanara district, Karnataka. J Indian Soc Pedod Prev Dent 2001; 19(2): 67-73.
- 17. Karande S. Autism: A review for family physicians. Indian J Med Sci 2006; 60: 205-15.
- Danielle Green, Dennis Flanagan. Understanding the autistic dental patient. Gen Dent 2008 Mar-Apr; 56(2):167-71.
- Trivedi HS, Pang MM. Discrepancy in the epidemiology of non diabetic chronic renal insufficiency and end – stage renal disease in black and white Americans: The third National Health and Nutrition Examination Survey

and United States Renal Data System. Am J Nephrol 2003;23:448-457.

- Davidovich E, Davidovits M, Eidelman E, Schwarz Z, Bimstein E. Pathophysiology, Therapy, and Oral Implications of Renal Failure in Children and Adolescents: An update. Pediatr Dent 2005; 27:2; 98-105.
- Wright GZ, Starkey PE, Gardner DE . Managing children's behavior in the dental office. C V Mosby Company, St. Louis, Toronto, 1983; 146
- Major M. Ash: Wheeler's Dental Anatomy, Physiology and Occlusion. 6<sup>th</sup> edi, W.B Saunders Company, 2001, 24.
- Nikiforuk G. Understanding dental caries. Etiology and Mechanisms, Basic and Clinical Aspects. Karger 1985, 115.
- Murray JJ, Rugg-Gunn AJ, Jenkins GN. Fluorides in caries prevention. Varghese Publishing House. Mumbai, 1999, 187.
- Home care of the mouth. In Fones, A.C., Ed. Mouth Hygiene (4<sup>th</sup> ed.) Philadelphia : Lea & Febiger, 1934: 294-315.

## Esthetic Management of Gingival Hyperpigmentation By Three Different Surgical Techniques - Case Reports

Dr Shivanand Aspalli<sup>1</sup> MDS, Dr Siddhant Jajoo<sup>2</sup> MDS, Dr V Sudhir Shetty<sup>3</sup> MDS, Dr Asif K<sup>4</sup> MDS

<sup>1</sup>Professor, <sup>2,3</sup>Professor, <sup>4</sup>Assistant lecturer, Department of Periodontics and Oral Implantology, A.M.E's Dental College and Hospital, Raichur, Karnataka, India

#### Abstract

Excessive gingival pigmentation is a major esthetic concern for many people. Though, it is not a medical problem, many people complain of dark gums as unaesthetic. Esthetic gingival depigmentation can be performed in such patients with excellent results. Few cases are reported here in which a simple and effective surgical depigmentation was performed by three different surgical techniques.

Keywords: depigmentation, esthetics, melanin.

#### INTRODUCTION

Smile is the gateway to buildup good personality and rapport. Facial profile, lips, arrangement of teeth and colour of gingiva are integral part of good and beautiful smile. The color of the gingiva is an integral part of many epidemiological evaluations of gingival health, ranging from pale pink and coral pink to deep red and violet.<sup>1</sup> The attached and marginal gingiva is generally described as coral pink and is produced by the vascular supply, the thickness and degree of keratinization of the epithelium and the presence of pigment containing cells (melanocytes).

Melanin pigmentation often occurs in the gingiva as a result of an abnormal deposition of melanin. The pigmentation may be seen across all races and at any age, and it is without gender predilection.<sup>2,3</sup> Melanosis of the gingiva is frequently encountered among dark skinned ethnic groups, as well as in medical conditions such as Addison's syndrome, Peutz-jegher's syndrome and von Recklinghausen's disease (neurofibromatosis).<sup>4,5</sup>

Although melanin pigmentation of the gingiva is completely benign and does not present a medical problem, patient's complaint of "black gums" is

Author for Correspondence: Dr Siddhant Jajoo, B2-38, Motiramnagar, Opposite Cipla Cancer institute, Warje, Pune 58. Maharashtra

E-mail: siddhantjajoo@gmail.com

common due to their unacceptable aesthetics which demands cosmetic therapy.<sup>6</sup> Many attempts have been made in the past to answer this cosmetic demand and eliminate these dark patches of pigmentation on the facial aspects of gingiva. Procedures which include non surgical and surgical techniques like gingival epithelial scraping, split thickness epithelial excision, electrocautery, gingival abrasion using bur, free gingival grafts, cryosurgery, laser therapy etc.

This article assesses the clinical effectiveness of three different procedures for gingival depigmentaion which can simplify and provide predictable and esthetic solution for this clinical condition.

#### **TREATMENT PROTOCOL:**

The following sequence was observed

1.Recording a thorough case history to rule out systemic factors for gingival hyperpigmentation.

- 2. Patient education.
- 3. Oral prophylaxis
- 4. Surgical depigmentation procedure

#### **DEPIGMENTATION PROCEDURES**

#### A. Gingival scraping.

#### Case 1:

A female patient aged 26 years reported with moderately pigmented gingiva and requested depigmentation for cosmetic reasons (fig 1). The patient had acceptable oral hygiene levels, with good plaque control. After proper isolation of the surgical field, the operative site was anaesthetized using 2% lidocaine hydrochloride with adrenaline (1:80000). Blade no.15, with bard parker handle was used to scrape the epithelium carefully with underlying pigmented layer (fig 2 and 3). The raw surface was irrigated with saline solution. The surface was cleaned and checked for bleeding. The exposed depigmented surface was covered with Coe-pack periodontal dressing for one week. The patient was prescribed 0.2% chlorhexidine. The patient experienced no discomfort during the healing phase (fig4, 5 and 6)

#### Case 2:

A 29 years old female had a chief complaint of black gingiva (fig 7). The procedures were performed with the same method as described in the previous case. The wound healed well after two weeks. No pain or bleeding complications were found. The gingiva became pink and healthy within 3 weeks. No repigmentation was seen till 3 months (fig 8).

#### **B. Split thickness epithelial excision**

#### Case 1:

A 21 years old female had a chief complaint of black gingiva (fig 9). Local anesthesia was obtained with infiltration in relation to the surgical site. The gingival epithelium was excised with Bard Parker blade No. 15 for the lower arch. The excision involved excising the entire pigmented area extending from the free gingival margin to the mucogingival junction from the mid line extending upto the second premolar with the blade place almost parallel to the long axis of the teeth with care taken not to expose the underlying bone (figure 10). The upper arch was treated by the scraping technique (Fig 11). Post operative healing was uneventful and the results were esthetic (fig 12).

#### **C.** Electrocautery.

#### Case 1:

A 19 years old female patient reported with a chief complaint of unaesthetic black gums (fig 13). The patient had acceptable oral hygiene level with good plaque control. Depigmentation was done for upper arch from canine to canine. Patient did not report any

RGUHS J Dent. Sciences, June 2011 / Vol 3 / Issue 2

discomfort, however the 2 weeks healing was slow as compared to the scalpel blade techniques (fig 14). No repigmentation was observed for 6 months (fig 15).

#### RESULT

No post-operative pain, hemorrhage, infection or scarring occurred in any of the sites on first and subsequent visits. Healing was uneventful. Patient's acceptance of the procedure was good and results were excellent as perceived by the patient. The follow up period spanned for 3-6months. There was no repigmentation and the patients are being monitored longitudinally for any repigmentation.

#### DISCUSSION

Oral pigmentation occurs in all races of man.<sup>2</sup> There are no significant differences in oral pigmentation between males and females. The intensity and distribution of pigmentation of the oral mucosa is variable, not only between races, but also between different individuals of the same race and within different areas of the same mouth. Melanin pigmentation is frequently caused by melanin deposition by active melanocytes located mainly in the basal layer of the oral epithelium. Pigmentations can be removed for esthetic reasons. Different treatment modalities have been used for this aim.<sup>7</sup> The selection of a technique for depigmentation of the gingiva should be based on clinical experience, patient's affordability and individual preferences.

Scalpel surgical technique is highly recommended in consideration of the equipment constraints that may not be frequently available in clinics. It is known that the healing period for scalpel wounds is faster than other techniques. However, scalpel surgery may cause unpleasant bleeding during and after the operation, and it is necessary to cover the exposed lamina propria with periodontal dressing for 7 to 10 days.<sup>8</sup>

Split thickness epithelial excision performed with a blade is precise, definite and under control. With this technique it is possible to appreciate the depigmented areas immediately and does not leave room for any residual pigments. However this technique resulted in more bleeding and required great care while excising the epithelium in order not to expose the bone or to create gingival recession.

#### Esthetic Management of Gingival Hyperpigmentation By Three Different Surgical Techniques - Case Reports

et al Dr. Siddhant Jajoo



Fig 2: Gingival Epithelial Scraping Done Using No 15 Blade For Upper Arch



Fig. 3: Gingival Epithelial Scraping Done Using No 15 Blade For Lower Arch

Fig. 4: Post Operative 15 Days– Upper Arch





Fig. 6: Post Operative 3 Months



Fig. 7: Preoperative Melanin Pigmentation



Fig. 8: Post Operative 3 Months



#### Esthetic Management of Gingival Hyperpigmentation By Three Different Surgical Techniques - Case Reports

et al Dr. Siddhant Jajoo







Fig. 12: Post Operative 3 Months







Fig. 15: 6 Months Postoperative



Electrosurgery requires more expertise than scalpel surgery. Prolonged or repeated application of current to the tissues induce heat accumulation and undesired tissue destruction. Contact of current with the periosteum or the alveolar bone and vital teeth should be avoided.<sup>9</sup>

Surgical removal of portions of pigmented gingiva and covering the exposed lamina propria with periodontal packs for 7 to 10 days has been reported by.<sup>10</sup> It took 6 weeks to heal and left a delicate scar, but in our case, there was no scar after healing and healing time was 2-

4 weeks. Care should be taken while removing pigmentation in thin gingival tissue, so the alveolar bone should not be exposed

Post surgical repigmentation of gingiva has been previously reported. Repigmentation is described as spontaneous and has been attributed to the activity and migration of melanocytic cells from surrounding areas.<sup>11</sup> The cases are being followed up to estimate further the extent and rate of repigmentation.

Cryosurgery is followed by considerable swelling and it is also accompanied by increased soft tissue destruction. Depth control is difficult and optimal duration of freezing is not known, but prolonged freezing increases tissue destruction.<sup>12</sup>

Another effective treatment for depigmentation is using lasers. A one step laser treatment is usually sufficient to eliminate the pigmented areas and do not require any periodontal dressing. This has the advantage of easy handling, short treatment line, haemostasis and decontamination and sterilization effects. But this approach needs expensive and sophisticated equipment that is not available commonly at all places and it makes the treatment very expensive.<sup>13</sup>

#### CONCLUSION

The depigmentation procedure was successful and the patient was satisfied with the result. Thus, we conclude that depigmentation of hyperpigmented gingiva by scalpel surgery is simple, easy to perform, cost effective and above all it causes less discomfort and is esthetically acceptable to the patient. Scalpel surgical technique is highly recommended in consideration of the equipment constrains in developing countries. It is simple, easy to perform, cost effective and above all with minimum discomfort and esthetically acceptable to patient.

#### REFERENCES

- 1. James Jones. A Photometric study of the color of healthy gingiva. J Periodontol 1977;1:21-26.
- Dummett C.O. and Gaida Barens. Oral mucosal Pigmentation: an update literary review. J Periodontol 1971;42:726-736.

- Trelles MA, Verkmysse KL, SeguiJM,Udaeta A. Treatment of Melanotic Spots in the Gingiva by Argon Laser. J Oral Maxillofac Surg 1993:51:759-61.
- ShaferWG, HineMK, LevyBM. A Textbook of Oral Pathology. Philadelphia: W.B.Saunders Co.;1984;pp.89-136.
- Eversole LR. Clinical outline of Oral Pathology; Diagnosis and Treatment. Philadelphia: Lea and Febiger; 1984;pp.124.
- Chin- Jyh Yeh. Cryosurgical treatment of melanin pigmented gingiva. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1988; 86:660-3.
- Pontes AE, Pontes CC, Souza SL, Novaes AB (Jr), Grisi MF, Taba M (Jr.). Evaluation of the efficacy of the acellular dermal matrix allograft with partial thickness flap in the elimination of gingival melanin pigmentation. A comparative clinical study with 12 months of follow-up. J Esthet Restor Dent 2006;18(3):135-143.
- Almas K, Sadiq W: Surgical Treatment of Melanin-Pigmented Gingiva: An Esthetic Approach. Indian J Dent Res 2002; 13(2): 70-73.
- 9. Gnanasekhar JD, Al-Duwairi YS. Electrosurgery in dentistry. Quintessence Int 1998; 29(10)649-54.
- 10. Perlmutter S, Tal H. Repigmentation of the gingiva following surgical injury. J Periodontol 1986;57:48-50.
- Mokeem SA: Management of Gingival Hyperpigmentation by Surgical Abrasion: Report of Three Cases. Saudi Dent J 2006;18(3):162-166.
- Tal H, Landsberg J, Kozlovsky A. Cryosurgical depigmentation of the gingival. A case report. J Clin Periodontol 1987;14(10):614-7.
- Atasawasuwan P, Greethong K, Nimmanon V. Treatment of gingival hyperpigmentation for esthetic purposes by Nd:YAG lasers; Report of 4 cases. J Periodontol 2000;71(2):315-21.

## Zirconia Ceramics and its applications in fixed Prosthodontics - A review

**Prof. (Dr.) D. Krishna Prasad<sup>1</sup> MDS, Prof. (Dr.) Chethan Hegde**<sup>2</sup> MDS, **Dr. K. Meghashri K<sup>3</sup>** MDS and **Prof. (Dr.)Manoj Shetty**<sup>3</sup> MDS

<sup>1</sup> Professor and Head, <sup>2</sup> Professor, <sup>3</sup> Postgraduate student, <sup>3</sup> Professor Department of Prosthodontics, A.B. Shetty Memorial Institute of Dental Sciences, Deralakatte, Mangalore, Karnataka, India.

#### Abstract

All-ceramic restorations must combine the mechanical properties of metal and optical properties of ceramics to be accepted as an alternative to porcelain-fused to metal restoration. At present, zirconia-based ceramic materials stand out as the strongest, most esthetic and biocompatible materials available. Due to their remarkable properties such as flexural strengths of over 1000 MPa, high fracture toughness and resistance to water degradation, dentistry finally has a ceramic system that rivals or exceeds that of conventional metal-ceramics.

Keywords: zirconium oxide, Y-TZP ceramics, transformation toughening, clinical guidelines, bonding/cementation.

#### INTRODUCTION

Zirconium has been known as a gem from ancient times. The name of the metal, Zirconium, comes from the Arabic Zargon (golden in color), which in turn comes from the two Persian words Zar (gold) and Gun (color). The German chemist Martin Heinrich Klaproth accidentally identified zirconium dioxide (ZrO2, zirconia) in 1789, while he was working with certain procedures that involved the heating of some gems. Zirconium dioxide in its impure form was used as a rare pigment for a long time. In the late sixties, the research and development of zirconium as a biomaterial was refined. The first documented use was in the form of ball heads for the total hip replacements in orthopedics.

In the early stages of development, many combinations of solid solution ( $\text{ZrO}_2$  -MgO,  $\text{ZrO}_2$  - CaO,  $\text{ZrO}_2$  -Y<sub>2</sub>O<sub>3</sub>) were tested for biomedical application. However, in subsequent years, research efforts significantly focused on the development of zirconia-yittria ceramics combinations, commonly known as tetragonal zirconia polycrystals (TZPs).<sup>1</sup> The *in vitro* evaluation of the mutagenic and carcinogenic

Author for Correspondence:

Dr. Meghashri K, Post graduate student, Department of prosthodontics, A.B. Shetty Memorial Institute of dental sciences, Deralakatte, Mangalore-575018 Karnataka, India. E mail: dr\_prasanna\_74@yahoo.com capacity of high-purity zirconia ceramic confirmed that it did not elicit such effects on the local cellular or systemic reaction to material. In 1990s, zirconium material was used as endodontic posts and as implant abutments, this heralded the use of zirconium into dentistry. Due to its excellent physical properties, white color and superior biocompatibility, it is being evaluated as an alternative framework for full coverage all-ceramic crowns and fixed partial dentures.

**CRYSTALLOGRAPHIC FORMS (Fig 1)** Pure zirconia exists in three crystal phases at different temperatures.<sup>2,3</sup>

 $\label{eq:constructive} Very high temperatures (>2370 ^{\circ}C) \qquad \ \ \, - \ \ cubic structure.$ 

Intermediate temperatures (1170 to 2370°C) tetragonal structure.

Low temperatures (below 1170°C) monoclinic structure.



#### **TRANSFORMATION TOUGHENING**

The British thermodynamics specialist, R.C. Garvie (Ceramic Steel, Nature 1975), discovered the reinforcing phenomenon via phase transformation. His research provided the breakthrough for developing Zirconia with excellent mechanical properties. The transformation from tetragonal to monoclinic is rapid and is accompanied by a 3 to 5 percent volume increase that causes extensive cracking in the material (Fig 2). This behavior destroys the mechanical properties of fabricated components during cooling and makes pure zirconia useless for any structural or mechanical application. Several oxides that dissolve in the zirconia crystal structure can slow down or eliminate these crystal structure changes. Commonly used effective additives are MgO, CaO, and Y2O3. The controlled, stress induced volume expansion of the tetragonal to monoclinic inversion is used to produce very high strength, hard, tough varieties of zirconia available for mechanical and structural applications.<sup>2</sup>

#### **TYPES OF ZIRCONIA BLANKS AVAILABLE**

1. Fully sintered or HIP type of zirconia ( "hot isostatic pressing")

- 2. Partially sintered zirconia,
- 3. Nonsintered or "green state" zirconia.

#### Fully sintered (or) HIP type of zirconia

Sintering technique used in the ceramic industry that utilizes high temperatures and pressures to increase density of the material.<sup>4</sup>

# Partially sintered (or) non-HIP type of zirconia

Blocks of these types of materials are manufactured by utilizing a spray-dried zirconia powder that is then isostatically pressed and incompletely sintered. These materials remain softer than the HIP zirconia and are easier to mill. After milling, the zirconia is then sintered completely in a furnace at 1,350°C to 1,500°C to achieve its final shape, strength, and physical properties.<sup>4</sup>

# Fully sintered versus partially sintered (Table 1):

Fully sintered HIP zirconia has a denser polycrystalline structure with less porosity than non-HIP material, and this should translate clinically into increased resistance to fracture.

On the other hand, grinding needed to mill the fully sintered zirconia, and the heat that is generated, cause surface and structural defects that can have adverse clinical implications. The marginal fit of either type of material is associated with very acceptable clinical



Table 1: T	Table 1: The commercial examples of different types of CAD/CAM-based fabrication of zirconium oxide substructure				
Type of block	Milling procedure	Advantages	Commercial examples		
Green stage	Dry carbide burs	Less time for milling Less flaws Post milling sintering at 1500 0 c	Cercon (Degudent, Germany) Lava (3M ESPE) Zirkon Zahn (Brunneck, Italy)		
Presintered	carbide burs under coolant	Less time for milling Less flaws Post milling sintering at 1500 0 c	Cerec Inlab (Sirona, Germany) ZS-Blanks, (KaVo, Germany) Precident DCS(Switzerland)		
Completely sintered	Diamond burs under coolant	More time for milling Expensive No sintering shrinkage	Z-Blanks, (KaVo, Germany) DigiDent (Girrbach, Germany) DC-Zirkon(Precident DCS Switzerland)		

results. The milled margins are the equal of, or are superior to, the fit of a restoration fabricated of a high noble alloy. Studies have measured the marginal gap of *CAD*/ CAM-milled zirconia of both varieties and found that to be 40 to 70 micrometer.<sup>5</sup> The manufacturing process for HIP zirconia is more expensive, involves more machining time, and is more labor-intensive to fit the coping than non -HIP systems. As a result, non-HIP systems currently dominate the marketplace.

#### DIFFERENT TYPES OF ZIRCONIA CERAMICS AVAILABLE FOR DENTAL APPLICATIONS

 $1. \enskip Yttrium \ cation-doped \ tetragonal \ zirconia \\ polycrystals (3Y-TZP)$ 

2. Magnesium cation-doped partially stabilized zirconia (Mg-PSZ)  $% \left( Mg-PSZ\right) =0$ 

3. Zirconia-toughened alumina (ZTA)

# Yttrium cation-doped tetragonal zirconia polycrystals (Y-TZP)

• Biomedical grade zirconia usually contains 3-5 mol% yttria (Y2O3) as a stabilizer (Y-TZP). The microstructure of 3Y-TZP ceramics for dental applications consists of small equiaxed grains (0.2–0.5  $\mu$ m in diameter, depending on the sintering temperature). The mechanical properties are well above those of all other available dental ceramics, with a flexural strength in the 800–1000 MPa range and

fracture toughness in the 13 MPa.m<sup>1/2</sup> range (**Table 2** and **3**).

• The restorations are processed either by soft machining of pre-sintered blanks followed by sintering at high temperature, or by hard machining of fully sintered blocks.

• The mechanical properties of 3Y-TZP strongly depend on its grain size. Above a critical grain size, 3Y-TZP is less stable and more susceptible to spontaneous t - m transformation whereas smaller grain sizes (<1 µm)) are associated with a lower transformation rate. Moreover, below a certain grain size (0.2 µm)), the transformation is not possible, leading to reduced fracture toughness.

• Consequently, the sintering conditions have a

strong impact on both stability and mechanical properties of the final product as they dictate the grain size. Higher sintering temperatures and longer sintering times lead to larger grain sizes.

• Currently available 3Y-TZP for soft machining of dental restorations utilizes final sintering temperatures varying between 1350 and 1550 °C depending on the manufacturer.

• Most manufacturers of 3Y-TZP blanks for dental applications do not recommend grinding or sandblasting to avoid both the t m transformation and the formation of surface flaws that could be detrimental to the long-term performance, despite the apparent increase in strength due to the transformation-induced compressive stresses.

▶ In contrast, restorations produced by hard machining of fully sintered 3Y-TZP blocks have been shown to contain a significant amount of monoclinic zirconia. This is usually associated with surface microcracking, higher susceptibility to low temperature degradation and lower reliability.<sup>6</sup>

# Magnesium cation-doped partially stabilized zirconia (Mg-PSZ)

• Although a considerable amount of research has been dedicated to magnesia partially stabilized zirconia (Mg-PSZ) for possible biomedical applications, this material has not been successful due mainly to the presence of porosity, associated with a large grain size  $(30-60 \,\mu\text{m})$ ) that can induce wear.

► The microstructure consists of tetragonal precipitates within a cubic stabilized zirconia matrix. The amount of MgO in the composition of commercial materials usually ranges between 8 and 10 mol%. In addition to a high sintering temperature (between 1680 and 1800 °C), the cooling cycle has to be strictly controlled, particularly in the aging stage with a preferred temperature of 1100 °C.

• Due to the difficulty of obtaining Mg-PSZ precursors free of SiO2, magnesium silicates can form that lower the Mg content in the grains and promote the t m transformation. This can result in lower mechanical properties and a less stable material.

• Denzir-M<sup>®</sup> (Dentronic AB) is an example of

Table 2: Engineering Properties of $Y_2O_3$ stabilized (TZP) and MgO stabilized (TTZ) zirconia ceramics			
Mechanical	TPZ-SI/Metric	TTZ-SI/Metric	
Density	6 gm/cc	5.5 gm/cc	
Color	lvory	Tan	
Flexure strength	900 MPa	400-620 Mpa	
Elastic modulus	200 GPa	200 Gpa	
Hardness	1300 Kg/mm2	1100 Kg/mm2	
Fracture toughness	13 MPa. m <sup>½</sup>	6-10 MPa. m <sup>½</sup>	
Maximum use temperature	1500 degree centigrade	400-980 degree centigrade	
Thermal			
Thermal conductivity	2 W/m degree Kelvin	2 W/m degree Kelvin	
COTE	10.3x10 <sup>-6</sup> /degree centigrade	5-10x10 <sup>-6</sup> /degree centigrade	

Table 3: Comm	Table 3: Commercial Brands of TZP Zirconia Ceramics				
Commercial brands	Manufacturing	Composition			
Cercon Smart Ceramics (DeguDent, Hanau, Germany)	CAM of partially sintered Y-TZP blanks	5% Y <sub>2</sub> O <sub>3</sub> TZP			
LAVA All-Ceramic System (3M ESPE, Seefeld, Germany)	CAM of partially sintered Y-TZP blanks	3% Y <sub>2</sub> O <sub>3</sub> TZP			
Procera Zirconia (Nobel Biocare, Goteborg, Sweden)	CAM of partially sintered Y-TZP blanks	4.5-5.4% Y <sub>2</sub> O <sub>3</sub> TZP			
Vita In-Ceram YZ Cubes (Vita Zahnfabrik, Bad Sackingen,Germany)	CAM of partially sintered Y-TZP blanks	5% Y <sub>2</sub> O <sub>3</sub> TZP			
DCZirkon (DCS Dental AG, Allschwil, Switzerland)	CAM of fully sintered blanks	5% Y <sub>2</sub> O <sub>3</sub> TZP			

Mg-PSZ ceramic currently available for hard machining of dental restorations.<sup>6</sup>

#### Zirconia-toughened alumina (ZTA)

Another approach to advantageously utilize the stress-induced transformation capability of zirconia is to combine it with an alumina matrix, leading to a zirconia-toughened alumina (ZTA)

• The two materials exhibited a very similar microstructure with large alumina grains ( $6\mu$ m) long, 2  $\mu$ m) wide) together with clusters of small zirconia grains (less than 1  $\mu$ m) in diameter). Some faceted zirconia grains (2  $\mu$ m)) were also added.

▶ One commercially available dental product, In-Ceram<sup>®</sup> Zirconia<sup>®</sup> (Vident<sup>™</sup>, Brea, CA), was developed by adding 33 vol.% of 12 mol% ceriastabilized zirconia (12Ce-TZP) to In-Ceram® Alumina®.

▶ In-Ceram® Zirconia® can be processed by either be slip-casting or soft machining. Initial sintering takes place at 1100 °C for 2 h, prior to this porous ceramic composite being glass-infiltrated. The glass phase represents approximately 23% of the final product. One of the advantages of the slip-cast technique is that there is very limited shrinkage.

▶ However, the amount of porosity is greater than that of sintered 3Y-TZP and comprises between 8 and 11%. This partially explains the generally lower mechanical properties of In-Ceram® Zirconia® when compared to 3Y-TZP dental ceramics.

• It should be pointed out, however, that Ce-TZP ceramics usually exhibit better thermal stability and

resistance to low temperature degradation than Y-TZP under similar thermo-cycling or aging conditions.

▶ In-Ceram® Zirconia® for machining is thought to exhibit better mechanical properties due to more consistent processing compared to the slip-cast ceramic.

• Conversely, Guazzato et al. reported a significantly higher flexural strength for In-Ceram® Zirconia® processed by slip-casting (630  $\pm$  58 MPa) compared to the machined material (476  $\pm$  50 MPa). There was no significant difference in fracture toughness.<sup>6</sup>

#### **CLINICAL GUIDELINES**

#### **Contraindications:**

- Very short clinical crown
- In Class II Division II malocclusion patients
- As cantilever pontic
- Bruxism
- Participation in extreme sports

• Clinical situation wherein biomechanics is compromised (i.e., not satisfying the Ante's law and the presence of Bruxism)<sup>7</sup>

#### Tooth preparation:

• 1.5 to 2.0 mm of incisal/occlusal reduction to 2.0 mm of axial reduction.

► Some advocate 2.0 to 2.5 mm of incisal/occlusal reduction for optimal appearance and anatomical form.

• The axial taper should be greater than or equal to 4 degree.

• The horizontal angle of the margin should be greater than or equal to 5 degree.

• Due to the limitations of the die-scanning process and the subsequent machine milling, sharp angles in the preparation must be avoided

• A circumferential deep chamfer or rounded shoulder at the gingival margin is recommended. (0.8-1.2mm)

• Ninety-degree shoulders, troughing at the margins, feather edge margins, undercuts , or sharp

line angles are not acceptable.

► To enhance anterior aesthetics, rounded shoulder preparation is done, and then cut back the zirconia coping slightly to place more translucent porcelain at the margin.<sup>7</sup>

#### On average, manufacturers recommend

• Minimal thickness for a zirconia coping 0.3 mm for anterior teeth and 0.5 mm for posterior teeth.

• Cross -sectional dimension for a connector  $7 \text{ mm}^2$ -9 mm<sup>2</sup>

> 2 abutment bridges can have a 38-mm span

• Multiple abutment bridges can have a span of 47 mm.<sup>4</sup>

#### Bonding to zirconia ceramics

• Placement of zirconia restorations can be via standard cementation or by bonding.

▶ Due to zirconia's inherent strength, conventional cements like zinc phosphate or polycarboxylate can be used, however these cements may not be the first choice, due to their physical properties as well as their opaque nature. Opaque cements may show through the zirconia and affect the final appearance of the restoration.

► Glass ionomer, resin-modified glass ionomer, and self-etching resin cements have all been used with success and these have the potential to enhance aesthetics. Further, with these cements, the cleanup of the excess cement at the margin is easy, and elimination of excess cement is always clinically beneficial.

▶ In the case of short or extremely tapered preparations, bonded resin cement may be best. The problem is how to achieve adherence to the zirconia, as it does not etch with hydrofluoric acid due to lack of a glass matrix, nor does it contain silica to allow silane coupling to occur.

► By sandblasting the intaglio surface with aluminum oxide particles, a relatively weak bond can occur between the zirconia and the resin. The bond to zirconia can be further improved by using a chemical surface treatment with the Rocatec system (3M ESPE) prior to bonding.<sup>89,10,11</sup>

• The choice of placement technique ultimately

depends upon the clinical situation. The dentist needs to determine how much retention the preparation provides, the aesthetic demands, the types of restoration being placed and the location of the mouth.

#### Rocatec system (3M ESPE)

• Rocatec is a tribochemical method for silicatising surfaces.

▶ Tribochemistry involves creating chemical bonds by applying mechanical energy. This supply of energy may be in the form of rubbing, grinding or sandblasting.

▶ The Rocatec system consists of the coating unit Rocatector delta or Rocatec junior and the blasting mediums Rocatec Pre, Rocatec Plus and Rocatec Soft as well as silane solution 3M ESPE Sil.

- Rocatec Pre: High-purity aluminium oxide 110 μm
- Rocatec Plus: High-purity aluminium oxide 110
  μm, modified with silica (SiO2)

 Rocatec Soft: High-purity aluminium oxide 30 μm, modified with silica (SiO2)

• 3M ESPE Sil: Silane in ethanol (resin primer)

▶ The surface to be coated is blasted with 110-µm aluminium oxide sand (high-purity aluminium oxide, Rocatec Pre) (**Fig3**). This activates the surface and creates a uniform pattern of surface roughness, which is ideal for the ensuring microretentive anchorage of the resin. This is followed by tribochemical coating of the microblasted surface with silica-modified aluminium oxide (Rocatec Plus or Rocatec Soft). Ceramization of the blasted surface takes place when these grains hit the surface and SiO<sub>2</sub> is impregnated into the surface up to a depth of  $15 \,\mu\text{m}$ . (**Fig 4**).

▶ The coated surface is conditioned and then silanated with 3M ESPE Sil to create chemical bond between the inorganic silicatised surface and the organic resin.<sup>13</sup>

#### **Potential problems**

• Substructure failure (usually vertical fracture of connector at the pontic region)

Failure of the bond at the interface between the

zirconia and the layering porcelain

• Breakage and chipping of the porcelain veneer

# Low-temperature degradation (LTD) or "aging".

▶ One property of zirconium oxide that has not been well studied is the phenomenon of lowtemperature degradation or "aging". Water and nonaqueous solvents are involved in formation of zirconia hydroxides along a crack. This process accelerates expansion of the fracture and can result in reduced strength, toughness, and density, leading to failure of the restoration.

#### SUMMARY

All-ceramic crowns and fixed prostheses have had many false starts across the past several decades. Most dentists have frustrating memories of placing beautiful all-ceramic restorations, only to have them fracture after a few months or years of service. However, dentists long have sought stronger all-ceramic crowns





and fixed prostheses in both anterior and the posterior portions of the mouth. In the past several years, numerous brands of zirconia-based all ceramic crowns and fixed prostheses have been introduced to dentistry and these materials have significant effect on the fixed prosthodontic laboratory industry, as well as on practitioners and their patients.

• They are better esthetically than typical PFM restorations.

▶ The margins of the restorations have more acceptable appearances than those of PFM restorations when gingiva recedes.

• Gingival sensitivity to metal is reduced or eliminated.

• Strength and service record of zirconia-based all ceramic crowns and a fixed prosthesis are very good compared to all other all-ceramic restorations.

However, research shows that the strength and service record of PFM restorations and zirconia-based restorations in three-unit prostheses is almost similar, but longer clinical observation is necessary for final judgment. The long-term color stability probably will be same as that observed with PFM restorations. The long-term wear characteristics on opposing teeth for both PFM and zirconia-based restorations will be similar, as the external ceramic materials are similar. Prostheses requiring precision attachments or stress breakers are best made with PFM restorations (limitation). The cost of zirconia-based restorations is higher than that of PFM restorations, but it probably will decrease as further developments take place.

#### CONCLUSION

Although clinical long-term evaluations are a critical requirement to conclude that zirconia ceramics has a good reliability for dental use, biological, mechanical, and clinical studies published to date seem to indicate that  $ZrO_2$  restorations are both well tolerated and sufficiently resistant. Ceramic bonding, luting procedures, ageing and wear of zirconia abutment should be evaluated in order to guide adequate use of zirconia as prosthetic restorative material. Patient selection, coupled with adequate clinical and technical protocols, is imperative in order to obtain good performance of these restorations.

#### REFERENCES

- Piconi C, Maccauro G. Zirconia as ceramic biomaterial. Biomaterials 1999;20:1-25.
- Manicone PF, Iommetti PR, Raffaelli L. An overview of zirconia ceramics: Basic properties and clinical applications. Journal of dentistry 2007;35:819-826
- Cavalcanti AN, Foxton RM, Watson TF, Oliveria MT, Giannini M, Marchi GM. Y-TZP ceramics:key concepts for clinical application. Operative dentistry,2009;34(3):344-351.
- 4. Richard M. Parker, DDS. Use of Zirconia in Restorative Dentistry. Dentistry Today; March 2007: 114-119
- Hertlein G, Hoscheler S, Frank S, et al. Marginal fit of CAD/CA M manufactured all ceramic zirconia prostheses.J Dent Res.2001;80:abstract 49.
- 6. Isabelle Denry, Robert Kelly. State of the art of zirconia for dental application. Dent Mater 2008;24:299-307.
- Shriharsha P, Dagmar V, Sujith S, Tomas V. A new oxidebased high-strength all-ceramic material: An overview. The Journal of Indian Prosthodontic Society; October 2007;7(4)
- Atsu SS, Kilicarslan MA, Kucukesmen HC, Aka PS. Effect of zirconium-oxide ceramic surface treatments on the bond strength to adhesive resin. J Prosthet Dent 2006;95:430-6.
- Kern M, Wegner SM. Bonding to zirconia ceramic: adhesion methods and their durability. Dent Mater January 1998;14:64-71,.
- Derand P, Derand T. Bond Strength of Luting Cements to Zirconium Oxide Ceramics. Int J Prosthodont 2000;73:731-735.
- 11. Luthy H, Loeffel O, Hammerlea CHF. Effect of thermocycling on bond strength of luting cements to zirconia ceramic. Dent mater 2006;22:195-200.
- Piwowarezyk A, Ottel P, LauerHC, Kuretzky T. A clinical report and overview of scientific studies and clinical procedures conducted on the 3M ESPE Lava allceramic system. J Prosthodont 2005; 14:39-45.
- 13. 3M ESPE. Rocatec Bonding: Scientific product profile; Scientific affairs 12/01.
- 14. Christensen GJ. Choosing an all-ceramic restorative material JADA. May 2007;138(5):662-665.

#### REVIEW

### **Oral Antimicrobial Peptides-Protectors of the Oral Cavity**

Dr. Y. Shweta Somasundara<sup>1</sup> MDS and Dr. H.L. Jayakumar<sup>2</sup>

<sup>1</sup>Senior lecturer, Department of Preventive and Community Dentistry, D. A. Pandu Memorial R.V. Dental College, Bangalore.

<sup>2</sup>Professor and Head of Department, Department of Preventive and Community Dentistry, A.E.C.S. Maaruti College of Dental Sciences and Research Centre, Bangalore

#### Abstract

The term 'antimicrobial peptides', refers to a large number of peptides that were first characterized on the basis of their antibiotic and antifungal activities. They may provide protection against microbial pathogens, assist in oral biofilm control, and function as an important part of the innate immune system in response to local and systemic infection. Synthetic versions of these peptides may be useful to supplement natural anti-microbial peptides or as therapeutic agents. This review highlights the influence of oral antimicrobial peptides on dental caries, periodontal health, oral cancer and the novel synthetic antimicrobial peptides and potential applications.

Key words: anti-microbial peptides, dental caries, periodontal health, oral cancer, synthetic antimicrobial peptides

#### INTRODUCTION

Antimicrobial peptides are an abundant and diverse group of molecules that are produced by many tissues and cell types in a variety of invertebrate, plant and animal species.<sup>1</sup> Antimicrobial peptides are conventionally defined as polypeptide antimicrobial substances, encoded by genes and synthesized by ribosomes, with fewer than 100 amino acid residues.<sup>2</sup> In addition to their role as endogenous antibiotics, antimicrobial peptides, also called host defence peptides, participate in multiple aspects of immunity (inflammation, wound repair, and regulation of the adaptive immune system) as well as in maintaining homeostasis.<sup>3</sup> The growing problem of resistance to conventional antibiotics is a global public health problem and the need for new antibiotics has stimulated interest in the development of AMPs as human therapeutics<sup>4</sup>. Several AMPs have already entered preclinical and clinical trials to promote wound healing and for the treatment of cystic fibrosis, catheter site infections, acne, and patients undergoing stem cell transplantation<sup>5,6,7</sup>.

The oral cavity, which is colonized by numerous microorganisms, contains a wide selection of antibacterial peptides that play an important role in maintaining its complex ecological homeostasis.<sup>8</sup>

#### HISTORY

The antimicrobial activities of secretions, blood, leukocytes, and lymphatic tissues were recognized as early as the "last fifteen years of the nineteenth century", and between 1920 and 1950 many antimicrobial compounds that were isolated

Author for Correspondence:

Dr. Y. Shweta Somasundara, Senior lecturer, Department of Preventive and Community Dentistry, D. A. Pandu Memorial R.V. Dental College, Bangalore, No. CA 37, 24<sup>th</sup> Main, I Phase, J P Nagar, Bangalore – 560078, Karnataka, India.

Email: shwetaavinash40@gmail.com

from these secretions were shown to be selective for Grampositive and Gram-negative bacteria.9 The list of compounds included a bacteriolytic substance in nasal mucous (which was later named lysozyme2), basic antimicrobial proteins and basic linear tissue polypeptides. The association of the presence of these antimicrobial substances in normal tissues and fluids with natural resistance to microorganisms was clearly made. They were described as being inducible on exposure to infecting microorganisms, to kill or slow the growth of invading microorganisms and to aid allied mechanisms of natural and adaptive immunity. Thus the field of antimicrobial peptide research was born.<sup>1</sup>To date, more than 900 different AMPs have been identified.<sup>10, 11</sup> The first antimicrobial peptide identified in oral epithelium was the  $\beta$ -defensin, lingual antimicrobial peptide (LAP), described in bovine tongue. We now know that several families of natural antibiotic peptides or proteins are expressed in oral epithelium.<sup>12</sup>

#### **ORAL ANTIMICROBIAL PEPTIDES**

Oral Antimicrobial peptides (AMPs) are natural antibiotics that are found in each of these compartments: in the saliva, in the epithelium, and in neutrophils. Evidence is accumulating that AMPs are important contributors to maintaining the balance between health and disease as part of the host innate immune response.

Members of the three main AMP families are found in the oral cavity. These are defined by amino acid composition and three-dimensional structure<sup>13</sup>:

▲ -helical peptides without cysteine (the cathelicidins),

A peptides with three disulfide bonds (the - and β- defensions),

▲ peptides with an unusually high proportion of specific amino acids, for example, the histatins.

Peptide	Origin	Role/Comments	Major Oral Microbial Targets
Alpha- defensins HNP 1–4	Neutrophils, gingival sulcus, sites of inflammation, salivary duct cells	Antibacterial, antifungal, antiviral. Present in GCF	Candida albicans, HIV, S.mutans (poor)
LL-37	Neutrophils, gingival sulcus, salivary glands and ducts	Primarily antibacterial	S. mutans, F. nucleatum, A.actinomycetemcomitans Capnocytophaga sputigena
Beta- defensins hBD1 hBD2 hBD3	Epithelia, salivary ducts	Antibacterial, antifungal, antiviral. Part of the protective barrier function of epithelium. Secreted	hBD1: Poor antibacterial hBD2, hBD3: S. mutans S.sanguis F.nucleatum, P.gingivalis, Candida albicans,HIV
Histatins	Salivary glands/ducts	Antifungal	Candida albicans

#### AMPS AND CARIES EXPERIENCE

The expression of AMPs in saliva and throughout the oral cavity suggests that they may have a role in protecting tooth structure from caries as well as protecting oral mucosa. Several reasons for this proposal are:

1. AMPs have broad antimicrobial activity;

2. Their action is synergistic with other antimicrobials in saliva; co-expression of cathelicidins and defensins with peptides such as histatin, proline-rich proteins may enhance antimicrobial function;

3. They stimulate the acquired immune system and could function to enhance IgA production as well as IgG production;

4. These AMPs may function to keep overall bacteria in check and to help prevent biofilm formation. Thus, oral AMPs may provide a natural antibiotic barrier.<sup>13</sup>

#### HNP AND CARIES PROTECTION

A study conducted to determine a possible correlation between AMP levels in saliva and caries experience in children showed extensive variation in AMP levels between individuals. The study findings suggested that low salivary levels of HNP1-3 (a mixture of HNP1, 2, 3) may contribute to caries susceptibility.<sup>14</sup> HNP1–3 in saliva could contribute to resistance to caries by direct antimicrobial properties (either alone or in combination with other saliva components) or by preventing biofilm formation on the surface of the tooth via its ability to bind bacterial outer membranes. The inverse correlation of HNP1–3 with caries experience suggests its possible protective effect. Conversely, low levels of HNP1–3 may result in increased susceptibility to caries.<sup>13</sup>

#### **AMPS AND PERIODONTAL HEALTH**

AMPs can be used to either prevent bacterial colonization at early stages of biofilm development or to reduce the load of biofilm formed at later stages.<sup>15,16</sup> Two major defense mechanisms for bacterial clearance in gingival sulcus are direct killing by antimicrobial peptides and phagocytosis by neutrophils. Gingival epithelia form not only physical, but also chemical, barriers by secreting the antimicrobial peptides known as human b-defensins (hBDs). Neutrophils that emigrate through the junctional epithelium form a barrier between the plaque and the underlying epithelium and actively phagocytose the bacteria. Neutrophils also produce the antimicrobial peptides, LL-37 and human neutrophil defensins .The striking importance of LL-37 has been shown in patients with Kostmann syndrome, who develop severe periodontitis in young adulthood and lack LL-37 in their neutrophils restored by treatment with recombinant granulocyte colony-stimulating factor.<sup>17</sup> This led to the suggestion that LL-37 may be particularly important in its effects vs. the Gram-negative, Actinobacillus actinomycetemcomitans, an organism associated with rapidly progressive PD especially in young people.<sup>12</sup> There appears to be a great deal of heterogeneity in the basal expression of hBDs, and studies suggest that some individuals may be genetically predisposed to

express a higher basal level of hBDs, making it easier to maintain mucosal and gingival health.<sup>18,19</sup> When hBD levels were compared between healthy and diseased gingival tissues, lower levels of hBD-2 and hBD-3 were expressed in diseased tissues.<sup>20</sup>

#### ANTIMICROBIAL PEPTIDES IN ORAL CANCER

There is increasing evidence that antimicrobial peptides (AMPs) are differentially regulated in cancers such as oral squamous cell carcinomas (OSCC). Data showing that AMPs influence the growth of tumor cells, exhibit direct cytotoxic activity towards cancer cells, function as a tumor suppressor gene or activate the adaptive immunity suggest that a dysregulation of AMPs may be associated with the development of cancer.<sup>21</sup>

#### ANTICANCER PEPTIDES

Anticancer peptides such as Human neutrophil peptides (HNPs)-1 and HNP-3 which are -defensins were found to have a cytotoxic effect on several different types of human and mouse tumor cells, including human B-lymphoma cells and human oral squamous carcinoma cells.<sup>22</sup> Natural AMP or synthetic derivatives can be used to develop novel strategies to fight cancer diseases and may represent a novel family of anticancer agents.<sup>21</sup> In the relatively near future, AMPs that have been optimized for anticancer activity may be an economically viable and therapeutically superior alternative to the current generation of chemotherapeutic drugs.<sup>23</sup>

#### NEW DEVELOPMENTS & POTENTIAL APPLICATIONS OF AMPS

## 1. Specifically (or selectively) targeted antimicrobial peptides (STAMPs):

A new class of targeted antimicrobials, called specifically (or *s*electively) *t*argeted *a*nti*m*icrobial *p*eptides (STAMPs) having increased killing potency, selectivity, and kinetics against targeted bacteria have been developed. The STAMPs were capable of eliminating *S. mutans* from multispecies biofilms without affecting closely related non-cariogenic oral streptococci, indicating the potential of these molecules to be developed into "probiotic" antibiotics

which could selectively eliminate pathogens while preserving the protective benefits of a healthy normal flora.<sup>24</sup>

2. A novel, sustained release chewing gum formulation of the water-soluble antimicrobial peptide KSL-W for use as an antiplaque agent:

KSL-W is an antimicrobial decapeptide shown to inhibit the growth of oral bacterial strains associated with caries development and plaque formation. KSL-W may be readily formulated into a variety of chewing gums, alone or in combination with established antiplaque agents, such as Cetylpyridinium chloride (CPC) for protection against dental disease in those individuals unable to perform routine dental care, such as brushing, but who are otherwise able to chew gums. Both in vitro and in vivo studies revealed that KSL-W is released from chewing gums in a controlled and reproducible manner, suggesting that it is likely to be released and retained in the oral cavity.<sup>25</sup>

#### 3. Risk assessment and salivary diagnosis:

Salivary defensin levels can be altered in oral diseases, and therefore may be a useful marker for risk assessment, salivary diagnosis and therapeutic strategies.<sup>26</sup> Assaying salivary levels of alpha-defensins HNP1-3 could be a new and useful measure of the risk for caries in children.<sup>14</sup>

#### 4. Use in toothpaste/mouthwash:

Formulation of toothpastes with complimentary agents such as anti-microbial peptides.<sup>27</sup>

A synthetic peptide derived from natural AMPs, a 12aminoacid histatin-based peptide (P-113) was formulated in a mouth rinse that was tested in humans with experimental gingivitis. A significant reduction in bleeding on pobing was reported in treatmentgroups.<sup>28</sup>

#### 5. Topical application:

Topical application of antimicrobial peptides may have utility in the treatment of oral diseases including periodontitis or candidiasis. Antifungal peptides Histatin-5 and several variants are under active investigation. At present, an anti-microbial peptide PAC113, based on the active segment of histatin 5, is in commercial development for treating oral candidiasis.<sup>29</sup> Beta Defensins may be useful in the treatment of oral infectious diseases, ulcerative lesions, and cancer.<sup>30</sup>

# CHALLENGES TO THERAPEUTIC USE OF AMPS

At present, the longitudinal studies using AMPs, naturally occurring or synthetic, for caries control are lacking. The role of AMPs alone, or in conjunction with other treatment agents for active reversal of early caries lesions, has not been determined. To date, there are many AMPs being investigated for use in therapeutics, though there are none currently commercially available.<sup>10</sup>

While AMPs hold promise, there are potential limitations that must be overcome, such as safety, stability, and costs associated with the use of peptides as therapeutic adjuncts for promoting oral health.<sup>10</sup>

#### **CONCLUSION:**

Although much research is required and on-going in the field of antimicrobial peptides they appear to be a promising weapon in the fight against oral diseases.

#### REFERENCES

- Brogden KA. Antimicrobial peptides: Pore formers or metabolic inhibitors in bacteria? Nature Reviews Microbiology Mar.2005; 3:238-250.
- Ganz T. The Role of Antimicrobial Peptides in Innate Immunity. Integr. Comp. Biol. 2003; 43:300–304.
- <u>Auvynet C, Rosenstein Y</u>. Multifunctional host defense peptides: antimicrobial peptides, the small yet big players in innate and adaptive immunity. 2009 Nov; 276(22):6497-508. Epub 2009 Oct 9.
- Devine DA, Hancock REW. Cationic peptides: Distribution and mechanism of resistance. Curr Pharm Design 2002; 8:703–714
- Mor A. Peptide-based antibiotics: A potential answer to raging antimicrobial resistance. Drug dev Res 2000; 50:440–447.
- Koczulla AR, Bals R. Antimicrobial peptides current status and therapeutics potential. Drugs 2003; 63:389–406.
- 7. Giuliani A, Pirri G, Nicoletto SF. Antimicrobial \_\_\_\_\_peptides: an overview of a promising\_class\_of

therapeutics. Cen Eur J Biol 2007; 2:1-33.

- Altman H et al. In vitro assessment of antimicrobial peptides as potential agents against several oral bacteria. Journal of Antimicrobial Chemotherapy 2006; 58: 198–201
- Skarnes RC and Watson DW. Antimicrobial factors of normal tissues and fluids. *Bacteriol. Rev.* 1957; 21(4):273–294.
- Gilmore K, Chen P, Leung KP. <u>Anti-microbial peptides</u> for plaque control and beyond. J Calif Dent Assoc. 2009 Nov; 37(11):779-88
- McDermott AM. Cationic anti-microbial peptides. A future therapeutic option? Arch Soc Esp Oftalmol 2007; 82(8):467-70.
- Dale BA, Fredricks LP. Antimicrobial Peptides in the Oral Environment: Expression and Function in Health and Disease. Curr Issues Mol Biol. 2005 Jul; 7(2):119-33.
- Dale BA, Tao R, Kimball JR, Jurevic RJ Oral Antimicrobial Peptides and Biological Control of Caries. BMC Oral Health 2006; 6:S13
- Tao R, Jurevic RJ, Coulton KK, Tsutsui MT, Roberts MC, Kimball JR, Wells NJ, Berndt J, Dale BA. Salivary antimicrobial peptide expression and dental caries experience in children. *Antimicrob Agents Chemother* 2005; 49(9):3883-3888.
- Etienne O, Picart C, et al, Multilayer polyelectrolyte films functionalized by insertion of defensin: a new approach to protection of implants from bacterial colonization. *Antimicrob Agents Chemother* 2004; 48(10):3662-9.
- Wei GX, Campagna AN, et al, Effect of MUC7 peptides on the growth of bacteria and on Streptococcus mutans biofilm. *J Antimicrob Chemother* 2006; 57(6):1100-9.
- Ji S, Hyun J, et al. Susceptibility of various oral bacteria to anti-microbial peptides and to phagocytosis by neutrophils. *J Periodontal Res* 2007; 42(5):410-9.
- Krisanaprakornkit S, Kimball JR, et al. Inducible expression of human beta-defensin 2 by Fusobacterium nucleatum in oral epithelial cells:

multiple signalling pathways and role of commensal bacteria in innate immunity and the epithelial barrier. *Infect Immun* 2000; 68(5):2907-15.

- 19. Gordon YJ, Romanowski EG, et al, A review of antimicrobial peptides and their therapeutic potential as anti-infective drugs. *Curr Eye Res* 2005; 30(7):505-15.
- 20. Joly S, Organ CC, et al, Correlation between betadefensin expression and induction profiles in gingival keratinocytes. *Mol Immunol* 2005; 42(9):1073-84.
- 21. Meyer JE and Harder J. Antimicrobial Peptides in Oral Cancer. Curr Pharm Des. 2007; 13(30):3119-30.
- Mc Keown STW, Lundy FT, Nelson J, Lockhart D, Irwin CR, Cowan CG, Marley JJ. The cytotoxic effects of human neutrophil peptide-1 (HNP-1) and lactoferrin on oral squamous cell carcinoma (OSCC) in vitro. Oral Oncol 2006; 42:685–690.
- 23. Hoskin DW and Ramamoorthy A. Studies on Anticancer Activities of Antimicrobial Peptides. *Biochim Biophys Acta*. 2008 Feb; 1778(2): 357–375.
- 24. Eckert R, He J, Yarbrough DK, Qi F, Anderson MH, Shi W. Targeted killing of *Streptococcus mutans* by a Pheromone-Guided "Smart" Antimicrobial Peptide. Antimicrobial agents and chemotherapy. 2006 Nov.; 50(11): 3651–3657.

- Faraj JA, Dorati R, et al, Development of a peptidecontaining chewing gum as a sustained release antiplaque anti-microbial delivery system. *AAPS Pharm Sci Tech* 2007; 8(1):26.
- Abiko Y, Saitoh M. <u>Salivary defensins and their</u> <u>importance in oral health and disease.</u> Curr Pharm Des. 2007; 13(30):3065-72.
- Slayton RL, Bryers JD, Milgrom P. <u>Biotech and biomaterials research to reduce the caries epidemic.</u>BMC Oral Health. 2006 Jun 15; 6 Suppl 1:S1.
- Van Dyke T, Paquette D, et al, Clinical and microbial evaluation of a histatin-containing mouth rinse in humans with experimental gingivitis: a phase-2 multicenter study. *J Clin Periodontol* 2002; 29(2):168-76.
- Hancock RE, Sahl HG, Anti-microbial and hostdefense peptides as new anti-infective therapeutic strategies. *Nat Biotechnol* 2006; 24(12):1551-7.
- Abiko et al .Role of beta-defensins in oral epithelial health and disease. <u>Med Mol Morphol.</u> 2007 Dec; 40(4):179-84. Epub 2007 Dec 21.

### Mechanism Of Disocclusion - A Review

# **Dr. Sanjana.J.Rao** MDS<sup>1</sup>, **Dr. Manoj Shetty** MDS<sup>2</sup>, **Dr. Krishna Prasad** MDS<sup>3</sup> and **Dr. Chethan Hegde** MDS<sup>4</sup>

<sup>1</sup>Senior lecturer, Department of Prosthodontics, Dayananda Sagar College of Dental Sciences Bangalore, Karnataka.

<sup>2</sup>Professor & Post graduate guide, <sup>3</sup>Professor & Head, <sup>4</sup>Professor & Post graduate guide, Department of Prosthodontics, A B Shetty Memorial Institute of Dental Sciences, Deralakatte, Mangalore, Karnataka

#### Abstract

The goal of dentistry is to increase the life span of the functioning dentition. Although the operations of all mouth rehabilitation procedures are performed on tooth units, they have one basic objective: the equalization of the forces directed against the supporting structures. Disocclusion is a must in eccentric movements and is crucial in controlling harmful lateral forces. Anterior guidance and condylar path previously considered as independent factors were found to influence each other and dependent factors. It was concluded that *Cuspal angle* is most reliable factor having maximal influence on amount of disocclusion.

Keywords: disocclusion, cuspal angle, mouth rehabilitation

#### INTRODUCTION

Various occlusal schemes have been developed over the years to prevent harmful horizontal occlusal forces on teeth caused by mandibular eccentric movements. Planning and executing the restorative rehabilitation of a decimated occlusion is probably one of the most intellectually and technically demanding task. Achieving optimum occlusion such that under occlusal stress the most favourable loading achieved is the goal of occlusal rehabilitation.

The ideal occlusion for eccentric movements can be classified by 3 schemes:

- Mutually protected articulation
- ▲ Group function
- $\mathbb{A}$  Balanced articulation

#### Mutually protected occlusion:

An occlusal scheme in which the posterior teeth prevent excessive contact of the anterior teeth in maximum intercuspation and the anterior teeth disengage the posterior teeth in all mandibular excursive movements. <sup>2</sup>(Fig 1)

#### Author for Correspondence:

Dr. Sanjana J Rao, Senior lecturer, Department of Prosthodontics, Dayananda Sagar College of Dental Sciences Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore-560078, Karnataka, India.

Email: raojsanjana@yahoo.com

#### **Canine guided occlusion:**

A form of mutually protected articulation in which the vertical and horizontal overlap of the canine teeth disengages the posterior teeth in the excursive movements of the mandible. (Fig 2)

▲ D'Amico stated that cuspid protected articulation and disocclusion were natural adaptations for preventing a destructive occlusion.

▲ In natural canine protected occlusions, the pattern of function is rather vertical ,and so the mandible do not use lateral movements that would subject the canines to stress in that direction either.<sup>3</sup>

#### **Group function:**

Established by Schuyler in 1959 intended to distribute occlusal forces uniformly to several teeth on the working side during the laterotrusive movement. (Fig 3)

Group function is defined as "multiple contact relations between the maxillary and mandibular teeth in lateral movements on the working side whereby simultaneous contact of several teeth acts as a group to distribute occlusal forces"- [Glossary of Proshtodontic Terms (GPT) - 8]. Desirable group function consists of canine, premolars & mesiobuccal cusp of first molar. It has been believed that this occlusal form exists extensively in natural dentition<sup>4</sup>. Fig. 1: Anterior group function







#### **Balanced articulation:**

It is the "bilateral, simultaneous, anterior and posterior occlusal contact of teeth in centric and eccentric positions (GPT-6, 1994).

Schuyler (1959) stated that in natural dentition, balancing contacts that are contact of all posterior teeth in protrusive relation or contact of teeth on the non-functional side in the lateral eccentric relation seems to be non-essential for the most favourable distribution of functional forces.<sup>5</sup>

#### DISOCCLUSION

The concept of disocclusion introduced by D'Amico is more commonly known in dentistry when considering distribution of horizontal occlusal forces. Posterior disclusion in all jaw positions except centric relation is the most desirable occlusion whenever it can be achieved by an acceptable anterior guidance. It must be accomplished with tripod or surface-to-surface morphology to prevent lateral interferences in any case with centric contact on inclines that are steeper than the lateral border movements of the mandible.<sup>4</sup>

Disocclusion is defined as separation of opposing teeth during eccentric movements of the mandible (GPT-8), and as "The superoinferior distance between maxillary and mandibular opposing cusps during eccentric movements of the mandible "- Hobo and Takayama

#### **Factors Affecting Disocclusion**

- ▲ Condylar guidance path
- ▲ Incisal guidance
- ▲ Cusp shape factor
- ▲ Angle of hinge rotation

#### Condylar path: (Fig 4)

▲ It is the path travelled by the mandibular condyle in the temporo mandibular joint during various mandibular movements - GPT 8

 $\bigstar$  Mc. Collum and Stuart stated that condylar path was fixed factor for an individual and that the anterior guidance was independent of the condylar path.<sup>6</sup>



#### Mechanism of Aisocclusion – A Review



△ Oliva, Hobo, Takayama repeatedly measured condylar path using electronic measuring system and observed a deviation width of 0.4 mm average and 0.8mm maximum on non-working side lateral condylar path.<sup>2</sup>

• Hobo and Takayama measured protrusive and lateral mandibular movements using computerized measuring systems in 17 healthy individuals between age groups of 20-24 yrs. They found distinct difference between eccentric and returning condyle.

Returning condyle path always passed above the eccentric condyle path in sagittal plane. Compared with an eccentric condylar path, a returning condylar path is shallower by a mean of 45%.<sup>6</sup>It was also stated that the condylar path is greatly influenced by anterior guidance <sup>7</sup> These observations can be attributed to the looseness of the TMJ structure in relation to the surrounding soft tissues. This indicates that the two posterior apexes of the mandibular triangle (the right and left condyles) are flexible.

In addition, a method of deriving the incisal path and cuspal angle from the condylar path is not known, therefore the use of the condylar path as the main determinant for occlusion has caused difficulties.

#### Incisal guidance: (Fig 5)

▲ "The influence of the contacting surface of the mandibular and maxillary anterior teeth on mandibular movements".- GPT 8

▲ Early gnathologic concepts focused primarily on the condylar path. The concepts were based on the theory that the condylar path does not change during adulthood and that the determination of anterior guidance is at the discretion of the dentist.

Although anterior guidance only ranges from 2 to 6 mm, it is crucial in human occlusion because it influences molar disclusion that controls horizontal forces.

▲ Dawson stated that the condylar path was not a determination of anterior guidance and that "it does not matter whether the anterior path is flat or curved, concave or convex or parabolic, the rotating condylar sliding down the unchanged condylar path permits the lower anterior teeth to follow any number of path variations without interferences". He concluded that anterior guidance could be freely changed by the dentist.<sup>9</sup>

▲ The anterior teeth guide the movement of the anterior portion of the mandible. As the mandible protrudes, the incisal edge of the mandibular anterior teeth occludes with the lingual surfaces of the maxillary anterior teeth. The steepness of the lingual surface determines the amount of vertical movement of the mandible. In healthy patients, anterior guidance is approximately 5 degrees steeper than the condylar path in Sagittal planes. The influence of the anterior guidance on disocclusion was found to be more than that of the condylar path. Though one out of five patients did not have an incisal path that reflected an appropriate standard.<sup>2</sup>

▲ Hence it was concluded that there were large variations in incisal path among patients with normal occlusion and the occurrence rate of malocclusion was high.

#### Angle of hinge rotation:

Posterior disclusion occurs when anterior

guidance is steeper than the condylar path. The mandible rotates around the intercondylar axis during eccentric movements when anterior guidance is steeper than the condylar path. The factor that compensates for the difference in steepness is the angle of hinge rotation.

Takayama and Hobo analyzed disclusion relative to the angle of hinge rotation by using kinematic formulae. The results indicated that the angle of hinge rotation contributed to posterior disclusion by approximately 0.2 mm for protrusive movement and 0.5 mm on average for lateral movement on both working and non-working sides. According to their investigation, the amounts of disocclusion were 1.1+/-0.6 mm during protrusive movement,  $0.5 \pm -0.3$  mm on the working side and 1 +/-0.6 mm on the non-working side during lateral movement. The actual disclusion during protrusive and lateral movements on the non-working side differ from the angle of hinge rotation. This leaves residual amounts of disclusion unaccounted for ,namely, 0.9 mm in protrusive and 0.5 mm on the non-working side thus suggesting that the angle of hinge rotation was not solely responsible for disclusion.<sup>6</sup>

Cusp angle (Fig 6):



et al Dr. Sanjana J Rao

Angle made by the average slope of a cusp with cusp plane measured mesiodistally or bucco lingually

#### Cusp plane:

Plane determined by two buccal cusp tips and highest lingual cusp of molar

#### Effective cusp angle:

Angle formed by the average cusp slope and horizontal reference plane

1. Sagittal protrusive effective cusp angle–the effective cusp angle during protrusive movement.

2. Frontal lateral effective cusp angle-the effective cusp angle during lateral movement on the working and non-working side.

When the slopes of the posterior cusps are parallel to the condylar path inclination and anterior guidance is parallel to the condylar path, the opposing cusps slide during protrusive movement without discluding, despite the degree of steepness. If anterior guidance is steeper than the condylar path, then the posterior teeth disclude. The posterior teeth disclude only when the cusp inclination of the molar is parallel to the condylar path and anterior guidance is steeper than the condylar path.

The shape of the cusp has a great influence on the disclusion of posterior teeth. To produce fully balanced occlusion it is then necessary to make the cusp with a straight edge ,whereas for disclusion the cusp requires a semicircular shape .If the shapes of the posterior cusps are less steep than the condylar path, the posterior teeth disclude even if anterior guidance is parallel to the condylar path. The residual amounts of disclusion that were not accounted for by the angle of hinge rotation can be attributed to this mechanism, regulated by the cusp shape factor. The semicircular shape of the cusps affects posterior disclusion and is the factor contributing to the posterior disclusion. This is called as the cusp shape face.<sup>2,6,10</sup>

# ▲ Cuspal angle is the most reliable among the factors affecting disocclusion.

Hobo and Takayama derived standard values for the amount of disocclusion as

Protrusive movement- 1.0 mm

RGUHS J Dent. Sciences, June 2011 / Vol 3 / Issue 2

Non-working side -1.0 mm

Working side  $-0.50 \,\mathrm{mm}^2$ 

#### **Necessity of Disclusion**

SECURITY INSURANCE to protect teeth from harmful effects due to cuspal interferences .An interference can be caused due to the difference between the eccentric and returning condylar paths<sup>2</sup>

#### REFERENCES

- Hobo. S, Takayama. H. Twin stage procedure. Part I-A new method to reproduce precise eccentric occlusal relations. Int J Perio Rest Dent 1997; 17:113-123
- Sumaiya Hobo, Hisao Takayama: Oral Rehabilitation
  Clinical Determination of Occlusion. Quintessence
  Publishing Co, 1997
- β. D'Amico. Functional occlusion of the natural teeth of man. J Pros Den 1961; 11:899-915
- 4. Dawson. P. E. Functional occlusion from TMJ to smile design. St.Louis: CV Mosby Co, 2007:227-232

- Schuyler C H: Evaluation of incisal guidance and its influence in restorative dentistry. J Prosthet Dent.1959; 9:374
- Sumiya Hobo. Twin tables technique for occlusal rehabilitation: Part I-Mechanism of anterior guidance. J Prosthet Dent 1991; 66:299-303
- Hobo .S, Takayama.H. Effect of canine guidance on working condylar path. Int J Prosthodont 1989;2:73-79
- Hobo.S, Takayama.H. Twin stage procedure. Part II-A clinical evaluation test. Int J Perio Rest Dent 1997; 17:457-463
- Dawson P.E .Evaluation, diagnosis and treatment of occlusal problems .St.Louis: CV Mosby Co.1974:148-9
- Sumiya Hobo .Twin tables technique for occlusal rehabilitation: Part II-Clinical procedures.J Prosthet Dent 1991; 66:471-7
- Shooshan ED.A pin ledge casting technique –its application in periodontal splinting. DCNA 1960;189-206

### **One Piece Implants Versus Two Piece Implants - A Clinical Review**

Dr.Sudhindra S Mahoorkar<sup>1</sup> MDS, Dr.Girish P Galagali<sup>2</sup> MDS

<sup>1</sup>Professor and head, Dept of Prosthodontics, HKE'S S.N. Institute Of Dental Sciences and Research, Gulbarga, <sup>2</sup>Professor and head, Dept of Prosthodontics, Navodaya Dental College, Raichur

#### Abstract

Ossee integration being an accepted and well documented concept, the attention is directed towards simplification of mechanical design of implant and uncomplicated yet a logical surgical technique and still have a biomechanical success. Slow and steady shift of paradigm from conventional two piece, two stage implantology to unibody single stage implantology is already on the horizon. The unibody design mimics natural tooth with seamless transition of radicular unit to coronal unit. The design redefines the existing concepts of implantology

Key words: one piece implants, unibody, 1 stage surgery, mini implants

#### **INTRODUCTION**

With Osseointegration now being a established scientific phenomenon, the major thrust in implantology is directed towards improving the design of implants, simplifying the surgical protocol, immediate placement and loading of the implants, to reduce the restoration time. The conventional two piece implant (TPI) design feature is the implantabutment connection, which renders the design with a weak link in the entire assembly. A seamless transition from the root analogue to the crown analogue overcomes the disadvantage of the two-piece (split) implant. Such a seamless transition of implant to abutment is design advantage offered by One Piece implant (OPI) which actually mimics the natural tooth in its construction and also offers many advantages viz strong unibody design, no split parts single stage surgery with either flap or flapless approach and simple restorative technique. The use of OPI reduces the requirement of multiple surgical and prosthetic components thereby reducing the inventory and cost.

#### DISCUSSION

OPI are not new to Implant Dentistry, and recent variations from the early designs have created a renewed interest in OPI for all indications of implants<sup>1</sup>.

Before a comparison of the split TPI is made with OPI

Author for Correspondence:

Dr. Sudhindra S Mahoorkar , Professor and head, Dept of prosthodontics HKE'S S N Institute of Dental Sciences and Research, Gulbarga , Karnataka, India. E-mail: drsudhindramds@gmail.com it is important to understand the evolution of endosseous TPI as made popular by the work of legendary scientist P I Branemark2. Based on the prevailing understanding of Osseointegration and design of the implants it was necessary that the endosseous root analogue be allowed to heal, submerged and unloaded for the period of 3 to 6 months in the bone<sup>3</sup>.

Protocol of the treatment required, second stage surgery to expose the submerged implant to proceed with a restorative phase where again a short healing phase for the soft tissue was required to form a well healed collar of tissue around the neck of the implant. The crown analogue abutment was attached through a screw to the internal body of implant.

Since TPI concept for endosseous (cylindrical) root like design was pioneer in ushering modern dental implatology and also well backed up with scientific documentation. It did convince many that the TPI and two stage surgical protocols was the only acceptable concept for achieving successful Osseointegration.

However, with improvement in the design of the implant, understanding of factors affecting Osseo integration, simplification of surgical technique, loading of implants it was possible to achieve and maintain Osseointegration with OPI<sup>4</sup>.

# Limitations and drawbacks of TPI Overcome by OPI-

1. The use of TPI in a narrow edentulous space face a mechanical challenge because as the diameter of the

conventional TPI approaches 3.00mm and less the implant body becomes structurally weak to accommodate the connecting screw or the screw remains thin which lead to repeated screw breakage<sup>5</sup> use of OPI in tight spaces of mandibular anterior, maxillary laterals and first bicuspids have shown good clinical success comparable to that of TPI<sup>6</sup>.

2. Surgical Technique: The surgical protocol of TPI required the implant to be submerged and heal unloaded for a period 3 to 6 months. This required an open flap technique for inserting implants into the bone. The healed implants required a second stage surgery to expose the submerged implants and Trans gingival component (TSG) was attached at this stage and the soft tissue was allowed to heal around TSG in second short healing phase. However as the understanding of the biomechanics of the OI improved with advances in material, surface treatment and emergence of root shaped implants<sup>7</sup> and patients reluctance to undergo 2 surgical protocol some clinicians<sup>8</sup> ventured to attach a TSG at first surgical appointment and allowed the implants to heal non submerged and unloaded and avoid second surgical phase and healing phase, and yet achieve complication free hard and soft tissue integration and exhibit cumulative survival rate similar to submerged implants heralding the one stage surgical protocol<sup>9</sup> However, components supplied by various companies were never intended the TPI to be assembled as single assembly at the first stage of surgery. Since the first non-submerged technique did not require flap closure over the implants inserted into the bone a flapless approach was evolved to place implants thereby eliminating the need of rising a flap, sutures, decreased blood loss and less post operative pain, reduced the appointments and cost of surgical procedures and also have good tissue response<sup>10</sup>. Therefore, it is logical to use OPI in a not submerged protocol, since the OPI demonstrates biologic width similar to that of natural tooth<sup>11</sup> and a predictable soft tissue barrier to prevent microbial invasion<sup>12</sup>.

3. Immediate placement: When an immediate placement of implant is planned in a fresh extraction socket since the procedure with TPI has no scope for

the flap closure and abutment has to be joined to the root implant in the same procedure. Use of OPI in such situation makes more sense and the soft tissue maturation on the implant body gives better esthetics. The other reason for the OPI in immediate placement is the socket guides the portion of the implant and emergence of the abutment matches that of natural crown, thereby reducing chance of crown angulations deviating from natural axial inclination and the need for angulated abutment is very minimal. The OPI implants can be used in immediate placement and immediately restored with an advantage of having no micro gap between the abutment and implant.

4) Restorative Phase / Prosthetic Phase: The conventional TPI were put to function only after 3 to 6 months of healing, but when a transgingival extension could be achieved in the first surgical phase itself, instead of a TSG a regular prosthetic abutment was connected and the implant was either progressively loaded or immediately restored if a good primary stability was achieved.

OPI implant can be successfully placed in bone and, can be either left unloaded or can be loaded progressively or immediately, eliminating the need of a separate abutment joined to the implant through a screw with the inherent drawbacks of disjoined connection.

Conventional TPI require a healing abutment around which soft tissue have to heal after second stage surgery and they require separate different prosthetic components, impression coping each different for closed tray or open tray impression techniques and also implant analogue for lab models.

OPI which come with an inbuilt abutment are prepared with proprietary TC burs following the principles of FPD preparations with which all are familiar and comfortable. Impression procedure are identical to the crown and bridge work, require gingival retraction and impression making with suitable impression techniques of putty wash or custom tray regular body method.

Laboratory phase of making restoration is also easy. and simple similar to that of the conventional fad technique with which many dental commercial laboratories are familiar with.

The cementation procedure with OPI is completed and checked with IOPA radiograph to confirm complete removal of set cement.

If we were to analyze all the above factors logically OPI can be used in all (situations) indications of implant except where the abutment needs to be angulated for better function and esthetics.

The existing product range of the manufacturers has more stress on the TPI with its confusing array of components creating lot of apprehension and doubt to a novice of implant logy whereas the OPI system reduces the components required, keeps the inventory low and cuts down the cost of implants also the operator is familiar with the FPD technique which can be effortlessly adopted to the needs of implant logy.

#### CONCLUSION

The field of implantology is constantly evolving and new paradigms created the attempt of man to copy nature in implant logy reflects the most, in OPI which has a similar seamless transition from radicular part to coronal part, with passage of time and new evidence, emerging to reinforce the success of OPI may become the standard protocol in near future.

#### **REFERENCE:**

- Babbush CA. Titnium plasma sprayed (TPS) screw implants for reconstruction of the edentulous mandible. J.Oral. Maxillofacial surgery 1986; 44: 274 – 282.
- Branemark P.I; Zarb GA, Albrektsson T. Tissue integated prosthesis: Osseointegation in clinical dentistry chicago, ill, Quintensence, 1985; 11-76.
- Alberktson T, Branemark P-I, Hansson H, Lundstrom J. Osseointegrated titnium implants requirement for insuring a long lasting direct bone to implant anchorage in man. Acta orthop scan 1981; 52: 155-70.

- 4. Hahn J. Onepiece root form implants A return to simplicity. J Oral implantol 2005; 2: 77-84.
- Akca k , Cehrelim C, Iplik cioglu H. Evaluation of the mechanical characteristics of implant – abutment complex of reduced diameter morse taper implant. A nonlinear finite element stress analysis. Clin Oral impl Res 2003;14:444-54.
- Stephen M. Parel, and Sterling R. Schow. One piece implant system in single tooth sites. In J Oral Maxillofac Surg 2005;2:77-84.
- Buser D, Weber HP, Donath K, Fiorellini JP, Pauette DW, Williams RC. Soft tissue reaction to nonsubmerged unloaded titanium implants in beagle dogs. J Periodontol 1992 March; 63(3):225-35.
- Becker et al . A prospective multicenter clinical trial comparing one and two stage titanium screw shaped fixtures with one stage plasma sprayed solid screw fixtures. Clin Implant Dent Res.2000;(3):159-65
- Astrand et al. Non-submerged and submerged implants in the treatment of partially edentulous maxilla. Clin Implant Dent Res.2002;4(3):115-27.
- 10. Brodala N. Flapless Surgery and its effect on dental implant outcome. Int J Oral Maxillofac Implants.2009;24 suppl:118-25.
- Hermann JS, Buser D, Schenk RK, Schoolfield JD, Cochran DL. Biologic Width around one and two piece titatnium implants. Clin Oral Implants Res.2001;12(6):559-71.
- Glauser R, Schupbach P, Gottlow J, Hammerle CH. Peri implant soft tissue barrier at experimental one piece mini implants with different surface topography in humans. A light microscopic view and histometric analysis.

### **Dentistry: The Time of Yore (Part IV: The Dentifrice Tale)** Dr. Suma S. MDS<sup>1</sup>

<sup>1</sup>Reader, Department of Oral and Maxillofacial Pathology, D.A.P.M.R.V. Dental College and Hospital, Bangalore

All of us in this world use it. Many use it at least once (it is recommended twice) in a day. It can be a liquid, paste or powder and can be used with a brush. Toothpastes, toothpowders and mouthwashes – now an integral part of everyday routine; only a few of us have probably given a thought about when did their use begin. Dating their use is difficult because references about using animal, plant or mineral products or their mixtures dates back till the earliest records.

#### THE EARLY DENTIFRICES

References as early as 2000 B.C. suggest the recommendation, experimentation and use of plant, animal and mineral products and their mixtures to maintain oral hygiene and prevent gum diseases. Some of them include:

▲ The use of urine of a child as a mouthwash

▲ Toothpowder made of powdered ashes of ox hooves, myrrh, powdered and burnt eggshells and pumice – used by the Egyptians. The mixture was rubbed onto the teeth and gums using fingers.

Mixture of small particles of triturated stones (abrasive), ocher (abrasive) and honey (emollient) – used by the Egyptians, 1550 B.C.

Mixture of ash (abrasive), marble (abrasive), honey (emollient), aniseed (antiseptic), myrrh (breath freshener)–suggested by Hippocrates, 460 B.C.

Mixture of lentil oil (antiseptic), hyoscyamus roots (analgesic, sedative) boiled in vinegar (astringent) used for periodontitis, A. D. 130–200

Rhazis, a doctor, alchemist and philosopher from Persia, advised the use of miswak branches to clean the teeth, along with a tooth-cleaning paste of deer horn

Author for Correspondence:

Dr. Suma S, Reader, Department of Oral and Maxillofacial Pathology, D.A.P.M.R.V. Dental College and Hospital, No. CA 37, 24<sup>th</sup> Main, I phase, J P Nagar Bangalore – 560078, Karnataka, India. Email: sumas11@rediffmail.com ashes, lentil, salt, alum, myrhh and honey, A.D. 860 -930

Similar preparations were used for oral hygiene procedures until around 1000 A.D., when, the Persians wrote about the adverse effects of using hard abrasives on the teeth. In 1558, the word dentifrice came into use. [Dentifrice = L. dentifricium; from dentem (tooth) + fricare (to rub)].

#### THE MODERN DENTIFRICES:

More gentle abrasives such as bicarbonate of soda, borax powder, chalk began to be used and flavouring agents were added to the dentifrices. In the early 19<sup>th</sup> century, a paste of hydrogen peroxide and baking soda was recommended for use with toothbrushes, and glycerine was added to convert powders into a paste. Dr. Peabody was the first to add soap to dentifrices in 1824. The year 1873 saw the mass production of toothpaste in jar for the first time (and it smelt good!). Dr. Sheffield's Crème Dentifrice was the first toothpaste in a collapsible tube (by Dr. Washington Sheffield, 1892). This company was later to become Colgate, with the Colgate Dental Cream in 1896. Fluorides were added to the dentifrices as early as 1914, but the American Dental Association (ADA) questioned this. 1942, Bibby conducted the first clinical trial of fluoride toothpaste and 1940s also witnessed the discovery of monofluorophosphate, After World War II, synthetic detergents were replaced with emulsifying agents like sodium lauryl sulphate and sodium ricinoleate. When Joseph Lister introduced the concept of antisepsis and W D Miller described the acidogenic theory of dental caries, dentifrices changed in their composition to become "therapeutic dentifrices". These included antiseptic, bactericidal, bacteriostatic, acid-neutralizing agents. The first symposium on this topic was held by the ADA in 1953. Later, the ADA nodded approval for the fluoride preparations (by then, research had proved the

anticariogenic property of fluoride). In 1955, the first clinically proven Stannous fluoride toothpaste (CREST, by Proctor & Gamble) was released. Among the therapeutic dentifrices developed was the first toothpaste for sensitive teeth containing strontium chloride.

Thus the modern dentifrice evolved to contain the following agents: an active component, abrasives, detergents/emulsifying agents, binding agents, humectants, preservatives, flavouring and sweetening agents. A few of the recent advancements include:

First toothpaste containing synthetic hydroxyapatite (Europe, 2006)

Critique of certain brands of toothpastes containing diglycol (DEG) as this chemical was found to be potentially fatal! (2007)

- ▲ Organic toothpastes
- ▲ Xylitol toothpastes
- Antioxidant toothpowder

This was the dentifrice tale, highly abridged. "Neither the nature nor the history can tell us what we should do. The facts, been of the nature or history, can not decide or determinate the ways we should take. We give purpose and sense to the nature and the history by ourselves." (POPPER, 1977)

Neither the nature nor the history can tell us what we should do. The facts, been of the nature or history, cannot decide or determinate the ways we should take. We give purpose and sense to the nature and the history by ourselves."

(POPPER, 1977)