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The journal of

# PROSTHETIC AND IMPLANT DENTISTRY

Official Publication of Indian Prosthodontic Society
Kerala State Branch

Volume 1
Issue 1
SEP–DEC 2017

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# PROSTHETIC AND IMPLANT DENTISTRY

**Official Publication of Indian Prosthodontic Society Kerala State Branch**

**Volume 1**

**Issue 1**

**September–December 2017**

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The Journal of Prosthetic and Implant Dentistry is the official publication of the Indian Prosthodontic Society, Kerala State branch. This is a tri-annual e-journal which will function as a medium of knowledge transfer among academicians and practitioners in the field of Prosthodontics. The Journal of Prosthetic and Implant Dentistry will contain articles based on original research, case series/reports, literature reviews and clinical tips.

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## The Journal

The Journal of Prosthetic and Implant Dentistry is a peer reviewed open access e-journal published on behalf of Indian Prosthodontic Society, Kerala State Branch. Articles on Complete Denture Prosthodontics, Removable Partial Denture Prosthodontics, Fixed Partial Denture Prosthodontics, Implantology, Maxillofacial Prosthodontics, Occlusion, Aesthetics and Materials used in Prosthodontics will be published in this journal. Journal will be published in January, May and September of every year.

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**Published by**
Indian Prosthodontic Society, Kerala State Branch.

Designed and Published by
Suman Graphics, Trivandrum.

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# CONTENTS

*The journal of*
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Kerala State Branch

# Editorial

The goal of education is the advancement of knowledge and the dissemination of truth

- John F Kennedy

'Success will never be a big step in the future… success is a small step taken just now'. It's with immense pride and honour we promulgate the maiden issue of the Journal of Prosthetic and Implant Dentistry (JPID), an official publication of Indian Prosthodontic Society, Kerala state branch. This is an endeavor of the newly constituted Indian Prosthodontic Society, Kerala state branch. We hope to carry forward the mission of the national Journal of Indian Prosthodontic Society (JIPS) and create new domains for research and publication in the field of Prosthodontics, without which, we are down to a handful of thoughts gone unexpressed.

To turn an assignment from laborious to effortless, you just have to do it together. I feel privileged to work alongside the cream of our specialty, in the effort of editing and publishing the first issue of this Journal, an amazing tool to crystallize your ideas, which is thoroughly vetted by an alpha editorial team. This journal is the result of an outstanding group of individuals who have put in their best efforts.

This indeed is a big leap forward for the science of Prosthodontics in Kerala, yet our mission doesn't end here, it only commences with it. Our immediate short term goal, after the release of this September –December 2017 issue of this tri annual e-journal, is to ensure that the Journal is reputedly indexed at the earliest possible opportunity, along with developing a strong online presence with a world of knowledge at your finger tips.

As a long-term goal, the JPID is envisioned to be the trail blazer that brings to light research and innovations in the field of Prosthodontics and Implant dentistry. This is all more imperative as our specialty is a continuously evolving one, be it in the academic, clinical or technological front.

This vision can be actualized only through original contributions from academicians, clinicians and students, in the form of original research, review articles, case reports and case series. This makes sure that their innovative ideas and arguments won't end up on the back burner, along with refining their flair of writing. We hope and strive hard to bring you more captivating and innovative ideas in the upcoming issues of our journal. In this regard, we hope and believe that we will always have the unconditional support of every member in the IPS family to make this vision, a sweeping success!!

Thank you for being part of this small, yet proud flying-start of the JPID.

Thanking God for his blessings as always. It would be unfair to conclude without thanking Indian Prosthodontic Society, Kerala state branch for showing wholehearted faith in this editorial board.

"Proud to be a Prosthodontist"

**Dr Prasanth Viswambharan**

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Kerala State Branch

JUSTICE (RETD.) P. SATHASIVAM
GOVERNOR OF KERALA

सत्यमेव जयते

RAJ BHAVAN
KERALA

13 June 2017

# MESSAGE

I am very glad to know that the Indian Prosthodontic Society, Kerala State Branch, proposes to publish a journal, Journal of Prosthetic and Implant Dentistry (JPID) during the month of September 2017.

I convey my hearty greetings to every member of the Society and wish the publication all success.

**(Justice (Retd.) P. Sathasivam)**

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Kerala State Branch

**PINARAYI VIJAYAN**
CHIEF MINISTER

GOVERNMENT OF KERALA

Secretariat
Thiruvananthapuram - 695 001

No. 1033/Press/CMO/17 August 22, 2017

# MESSAGE

Prosthodontics is a branch of dentistry dealing with replacement of lost teeth and other maxillofacial structures. This is the branch in dentistry which has undergone revolutionary changes in recent years. Evolution of dental implants has contributed substantially for its progress. However, conventional removal and fixed prosthesis still remain to be the choice of treatment among a large section of people. Aesthetic treatment options like ceramic veneers have reached a new level following the recent developments in the field of dental ceramics. Maxillofacial prosthetic materials and techniques have improved a lot. As a result Prosthodontists are able to rehabilitate many cancer patients who underwent surgical resection of orofacial structures. Prosthodontics is considered to be one of the noble branches of dentistry for these reasons.

Happy to know that Kerala State Branch of Indian Prosthodontic Society is coming up with a new tri-annual journal titled 'Journal of Prosthetic and Implant Dentistry'. I hope this will contribute substantially in the field of Dentistry in general and Prosthodontics in particular.

Wishing the journal all the success.

**Pinarayi Vijayan**

Dr. Prasanth V.
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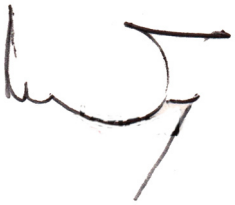
# MESSAGE

I am glad to know that the Kerala branch of Indian Prosthodontic Society is planning to publish a speciality journal named ' Journal of Prosthetic and Implant Dentistry' (JPID) With the demand of Prosthodontics increasing the procedures following road traffic accidents and surgical interventions, the importance of Prosthodontic branch of dentistry will increase in future. I wish this speciality journal, aimed at sharing scientific and clinical knowledge among the Prosthodontists, all success.



**Rajeev Sadanandan**

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Kerala State Branch

**Dr Prafulla Thumati MDS, PhD;**
*President 2016-17; I P S Head Office.*

It gives me immense pleasure to write a message for the Journal. As such, as President of I P S Head Office, I take this opportunity to congratulate your entire team for successful programs being taken up. I would like to congratulate you all for an outstanding C D E Program on Digital Dentistry being done couple of days back and also for the community outreach programs taken up..

At this point I would like you all to participate in a big way for the mass denture camp being planned in the entire country from the head office. Also urge all your members to register for Bali Conference, so that we can show case the strength of the Indian Prosthodontic Society over seas.

Once again I wish the Editor Dr Prasanth V and his team a grand year in bring out a beautiful state journal with meaningful articles for the information of the members.

Lovingly Yours

**Dr Prafulla Thumati MDS, PhD;**
President 2016-17; I P S Head Office.

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Kerala State Branch

Am very happy to note that the Kerala Branch of our Indian Prosthodontic Society is coming out with an e-journal for the benefit of the members. It is appropriate that the branch, which was one the first branches to form & function in the country, will also be one of the first local branches to provide this service to the members. A journal is the mouth piece of any organization and I congratulate the office bearers, especially the editorial team, & all the members for this very useful initiative & hope it will serve to be a hub of information in our specialty for a long time."

Wishing the journal & all the members the very best,

Sincerely yours,

**Dr. V. Rangarajan**
(Secretary-cum-treasurer, IPS)

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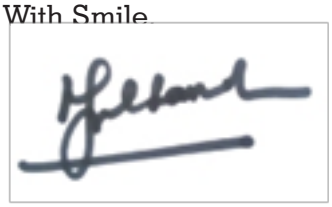
Official Publication of Indian Prosthodontic Society
Kerala State Branch

The Indian Prosthodontic society Kerala state branch has been one of the systematic branches of our society. The branch has been organizing a lot of events to the benefit of the members and especially for student members. The initiation of journal by state branch is highly appreciated. The Journal offers a lot of opportunities, visibility to the regional research, clinical issues and solutions that can enlighten our members. Hope and wish the regional journal aids in enriching our head office journal. I congratulate the IPS-Kerala state branch members and the editor in the launch of this Journal.

I wish them the best.

With Smile



**Prof. Dr. N. Gopi Chander**
Editor,
The Journal of Indian Prosthodontic Society

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PROSTHETIC AND IMPLANT DENTISTRY
Official Publication of Indian Prosthodontic Society
Kerala State Branch

The Indian Prosthodontic Society, Kerala State Branch has decided to release a new Journal namely 'The Journal of Prosthetic & Implant Dentistry'. As the President of the Association, I'm extremely glad to announce the launch of the first issue of the Journal. Scientific articles of International standards selected by the Editorial Board would be the hallmark of the Journal. The Journal would serve as a platform for researchers & clinicians to publish their work which would benefit the budding Prosthodontists & many others. I'm sure that under the guidance of 'Danthaacharya', Prof. Dr. K. Chandrasekharan Nair, the Editorial Board headed by Dr. Prasanth V. would bring glory to the Journal.

**Prof. Dr. Harsha Kumar K.**

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Official Publication of Indian Prosthodontic Society
Kerala State Branch

Dear Dr Prasanth Viswambaran

It is really heart warming to note that our dream of having a journal of Kerala Prosthodontic Society is finally being materialized.

It is even more praiseworthy that you have been committed to it in bring it out in a time bound exemplary manner

Am sure this journal will be a landmark one for the prosthodontist fraternity of Kerala to showcase and publish there research projects and special cases in a consummate manner.

I wish you and the whole editorial team god speed and look forward to time bound publications on the forthcoming issues

Best wishes and Best regards

**Prof (Dr) Rupesh P L**
Secretary
Indian Prosthodontic Society
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*The journal of*
PROSTHETIC AND IMPLANT DENTISTRY
Official Publication of Indian Prosthodontic Society
Kerala State Branch

# THE EFFECT OF LIGHT CURE POLISHING ON THE SURFACE ROUGHNESS, MICROBIAL GROWTH AND STAINING CHARACTERISTICS OF SELF-CURE DENTURE BASE RESINS.

* Faiz Ansari, **Rajesh C, ***S. Anilkumar, **** Nishanth M

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## *Abstract:*

*Aims & Objectives: To study the effect of light cure polishing on the staining characteristics, microbial growth and surface roughness of self-cure denture base resins.*

*Methods: Sixty rectangular samples of size 20mm×15mm×2mm were prepared for the test. The samples were divided into 2 groups of 30 samples. One group was polished by conventional mechanical method and the other by applying light cure material after the conventional mechanical polishing. Ten samples each from both the groups were tested for surface roughness, colour stability and microbial growth. Colorimetric measurements were done using UV-VIS-NIR spectrophotometer and surface roughness using Atomic Force Microscope. Tests for microbial growth were done by counting the number of colonies in the nutrient agar plate prepared after exposing the samples to culture media containing pseudomonas aeruginosa and escherichia coli.*

*Results: The mean surface roughness of self-cure samples reduced from 62.38 nm to 12.63 nm after polishing with light cure varnish. The mean colour change values were lower for light cure polished samples (1.9080) compared to the normally polished self-cure samples (3.9059). The mean microbial growth in the light cure polished samples were lower (855.50) compared to the normally polished self-cure samples (1433.50)*

*Conclusion: There was significant reduction in the surface roughness, staining and microbial growth on light cure polished self-cure denture base acrylic resins compared to the normally polished ones.*

Key words:
**Denture Base Acrylic Resin; Surface Roughness; Microbial Growth; Staining Characteristics; Colour Stability; CIE Lab colour system; Clinically Acceptable**

## Introduction

The loss of teeth by accident or disease has plagued mankind throughout the ages. In order to restore a degree of function and appearance, it has been necessary always to adapt contemporary materials to dental applications as they are available in that period.

As civilization has progressed there has been continued refinement of the materials available for dental practice and there occurred a slow but steady increase in both the quantity and quality of useful materials available for dental prostheses.

Dentures, also known as false teeth, are prosthetic

devices constructed to replace missing teeth and are supported by the surrounding soft and hard tissues of the oral cavity. Conventional dentures are removable (removable partial denture or complete denture). However, there are many denture designs, some of which rely on bonding or clasping onto teeth.

The various parts of a denture are:

- Denture base.
- Denture flange.
- Denture border.
- Denture teeth.

Among the various parts, the denture base forms the foundation of the denture. It helps to distribute and transmit all the forces acting on the denture teeth to the basal tissues. It has the maximum influence on the health of oral tissues. It is that part of the denture, which is responsible for retention and support. Various materials were used as denture base materials starting with wood from the 8th century to titanium and PEEK (Polyether ether ketone) recently. In 1937 methyl methacrylate was clinically evaluated by Wright and was found to fulfil virtually all the requirements of an ideal denture base material. The acrylic resin represented such significant improvement in its application that by 1946, it was estimated that 95% of all dentures were fabricated using methyl methacrylate polymers.

Based on the method of activation, PMMA material can be classified as heat activated and chemically activated. Initially acrylic resins were polymerized by heat. In Germany in 1947, acrylic resins were developed using chemical accelerators for polymerization and were termed as self-cure or auto polymerization resins. Chemically activated resins are widely used to reduce the processing time and to provide rapid delivery. Chemical activators like tertiary amines were added in these resins to induce polymerization at room temperature. Even though they have greater dimensional accuracy, the presence of greater amount of residual monomer not only reduces its transverse strength but also leads to tissue irritation.

Bacterial adhesion on hard dental surfaces is followed by the accumulation of dental plaque. Surface roughness and the surface free energy play a key role during this process. Changes in these clinically important variables might have a significant influence on bacterial adhesion and retention. The oral cavity is a dynamic environment. With the continuous presence of micro flora, saliva and frequent intake of coloured food (chromatogens), the colour stability of a denture base material may become compromised. Most materials used for prosthetic treatment are subjected to sorption, a process of absorption and adsorption of liquids, depending on environmental conditions. Changes in optical properties of a polymeric material after long term use may be caused by both intrinsic and extrinsic factors. Intrinsic factors involve resin discolouration itself and matrix changes while extrinsic factors include thermal changes, stain accumulation, artificial dyes used in food, cleaning procedures, and handling by the patient.

Dental technicians use effective techniques for polishing denture base acrylic resin. Traditionally in a dental laboratory, acrylic resin is finished and polished by mechanical procedure using felt-cones and slurry of fine pumice and water followed by felt-cones with chalk powder and water. Mechanical polishing results in surface abrasion and progressively reduces notches until a smooth polished surface result. Now an alternate polishing method is introduced using Megaseal N, a light cure acrylic denture varnish, which significantly increases the glazing and polishing of the denture base resin, which in turn reduces the colonization of microorganisms. The objective of this study is to study the effect of this light cure polishing on the staining characteristics, microbial growth and surface roughness of self-cure denture base resins.

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PROSTHETIC AND IMPLANT DENTISTRY
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Kerala State Branch

## Methodology

Sixty samples of self-cure acrylic resins 20mm in length, 15mm in width and 2mm in thickness were made and 20 samples each were tested for surface roughness, microbial growth and colour stability.

### Fabrication of master dies:

Master die was prepared in Stainless Steel. It was machine cut into 20mm in length, 15mm in width and 2mm in thickness so as to fit the specimen chamber or cuvette of spectrophotometer used in the study.

### Fabrication of autopolymerising acrylic resin samples:

Conventional flasking and compression moulding procedure was used to fabricate the resin samples. A total of 60 Autopolymerising Acrylic Resin samples were prepared.

- Wax patterns of the master die were prepared by pouring molten wax in the silicone mould.
- Prepared wax patterns were then invested in a conventional dental flask using Type III dental stone.
- The wax patterns were invested in such a manner that the superior surface of the wax pattern was allowed to flush with the surface of dental stone.
- Once the dental stone had set, dewaxing was done and the mould space was flushed with warm water to remove the wax remnants.
- A single layer of separating media was applied on the mould space and was allowed to dry.
- Polymer and the monomer were mixed in an acrylic mixing jar according to the manufacturer's instructions and the resin mix was packed into the mould space in dough stage.
- Trial closure was done and the flash was trimmed using a sharp Bard Parker #11 Knife.
- A thin layer of separating media was applied again and the flasks were closed.
- The flasks were then placed on a hydraulic press, press tightened until a metal to metal contact was obtained and maintained under 2000 lbs of compression for 30 minutes. The resin samples were cured at room temperature.
- After polymerisation, the samples were retrieved and flash was trimmed.
- The samples were polished with sequential grits of Silicon Carbide paper (120 and 320) attached to a mandrel at a speed of 300 rpm for 1minute for each sand paper, followed by buff polishing with pumice slurry.

### Polishing with megaseal n light cure denture varnish.

Thirty of the 60 self-cure samples were polished with Megaseal N. Megaseal N is a light curing liquid for the coating of resin surfaces of a denture.

- The samples were coated with Megaseal N liquid with the help of a brush and were kept in Megalight UV light curing chamber and cured for 5 minutes as instructed by the manufacturer.

### Preparation of staining solutions

Solution of tea was prepared by adding 8g of powder in 400ml of boiling water. The solution was then allowed to cool for 10 min and then the solution was filtered through a piece of gauze.

### Measurement of colour

Colour measurements were done using UV-VIS-NIR Spectrophotometer (Shimadzu, UV-3600) with an integrating sphere (BIS-603) attachment, using poly-tetrafluoroethylene (PTFE) as a reference. Optical measurements were performed at a constant wavelength range of 700 to 2500 nm. The chromatic differences were reported using

Standard Commission International de L' Eclairage (CIE Lab) colour system. It quantifies colour in terms of three coordinate values L*, a* and b*. L* represents brightness or lightness (value), a* and b* represents hue and chroma on green- red axis and blue- yellow axis respectively.

The magnitude of colour difference perceived between two samples were calculated by formula $\Delta E^* = (\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2})^{1/2}$, where,

$\Delta L^* = L^*specimen - L^*standard$

$\Delta a^* = a^*specimen - a^*standard$

$\Delta b^* = b^*specimen - b^*standard.$

Samples were tested after exposing to tea solution for 1 week.

## Preparation of subculture of pseudomonas and e. Coli and preparation of culture media

The strains used in the experiment were Escherichia coli CTN 15422 and Pseudomonas aeruginosa CTN 15422. The inocula were prepared in Nutrient Broth (Peptic digest of animal tissue 5.0 g/L; Sodium chloride 5.0 g/L Beef extract 1.5 g/L; Yeast extract 1.5 g/L) and were standardized to $5x10^8$ cells/mL, by using a 0.5 McFarland scale. Nutrient broth with a final concentration of $5x10^8$ cells/mL of each microorganism was prepared, and then incubated at $37^0$C for 24 h. Negative control was obtained by the immersion of the materials in uncontaminated broth.

## Exposure of samples

After confirming the microbial growth by the turbidity of the growth medium, 10 each of normal polished and light cure polished samples were inserted into the broth. All materials were removed from the broth using a pair of sterile tweezers and immersed in sterile distilled water for 5 min. After that, the resins were washed sterile distilled water for 5 min in a vortex mixture.

## Measurement of microbial growth

The solutions were serially diluted and 0.1 mL of the last two dilutions were plated on nutrient agar plates and incubated at 37°C for 24 h. Thereafter, the numbers of colonies were counted with the aid of a colony counter.

## Measurement of surface roughness

Surface roughness of 10 each of normally polished and self-cure polished samples was measured using Confocal Raman Microscope with AFM (Atomic Force Microscope). The measured roughness of any given surface depends on both the spatial and vertical resolution of the instrument. This is because real surfaces exhibit roughness on many length scales and can be thought of as a superposition of these profiles. Even an atomically flat surface has quantifiable roughness when using a high-performance instrument with sub-angstrom resolution, such as the Atomic Force Microscope (AFM).

There are two important factors which affect the resolution of the surface roughness measurement:

1) AFM instrument noise limits the vertical resolution.

2) Tip radius limits the spatial resolution. Tip wear also affects the precision of the measurement.

Compared to other stylus probes used to measure roughness, the relatively small tip radius of an AFM cantilever enables it to image and measure roughness with nanoscale spatial resolution. Furthermore, the precision of the surface roughness measurement also relies on a non-changing tip profile. Quality in instrument design is essential here – specifically the AFM should be very responsive in its mechanical Z-axis to prevent the tip from blunting.

Surface roughness of the self-cure acrylic samples were measured before and after light cure polishing.

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PROSTHETIC AND IMPLANT DENTISTRY
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Kerala State Branch

## Statistical analysis

The data was properly coded and entered in Microsoft excel. Further analysis was done using the statistical software SPSS 16.0 version. The quantitative variables were expressed as Mean ± Standard deviation and qualitative variables were expressed as proportions and are presented in the Tables and graphs.

For comparing means between 2 groups independent sample t test was used and ANOVA was used for more than 2 groups. For before and after comparison paired t test was used. The level of statistical significance was fixed at p value $<0.05$.

## Standardisation used in the study

- All the samples were prepared from a stainless steel master die of size (20mm*15mm*2mm) so as to fit the specimen cuvette of spectrophotometer.
- A manufacturer recommended fixed ratio of 3:1 was used to mix polymer and monomer for preparing PMMA samples.
- All the samples were polished using sequential grits of sandpaper (120 and 320) attached to a mandrel at a speed of 300 rpm for 1 minute by the same personnel.
- Colour measurements were done using UV-VIS-NIR spectrophotometer at a constant wavelength range of 300-700 nm.
- Surface roughness was measured by the same Confocal Raman Microscope with AFM.
- Microbial growth on acrylic resin samples were assessed in the same testing conditions and by the same personnel.
- Entire samples were tested by the same operator for each test.

## Results

Table 1. Comparison of surface roughness of Self Cure samples before and after light cure polishing

| | Mean | Std. Deviation | Std. Error Mean | P value |
|---|---|---|---|---|
| Before | 62.3830 | 6.56635 | 2.07646 | .001* |
| After | 12.6260 | 5.51041 | 1.74254 | |

(*The differences in mean were statistically significant, paired t test)

The mean surface roughness of heat cure and self-cure samples significantly reduced after light cure polishing with Megaseal N light cure varnish.

Table 2. Comparison of Mean Colour Change values of Self cure samples with different polishing after immersion in tea solution for 7 days

| | Mean | Std. Deviation | Std. Error Mean | P value |
|---|---|---|---|---|
| Normal polish | 3.9059 | 1.51400 | .47877 | .001* |
| Light cure polish | 1.9080 | .52713 | .16669 | |

(*The differences in mean were statistically significant, independent t test)

The mean colour change values were significantly lower for the light cure polished samples of both heat cured and self-cured resins when compared to the normally polished ones after immersion in tea solution for 7 days.

Table 3. Comparison of Mean Microbial growth in Self cure samples with different polishing.

| | Mean | Std. Deviation | Std. Error Mean | P value |
|---|---|---|---|---|
| Normal polish | 1433.50 | 88.935 | 28.124 | .001* |
| Light cure polish | 855.50 | 79.714 | 25.208 | |

(*The differences in mean were statistically significant, independent t test)

The mean microbial growth was found to be significantly lesser in the light cure polished self-cure samples when compared with the normally polished ones.

## Discussion

Polished surface of acrylic resin denture material is important, as it affects the oral health of tissues that are in direct contact. Rough surfaces of oral appliances promote colonization of bacteria and plaque accumulation.[1] A variety of soft tissue changes are associated with dentures. These changes manifest themselves as a series of related symptom complexes which includes denture stomatitis, inflammatory papillary hyperplasia and chronic candidiasis. The ability of microorganisms to adhere to surface exposed to the flushing action of fluids is a prerequisite for successful colonization.

The ultimate success of any prosthesis is seen when both aesthetic and functional excellence is achieved.[2] An ideal denture base polymer should have good aesthetics with a smooth and glossy surface and should match with the natural appearance of soft tissues. Prolonged use of dentures especially in Indian conditions where individuals feed on food stuffs that have staining capacity leads to discolouration of denture base material. For best aesthetic results, the material should not only maintain colour and translucency during processing, but also remain stain free in clinical use[3].

Of the various polishing methods available today, literature suggests mechanical polishing to be the most commonly used and the most effective polishing method. Traditionally in a dental laboratory, acrylic resin is finished and polished by mechanical procedure using felt-cones and slurry of fine pumice and water followed by felt-cones with chalk powder and water. Mechanical polishing results in surface abrasion and progressively reduces notches until smooth polished surface results. Research has been constantly going on to reduce the surface roughness of acrylic denture base. An alternate light cure polishing method with Megaseal N was introduced recently which claims to significantly improve the surface finish and glazing of acrylic denture base resins. Megaseal N is a light curing liquid for the coating of resin parts of acrylic dentures. It contains mobile liquid of methyl methacrylate and various dimethacrylates, photochemical initiators and stabilizers. It adds nanoparticles to the surface which is responsible for the high glazing produced. The present study was done to evaluate the effect of this light cure polishing on the staining characteristics, microbial growth and surface roughness of denture base resins.

The null hypothesis stated in the study was that there is no significant difference in the staining characteristics, microbial growth and surface roughness for the samples polished with different techniques. After the statistical analysis of the results obtained, the null hypothesis was rejected and it was observed that there were significant differences in the staining characteristics, microbial growth and surface roughness among the samples.

In this study, the mean surface roughness of self-cure samples were 62.4 nm, which significantly reduced to 12.6 nm after light cure polishing with Megaseal N light cure varnish. This might be due to the nanoparticles present in the varnish, which seals the micro holes present in the acrylic resin producing a highly smooth and glazed surface.

There is evidence that consumption of certain beverages, such as tea, coffee, wine and cola, and smoking causes staining of denture base polymers[4]. Liquid intake especially causes surface staining of which tea and coffee are the highest consumed beverages. In this study, it was observed, that the mean colour change values were significantly lower for the light cure polished samples of self-cured resins when compared to the normally polished ones after immersion in tea solution for 7 days. Tea leaves contain a considerable amount of flavonoid, which gives

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tea its functional properties and flavour, which may be responsible for the colour changes[5]. It was reported that the discolouration in tea was mainly due to surface adsorption of polar colorants at the surface. Acrylic resins exhibit the property of water sorption that is directly related to the polar properties of resin molecules. The physical process of water diffusion occurs through intermolecular space and the amount of residual monomer in the polymerised mass. Acrylic resins are made up of several inter polymeric chains which have gaps between them. The absorbed water enters these gaps and remains there. The size and number of these inter polymeric gaps determine the amount of water absorption[6]. Therefore, the colour change observed here is also due to the diffusion of water in the inter polymeric gaps along with the diffusion of water soluble secondary metabolites present in the tea. The light cure varnish provides a seal on the acrylic resin, which reduces the surface adsorption of polar colorants at the surface as well as water sorption and water diffusion occurring through the intermolecular space, thus causing lesser staining than the normally polished acrylic resins.

The rate of bacterial colonization of intraoral hard surfaces is positively correlated with surface roughness. Surface roughness exhibits more influence on plaque accumulation and plaque composition compared to surface free energy.[7] There are controversies as to the bacterial response to micro-scale surface features. A general perception regards that rough surfaces colonize

*Fig 1:* Stainless steel die and Silicone mould of the die


*Fig. 2:* Megaseal N and Megalight Light Cure Chamber


*Fig. 3:* Samples

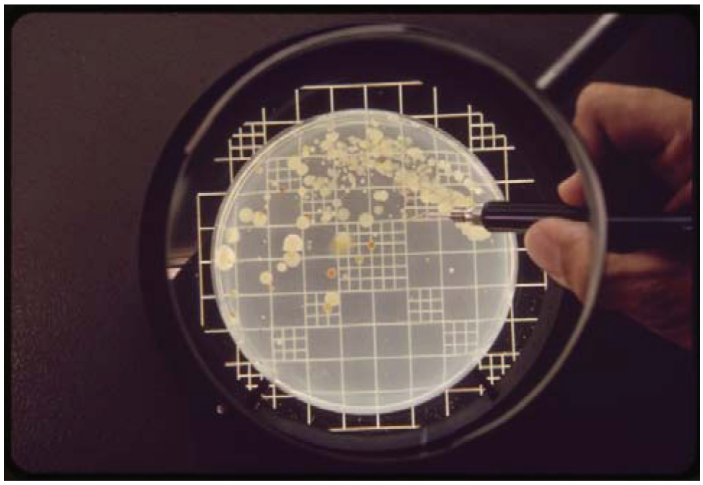

*Fig. 4:* Microbial Counting Chamber

more rapidly than smooth surfaces due to more surface area available for attachment and that the greatest initial accumulation occurs in the bottoms of roughness elements because of protection from shear.

The threshold surface roughness for bacterial attachment was reported to be 200 nm (Quirynen et al., 1990).[8] Surface roughness values more than that may promote plaque formation. Bollen et al. (1997) and Radford et al. (1999)[9] reported that high concentration of bacterial colonization occurs if the surface roughness value is greater than 2000 nm. The authors considered that characteristic surface roughness of smooth acrylic resin surface may vary between 30 nm and 750 nm depending upon the technique used for finishing and polishing (Bollen et al., 1997; Radford et al., 1999).[10] The results of this study showed that the mean surface roughness values of all normally polished samples were in this range. The mean surface roughness of self-cure samples in this study were 62.4 nm, which significantly reduced to 12.6 nm after light cure polishing with Megaseal N light cure varnish, which is even lower than the smooth acrylic resin characteristics considered by the authors.

It was also found out from the study that the mean microbial growth was found to be significantly lesser in the light cure polished self-cure samples when compared with the normally polished ones. This goes in accordance to the surface roughness values and supports the views of authors who suggested the role of surface roughness on microbial adherence.

The light cure polishing method significantly reduces the number of microorganisms adhering to the acrylic resin and can provide relief to a number of long term denture wearing patients suffering from denture stomatitis secondary to microbial infection.

### Limitations of the study

1. Only tea was used as staining agent in this study whereas in a clinical situation, there is a multifactorial influence on staining of the dentures.

2. Micro porosities present in denture samples could have an effect on surface roughness, microbial growth and absorption of the stains, though all samples were finely polished and visually checked for porosity prior to testing.

3. Abrasion resistance of the light cure polished surface was not evaluated.

### Further Scope of the study

Further studies need to be conducted under in vivo conditions to investigate the effect of this novel light cure polishing technique on the staining characteristics, microbial growth and surface roughness of denture base resins. The effect of the light cure varnish should be studied on the heat cure denture base resins also. Abrasion resistance of the polished surface needs to be assessed.

## Conclusion

Within the limitations of this study the following conclusions are drawn after the evaluation of the effect of using light cure polishing on the surface roughness, microbial growth and staining characteristics of self-cure denture base acrylic resins.

1. The surface roughness of self-cure acrylic resins significantly reduced after light cure polishing with Megaseal N light cure varnish.

2. The colour change was significantly lower for self-cure acrylic resins when compared to the normally polished acrylic resins after immersion in tea solution for 7 days.

3. The microbial growth was found to be significantly lesser in the light cure polished self-cure acrylic resins when compared with the normally polished acrylic resins.

Although there are a vast number of options available in materials for construction of denture

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bases, acrylic resins remain the mainstay for the management of partial and complete edentulous state till date, answering the requisites of economy and ease of fabrication. It is beyond doubt, that proper post insertion denture care and home maintenance is important for better oral health and long lasting prosthesis. Dentistry along with the help of ever advancing technology has always been in search of novel methods for making the task of patients easy for better oral health and long lasting prosthesis. A smooth and glossy surface, as well as a reduction in staining and microbial growth on dentures may be of great importance to patients and clinicians.

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# COMPARATIVE EVALUATION OF MICROLEAKAGE OF ZIRCONIA CROWN WITH THAT OF GLASS CERAMIC CROWN LUTED WITH RESIN CEMENT- AN INVITRO STUDY.

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## *Abstract:*

*An alternative to metal ceramic restoration is the All Ceramic restoration. The use of All Ceramic restorations have substantially increased over the last 20 years for restoring anterior and posterior teeth. In achieving aesthetically and functionally ideal restorations, three main factors- aesthetic value, resistance to fracture and marginal adaptation are important. However, the longevity of fixed prosthodontics depends upon the quality of the marginal adaptation in the abutment teeth*[1,2].

*Inadequate marginal adaptation leads to plaque accumulation which increases the risk for carious lesionswhich in turn can cause microleakage,endodontic inflammation and finally results inperiodontal diseases.*

*Here, the purpose of the present study is to evaluate the micro leakage of different typesof metal-free ceramic crowns.*

Key words:
**Microleakage, Zirconia, glass ceramic**

## Introduction

Apart from esthetics, yet another factor that determines the long term success of a restoration is its marginal adaptation to the tooth structure. Microleakage is defined as diffusion of material such as bacteria, oral fluids, molecules and/or ions into a fluid filled gap or into a structural defect that is present or one that occurs between restorative material and tooth structure. Even though, all ceramic restorations satisfies the clinical demand of a patient, the marginal fit of these systems can be a critical factor for long term success[1,2].

When pressable lithium di-silicate is used as a monolithic crown,similar to that of cast crown, it may require a reduction of 1- 1.5 mm only. LAVA is the most popular zirconia based restoration used in restorations where CAD CAM is used to mill the block[3].

Marginal fit of CAD CAM restoration is dependent on multiple factors like finish line, die spacing, different cements and cementation techniques. Efficacy of luting cements and their resistance to varying stresses are also important factors that influence extent of leakage. Resin luting cements are recommended for the cementation of all ceramic systems. However the multisystem application technique has been reported to be complex and sensitive, which can influence effectiveness of bonding[4,5].

This study mainly compares the microleakage of a zirconia crown (LAVA) with that of a glass ceramic (IPS E-max).

## Aims and objectives

1. Comparison of microleakage of a popular zirconia crown (LAVA), with a glass ceramic crown (IPS e-max).

## Materials and methods

In this study an effort was made to compare the microleakage of LAVA with that of IPS E-max,luted with resin cement (RELY X U 200, GERMANY).

In this study, 10 all ceramic crowns were made; five LAVA zirconia crowns and five IPS e-max crowns.

Group I - IPS e-max crowns.

GroupII - LAVA zirconia crowns.

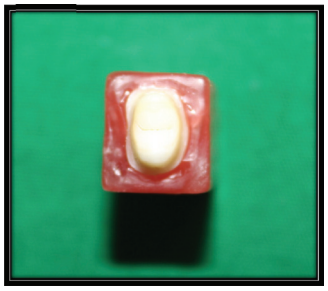


*Fig 1:* Prepared Natural first Premolar (Occulusal view)

*Fig 2:* Prepared Natural first Premolar (Lateral view)

*Fig 3:* Cobalt-Chorimium Tooth Model (Occlusal view)

*Fig 4:* Cobalt-Chorimium Tooth Model (Lateral view)

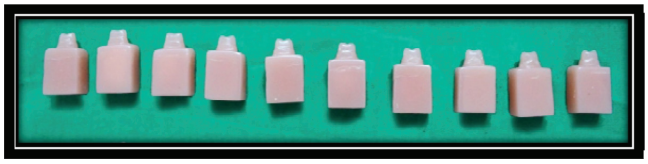


*Fig 5:* Heat Cure Acrylic Tooth Models (10 No's)

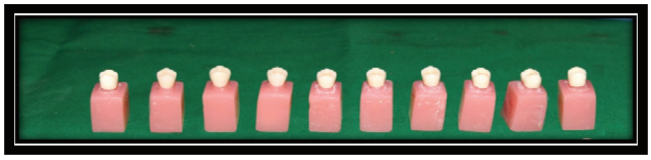


*Fig 6:* All Ceramic Crowns (10 No's)

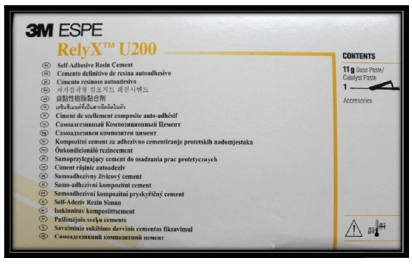



*Fig 7:* Self Adhesive Resin Luting Cement

*Fig 8:* Base Paste and Catalyst Paste

*Fig 9:* Composite Light Cure

*Fig 10:* Curing of Luted all Ceramic Crown

*Fig 11:* Distilled Water

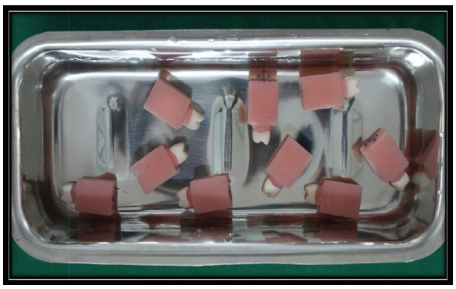


*Fig 12:* Samples Immersed in Distilled Water


*Fig 13:* Methylene Blue Solution 0.1%

*Fig 14:* Samples Immersed In 0.1% Methylene Blue Solution

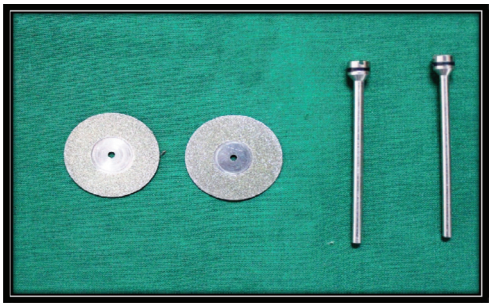


*Fig 15:* Diamond Wheel Disrs

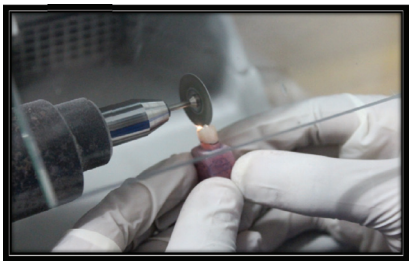


*Fig 16*: Sectioning of Samples

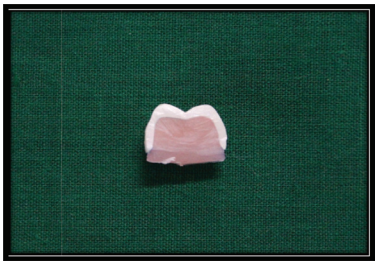


*Fig 17:* Prepared Sample

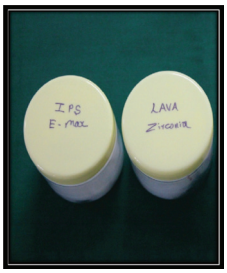



*Fig 18:* Sample Container

*Fig 19:* Stereomicroscope


*Fig 20:* Air Rotor

*Fig 21:* Casting Machine

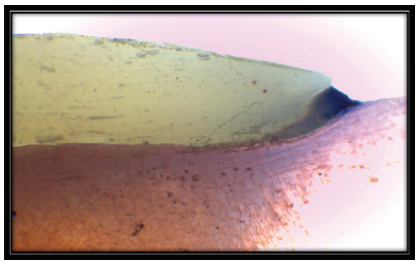


*Fig 22:* Stereomicroscope image showing Cervical Microleakage of Group Crown I Ips E-Max Pressable Glass Ceramic Crown

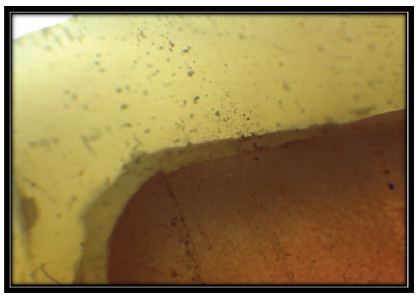


*Fig 23:* Stereomicroscope image Showing Occlusal Microleakage of Group Crown I Ips E-Max Pressable Glass Ceramic Crown

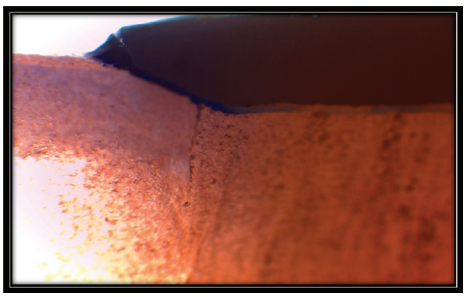
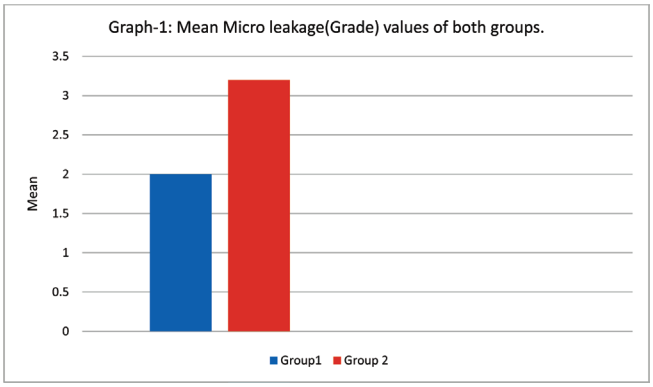


*Fig 24:* Stereomicroscope image Showing Cervical Microleakage of Group II Lava Zirconia Crown

*Fig 25:* Stereomicroscope Image Showing Occlusal Microleakage of Group II Lava Zirconia Crown




## Sample selection

Fresh human maxillary first premolars extracted for orthodontic purpose were selected. The mesiodistal crown size of teeth were 8mm. They were free from caries and restorations.

## Sample Preparation

The selected tooth was prepared for all ceramic crown. The preparation depth of 1 mm was maintained axially and 2 mm occlusally. Supragingival shoulder finish line margin was prepared. A convergence angle of 6 degree was ensured. Using addition silicone putty (AQUASIL), impression was made and wax tooth model was fabricated. The wax tooth model was invested and cast to fabricate cobalt – chromium tooth model. The cobalt – chromium tooth model was duplicated using addition silicone to fabricate 10 heat cure acrylic models.

A dual cure resin luting agent (Rely X U200 Self-Adhesive resin, 3M, Germany) was used to cement the crowns to each model. Equal length of the luting resin was dispensed on the mixing pad, manipulation was done according to the manufacturer instructions and the mixed cement was painted on the internal surfaces of the crowns[6,7,8]. Crowns were cemented on the prepared tooth model with finger pressure for 10 minutes. Buccal, lingual, mesial and distal tooth-crown margins were photo polymerized using dental light cure unit for 40 seconds with a light intensity of 400 MW(megawatts)/ cm2. The excess cement from the margins were removed.

After 24 hours of storage in distilled water at 37°C, all teeth were subjected to 500 thermal cycles between 5° and 55°C using a dwell time of 30 seconds. All the samples were placed in a flat container in upside down position and 0.1% methylene blue dye was poured till the finish line of all samples were covered and they were kept for 24 hours[6,7,8]. Sagittal section of all ten samples were made using a high speed Diamond wheel disc, having 0.01 mm thickness mounted on a high speed tooth cutting lathe (RAY FOSTER, USA).

## Measurement

The presence of microleakage was confirmed by the visualization of blue colour at the tooth-cement interface. Microleakage patterns were fully registered on the buccal and lingual margins as well as mesial and distal margins with the stereomicroscope 4X magnification [9,10].

Microleakage was scored using Tjan'setal. method:

0 - no microleakage

1- microleakage to one-third of axial wall

2 - microleakage to two thirds of axial wall

3 - microleakage along the full length of axial wall

4 - microleakage over the occlusal surface.

## Statistical analysis

The result data were statistically analysed. Analysis was carried out with one way analysis of variance (ANOVA) followed by Post Hoc and Dunnet 't' test to find statistical significance between and within the groups. The data was analyzed by Statistical Package for Social Sciences (SPSS 16.0) version. P value less than 0.05 considered statically significant at 95% confidence interval.

Table I: microleakage value in group I (IPS e-max)

| Sl. No | Microleakage(Grade) |
|---|---|
| | |
| 1 | 2 |
| 2 | 2 |
| 3 | 2 |
| 4 | 2 |
| 5 | 2 |

Table II: Microleakage value in group II (LAVA)

| S. No | Micro leakage(Grade) |
|---|---|
| 1 | 3 |
| 2 | 3 |
| 3 | 4 |
| 4 | 3 |
| 5 | 4 |

Table-III: Comparison of Micro leakage values of Group-I with Group II

| Groups | Micro leakage (Grade) (MEAN±SD) | P value |
|---|---|---|
| Group-I | 2.0±0.31 | |
| Group-II | 3.20±0.32* | 0.01 |

(*p<0.05 significant compared Group-I with other groups)

### Stereomicroscopic analysis to determine microleakage

➢ Figure 22 represents the stereomicroscopic image of group I under the magnification of 4x showed least penetration of die solution than group II in cervical region.

➢ Figure23 represents the stereomicroscopic image of group I under the magnification of 4x showed practically no penetration of die solution than group II in occlusal region.

➢ Figure24 represents the stereomicroscopic image of group II under the magnification of 4xshowed more penetration than group I in cervical region.

➢ Figure25 represents the stereomicroscopic image of group II under the magnification of 4x showed more penetration of die solution through axial wall, but not to the occlusal.

## Discussion

The purpose of this study was to investigate the microleakage of zirconia crown (LAVA) with that of pressable glass ceramics(IPS e-max).In this study microleakage was measured as scores, in which IPS e-max group materials showed the lowest mean value of (2.00±0.31)whereas LAVA group materials showed the mean value of(3.20±0.32). There was significant relation between groups and this may be due to the effect of the dual cure resin cement.

When these results were analyzed, the lowest microleakage observed for IPS e-max system (group I) may be due to the pressable ceramic that is subjected to a less firing cycles than that for LAVA (group II) which is double layered computer-aided design/computer-aided manufacturing material system.The above findings showed that value obtained for microleakage is least for IPS e-max.

Microleakage can be related to margin misfit, although no strong correlation between margin fit and microleakage scores in complete crowns have been demonstrated. Marginal opening did not directly correlate with marginal microleakage. Also, there is a complex interaction between variables related to dental restoration, luting agent, and tooth structure, which probably influenced microleakage.

The results in the stereomicroscopic section showed the penetration of stains between the restoration and the tooth surface. It could be due to the luting agents used (self-adhesive). Self-adhesive luting agents have been shown to be less soluble, biocompatible, and bacteriostatic.

To explain this, Fick's first law of diffusion states that "the rate of material dissolution is independent of the exposed area (amount of luting agent)". Correlation values between misfit and microleakage were low because the gap formation at the tooth cement interface partially accounts for the microleakage values observed.

## Summary and conclusion

In the present study, microleakage of IPS e-max and LAVA Zirconia were evaluated. Maxillary first premolar was prepared to receive all ceramic restoration. It was duplicated using addition silicon impression material (Aquasil - Dentsply, Germany) for fabricating Cobalt – Chromium metal die, which is used as a master die. Using the master die, 10 heat cure acrylic samples (DPI – India) were fabricated. Ten all ceramic crowns (5 IPS e-max, 5 LAVA Zirconia) were fabricated for the heat cure acrylic tooth models.

Self-adhesive resin cement (RelyU X U200 – 3M, Germany) was used for luting the All ceramic crowns. After 24hrs luted crowns were immersed in distilled water for 24hrs, and then the samples were transferred to methylene blue solution (0.1%) for 24hrs. Samples were retrieved from the solution using sterile tweezers and kept for drying for 48hrs. Dried samples were sagittal cross sectioned using diamond wheel disc

Stereomicroscopic analysis was done at SreeChitraTirunal Institute of Medical Science and Technology, Trivandrum for evaluating microleakage observed in both groups.

The following conclusions can be drawn from this study:

1. The Stereomicroscopic analysis of samples showed microleakage in both groups.

2. The Stereomicroscopic results showed the least microleakege in IPS e-max (Group I).

3. The Stereomicroscopic results showed more microleakage in LAVA Zirconia (Group II).

From the above findings, it can be concluded that IPS e-max showed least microleakage than LAVA ZIRCONIA.The long term stability and function of the all ceramic crowns is our definitive goal. Marginal adaptation and microleakage plays an important role in survival of the restoration and esthetics.

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# STABILIZATION OF AN EXISTING LONG- SPAN FIXED DENTAL PROSTHESIS WITH SCREW-RETAINED NON-RIGID CONNECTORS SECURED TO DENTAL IMPLANTS – A CASE REPORT

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## *Abstract:*

*Periodontally compromised teeth are often managed with extraction and replacement with full- mouth implant prostheses. Similarly, failing long-span fixed dental prostheses (FDPs) may also be extracted and replaced with implants. However, it may be advisable to retain some of the sound natural teeth and maintain an existing prostheses as long as possible. As an alternative, such treatments can be supplemented with dental implants to achieve better stability and support. A case of long- span FDP was stabilized and supported with palatally- placed dental implants and screw- retained non-rigid connectors. Such modifications can provide patients with a more cost effective treatment alternative without compromising any future rehabilitative procedures.*

Key words:
**Screw retained, non rigid connectors, implants**

## Introduction

Dental implants have been extensively used in the last few decades for rehabilitation of partially and completely edentulous arches. Extraction of periodontally weak teeth followed by replacement with implant supported prostheses has become common a routine practice. This practice is based on the assumption that implants tend to survive better than their natural counterparts. Thus, even in questionable clinical situations, teeth are extracted and replaced by implant prostheses[1].

Recent reports indicate that implants may follow the same survival curve as natural teeth. Inter-proximal bone loss around natural teeth is about 0.1mm per year[2,3,4] while the corresponding annual bone loss around dental implants, after the first year of placement, has been reported to be about 0.1mm-0.2mm[5]. Thus, the risk of bone loss seems roughly the same for implants as well as natural teeth over a period of time. This should be taken into consideration while planning prostheses for partially edentulous arches[1]. There are situations where one or several implants might be used in combination with a natural tooth or teeth, to support a so called "mixed bridge"[6]. In certain special situations, one or more strategically placed implants can be used to provide support for an existing FDP with periodontally compromised abutment health. This would save considerable treatment time and may afford an improved prognosis.

In this case report, a long- span FDP was supported and stabilized with the help of implants placed in the pontic region, without removing the FDP. The prognosis of the FDP improved with the help of implants.

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## Case report

A sixty year old female patient reported with the complaint of pain in relation to #25. On examination, she had been previously treated with full arch maxillary FDP with 12 units supported by 5 abutment teeth [Figure 1]. Abutment teeth in the maxillary arch were #18, #17, #15,#23 and #25, also an FDP replacing #44,#45, #46 and #47 was being used in the mandibular arch. On radiographic examination, #25 showed a vertical root/tooth fracture. Clinically, the unit of the FDP in relation to #25, 26 was mobile, while no mobility was seen in relation to any of the other abutments. It was planned to remove the fractured #25 after sectioning the FDP distal to #23. The patient was satisfied with the esthetics of the existing restoration and was also concerned about the cost of the treatment. The selected treatment plan, in consultation with the patient, involved sectioning the FDP distal to #23 and extracting the fractured #25. It was followed by the delayed placement of implants to replace #24,25 and 26. It was also planned to provide additional support for the remaining long span FDP by placing two implants palatal to #13, 22 without removing the

*Fig 1:* Pre-operative panoramic radiograph.

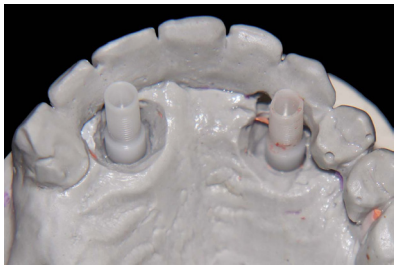

*Fig 2:* Castable plastic abutment secured to the implant analog.

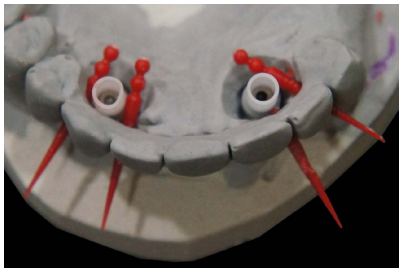

*Fig 3:* Castable plastic dowels positioned adjacent to plastic abutments.

*Fig 4:* Pattern before and after casting.

*Fig 5:* Different parts of the connector before and after joining.

*Fig 6:* Labial extension of the connector supporting the FDP.

*Fig 7:* Labial extension masked with gingival coloured composite resin.

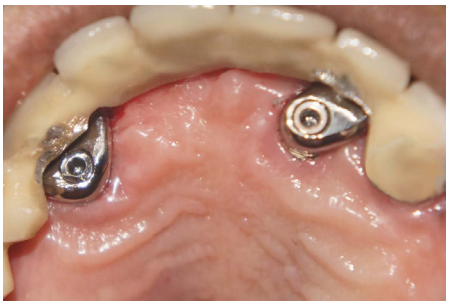

*Fig 8:* Palatal view of the connector in place.

*Fig 9:* Post-operative radiograph.

prosthesis. These implants were to be connected to the FDP with the help of screw- retained non-rigid connectors. The merits and demerits of the treatment plan were explained to the patient and an informed consent was obtained.

Sectioning of the FDP was done with a high speed air-driven Tungsten-Carbide bur under water cooling. Extraction of #25 was performed under local anesthesia followed by grafting with Plasma Rich Fibrin. Implants, 3.3x13mm (Touareg-S, Adin, Israel), were placed under local anesthesia using a flapless surgical technique, palatal to the pontics replacing 13 and 22 without removing the existing FDP. Healing abutments were placed immediately after placement of implants and antibiotics were prescribed for five days.

After one week, the healing abutments were removed and an impression was made with a putty wash addition silicone impression using direct technique. Before making the impression, gingival embrasures mesial and distal to 13 and 22 were opened by trimming the ceramic using high speed air turbine and diamond abrasives. The cast was made in type IV gypsum.

Two-piece castable, screw-retained plastic abutments (Adin, Israel) were secured onto the implant analogs [Fig. 2]. Two castable plastic dowels were placed on either side of the plastic abutment projecting into the labial aspect through the embrasures prepared mesial and distal to 13 and 22 [Fig. 3]. They were attached in this position to the plastic abutments using pattern resin (Pattern Resin, GC, Japan)[Fig. 4].

The entire pattern assembly was removed, invested, and cast with Chrome- Cobalt dental casting alloy (Wironium,Bego, Germany) under standard protocol. The finished casting [Fig. 4], was sectioned above the screw locking area [Fig.5] and positioned correctly in the patient's mouth. The extensions passed through the gingival embrasures to fit underneath the pontic. Initial contacts of the pontic with the extension was not sufficient, which was corrected using orthodontic pliers that provided a tight fit around the pontic. After securing the assembly in the mouth, the screw was tightened. The excess labial extensions of the connector were trimmed with air turbine under water cooling [Fig. 6].

For optimal esthetic results, the embrasure area adjacent to the labial extensions were isolated with cotton rolls and gingival barrier,etched with 10% hydrofluoric acid, (Ceramic etch, Ivoclar Vivadent, Liechtenstein), primed with silane coupling agent (Monobond-S, Ivoclar Vivadent, Liechtenstein) and the metallic extension and adjacent area was masked with gingival coloured composite resin (Crealine, Bredent, Germany). Finishing and polishing of the final restoration was done intraorally with a composite polishing kit [Figs 7, 8].

The patient was instructed to follow oral hygiene instructions. Follow-up was scheduled at one week and one month. This was followed by recall visits at six month intervals. One- year post operative radiograph showed excellent stability of the FDP [Fig. 9].

## Discussion

This treatment modality demonstrates an alternative method to stabilize existing long span FDPs under the pontic area without removing the fixed prosthesis and achieving adequate stability. In this case, natural teeth provide primary retention for the FDP and the forces acting in the apical and oblique direction will be resisted by both the teeth and the implants. Even though it is connected to a long span FDP, the implants are in a favorable position because of the short leverage and the non-rigid connection between the implant and the prosthesis. At the same time, they are capable of providing vertical support to resist masticatory loads. Thus, both implants and natural teeth work in a mutually protected manner. Combining natural teeth and implants using a non-rigid connection has been reported earlier[7]. This treatment method

is an example of cost effective therapy where the natural teeth are saved and additional support is provided by implants. Moreover, the treatment does not preclude or impair future alternative therapy with a complete implant supported FDP.

## Summary

Extraction of teeth with questionable prognosis and their replacement with implant supported FDP is common. Before executing such a treatment plan, the possibility of retaining the remaining natural teeth should be fully explored. The placement of implants to provide additional support for long span FDPs, increases their longevity and provides a cost- effective treatment alternative for the patient.

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# LASERS IN IMPLANT DENTISTRY- A REVIEW

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## *Abstract:*

*Implantology has become a treatment modality with high acceptance and success rate in the past few decades. Lasers were introduced into the field of clinical dentistry in 1989 with the hope of overcoming some of the drawbacks posed by the conventional dental procedures. The two expanding aspects may be combined to provide the patients with a better clinical experience. Since its first dental application, the use of laser has increased rapidly in the last couple of decades. Their use in implant dentistry has seen an upsurge in the past years. At present, wide varieties of procedures are carried out using lasers. Laser can be classified based on the wavelengths and tissue on which it acts. All available dental laser wavelengths cannot be used in every dental implant situation. The dentist must fully understand the characteristics, merits and demerits and applicability of the available lasers. The aim of this article is to review the applications of lasers in implant dentistry.*

Key words:
Laser, Dental implant, peri-implantitis, Photosterilization

## Introduction

LASER (Light Amplification by Stimulated Emission of Radiation) is a device that transforms light of various frequencies into an intense, small, and nearly non-divergent beam of monochromatic radiation, within the visible range. Lasers have been used for performing a variety of procedures, both in the medical and dental fields since its introduction by Maiman in 1960[1-3]. Drs.William and Terry Myers used a modified opthlamicNd:YAG laser for dental use in 1989[4]. Lasers can be classified as Soft tissue lasers and Hard tissue lasers based on the tissue interaction. The soft tissue lasers include CO2, Nd:YAG (Neodynium:YttriumAluminum Garnet), diode, argon, and holmium wavelengths whereas Er:YAG (Erbium:Yttrium Aluminum Garnet) and Er: YSSG (Erbium:Yttriumscandium-gallium-garnet) are hard tissue lasers. Their use can be either an adjunct to other procedures or the main form of treatment itself. Lasers have become the treatment of choice in various clinical situations as they could be used for both hard and soft tissue without anaesthesia. Both implant dentistry and lasers in dentistry has evolved so much since its introduction and combining the two sought after treatment modalities can be beneficial for the dentist and the patient as well. The advantages of using lasers in implant dentistry include increased haemostasis,

improved visibility of surgical site, minimal damage to the surrounding tissue, reduced swelling, decreased infection due to photo sterilisation effect and in turn less pain postoperatively. Use of lasers depends on the situation to which it is applied and the particular wavelength suitable for that. The dentist should have thorough knowledge regarding the specific wavelength of laser that can be used in a particular procedure and also be aware of the laser-tissue interactions that may result. Here we discuss various applications of lasers in implant dentistry and the different wavelengths of lasers that may prove helpful.

## Applications of laser

### Implant placement

Minimally invasive Implant Placement, using the tissue punch method, has become a popular way to place implants when proper bone height and width are available. Hard tissue lasers like Er:YAG can be used to obtain the initial breach for implant placement rather than using micromotor. A laser is used to remove the soft tissue and the cortical plate of bone in a circular pattern to approximately 2-3 mm and rest of the osteotomy site can be prepared using a hand piece drill. Unlike conventional drills, the laser tip has less tendency to slip. This leads to quick healing time, fast integration, minimal patient discomfort, and superior bone-to-implant contact. This also eliminates the need for trauma during flap elevation and suture placement[5]. The procedure can be accomplished using a surgical guide prepared for laser placement of the implant. The advantages include a reduction in post-operative inflammation due to cleaner and sterile surgical field & better patient comfort. A study on rats by Kessler, Ramanos, and Koren[6] showed that there was significantly more bone contact and faster bone contact when comparing laser implant placement to implants placed with a conventional drill. However, the entire osteotomy site cannot be prepared using lasers.

### Uncovering implants in second stage

All wavelengths of laser can be used to Uncover Implants in stage II implant surgery with precision and ease for the practitioner & significant patient comfort by vaporizing the tissue overlying the implant till the surgical cap is reached[7]. The $CO_2$ lasers and Er:YAG lasers are used with success while Nd:YAG laser is contraindicated as this causes temperature build up around the implants and also melting of the implant surface. This procedure is atraumatic and helps to prevent crestal bone remodelling. Care must be taken to move the laser tip in a normal manner and not to hold in one location too long to avoid any heat build up to the implant fixture. Also care is taken to maintain adequate amount of attached gingiva around the implants. Laser treated tissue margins do not recede after healing. The laser is tipped at a 450 angle toward the implant. The prime advantages of laser used in this procedure are haemostasis, facilitate easier visual access to the cover screw, production of a protective coagulums - an aid to healing and patient comfort during and after treatment. It also allows impression procedures to be carried out in the same appointment.

### Management of peri-implantitis

Peri-implantitis is a rapidly progressive failure of osseo-integration and there is production of bacterial toxins leading to inflammatory changes and bone loss[8,9]. In the case of peri-implantitis, the implant surface is contaminated with soft tissue cells, bacteria and other bacterial by-products[10]. It is difficult to remove entire bacterial plaque and endotoxins by mechanical instrumentation between the implant threads. Debridement and Degranulation of failing and ailing implants can be done using a laser wavelength that is non-injurious to bone. $CO_2$ lasers, diode lasers and Er:YAG were shown to be able to effectively remove plaque and calculus on implant abutments without injuring their surfaces[11]. Nd:YAG lasers even with their excellent sterilisation qualities

are contraindicated for use in the treatment of peri-implantitis as they cause an increase in the surface temperature and also changes of the implant surface. Kreisler et al[12] performed a study on various wavelengths including Nd:YAG, holmium:yttrium- aluminum-garnet (Ho:YAG), Er:YAG, $CO_2$, and gallium-aluminum-arsenide for implant surface decontamination. They concluded that Nd:YAG and Ho:YAG lasers are not suitable for decontamination of dental implant surfaces at any power output. With Er:YAG and $CO_2$, the power output must be limited so as to avoid surface damage. The gallium-aluminum- arsenide laser did not cause any surface alterations.

Photosterilization of compromised dental implant after debridement is done and the bone defect is grafted subsequently. Since laser surgery is bactericidal, infected implant sites can be relieved of pathogenic bacterial load and apical granulomas. Using scanning electron microscopy, Romanos et al.[13] investigated the attachment of osteoblasts to the titanium surface after $CO_2$ and Er:YAG laser irradiation of the implant surface on four different types of autoclaved titanium disks with machined, HA-coated, sandblasted, or TPS surfaces. All the implant surfaces examined were well colonized with osteoblasts. The study data showed that laser irradiation of titanium surfaces did not negatively influence osteoblast attachment and cell proliferation. Lasers can also be used to debride extraction sites for immediate placement of implants.

## Implant explantation

Increased use of dental implants has been followed with an increased rate of failing implants and the need for treatment[14]. Failing implants sometimes requires surgical removal using techniques like block resection, buccal bone ostectomy and trephine osteotomy[15,16]. "Failed implants" can be removed by using Er,Cr:YSGG laser which provides a minimally invasive technique instead of conventional methods of removal. The Er,Cr:YSGG laser has been demonstrated to effectively cut bone without burning, melting or altering the calcium: phosphorus ratio of the irradiated bone[17]. The mechanism of cutting is through the laser energy being absorbed by the air-water spray which produces microexplosions on the target tissue. This hydrokinetic effect produces clean cuts without thermal damage. The decontamination effect of lasers may occur in the surrounding tissues during explantation and may promote uncomplicated tissue healing. In case selection for laser assisted explantation, relative contraindications to surgical tooth extraction should be applied, especially patients that have a propensity for poor wound healing, are immunocompromised or those that have had previous jaw radiotherapy.

## Gingival retraction

The aim of gingival retraction is to atraumatically allow access for the impression material beyond the abutment margins and to create space so that the impression material is sufficiently thick so as to be tear-resistant[18]. The mechanical retraction of gingival tissues by using cords, which were developed for application around natural teeth, can lead to ulceration of the junctional epithelium when used around implant restorations. The forces used in cord placement may exceed peri-implant tissues' capacity resulting in laceration of the sulcular epithelium and ulceration. There is risk of permanent recession and loss of attachment developing. The use of mechanical retraction with cords may be contraindicated around implants, except in situations in which patients' sulcus depths are shallow with a healthy mucosa and a thick gingival biotype is present. The advantages of lasers in gingival retraction are excellent hemostasis (carbon dioxide laser is safe for implants as it is reflected by metal), reduced tissue shrinkage, relatively painless procedure and sterilizes the sulcus. The use of Nd:YAG lasers is contraindicated near implant surfaces, as they absorb energy, and heat transmission to bone[4]. There is also a tendency for Nd:YAG lasers to

damage the fragile subjunctional epithelium at the sulcus base around implants. Erbium:yttrium-aluminum-garnet (Er:YAG) lasers with a wavelength of 2,940 nm are reflected by metal implant surfaces and minimally penetrate the soft tissues, so they are relatively safe to use. The hemostasis achieved with the Er:YAG laser, however, is not as effective as that achieved with the carbon dioxide ($CO_2$) laser[19]. The $CO_2$ lasers expose implant margins by creating a trough by excision rather than by displacing soft tissue resulting in a large defect. In anterior areas where esthetics is critical, the effect can be traumatizing. Surgical wounds created by lasers heal by secondary intention, and incision lines show disorganized fibroblast alignment. This reduces tissue shrinkage through scarring, which helps preserve gingival margin heights[19]. Evidence does not support the use of destructive procedures such as surgical retraction in the implant situation[4,19]. Peri-implant mucosa does not have the same capacity for regeneration as peridental mucosa. The correct use of lasers with appropriate wavelengths may be applicable in some, but not all, implant situations during retraction and while making impressions.

## Laser micropatterning of dental implants

Laser peening, which is a form of cold working, produces a surface with refined grain structures, compressive residual stresses, and increased hardness in metallic materials[20-23]. This is done using precision laser micromachining (excimers or Nd:YAG laser) on implant surface which creates a controlled surface roughness and has shown to stimulate bone-growth at the surface. Laser peening can achieve more significant surface enhancement than grit blasting [24]. The experiment conducted in a study showed that micropatterns of 20 micrometer wide and 7 micrometer deep imprinted on the biomedical implant material of cpTi via HEPLP (High Energy Pulsed Laser peening) was successful in creating a patterned surface and also improved the material mechanical strength. The patterned area appeared to have a significantly higher cell density than that on the untreated surface of the cpTi foil[25]. Higher removal torque values for laser micropatterned implants compared to machined implants were reported in several studies[26,27].

## Gingival contouring

Gingival contouring of the soft tissue is desired or indicated before the preparation or impression, then a laser is the instrument of choice to accomplish this procedure. Height or shape discrepancies can be easily corrected, and the gingival contours are maintained and the field can remain dry and clean, ready for impressions. The negligible tissue shrinkage after laser therapy is an advantage. Minor surgical correction of the gingival margin can be carried out, to assist adequate implant exposure or to establish the correct emergence profile. The emergence profile of a restoration is the shape of the restoration in relation to the gingival tissues. Davarpanah et al.[28] proposed the emergence profile concept in implant therapy and a three stage approach to ensure that concept: implant stage, intermediate abutment stage, and definitive crown placement stage. The creation of a proper contoured restoration with a natural emergence profile and gingival architecture that harmonizes with the adjacent teeth is very important for aesthetic and functional implant therapy[29]

## Laser welding of titanium components

One of the hallmarks of the osseointegration technique is a passive fit of the prosthesis on the implants[30]. Laser welding can be advocated in fabricating frameworks to obtain a passive fit of implant prostheses on multiple implants. This eliminates the casting procedures and the consequences of expansion-contraction occurring during casting of the framework and the subsequent non-passivity of the framework. Bergendal and Palmqvist[31] found that there was a

tendency for more fractures of artificial teeth and acrylic resin in the titanium-welded framework group. Reidy et al[32] concluded that the laser-welded framework exhibited a more precise fit than the one-piece casting.

## Computer aided laser cured surgical template

Pre surgical planning is essential to obtain esthetic and functional implants, and a variety of techniques is presently available[33]. Surgically guided placement of implants is more accurate than freehand placement[34]. Rapid prototyping techniques allow the production of physical models on the basis of virtual computational models. The rapid prototyping technologies that are currently in use are stereolithography (SLA), inkjet-based system(3DP), selective laser sintering (SLS), and fused deposition modeling (FDM). Stereolithography uses an ultraviolet laser to "laser cure" cross-sections of a liquid resin and is the technique which is commonly being used for the generation of computer-generated surgical guides [35,36,37]. SLS models are opaque, whereas SLA models are translucent[38]. Fabrication of surgical templates using Stereolithography have been proved to benefit from high precision by several well-documented researches[39-45].

## Low level laser therapy [LLLT]/ Phototherapy/Photobiomodulation

Also known as therapeutic lasers or Soft Lasers use sub thermal energy density in the Red wavelength (1mW – 500 mW). Therapeutic Uses include post-operative care, tissue healing, reduced edema inflammation and pain. The biostimulatory effect of low-level laser (LLL) was pioneered by EndreMester in Budapest in the late 1960s, who demonstrated an increase in collagen synthesis in skin wounds. LLLT is based on biostimulation of the tissues with monochromatic light. After implant surgery, 1-5j/ cm2 energy twice weekly is used for soft tissue healing. Dortbudak et al[46] found that the use of low-level laser therapy with a diode soft laser (690 nm) for 60 seconds after the placement of toluidine blue O for 1 minute on the contaminated surface reduced the counts of bacteria by a minimum of 92%. However, complete elimination was not obtained. In implantology, LLLT seems to be a promising treatment to accelerate osseointegration, as demonstrated by its effects on bone repair[47,48]. Laser therapy improves bone matrix production because of the improved vascularization and anti-inflammatory effects. The effect of LLLT on activation and increasing collagen production demonstrated by Kana et al[49] can also lead to a better bone matrix for bone repair. Various in vitro and in vivo animal studies have shown that LLLT has got the potential of beneficial effects on the initial establishment of the implant– bone interface[50,51] using GAAlA (gallium-aluminum-arsenide) diode laser. Further investigations are needed as to the laser dosage for use in humans.

## Summary

The use of lasers in implant dentistry has expanded and improved certain treatment options for clinicians who have adopted the technology. As with all dental materials and instruments, the practitioners must undergo proper training, before incorporation of laser technology in their practice. A wide variety of procedures can be performed in a painless and comfortable way using lasers. Lasers can be used for planning of implant placement, implant site preparation, second-stage surgery of submerged implants, surgery to establish the health of soft tissue surrounding the implant and decontamination of titanium implant surfaces. The laser is an extremely useful piece of equipment for the implant dentistry and is rapidly becoming an essential component of modern implant practice. In the past few years a wide spectrum of indications in implant dentistry has been proposed for laser systems.

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Kerala State Branch

# A NEW SOLUTION FOR AN OLD PROBLEM

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***Abstract:***

*An innovative use of currently available technologies used in a way that made a difficult case simple. The original intended use of the equipment has been enhanced by the modified method and has produced a reproducible and consistent technique for helping patients with similar needs. Cone Beam CT scanning, 3D printing and Digital Impression technology was used in combination to replace a long span bridge with a pier abutment and an emergency immediate denture was provided in one visit*

Key words:
3D printing, CBCT

## Introduction

3D printing is getting more and more popular, 3D printers are getting more and more affordable, schools have it, artists have it, sculptors have it, designers have it and in many other disciplines 3D printing and rapid prototyping is used in daily basis. Medical 3D printing has been in use in mainstream medicine and surgery for years. Prosthetic limbs are 3d printed. There is even a crowd funding prosthetic limb project where people with home 3d printers are printing parts for the limbs.

Cone beam CT scanners (CBCT) has been in use for more than a decade and now it is much more affordable and the accuracy and resolution has increased considerably improving the diagnostic yield considerably.

Digital impression technologies has been present from 1973 first postulated by Prof Francois Duret in his thesis titled 'The Optical Impression'. However the first real clinically applicable chairside optical impression and milling system was the Cerec systems by Sirona,Germany just about twenty years ago. From then onwards the technology available has made leaps and bonds and affordable to the average dentist. Accuracy improved and marginal fit, occlusal accuracy, tooth anatomy all improved significantly

## Case presentation

A patient who was a social worker attended the practice on a Friday afternoon. The presentation was a fracture of a very old long span and double and pier abutted bridge which fractured at the anterior abutment and the pier abutment had massive caries (Fig 1). The patient had an unavoidable speaking engagement abroad and was flying first thing in the morning on the coming Wednesday.

PVS impressions were taken with the bridge in situ and scanned with the CBCT (Fig,2,3)

The CBCT scan of the impressions were then 'digitally poured' and converted to STL file using Autodesk Meshmixer 3D modelling software, the resulting data was emailed to the lab (Fig 4,5)

A bite registration optical scan was taken of the contra lateral side (Fig 6)

## Materials and Methods

The lab 3d printed the models using SLA technology (Stereolithography printing using an UV laser with a wavelength of 405nm). The optical impression bite scan and the STL (stereolithography file) generated was used to get the vertical, horizontal and translational occlusal movements dialed in electronically into the models before printing, digital extraction of the broken roots was also done in the CAD software (computer aided design)

Once the models were 3D printed conventional PMMA acrylic immediate denture was constructed on the following Monday morning, this was overnight couriered over to us to arrive Tuesday morning (Fig 7,8). We fitted the denture Tuesday afternoon, after removal of the broken root (Fig 9) with virtually no adjustments needed with a very good color match as the optical impression also records colour data (Fig 10). The patient flew on Wednesday morning for attending her public

*Fig 1* case presentation

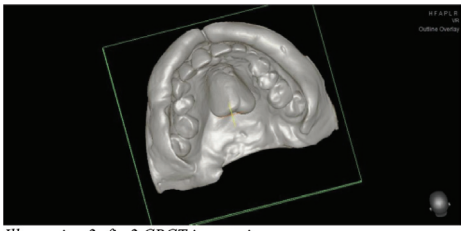

*Fig 2* CBCT impression scan

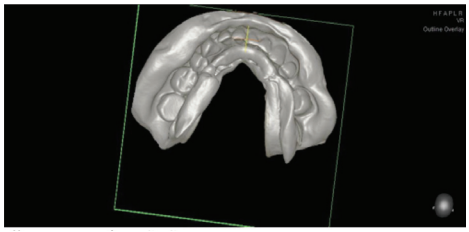

*Fig 3* CBCT impression scan

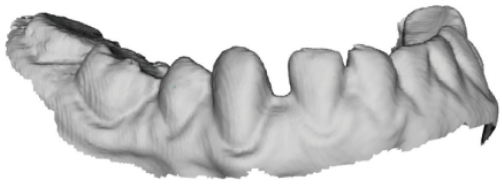

*Fig 4* Digital pour

*Fig 5* Digital pour

*Fig 6* Optical impression of the bite contralateral side

*Fig 7*

*Fig 8* Immediate denture after digital extraction

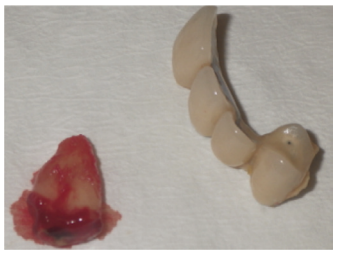

*Fig 9* Extraction of root and fractured bridge

*Fig 10* Denture fit

speaking engagement. Follow up appointment two weeks later when the patient returned from abroad was very satisfactory.

## Discussion

The question whether this could be done without any of the technology arises. Of course it could be done without the expensive technology. However there was no way to do the conventional protocol that has been proven in the time scale available. There was also how important it was to the patient to meet an important public speaking engagement. The stress levels of the patient was extremely high so patient demand and expectations were very high.

Meeting of the patient expectation is a key feature in case acceptance and return of the investment that was made in running a specialist practice. The availability of the technology and the ability to utilise it to its potential is the key message from this case.

The case also demonstrated the accuracy of the various methods available and how it all tied together to provide exceptional patient care and meeting patient expectation. This is the modern digital workflow which can integrate the conventional analogue techniques with the digital techniques that are now available. There are studies which show patients actually prefer the digital techniques of today compared to the conventional impression techniques[1].

If a decision to invest in modern technology is made a feasibility study should be made in conjunction before investment is done. This is to ensure that the techniques available already and the new technology is compatible with each other. That it is simple to implement with a simple learning curve. That it is consistent and reproducible. The prostheses manufactured by the digital methods have been tested and been found comparable in the accuracy and fracture resistance to conventional methods.[2]

CAD/CAM techniques are already been in use for the past 15 years to provide everything from single crown, implant crowns, digital dentures and full arch implant reconstruction and rehabilitation with a high degree of accuracy and predictability[3]. Cases like these shows it can be used for routine and daily problem solving as well. Many more applications of the techniques are yet to be discovered[4].

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# TEMPOROMANDIBULAR DISORDERS IN EDENTULOUS PATIENTS – A REVIEW

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## *Abstract:*

*Temporomandibular disorder is a collective term that embraces a number of clinical problems that involve the masticatory musculature, temporomandibular joints (TMJ) and associated structures or both. The relationship between occlusion and TMD has always been debated. Literature shows that the signs and symptoms of TMDs, observed in patients with natural dentition occur in edentulous patients with or without denture rehabilitation also. The objective of this paper is to review the prevalence of temporomandibular disorders in edentulous patients.*

*Data for this review was identified and collected using electronic search engines - PubMed, EBSCOhost, and Clinical Key using the keywords: occlusion, temporomandibular joint, temporomandibular disorders, edentulism and denture. No restrictions were placed on the date of publication, when searching the electronic databases. Articles in English alone were searched, followed by manual search of the relevant references cited in the retrieved articles for additional literature.*

*There has always been controversies regarding occlusion as a causative factor for TMD. The effect of partial/total edentulism and their rehabilitation on TMJ has not been documented in any long term clinical trials. To better understand this phenomenon, long term studies that evaluate both edentulism as a cause of TMD and prosthetic rehabilitation as a prevention or cure of TMD, has to be conducted.*

Key words:
TMD, Completely edentulous patients

## Introduction

The stomatognathic system is a specific arrangement of various structures of the oral cavity and facial skeleton. In particular its key elements are: the teeth along with the periodontium, the masticatory muscles, and the temporomandibular joint (TMJ)[1]. Among the various key elements the temporomandibular joint is considered as one of the most complex joints of the body and classified as a compound joint which is made up of two bones and a disk between them[2]. Chewing, swallowing, phonation and posture depend heavily on the function, health and stability of this joint[3]. Hence the uncreased functioning of the joint is essential for the patient's orofacial comfort and overall well-being.

Temporomandibular disorders (TMD) are defined by the American Academy of Orofacial Pain as "a collective term that embraces a number of clinical problems that involve the masticatory muscles, the temporomandibular joint, and the associated structures"[4]. Temporomandibular disorders are characterized by clinical signs such as muscle and/or TMJ tenderness; TMJ sounds (clicking, popping, or grating) while opening or closing the mouth or while chewing; and restriction, deviation, or deflection of the mouth while opening or closing. TMD are considered to be the most common orofacial pain conditions of non-dental origin. Earache, headache, neuralgia, and tooth pain are the other symptoms that may present as ancillary findings for TMD. The associated

signs and symptoms vary from person to person in various combinations and degrees. The sum or the exacerbation of these signs and symptoms eventually limits or even disables individuals in their physiological activities[5].

Epidemiological studies estimate that 40% to 75% of the population has at least one TMD sign, such as noise in the TMJ, and 33%, at least one symptom, facial pain or TMJ pain[6]. Approximately 65- 85% of humans experience some symptoms of temporomandibular joint dysfunction (TMD) at some time during their life. In this context, 5-7% of the whole population require treatment to decrease the symptoms of TMD[7].

Temporomandibular disorders have a very complex and multifactorial etiology. One contributing factor which has been debated over for years is the "occlusal condition" of the patient. Even after decade long discussions on the topic, the assumed role of occlusion on predisposition, initiation and propagation of temporomandibular disorders is not understood. Earlier the dentists were more or less convinced that the occlusion was the most important etiology for temporomandibular disorders. But recently, the researchers have argued that occlusal factors play little or no role in TMDs. This turns the topic of "occlusion and temporomandibular disorders" a critical issue in dentistry.

Today, the first step in the treatment plan for the management of patient with TMD with edentulism is prosthetic rehabilitation. It is based on the belief that, as the teeth are the most important components of the masticatory system and as they have a close relationship with temporomandibular joint and the masticatory muscles, any change to their normal functioning can induce pathological changes in the temporomandibular joint. But observations in the research done till today neither determine occlusion as the dominant cause of TMD nor justify prosthetic rehabilitation as the primary treatment modality for the management of TMD. Moreover, prosthetic rehabilitation as a cause or cure with regards to TMD is also questionable. Even though the prevalence of TMD in association with edentulism as well as in rehabilitated patients has been increasing, proper guidelines for the management of such cases have not been established. Any attempt to identify and symptomatically treat, to relieve such patients from pain also means improvement of quality of their life.

## Review of literature

The temporomandibular disorder as described has a multifactorial etiology[8,9,10]. Various epidemiological studies show that TMDs are more prevalent in females[11,12,13,14,15] and females look for treatment three times more frequently than males[10,16,17,18,19,20,21]. This has been interpreted as a reflection of biological, psychosocial and hormonal differences between the two groups[22]. Oestrogens would play a role by enhancing the diligence in connection to pain stimuli, tweaking the activity of the limbic system neurons[23]. Some reports have demonstrated that the presence of pain in connection to TMD escalates nearly 30% in individuals receiving hormone substitution treatment in post menopause (oestrogens) and around 20% among females who utilize oral contraceptives[24]. Contradictory to this an epidemiological survey showed that signs and symptoms of TMJ dysfunction are present in both sexes in equal proportion[25].

It was concurred that edentulous individuals do not present with TMDs to the extent of those having natural dentition because of the lack of proprioceptive feedback from dentition to trigger the symptom complex of TMD[26,27]. To contradict this, if occlusion and the masticatory function has a role in the development, functioning and remodelling of TMJ, then long span edentulism would pathologically affect the TMJ. An animal study on rats evaluated the effect of altered masticatory function on TMJ. Rats were fed a soft diet after weaning, and the incisors were shortened regularly to keep them out of occlusion. The control rats were fed a hard diet. Immunohistochemical techniques and image analysis were employed to investigate the deposition of pro-type I collagen and type II

collagen and the thickness of articular cartilage layers in the mandibular condyle. In the soft-diet animals, the total number of chondroblasts was reduced by 35% after 50 days. The results suggest that the deposition of type I and II collagens, thickness of the cartilage cell layers, and number of chondrocytes are sensitive to alterations in joint loading and decreased function[28].

Another similar study evaluated the effect of a reduced functional dentition (no incisal contacts) on the development of the TMJ articular disk in young rabbits by measuring cell proliferation within the TMJ disk after tooth extraction. Maxillary and mandibular incisor teeth were extracted from 18 animals that were 5 weeks of age. Eighteen age- and sex-matched control rabbits with intact dentition were treated in parallel. In the absence of incisor teeth, reflex gnawing and incising failed to develop, resulting in altered jaw movements and muscle force requirements. The mitotic rate in the anterior band of the TMJ disk was reduced significantly; rates for the intermediate and posterior bands were not significantly affected. An associated reduction in alveolar bone mass and deformation of the developing craniomandibular complex was noted. These observations suggest that altered function affects alveolar bone and TMJ disk development in the rabbit[29].

A group of authors proved that TMD was almost as equally prevalent in CD wearers as in the natural dentition [30, 31, 32]. Ribeiro et al found that patients with complete dentures had TMD symptoms with a frequency similar to natural dentition[33]. Dervis et al[34], Zissis et al[35], Gibson et al[36], and Monteith et al[37] stated that the reason for increased prevalence of TMD in complete denture patients was frequently due to incorrect vertical dimension and centric relation. According to Shumailan et al[38], TMD is LESS prevalent in CD wearers than in natural dentition. His explanation for this observation was that CD wearers may be relied upon limited jaw opening levels because of the muscular co-ordination needed to counteract relocation of the lower denture. Al-Shumailan and Al – Manaseer[39] found twice as many TMD signs and symptoms in dentate patients than in patients using complete dentures. In another study a higher figure of TMD signs in dentate individuals, were seen when compared to completely edentulous patients[40].

According to the observations of Bontempo and Zavanelli[41], wearing the same prosthesis for an extended time (more than 5 years) causes the occlusal surfaces of the artificial teeth to wear out, causing alteration of the vertical dimension of occlusion, which may facilitate the development of TMD signs and symptoms. Poor adaptation of the prosthesis can cause constant muscular contractions to try to stabilize it, and can also cause pain and muscle dysfunction[42]. Not wearing dental prostheses causes changes in the TMJ and muscular system, whereas the rest position is changed due to loss of vertical dimension, interfering in the condylar position[43].

But dilemma persists with the observations of Dervis et al[44], Okimoto et al[45] and De Boever et al[46] who stated that there exist no correlation between certain characteristics of dentures (retention, stability, occlusal errors, freeway space, age of present denture, or number of sets of dentures) and the presence or severity of TMD signs and symptoms. Complete dentures are not as resistant to deflective occlusal forces as natural teeth, and therefore dentures are able to shift without harming the muscles and TMJs. Franks et al[47], Macentee et al[48], Wilding et al[49] and McCarthy et al[50] also stated that discrepancies in vertical dimension of existing complete dentures does not affect the severity of TMDs.

There is a consensus among the authors that patients should be instructed to remove their dentures at bedtime to relieve the pressure on soft tissues and reduce the incidence of stomatitis[51, 52]. However, the literature shows that patients who do not wear their dentures while sleeping have higher muscle activity during the night[53]. The loss of natural teeth can cause psychological problems that increase emotional stress and may contribute to the development of TMD[54, 55, 56].

The rationale for addressing malocclusion as a cause for TMD is based on the observation that the teeth may direct the jaw into uncomfortable

positions causing muscle fatigue and pain. The controversy that lies in defining the prevalence of TMDs in complete denture wearers is the belief that the role of occlusion in producing muscle spasm resulting in the above mentioned TMD signs and symptoms cannot be applied to complete denture patients as edentulous patients lack proprioceptive response. Even if an occlusal prematurity occurs, the denture displacement acts as a protective mechanism for the TMJ. Moreover overclosure of the jaws in patients with natural dentition can predispose to TMD whereas long standing edentulous individuals without the dentures rarely develop TMDs despite overclosure.

A significant increase in the prevalence of TMDs has been noted as the length and the duration of the edentulous span increases. Subjects with missing teeth in all four quadrants showed significantly higher TMJ dysfunction signs with study done by Shet et al[19], MQ Wang et al[55] and Osama et al[57]. A significantly high prevalence of TMJ dysfunction signs was also noted in subjects with edentulous span of more than 5 years[19]. Though there are no sufficient evidence to support this results from the results of the study, they inferred that with time pathologic migration of teeth/tooth take place resulting in occlusal inaccuracies, missing posterior teeth will cause constant overloading of joint moreover, the existence of a unilateral unique molar induced asymmetric overloading in the TMJ disk without posterior contact and all this factors will effect TMJ leading to TMJ dysfunction in long run. A study by Dallanora et al on the prevalence of TMDs in a population of complete denture wearers revealed a positive association between the time of use of complete dentures and the presence of TMDs. According to their results, when the individual continuously wore the same complete dentures for more than 10 years, a higher prevalence of TMD symptoms was found[58].

In particular, loss of teeth mainly from the supporting zones has been accused to be the reason for TMDs. This situation alters several angles and pressure relationships affecting TMJ mechanics that the incidence and intensity of TMDs are higher in subjects with greater tooth loss in the supporting zones[59, 60, 61, 62, 63, 64]. Several epidemiological investigations have demonstrated a correlation between the number of occluding teeth and osteoarthritis in the TMJ[65]. Supporting this is the observation that restoration of posterior teeth decreases or eliminates the pain associated with TMDs. The treatment effect has been attributed to stabilization of the occlusion, redistribution of occlusal forces, and reduction of joint loading[66,67,68]. Ueno et al evaluated the uptake of HRP in the TMJ synovium of rats after unilateral extraction of the maxillary molars. He demonstrated that uptake in type A synovial cells decreased as the experimental time increased. The decrease suggests that degenerative changes may have occurred in these cells[69]. But there are also a few studies which established that there is neither any relationship between TMD severity and decrease in occlusal support. DeBoever and Adriaens[70] found no relationship between the number of occluding molars and premolars and the severity of TMJ symptoms or the evolution of complaints nor restoration of missing teeth decrease the prevalence of TMDs[71,72,73,74].

It has been shown that there is a relationship between the number of teeth in the oral cavity and changes in the TMJ[75]. Agerberg[76] documented that patients with few remaining natural teeth may have a higher incidence of TMJ dysfunction signs. Loss of teeth exerts extra loads on the TMJ, contributing to the progression of structural changes in TMJ, which increase with aging[77]. Loss of first and second molars results in a mean of 0.56 mm of condyle displacement relative to the cranium[78]. Joint sounds are present in 44.3% of patients with partial edentulism and the prevalence increases to 55.7% in patients with bilateral edentulism[79] 60.2% of patients with loss of occlusal support have joint dysfunction, indicating that occlusal support is a factor in mastication and progression of TMD[80]. Opposing these findings, Pullinger et al showed no sufficient evidence of an association between TMJ dysfunction and partial loss of teeth[81].

With respect to incidence of TMDs in removable partial dentures, there are more studies supporting the increased incidence[18]. In Al abrah's[43] study,

compared to CD wearers, partially edentulous patients wearing acrylic removable partial dentures, had a higher prevalence of TMD signs (36% compared to 17%).

Palomar et al[82] found that temporomandibular joint dysfunction signs in relation to Kennedy's classification showed class I Kennedy's classification shows more signs of TMJ dysfunction. The explanation given by him for this observation was that as there is no contact between the posterior teeth an overload of the joints appeared. During clenching, a uniform distribution of the dental contact along the maxillary arches prevents the TMJ from overloading. In contrast, severe partial edentulism seems to induce overloading of the TMJ with severity depending on the type of contact. Hamid et al contradicted this by the results of his study which showed no significant relationship between TMD and Kennedy Class I and Class II partial edentulism; however, in relation to the type of partial edentulism (Kennedy classification) the highest prevalence of TMJ disorders was associated with Kennedy Class I partial edentulism (59%). Similar observations where stated by Hamid et al[83], Garcia et al[84] and Amini et al[85]. The explanation being in bilateral free-end partial edentulism there is an increase in the load exerted on TMJ, compared to other types of partial edentulism, resulting in deviation, biomechanical changes and joint instability.

A study by Barghi et al[86] in 1992 has stressed on the impact of prosthetic rehabilitation on temporomandibular joint. It was observed that following replacement of posterior teeth, the clicking amplitude decreased in 68% of recordings, remained unchanged in 11%, and increased in 21%. Hence, in view of the various contradictory and supporting studies, it was inferred from the present study, that these malocclusions due to the non replaced mandibular molar may be viewed as a contributing factor, if not a causal factor in the pathogenesis of TMJ dysfunction. Witter et al[71, 72] also proved that removable partial dentures do not have any role in prevention of TMDs through both his studies. Moreover he claimed that shortened dental arch can provide better occlusal stability.

Patients with temporomandibular disorders can present with a multitude of signs and symptoms, of which the most prevalent joint condition is joint sound[83]. Recent researchers have related clicking to a sudden acceleration of condylar and internally displaced disc tissues[87]. Kirov et al[17] found joint sounds (11.54%), muscle tenderness (7.69%), joint tenderness (5.77%), deviation of mandible (3.85%), and limitation on mouth opening (2.88%) in decreasing order of frequency in patients with temporomandibular disorder. Al-Jabrah et al determined the prevalence of TMJ sounds in 100 completely edentulous patients wearing complete dentures with severe bone resorption and 100 patients wearing removable partial dentures. The patients wearing both full and removable partial dentures had a significantly higher prevalence of vibrations. Tenderness upon palpation in the periauricular region was the most common response in both groups. Patients with both complete and partial dentures showed higher tenderness and the masseter muscle was the most affected[43]. Joint sound (clicking) was the most common sign observed in the selected subjects (46%), and mandibular deviation (40%) was the second most common sign in the study carried by Carlsson GE and Akhter R et al[88]. Elfving et al[89], described joint sounds as the least common finding in TMDs. Joint noises in completely edentulous patients wearing denture were related to abnormal condylar surface forms. Osama et al[57] observed in his study that association of muscle tenderness with TMJ dysfunction shows that masseter muscle 32% is most commonly involved muscle followed by temporalis and finally lateral pterygoid. This is because of posterior bilateral edentulism patients get habit of clenching to masticate the food.

## Conclusion

The relation between the occurrence of temporomandibular disorders and loss of teeth has always been controversial. It is realistic to assume that the more complex a system, is the greater the likelihood that its breakdown will occur. In this context occlusal factor including edentulism has been reported as a major etiology for pathologic conditions of TMJ. It is then recommended that

professionals follow guidelines for rehabilitation of such patients to attain a stable occlusion. The reason for conflicts among results of various studies may be attributed to the diversity of study population, and lack of standardization in clinical examination and diagnostic criteria. Moreover, the extensive human studies in this field are not ethically acceptable. To better understand this phenomenon a continuous follow up of edentulous patients to understand the TMJ changes, followed by rehabilitation and then the changes incurred in the cure of the disease or prevention of further progression of disease, under standardized examination, evaluation, diagnostic and treatment criteria has to be piloted.

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*The journal of*
PROSTHETIC AND IMPLANT DENTISTRY
Official Publication of Indian Prosthodontic Society
Kerala State Branch

# TRISMUS: AETIOLOGY AND MANAGEMENT

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## *Abstract:*

*The word trismus is modern latin, derived from the greek word "trismos" meaning "grinding" or "rasping". Trismus is defined as a limitation in the mouth/jaw opening ability due to reduced mandible mobility. A Maximal Inter-incisal Opening, (MIO) ≤35mm is often used as the cut-off point for trismus. It can occur as a result of tumor growth, and more importantly, as a side-effect to head and neck (H&N) Oncology treatment. Trismus can also result from benign jaw related conditions, often referred to as temporomandibular disorders (TMD). Newer radiation modalities may decrease the prevalence of trismus compared to conventional radiotherapy. Although trismus has been recognized to have a large impact on Health Related Quality of Life (HRQL) the knowledge about these patients and the incidence of trismus is limited. This review represents an appraisal of the literature to clarify the impact of trismus. The literature search was conducted with databases MEDLINE/ PubMed and EBSCOHOST for articles published between January 1990 and December 2016, with keywords as trismus, mouth opening, incidence and management.*

Key words: Trismums, exercise therapy

## Introduction

Trismus is defined in Taber's Cyclopedic Medical Dictionary as a tonic contraction of the muscles of mastication. In the past, this word was often used to describe the effects of tetanus, also called 'lock-jaw'. Trismus can be caused by trauma to head and neck region, inflammation of the muscles of mastication, masticatory space infection, pericoronitis, impacted third molar, temporomandibular disorders, oral submucous fibrosis, ankylosis of temporomandibular joint, as a complication of local anesthetic injection.[1,2,3] The curative treatment of Head & Neck tumours consists of radiation therapy, chemotherapy or surgery in different combinations. It usually causes trismus 3 to 6 months post- radiotherapy and a progressive decrease in mouth opening can be observed upto 2 years.[1] The patient group that received higher external beam radiation dosages (i.e. >50 Gy) presented with a significantly higher incidence of trismus. The percentages of trismus in Head & Neck cancer patients reported in the literature vary, and a recently published study including sixty- nine patients by Johnson et al. revealed a high incidence of trismus (42%).[2] This is a disorder characterized by a lack of ability to open the mouth fully due to a decrease in the range of motion of the muscles of mastication.

It can be graded into three categories: mild (decreased range of motion without impaired eating), moderate (decreased range of motion requiring small bites, soft foods or purees) and severe (decreased range of motion with an inability to adequately feed or drink).4 A restricted mouth opening affects mandibular function, including biting, chewing, speech, laughing and yawning.[5] In case of an extremely restricted mouth opening,

oral hygiene, dental treatment and oncological follow-up may also be impeded. In healthy adults, maximum mouth opening (MMO) is between 40 and 60 mm. An MMO of < 35 mm is defined as trismus; this threshold value is based on functional problems experienced by patients with head and neck cancer.[5,6] Kazanjian divided ankylosis of the temporomandibular joint into true and false. The true type of ankylosis is attributed to pathological conditions of the joint, and false ankylosis was applied to restrictions of movement resulting from extra-articular joint abnormalities. This latter type of ankylosis is what most clinicians know as trismus.[7]

The majority of the muscles of mastication are innervated by the mandibular division of the fifth cranial nerve. The lower hyoid muscles are supplied by the cervical plexus, and the posterior belly of the digastric muscle by the facial nerve. The muscle groups controlling jaw opening and closure act as antagonists, as neurogenic stimulation of one muscle group reflexly results in neurogenic inhibition of the other. Sensory nerve impulses in the second and third divisions of the trigeminal nerve and in the glossopharyngeal nerve are of pathogenetic importance in trismus. The sensory innervation of the soft palate and tonsillar region, by the lesser palatine nerves derived from the maxillary nerve and by sensory nerve fibres from the glossopharyngeal nerve, is of special interest to the otolaryngologist, as these nerve fibres pass through the pterygopalatine ganglion.[8] The clinical conditions associated with trismus varies widely, and may be considered of either general or regional origin. In Table 1 a combined aetiological conditions is presented.

Trismus has been associated with significant morbidity following radiotherapy (RT) with serious health implications. Limited mouth opening frequently results in reduced nutritional status. It may also make proper mastication of food difficult and results in compromised airway clearance. For an individual to swallow normally, a cohesive bolus has to be formed by manipulation of the food. Excess residue after swallowing may occur if proper movement of tongue is not present. Aspiration of food due to increased residue may be the consequence of poor bolus formation along with compromised mastication. Reduced mouth opening can also result in compromised oral hygiene. Patients who have received radiation involving the salivary glands must maintain excellent oral hygiene in order to prevent caries. Deficits in oral hygiene can aggravate mucosal and dental problems with the subsequent risk of mandibular osteoradionecrosis. Such conditions can negatively influence the functional outcome.[9,10]

## Does trismus resolve on its own?

Patients and their care- givers frequently overlook trismus and may assume that reduced mobility of jaw normally resolves by itself. Moreover, patients receiving radiotherapy or combined radiation and chemotherapy often require feeding tubes or limit their intake to mostly liquids during treatment. Thus, they may not realize the slow progressive onset of trismus, until they attempt to resume intake of soft or solid foods.[8] Diets may need texture modifications depending on the patient's ability to open his or her mouth and chew. The maximum mouth opening (inter-arch or inter-incisal distance) should be measured before radiotherapy is started, and the patient and/or clinician should measure this distance frequently thereafter to ensure its maintenance. Trismus has been defined variously as a mouth opening less than 20 mm to an extent of less than 40 mm. One of the reasons for this variation is the lack of uniform criteria. Patients at risk of trismus should be put on home exercises to maintain maximum opening and jaw mobility as soon as radiotherapy begins (Dreizen et al. 1977; Engelmeier and King 1983; Lockhart 1986). If the clinical examination reveals the presence of limited mouth opening and diagnosis determines the condition due to be trismus, treatment should begin as soon as it is practical. As restriction becomes more severe and likely irreversible, the need for treatment becomes more urgent and can minimize or prevent many of its consequences.

Aetiology of trismus[3,8]

| Aetiology | Intra-Capsular | Extra-Capsular |
|---|---|---|
| Congenital | Malformation of the Mandibular Condyle | Hect-Beak-Wilson Syndrome Craniocarpotarsal Dysphophy Hemifacial Microsomia<br>Oculodentodigital Syndrome<br>Fibrodysplasia Ossificans |
| Traumatic | Haeniarthrosis<br>Dislocation of the Articular Meniscus<br>Foreign Body<br>Fracture of the Mandibular Fossa<br>Fracture of the Mandibular Condyle<br>Osteoarthritis | Haematoma of the Jaw Muscles<br>Haematoma of the Infratemporal Fossa<br>Haematoma of the Pterygopalatine Fossa<br>Contusion of the Jaw Muscles<br>Fracture of the Zygomatic Bone<br>Fracture of the Mandibular Ramus<br>Foreign Body of the Infratemporal Fossa<br>Soft Tissue Fibrosis<br>Zygomatic Fracture healed in Malposition |
| Inflammatory. | Pyogenic Arthritis<br>Rheumatoid Arthritis<br>Osteomvelitis of the Mandibular Condvle<br>Fibrous Ankylosis<br>Bony Ankylosis | Abscess of the Auricle<br>Abscess of the External Ear Canal<br>Peritonsillar Abscess<br>Lateral Pharyngeal Space Abscess<br>Cancrum Oris<br>Alveolar Periostitis<br>Odontogenic Abscess<br>Cervical Lymphadenitis<br>Parotid Abscess<br>Mumps<br>Masseter Space Abscess<br>Abscess of the Infratemporal Fossa<br>Abscess of the Pterygopalatine Fossa<br>Temporal Arteritis<br>Myositis Ossificans of the Jaw Muscles<br>Osteomyelitis of the Mandibular Ramus<br>Paget's Disease of the Mandible<br>Fibrous Dysplasia of the Mandible<br>Scleroderma<br>Cervicofacial Actinomycosis<br>Soft Tissue Fibrosis<br>Elongation of the Styloid Process |
| | | |

| | | |
|---|---|---|
| Neoplastic. | Mesodermal Tumours of the Mandibular condyle<br>Hyperplasia of the Mandibular Condyle<br>Sarcomas of the Mandibular Condyle<br>Myeloma of the Mandibular Condyle<br>Metastases of the Mandibular Condyle | Mesodermal Tumours of the Coronoid<br>Hyperplasia of the Coronoid Process<br>Jacob's Disease<br>Sarcomas of the Mandibular Ramus<br>Sarcomas of the Infratemporal Fossa<br>Metastases of the Mandibular Ramus<br>Metastases of the Infratemporal Fossa<br>Carcinomas involving the Infratemporal Process |
| TMD | | Trauma to TMJ Due to wide and prolonged opening<br>Myofacial Pain Spasm<br>Internal Derangement |
| Miscellaneous | | Hysteria<br>Lupus Erythematosis |

In a group of patients with temporomandibular disorders, mouth opening could only explain 5% of the variance in mandibular function as assessed on the mandibular function impairment questionnaire.[11] In patients suffering from trismus such an analysis has not been performed. As a result, clinicians do not know what degree of mouth opening is sufficient for normal oral functioning nor the effect of restricted mouth opening in patients treated for malignant tumours in the head and neck. In addition, physical therapists do not know what degree of mouth opening should be aimed for.

A systematic review investigating the incidence of trismus revealed a weighted prevalence for trismus of 25.4% for conventional radiotherapy and 5% for intensity modulated radiotherapy (IMRT). This variation of incidence in earlier studies is most likely due to the different treatment regimens used and the difference in criteria used to define trismus.[23]

## Management of trismus

Treatment options of trismus can be varied according to the aetiology. Due to nerve blocks administered at superior or inferior alveolar aspects, there could be some difficulty in mouth opening on the day of dental treatment. The amount of discomfort functional disability varies, but usually mild. When mild pain and dysfunction is experienced by a patient, the patient should be examined at the earliest. In the interim, the practitioner may also prescribe the following: heat therapy; analgesics;a soft diet; and (if necessary) muscle relaxants to manage the initial phase of muscle spasm. Heat therapy done by placing hot moist towels at the area affected for about 15 minutes every hour. An anti-inflammatory like aspirin can usually prescribed in managing the associated pain. A narcotic analgesic may be required if the discomfort is more intense. If necessary, diazepam (2.5–5 mg three times daily) or other benzodiazepine may be prescribed for muscle relaxation.[3] When the acute phase is over the patient should be advised to start physiotherapy for closing and the lower jaw and lateral excursions of the lower jaw for about 5 minutes for every 3 to 4 hours. Lateral movement of the temporo-mandibular joint can be provided by using chewing gum. Any trauma or event that

may be suspected of having triggered the TMD should be recorded in the patient's dental record, as should the findings and the treatment. Further treatment in the affected region has to be avoided till symptoms resolve. If further dental care is needed, as with a painful infected tooth, access for local anaesthesia may be difficult when trismus is present. The (closed mouth) nerve block usually provides relief of the motor dysfunction, permitting the patient to open and allowing the practitioner to provide the appropriate treatment.

Almost all cases that were treated as above, improvement was evident within 48 hours. Therapy should be continued until the patient is free of symptoms. When pain and dysfunction continues beyond 48 hours, infection should be taken in to consideration. Antibiotics should be added to the treatment regimen and continued for 7 days. In the case of severe pain or dysfunction, if no improvement is noted within 2–3 days without antibiotics or 5–7 days with antibiotics, or if the ability to open is compromised, consultation of oral and maxillofacial surgeon for evaluation should be sought. Diagnostic assessment should be made before any type of therapy is applied.[24]

Current methods of increasing the mouth opening in post –radiation patients following head and neck cancer include unassisted and finger-assisted stretching exercises, stacked depressors of the tongue, and the Ferguson mouth gag. The jaw can also be forced apart by gradually turning threaded screws placed between the jaws. Dynamic bite openers can be used to depress the mandible by springs or elastic bands. The TheraBite Jaw Motion Rehabilitation SystemTM (Atos Medical AB, Sweden), is a device designed to help restore opening of the jaw. It is controlled by the patient and uses repetitive passive stretching of connective tissues by lengthening and realigning muscle and collagen fibres, and strengthening muscles across their full range of movement. It follows the natural pathway of the jaw, ensuring anatomically correct movement during exercise.[12-14]

Maloney et al. (2002) reported 43 patients with disorders of the temporomandibular joint, who were randomly assigned to three treatment groups: TheraBite, tongue depressors, or no additional intervention. Their results showed that the TheraBite device increased range of movement, and reduced pain in patients with disorders of muscles and joints. The relief of pain was greater in those with muscle disorders.[15]

A decrease in mouth opening of head and neck cancer patients cannot be always prevented by exercise therapy. Therefore, preventive excersises are only advised for patients with a high risk for developing trismus.[16-18] When trismus is present, generally a limited increase in mouth opening can be achieved by a combination of drug therapy and exercise therapy. Drugs like pentoxifylline appears to exert a modest therapeutic effect in patients with radiation-induced trismus[19] There is no standard treatment for trismus; different types of therapy have been described in literature and are clinically acceptable.[20-23] Stretching techniques are used as exercise therapy, for example conventional range of motion exercises that are sometimes combined with tools as dynamic bite openers, tongue depressors and rubber plugs. An unusual stretching technique was mentioned in a case report where the patient tied a sledgehammer for 2 minutes twice a day.[24]

Certain adjunctive home exercises can reduce the severity of the muscle spasm. In order to maintain correct posture the shoulder and neck has to be kept flexible and strong. The exercises listed below help to do this. Patients must be instructed to do these exercises twice a day.

## Neck Stretching (fig 1)

Patient must be instructed to sit or stand with arms at their side. Hold each stretch for 30 seconds.

1. Bend the head down.
2. Extend the head backwards.
3. Rotate the head to the right.
4. Rotate the head to the left.
5. Bend the left ear towards left shoulder.
6. Bend the right ear towards right shoulder.

## Chin Tuck (fig 2)

Patient must be instructed to sit or stand with your arms at their side. While looking forward tuck your chin. Pull the head back to line up the ears with the shoulders. Hold for 3 seconds. Perform 10 times slowly.

## Shoulder Blade Pinch (fig 3)

Patients must be instructed to sit or stand with your arms at their side. Hold the chin tuck above. Shoulder blades to be pinched as tightly as possible to be brought together. Hold for 3 seconds. Perform 10 times slowly.

## Massage Your Jaw Muscle (Masseter Muscle)

The index finger and middle finger should be placed on the cheek bone. Ask the patients to move the fingers to find that points that feel tender or tight at the lower end of masseter at the bottom of the jaw. Each area has to be massaged for thirty seconds in a circular fashion. To keep the muscles of jaw relaxed, clenching of jaw while stressed or as a habit has to be avoided.

Also, Hold the head still while doing these exercises. Move the jaws as described below. Hold each position for 3 seconds. Repeat 5 times.

- Open the mouth wide.
- Move the jaw to the left.
- Move the jaw to the right.

Repeat each position once more. This time stretch each for 30 seconds. Then combine these movements to move the jaw in a circle. Jaws should be opened and closed as the jaw is rotated left and right. Make 5 circlesThen repeat the circle in the other direction. Make 5 circles.

For passive stretching exercises, one has to keep a thumb on the upper teeth in the middle of the jaw (fig 4). The index finger of the other hand has to be placed over the mid- lower teeth of the lower jaw. Jaw has to be stretched open by pushing down the lower jaw using the index finger. Hold this stretch for 30 seconds.[28]

Advanced stretching devices as the dynasplint trismus system (DTS) the TheraBite Jaw Motion Rehabilitation SystemTM (TheraBite) can be used to treat trismus.[25] Trismus can also be treated by surgical procedures that are mainly used if exercise therapy has failed. Tissue release, a coronoidectomy or lowering the height of the mandible are apllied to obtain a larger mouth opening.[26, 27]

## Conclusion

Due to the high incidence and prevalence of trismus, efforts has to be taken for patient education, its prevention and early intervention. Although a Maximal Interincisal Opening (MIO) of less than 35 mm is often considered as the functional cut – off point for trismus, the criteria to define trismus may vary with the population under consideration. Also, reduced mouth opening is often a challenge from the prosthetic rehabilitation point of view. Therefore, future studies should aim to define the mouth opening in a group of

Fig 1. head bend down and backward

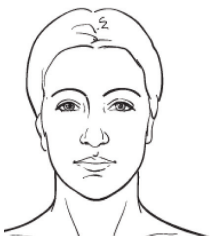

Fig 2: chin tuck excercise

Fig 3: shoulder blade pinch excercise

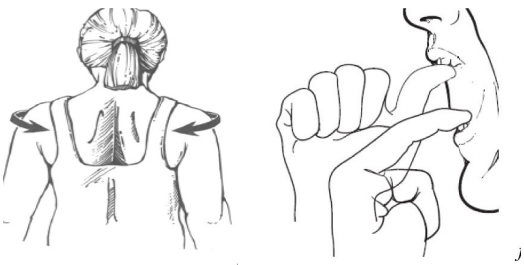

fig 4: passive stretching excercise

patients with restricted mouth opening due to temporomandibular disorders or those treated for oral cancer for normal functioning, with respect to, the population under consideration.

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# ENHANCING ESTHETICS THROUGH AN ALTERNATIVE POLYOXYMETHYLENE DENTURE POLYMER-A CASE REPORT

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## *Abstract:*

*Even in this era of advanced technology with fixed dental prosthesis and dental implants, removable partial dentures play a significant role in the field of dentistry. Although it provide satisfactory functional replacement for missing teeth, providing in the anterior area-esthetics remains as a major challenge. It is always a big task to obtain optimal esthetics while maintaining retention and stability, and healthy tooth structure with partial dentures. Polyoxymethylene resins are highly versatile engineering polymers that bridge the gap between metals and ordinary plastics. Because they offer the strength of metal and the flexibility and comfort of plastic, they make an ideal material for the fabrication of dental prostheses, particularly clasps. This article describes the advent of a new material as an alternative for conventional denture base materials that maintains excellent aesthetics as well as retention.*

Key words: Polyoxymethylene, aesthetics, biocompatible, retainers.

## Introduction:

Although the advent of successful osseointegration has dramatically reduced the need for removable prostheses, patients who are not candidates for implants due to reasons like health, anatomic, psychological, or financial reasons also deserve the same level of aesthetics, as those who are restored with fixed dental prostheses. For partially edentulous patients, the major problem is designing a removable partial denture that avoids the unsightly display associated with conventional clasp assemblies[1].

For patients who do not wish to have metal in their mouth, for cases where no preparation of teeth is desired, or in periodontally compromised cases where minimum stresses onto the abutments are desired, polyoxymethylene resin partial and removable bridges offer a vastly expanded range of applications. The traditional use of the metal clasp with cobalt chromium (Co–Cr), noble alloys, stainless steel, and titanium hampers esthetics. Polyoxymethylene resin, a thermoplastic resin, can be used as an alternative denture clasp material. This material was promoted primarily on the basis of superior esthetics, which allowed the clasps to better match the color of abutment tooth[2]. For partially edentulous patients, the major problem is designing a removable partial denture that avoids the unsightly display associated with conventional clasp assemblies 1. In such aesthetically demanding situations, various methods to overcome this aesthetic dilemma have included a conventional clasp type partial denture that incorporates a rotational path of

insertion[3,4,5], Twin Flex Clasp, use of extra-coronal adhesive attachments, painting of clasps with tooth- colored resin, use of lingually positioned clasps, engagement of mesial rather than distal undercuts[1,5,6], use of precision attachments, use of gingivally rather than occlusally approaching clasps[7,8,9].

Research in polymer science has provided us with an alternative material called "Acetal resin- also known as Polyoxymethylene (POM).This is formed by the polymerization of formaldehyde and is a thermoplastic polymer with a monomer-free crystalline structure[10, 11]. This material has been shown to have good biocompatibility and this has fostered its use in total hip replacement and as artificial valve occluders[11]. It has been used to form a stress absorbing component in a dental implant system (IMZ)[12]. The possible use of these resins as denture base materials was

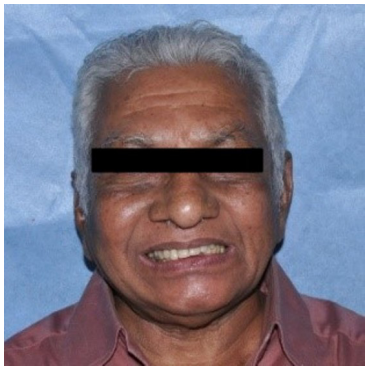

*Fig 1* Preoperative extraoral view

*Fig 2* Preoperative intraoral view maxilla

*Fig 3* Preoperative intraoral view mandible

*Fig 4* Intraoral view in occlusion

*Fig 5* Restored cervical abrasions

*Fig 6* Wax pattern for maxillary framework

*Fig 7* Wax pattern for mandibular framework

*Fig 8* Mounted casts

*Fig 9* Maxillary tryin

considered by Smith[13]. Thermoplastic resins have been used in dental medicine for fifty years. In the meantime, their use has spread due to their superior characteristics. Their ongoing development has yielded new classes of more and more advanced materials and technologies, which make possible the manufacturing of dentures with better splinting properties then traditional dentures.

## Thermoplastic resins used in dentistry:

Usage of thermoplastic resins in dental medicine has significantly grown in the last decade. The technology is based on plasticizing the material using only thermal processing in the absence of any chemical reaction. The possibility of injecting the plasticized resin into amold has opened a new perspective to complete denture and removable partial denture technology[14]. Successive alterations to the chemical composition led to the diversification of their range of application, so that at present thermoplastic materials are suitable for the manufacturing of removable partial dentures which totally or partially eliminate the metallic component, resulting in the so-called "metal-free removable partial dentures" (Bortunet al., 2006)[15].

They are monomer free and offer an innovative and safe treatment alternative for patients who are allergic to conventional resins. This resin is very strong, resists wear and fracturing, and it's flexible, which makes it an ideal material for pre-formed clasps for partial dentures, single pressed unilateral partial dentures, partial denture frameworks, provisional bridges, occlusal splints and implant abutments, partial denture frameworks, artificial teeth for removable dentures, orthodontic appliances. They resist occlusal wear and are well suited for maintaining vertical dimension during provisional restorative therapy. The possible use of polyacetal resin as a denture base material was considered by Smith over 40

*Fig 10* Mandibular try in

*Fig 11* Denture

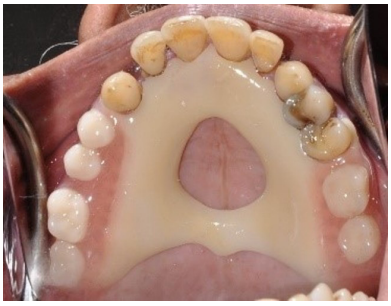

*Fig. 12* Maxillary denture

*Fig 13* Mandibular denture

*Fig 14* Intraoral lateral view

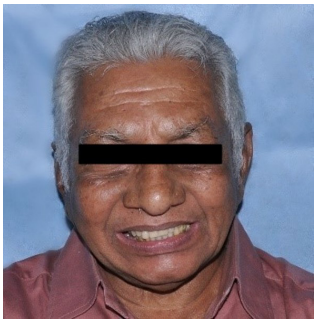

*Fig 15* Postoperative extraoral view

years ago[16]. The retainers are flexible, do not need periodic adjustment to keep them tight, and the tooth-colored esthetics were appreciated by the patients.

## Case report:

A 69 -year-old patient with an uneventful medical history sought dental care (fig. 1) in Department of Prosthodontics, Government Dental College Trivandrum for multiple missing teeth in maxillary posterior region and mandibular anterior region, which had been extracted due to caries and mobility (fig. 2,3). The adjacent teeth were vital and periodontally stable, with no tooth mobility, and had multiple cervical abrasions and arrested caries (fig. 4). Radiographs of the prospective abutments revealed healthy periapical conditions. Oral hygiene was optimum,with minimal plaque. Functional evaluation revealed no signs or symptoms of temporomandibular disorders. Minor attrition facets were visible in posterior teeth. After oral prophylaxis and oral hygiene instructions, the treatment was started by restoration of cervical abrasions (fig. 5) Diagnostic casts were obtained using irreversible hydrocolloid impression material. Clinical examination and diagnostic mounting of the patient's casts demonstrated no discrepancy between the centric relation and maximal intercuspation positions. Considering his overall dental status a polyoxymethylene removable prosthesis was planned which required minimum mouth preparation. After a complete diagnostic workup and thorough discussion with the patient, wax pattern was fabricated for framework processing (fig. 6, 7). The jaw relation record (fig. 8) and try in was done (fig. 9,10). After taking patient consent, the prosthesis was delivered successfully (fig. 11-15). The patient was satisfied with esthetic and functional rehabilitation.

## Discussion:

Removable partial dentures are widely used in clinical practice. Rehabilitating partial edentulism with metal-free removable partial dentures represents a modern alternative solution to classical metal framework dentures, having the advantage of being lightweight, flexible and much more comfortable for the patient (Wostmannet al., 2005). Metal-free removable partial dentures made of thermoplastic materials are biocompatible, nonirritant, nontoxic, biologically inert, with superior esthetics, which make them rapidly integrate in dento-maxillary structure. They offer static and dynamic stability. The effectiveness of the technique is augmented by the use of the same material in making the retainers or the use of ready-made retainers from the same material (Ardelean et al., 2007)[15,17]. A removable partial denture with the framework made of polyoxymethylene resin will be quickly integrated into the dento-maxillary system and accepted by the patient due to its reduced volume, esthetics and flexible retainers. These thermoplastic materials are not bulky, resin frameworks may be as thin as 0.3-0.5 mm, clasps are flexible and esthetic[15], being rapidly integrated in; thus representing a comfortable solution for the patient.

### Clinical uses:

- Removable partial prostheses
- As direct retainers attached to a cobalt-chromium removable partial denture framework, as well as the supportive components of removable partial dentures.
- Post-surgical space maintainer.
- Gingival masks
- Provisional restorations.
- Splints.
- Positioning stents prior to radiation therapy.
- Framework material for patients with allergic reactions to cobalt- chromium removable partial denture framework.

## Properties:

- Biocompatible.
- Non allergic and non-toxic
- Highly aesthetic.
- High resistance to abrasion.
- Excellent tensile and shock strength.
- High proportional limit with little viscous flow (enabling it to behave elastically over a large enough range to be used as a material for clasp fabrication).
- High impact strength (69-122 J/m at 23°C)
- Low modulus of elasticity (2.9 to 3.5 KN/mm2) which allow for its use in larger retentive undercuts.
- High elastic memory.
- Low thermal conductance.
- Resistance to organic solvents, oils, alkalis, hot and cold water.
- Clinically acceptable color changes after 300 hours of thermocycling.

## Limitations:

- Pink polyoxymethylene resin is more resistant to stress than the white variety. This is because in colouring it, acrylic fibres are added to the rough material and they amalgamate with the matrix, hence, decreasing the resistance of the white polyoxymethylene resin as compared to the pink variety.
- Due to the greater flexibility of this resin, when compared with the Cobalt- Chromium and noble alloys, a more bulky design would be required if the same degree of retention is sought.
- Insufficient retention in extensive cases due to less elastic modulus[18].

## Conclusion:

In recent years, flexible polymers has been attracting attention as a denture base material because of various advantages like:favorable aesthetic outcome,toxic safety, higher elasticity, sufficient strength, and use of heat moulding instead of chemical polymerization without presence of residual monomer. Furthermore, the higher elasticity and higher moulding precision than heat-polymerizing base resins decreases the stress on abutment teeth as well as facilitate denture retention by utilizing the undercuts of abutment teeth in the denture base design[19]. In addition to the demand for aesthetics[20], shortcomings of acrylic resins such as mechanical failure, dimensional changes, color instability and allergic reactions have caused the need for better improvised materials such as polyoxymethylene resin to replace them. However, further research on the clinical efficacy of this resin as aesthetic clasps, removable partial denture prostheses is recommended[18]. In removable partial denture fabrication, unsightly facial clasps have always been a cosmetic problem with traditional options, either expensive or technically difficult. Changes in dental patient's attitudes and awareness have been apparent in all aspects of dentistry, especially aesthetics. This has increased the demand for not just improved functional care, but aesthetically functional care.

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# "MAGNETIC ATTACHMENTS: AN ADJUNCTIVE RETENTIVE TOOL"

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## *Abstract:*

*Magnets have been used widely in the field of dentistry. They are used as retentive aid for overdentures, maxillofacial prosthesis, and obturators. Magnets are either attached to the remaining root structure or osseointegrated implants which help to transfer the occlusal load to the bone through the periodontal ligament of the retained roots. This helps to prevent the resorption of remaining alveolar bone and inter-radicular bone present. The present article is about the management of a patient whose remaining teeth were of poor prognosis. A multidisciplinary approach was taken to retain 4 teeth in strategic positions for rehabilitation with a tooth supported overdenture with magnet attachment. Magnetic attachment assembly consists of a magnet and a coping with a keeper cemented onto the remaining tooth structure.*

Key words: Magnet attachment, retention

## Introduction

Retention is one of the primary necessity for a removable prosthesis. Various retentive aids were tried and tested over the past century. Magnets are often used for the stabilization and retention of removable dental prostheses. The use of magnetic attachments is an established treatment modality. The repulsion power of aluminium-nickel-cobalt (AlNiCo) magnets were integrated initially into the prosthesis for management of patients with highly atrophied alveolar ridges.[1] Later the attractive forces between magnets were successfully used to aid in retention.[2] These initial attempts were associated with a range of complications, including low magnetic forces,corrosion, large size, expense, and technical difficulties, and hence they were only marginally successful. The evolution of samarium-cobalt (SmCo) magnets and, later, neodym-iron-boron (NdFeB) magnets[3] resulted in significant improvement. These magnets were smaller in size and yet had considerable retentive forces. Consequently, the use of remaining teeth to support magnets to retain and stabilize removable prostheses became quite popular.[4]

Concerns regarding the mucosal health and the biocompatibility of cemented permanent magnets led to the development of keeper system. Keepers are individually cast post and root cap components of an attachment system incorporating industrially produced magnetisable discs, or are available in prefabricated forms.[5,6] Keepers do not possess a permanent magnetic field; they are made of magnetizable alloys. The diameter of the corresponding magnet in the prosthesis is determined by the size of the disc in the keeper[7]. In conventional removable dental prostheses, magnetic attachments are used to improve retention.[8] Initially restricted to

maxillofacial indications, including craniofacial deficiencies and epithetics,[9,10,11] the use of magnetic attachments has been successfully established for implant-retained removable dental prostheses. Clinical and in vitro studies has established the advantages of magnetic attachments for these indications[12]. Advantages include control of load transmitted to implants, and the relative ease of prosthesis fabrication in complicated patients.

Different types of magnetic systems are available. They are open and closed magnetic systems[1]. In open systems, a static magnetic field exists around the two magnetic components in close contact with each other. Food debris or deposits may result in the separation of corresponding magnetic pairs.[13] When the magnets are separated, the magnetic force of attraction decreases nonlinearly. Self-centering of the prosthesis is possible. Depending on the design, the magnetic field in closed systems is within the magnetic components in contact with each other.[14] Thus, in contrast to an open system,the magnetic field in the oral cavity is reduced significantly. Compared to an open system of the same size, the effectiveness of the magnetic anchorage rises. But if the corresponding magnets are separated, the retentive force will decline more rapidly than that observed for an open system of

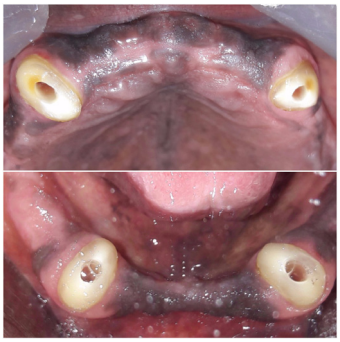

*Fig. 1* Post space prepared

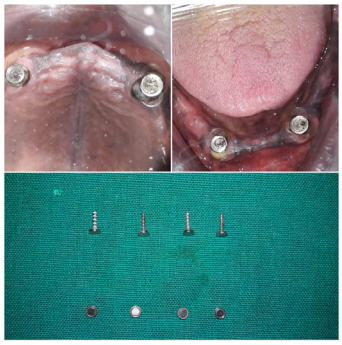

*Fig. 2* Keeper post cemented

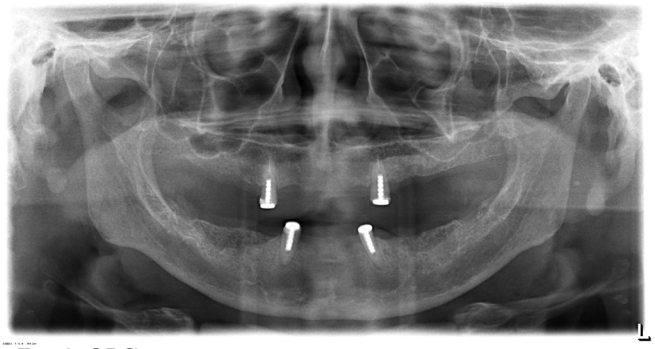

*Fig. 3* OPG

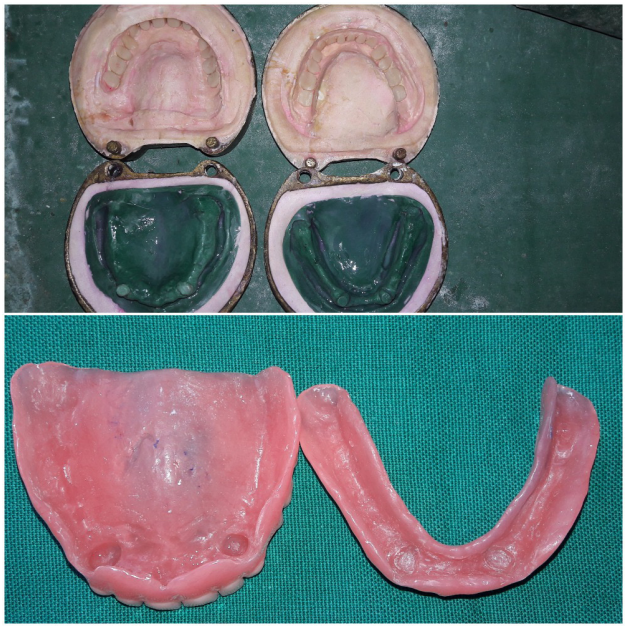

*Fig. 4* Flasked and acrylised

*Fig. 5* Magnet attachment picked up in self cure acrylic

the same size.[15,16] In addition, there is a difference between mono and duo systems. In mono systems, the magnetic pair incorporates a soft alloy with no static magnetic field, but it can easily be magnetized.[1] This system saves space, and may be applied as a keeper on preserved roots or as a manufactured abutment on implants. A duo system consists of two polarized magnets, one of which acts as a keeper or abutment being permanently positioned in the mouth. Recent research has shown no negative effects of such magnetic fields on soft tissue.[1,17] Recently developed magnetic retention systems are quite small but the retentive forces are very high. Although established and reliable magnetic attachments continue to be technologically modified and improved the corrosion leading to inonic leaching is an identified threat to these attachments.[18]

## Case report

A 65 yr old male patient reported to our department with chief complaint of mobile teeth. Patient wanted total extraction of all teeth and replacement with complete denture. Clinical and radiographic examination was done. Extraoral examination showed square face with convex profile and normal tonicity of muscles. Mouth opening was adequate with normal co ordinated movements of mandible. Intraoral examination showed normal mucosal texture. Teeth present were 15,13,11,21,23,38.37,35,34,33,43,47and 48. On the basis of clinical and radiographic findings the treatment options available were: 1) tooth supported overdenture with or without attachments 2) total extraction followed by conventional removable complete denture 3) total extraction followed by implant supported prosthesis.

Considering the philosophy of preventive prosthodontics in mind the case was planned to receive tooth supported overdenture with magnet attachments. Patient was made aware of the clinical condition and he was willing to preserve the remaining teeth as long as possible. 13,23,33,and 43 were planned to receive the attachments hence intentional RCT was advised. Remaining teeth were extracted. Tentative jaw relation was done to assess the amount of space available for magnet attachments. The abutment teeth were reduced to height of 2mm above gingival margin. Post space preparation was done upto size 5 peso reamer so as to receive the keeper post (Fig. 1). The keeper posts (MK 1000 length 16mm diameter 0.8mm surface diameter 4.5 mm)were cemented using resin cement (Kerr) (Fig. 2). OPG was taken and evaluated (Fig. 3). Primary impression was made followed by primary cast and fabrication of primary cast. Secondary impression was made using PVS light body (GC FLEXSEED) after border molding with green stick compound (DPI). Mast cast was prepared and occlusal rims were fabricated. Jaw relation was done. After teeth arrangement, trial insertion done. This was flasked and acrylised in the conventional method (Fig. 4). The processed dentures were tried in the patients mouth after relieving the undercuts and evaluated for fit and occlusion. The interceptive occlusal contacts were eliminated before incorporating the magnetic assembly. After 1 week the patient was recalled. The magnetic attachments (magnet thickness 1.5mm) were placed on the keeper and picked up in the processed denture using self cure acylic resin (Fig. 5). This prosthesis exhibited superior retention and patient satisfaction.

## Discussion:

Magnets can be easily incorporated into a denture which involves simple non surgical clinical procedures. Other advantages include ease of maintaining hygiene, ease of placement for physically disabled or patients who have neuromuscular incoordination, and constant retention with repeated cycles.[1] Huang et al[19] reported a relationship between the retentive force and surface abrasion of magnetic attachments, demonstrating that even after 90,000 cycles of grinding, the in vitro abrasion was recognized clearly through a microscope, but there were

no significant differences in attractive force between the before and after abrasion samples. Magnetic attachments are relatively shorter than mechanical attachments, are useful for patients with restricted interocclusal space and challenging esthetic demands. They can also accommodate a moderate divergence of alignment between the abutments,[20] and dissipate lateral functional forces.[5] Failure of magnets occur due to moisture diffusion through the epoxy resin seal and breakdown of encapsulating material leading to corrosion of magnet. The corrosion products weaken the overall magnetic attraction[13]. Drago[21] reported that among the patients with magnetic attachments, 68% of the attachments became discolored and 40% corroded. Thean et al[22] during a 3-year, long-term clinical study found that magnetic attachments with a sealed yoke exhibited successful corrosion resistance. Magnets do not provide a positive locking, thus the retention provided is less compared to intra radicular retention systems[5].

## Conclusion:

Magnetic assembly provides predictable retention, stability, support. Even though potential problems with the magnets may exist, ranging from uncertainty about long-term protection from salivary corrosion to the potential for distortion of images if patients undergo MRI of the head and neck. Magnet retained overdenture preserving natural abutment teeth has better proprioception and patient satisfaction. Hence they can be used as an adjunctive retentive aid.

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*The journal of*
PROSTHETIC AND IMPLANT DENTISTRY
Official Publication of Indian Prosthodontic Society
Kerala State Branch

# PLUMPING TECHNIQUE TO RESTORE FACIAL SYMMETRY IN A COMPLETELY EDENTULOUS PATIENT WITH FACIAL PARALYSIS: A CASE REPORT

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***Abstract:***

*Deformity of face is a devastating condition which has a negative influence on the patient's psychological well-being. The condition may be congenital or due to any disease, pathology, accident or as a result of resection of a benign or malignant lesion or idiopathic. The patient may feel reluctant to face the society since today's world is giving prime importance to esthetics. Facial paralysis is such a condition in which the most recognizable feature is the drooping of corner of mouth of the affected side and facial asymmetry. In this case report, a simple method called plumping to support the drooped corner of mouth and thereby restoring symmetry of a completely edentulous facial paralysis patient is discussed.*

Key words: Bell's Palsy,facial paralysis, plumping,

## Introduction

It is the right of every human to look like human! But in Bell's Palsy patients, there is loss of muscle control on the affected side of the face which results in drooping of corner of mouth. The expression of face changes drastically resulting in a mask-like appearance. Bells palsy is the most common acute lower motor neuron paralysis (LMN) of face. Permanent facial paralysis can be devastating to the patient[1].

Modern society's particular concern about the external and physical beauty has made the facial paralytic patient to seek for restoring proper contour of face. If a facial paralysis patient is completely edentulous, then the real challenge begins. This paper describes a case report, which uses a simple, effective,and non-invasive technique called plumping to restore facial symmetry in a completely edentulous facial paralysis patient. Plumping involves incorporating acrylic extensions in complete denture from canine to second molar region of buccal flange on the affected side. This cheek plumping technique restores facial symmetry and makes the patients mile more beautiful.

## Case report

A 60 year old completely edentulous male patient was referred from the Department of Oral medicine and Radiology with the diagnosis of Unilateral Bell's Palsy to the Department of Prosthodontics. The chief complaint of the patient was completely missing upper and lower teeth. The patient was a denture wearer for the last 8 years. His denture

was ill fitting and wanted replacement with a new denture. The patient also wanted to restore his drooping face on the right side of his face (Fig 1). He reports that his face was drooping to one side since childhood. Examination of the old dentures revealed decreased retention and stability of the maxillary and mandibular dentures. The diagnosis of unilateral Bell's palsy with complete edentulism was confirmed and was considered for rehabilitation of the patient with complete denture with modified buccal flanges by a technique called plumping.

Fig:1 Patient with drooping of right side of face

Fig 2: Wax added to maxillary buccal flange from canine to second molar area on right side

Fig 3: Try in done

Fig 4:Extra oral view of modified maxillary complete denture with buccal flange extention

## Procedure

Preliminary impressions were made for both maxillary and mandibular arches using Alginate impression material. Border molding was done with low fusing impression compound (Green stick) and final impressions were made with alginate. Vertical and horizontal jaw relation was recorded by using maxillary and mandibular occlusal rims. Teeth selection was done by assessing the facial form, contour and high smile line and matching shade was selected. After teeth setting, during wax up for try in of complete denture, a fold of modelling wax was added incrementally to the upper border of buccal flange area from canine to second molar area on the right side (Fig 2). During try in procedure the thickness of wax added on the buccal flange area was assessed and modification was done till the cheek was raised enough to lift for the restoration of satisfactory facial symmetry (Fig3). Anterior esthetics, occlusion, and phonetics were checked and found satisfactory. Acrylization was carried out, dentures were finished and polished (Fig 4). Denture insertion was done (Fig 5) and post insertion instructions were given. A slight lift in his right corner of mouth was perceivable which restored his facial asymmetry to some extent (Fig 6). Recall checkups were done after 3 days, one week, 1 month interval, and necessary corrections were done. The patient was happy and satisfied with the improved esthetics, masticatory efficiency,

Fig 5: Intra oral view of complete denture

Fig 6: Post operative view

and phonetics. On examination it was found that the extended flange did not cause any discomfort or lack of retention.

## Discussion

Bell's Palsy is defined as idiopathic paralysis of facial nerve of sudden onset[1]. Bell's palsy is one of the most common neurological disorder affecting cranial nerves. It is abrupt, isolated unilateral peripheral facial nerve paralysis without detectable causes. Idiopathic facial paralysis was described more than a century ago by Sir Charles Bells, however much controversy still surrounds its etiology and management. Bell's Palsy is the most common cause of facial paralysis world wide[2].

Bell's Palsy affects the unilateral facial muscles with typical features like inability to blink, absence of wrinkles on the forehead and asymmetry of face. The problems encountered during prosthodontic rehabilitation include uncontrolled flow of saliva, a mask like expressionless appearance and cheek biting. All these features may result in impairment of the prosthesis since they interfere with the steps like impression making,border molding, jaw relation and denture retention and stability.

A combination of surgical and mechanical support has been reported for patients with Bell's Palsy. Conservative treatment which includes non-invasive techniques and palliative approach has been drawn great interest for the patients for whom surgical procedures are a nightmare. Modifications of the denture to provide support to the cheek like padding of the buccal flanges, extending the width of the acrylic flanges, spring loaded acrylic flanges and magnet retained cheek plumpers are some of the conservative approaches to restore the facial asymmetry by providing support to the flaccid buccal musculatures[3].

In Bell's Palsy patients, the most common problem in prosthetic rehabilitation is the hampering stability due to the inability to maintain and transfer food on the occlusal table. Nevertheless, the advantage that can be drawn from the perioral musculature paralysis is that it would permit the over extension of the maxillary buccal flange without any loss of retention and stability. The extended flange provides fullness below the zygoma and also physically lifts the sagging cheek into position. This helps to relatively improve the facial esthetics and position the corner of mouth closer to the occlusal plane. Repositioning the corner of mouth helps to prevent the drooling of saliva which is accumulated in the buccal vestibule of the affected side. Extension of the buccal flange beyond the occlusal plane towards the mandible was adjusted to come in the contact with the mandibular denture while the teeth are in firm occlusion. This further prevented the food being escaped into the buccal vestibule and also provided stability to the mandibular denture during mastication. Recall checkups were done to monitor the changes in the occlusal contacts and need for correction in the downward extension of the maxillary buccal flange.

As seen from the literature it can be confirmed that rehabilitation of completely edentulous Bell's Palsy patient has always been a topic of interest since the past. Many authors have advocated improvisations in denture designs which can support the drooping corners and restore the symmetry. Lazzari in 1955 fabricated a removable partial denture framework with an attached open loop of wire that was used as a hook to engage the corner of the mouth and raise the lip[4].

Many years later, in 1976 Larsen designed a modified maxillary removable partial denture with buccal retentive mesh, on which modeling plastic was added to elevate the vestibule and the cheek. After evaluation of the esthetics and phonetics, acrylic resin was substituted for modeling plastic[5].

Around the same time, in 1977 Tautin used a 19 guage stainless steel wire extending from the mandibular complete denture extraorally to support the lower lip[6]. Suresh Sajjan in 2012 made

a prosthesis with extra oral loops to support lower lip in a patient with bilateral Bell's Palsy[7].

Hussain S in a clinical report described about how a completely edentulous Bell's Palsy patient was rehabilitated with hollow denture with monoplane occlusal scheme for improved retention and stability[8]. Different techniques evolved as the time passed on and modifications in denture came as per the dentist's creativity.

## Conclusion

Patients who seek complete denture treatment are normally old age people who may be debilitated because of poor systemic and mental health. There will be impairement in stomatognathic function and neuromuscular coordination. Providing a well retained complete denture which aids in mastication can improve the overall health of patient.

However the clinical techniques of complete denture construction is a challenging task and requires modifications if patients suffer from various neuromuscular disorders such as facial paralysis, cerebral ataxia, Bells Palsy, acoustic neurinoma, myasthenia gravis etc[9].

Prosthodontics is a field where the artistic skills and technical skill has to blend in correct proportion so that the prosthesis which we give should satisfy both functional and esthetic requirements of the patient. An implant supported prosthesis would be a better option to restore the function better than a removable prosthesis but due to collapse of cheek on the affected side the longevity of implant will be questioned. Descriptions about the methods to augment the muscle support like surgical correction, neutral zone technique,undetachable or detachable cheek support prosthesis, intraoral splints,spring loaded acrylic flanges, magnet retained cheek plumbers etc are available in Dental literature. The main disadvantage of undetachable cheek plumbers is food impaction resulting from the weak buccinator and proneness to candidiasis infection. Continuous review and monitoring of patient is necessary[10]. Mithra and Rajapurhas suggested from their experience that a systemic step wise approach of providing an interim denture for neuromuscular training which ensures predictable mandibular movements before the fabrication of final dentures[11].

In this case a simpler approach of modifying buccal flange of the maxillary denture by a technique called plumping was practiced. The described technique offers an inexpensive, non invasive, simple technique to restore the facial symmetry in a unilateral Bell's palsy patient.

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Volume 1 Issue 1 SEP–DEC 2017