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EDITORIAL – TILTING AT WINDMILLS

A plethora of conferences, conventions and CDE’s are designed with the noble intention of helping doctors upgrade their knowledge. However, attendance at the scientific sessions are sparse in contradiction to the number of registration. Apparently these programs are perceived more for their social networking and fellowship value.

The essence of knowledge is basically the desire to learn and is not pursued in all seriousness is a grave injustice to the very fabric of the scientific temper.

Registering for conferences and not actively participating in the scientific deliberations is, to use a literary metaphor, akin to tilting at windmills.

Miguel Cervantes in his seminal work, Don Quixole, recounts the adventures of simpleton Alonso Quixano. Quixano, detached from reality and saturated with stories of chivalry sets out on a quest to revive chivalry. The novel appears frivolous and humorous but is pregnant with meaning. The enduring image of a knight attacking a windmill in the belief that they are giants best exemplifies the conference attendance conundrum!

Just by registering and not attending the scientific session is akin to tilting at windmills! Just by opening the books and not reading the words, you don’t gain knowledge. So just by registering and not attending the sessions ???

I rest my case.

–DR. KENNETH E.H.TAN
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INTRODUCTION

The introduction of computer-aided design and computer-assisted manufacturing (CAD/CAM) for the fabrication of crowns, inlays, and fixed partial denture fabrication is well advanced. Furthermore, CAD/CAM and rapid prototyping (RP) have also been used in areas of maxillofacial technology. The development and evaluation of these advances continue. Advantages of such systems have been well documented and may well eventually become the “next generation” of methods of fabrication.\(^1,2,3\) Research has shown that, in principle, CAD/CAM/RAPID PROTOTYPING technologies can be successfully applied in the fabrication of removable partial denture(RAPID PROTOTYPING) alloy frameworks.\(^4\)

Various methods of scanning are used throughout dentistry, including lasers. The most common type of scanner used is an optical system that uses projected light and digital camera technology to capture approximately 140,000 points in 3-D on the surface of the object, termed

**ABSTRACT**

The extensive use of computer-aided design and manufacturing(CAD/CAM) techniques for the fabrication of casts partial dentures is largely unexplored. This review article emphasizes the development and investigation of computer-aided techniques that may eventually enable the prosthodontist a method to digitally survey and build virtual patterns for removable partial denture (RPD) framework using a new three-dimensional(3D) computer-aided design/computer-assisted manufacturing (CAD/CAM) software package developed specifically for RPD design.

**Key Words:** CAD/CAM, 3-D, Survey, removable partial denture designing, Rapid Prototyping(RP)
a “point cloud.” The scanner can only collect data on surfaces within the line of sight. Areas on the surface that are obscured or at too great an angle to the line of sight will not appear in the scan data.

**TECHNIQUE**

**3-D surface capture**

1. Obtain a 3-D computer model of the patient's cast using an optical surface capture device.
2. Align and combine the data points from each of these scans using CAD software to provide a single coherent data set of the entire object. Use the resultant data points (termed a “point cloud”) to create a 3-D surface model.
3. Produce a solid 3-D computer model on the screen using a triangular-faceted polygon mesh.

**3-D computer-aided design**

4. Electronically survey the scan using the software package described previously. The depth of undercut can be copied from the definitive cast to determine clasp termination.
5. Model the shape of the components of a removable partial denture framework on the scanned surface model using 3-dimensional CAD software.
6. Use a Rapid Prototyping (stereolithography) machine to produce a plastic (WaterClear 10110 Epoxy Resin for Stereolithography) physical model of the components described above.

**SCANNING THE DENTATE CAST**
DESIGNING DIGITALLY SURVEYING THE CAST

DESIGNING THE COMPONENTS
which can be used for trial fit before casting. Use RAPID PROTOTYPING processes to create a sacrificial pattern of a removable partial denture framework, to be incorporated directly into the existing casting procedures found in the typical dental laboratory.¹

Fabrication

7. Use the sacrificial pattern to invest, cast, and finish

FABRICATION OF PROSTHESIS

Fabrication of the framework is done by Rapid Prototyping Technology and Stereolithography is among the most accurate and precise rapid prototyping technologies available.

RAPID PROTOTYPING

Rapid prototyping is the process of producing physical prototype in a layer by layer manner from their CAD models without any human intervention or any tools, dies or fixtures specific to the geometry of the object being produced. Rapid prototyping although initially developed for engineering, product development environment has found its place in almost all areas of our lives. One of the most exciting applications of RP is in medical field often referred as rapid biomodelling or rapid bioprototyping.

RP is a type of computer-aided manufacturing that refers to automatic construction of mechanical models from graphical computer data. The two main methods of RP are as follows firstly, additive which is widely used and secondly, subtractive which is less effective.

Fabricate a scale model of a physical part or assembly using three-dimensional computer aided (CAD) data. Construction of the part is usually done using 3d printing technology.

STEREOLITHOGRAPHY

The term “stereolithography” was first introduced in 1986 by Charles W. Hull, who defined it as a method for making solid objects by successively printing thin layers of an ultraviolet curable material one on top of the other. A concentrated beam of ultraviolet light is focused onto the surface of a vat filled with liquid photopolymer and, as the light beam draws the object onto the surface of the liquid, each time a layer of resin is polymerized or crosslinked. The item is built up layer by layer, to give a solid object. The basic manufacturing process is as follows:

- A 3D model of the desired object is created in a CAD program.
- A software package slices the CAD model up into thin layers, which may be anything from 5 to 20 layers per millimetre and the more layers the better the resolution.
- The laser scans the liquid resin in the vat and it sets, thus creating the first layer.
- The platform drops down into the vat by a fraction of a millimeter and the laser scans the next layer. This process is repeated layer by layer until your model is complete.
- Once the run is complete, the objects is rinsed with a solvent to remove uncured resin and then placed in an ultraviolet oven that thoroughly cures the resin.⁶
(top) Virtual RAPID PROTOTYPING framework and supports prepared for building. (center) Metal frameworks emerging from the SLM machine. (bottom) The RAPID PROTOTYPING frameworks fit to the casts.
DISCUSSION

The many benefits associated with CAD/CAM generated dental restorations include: the access to new, almost defect-free, industrially prefabricated and controlled materials; an increase in quality and reproducibility and also data storage commensurate with a standardised chain of production; an improvement in precision and planning, as well as an increase in efficiency. As a result of continual developments in computer hardware and software, new methods of production and new treatment concepts are to be expected, which will enable an additional reduction in costs.

The concept of introducing CAD/CAM into the fabrication of RPD frameworks is taken a step further than previous work. The successful trial-fitting of the cast cobalt–chromium framework to an actual patient in the clinic has indicated that the accuracy, tolerances, and overall ‘fitness for purpose’ suggested in previous studies can be achieved in clinical case.

Super-alloys, such as Co–Cr, are suited to the SLM(Stereolithography) process as the material properties facilitate the process physics, such as melt-pool and temperature gradient control.7 The first and the most important step in designing and fabrication of cast partial denture through this technology is visual inspection of the diagnostic cast and thorough treatment planning which can then be improvised in the final prosthesis.7 The current software will not help in deciding the design of the prosthesis, the design has to be evaluated by the clinician and the software will only help in placing the components wherever required.

The disadvantages of the methods at this time include the cost of the scanning equipment,
CAD software, trained personnel required and RAPID PROTOTYPING techniques. Though the initial investment of the machine is expensive, the framework can be fabricated at the same cost as the conventional partial denture. This could be attributed to the labour needed to fabricate a conventional cast partial denture is much higher whereas for this procedure only one person is required. However, the majority of the cost is in this initial investment, and such costs are likely to decrease with further technical development.

To produce a scanned model with a surface takes approximately 5 to 15 minutes of operator time and 1 hour of machine time. Time taken to virtually survey the 3-D cast is comparable to physical surveying or perhaps slightly faster. Building the framework on screen may take about 40 minutes, but it is likely that with practice, this time could be greatly reduced.4 Furthermore, a degree of time and experience is needed to learn and create a valid surface from scanned “point cloud” data. However, as familiarity with this technology increases, time saving can become the major advantage of this procedure, because as many as 50 CPD’s can be fabricated in 14 hours. This can be compared favourably with the considerable amount of time required to manually survey a cast. The adoption of CAD/CAM techniques may be highly advantageous in the field of removable partial dentures. The electronic surveying technique described previously allows the almost instant identification of survey lines but is only the first step in the development of dedicated dental design software.8

Future developments may enable the computer to automatically determine a suggested path of insertion and, with further research, undesirable undercuts could be eliminated and favourable undercuts can be identified. At another stage, components of a removable partial denture could be stored in a library and “dragged and dropped” in place on a scanned and surveyed cast from icons appearing on the screen. This would allow virtual patterning to be carried out in a much faster time than is achieved by current techniques. In addition, RAPID PROTOTYPING machines build the object directly, the framework can be checked for trial fit in patients mouth before casting. The CAD/CAM process also delivers inherent repeatability, helping to eliminate operator variations and therefore potential time saving.8

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<th>SCOPE</th>
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<td>LABORATORY PURPOSE</td>
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<td>50 CPD’s in 14 hours</td>
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<td>More initial investment</td>
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CONCLUSION

In practical application, the procedure is much simpler than explained here. However, every component needs to be modified using the tools the software provided to meet RPD design requirements and obtain a satisfactory shape. The current technique compared to the conventional technique is less complicated and time-consuming and makes the design of an RPD simpler and faster. It could therefore gain new clinical applications.

REFERENCES


LASERS IN PROSTHODONTICS

Dr. Sharvika Ahuja¹, Dr. Malathi Dayalan²

INTRODUCTION

Laser dentistry is the most exciting new frontier in dentistry today. Only 10 years ago procedures with a beam of light, which are routine today, would have been thought impossible. Safe, painless dentistry has long been the dream of dentists and patients alike, and in many clinical cases this is now being achieved by lasers.¹ Procedures that may have been intolerable to some, previously, are now entirely reasonable.²

ABSTRACT

LASER: “Light amplification by stimulated emission of radiation”. The word light in this phrase is used in the broader sense, referring to electromagnetic radiation of any frequency, not just that in the visible spectrum. The speciality of prosthodontics takes all concepts of dentistry and integrates effective comprehensive treatment planning. Laser has wide application in Prosthodontics; removable prosthetic reconstruction, fixed Prosthodontics, dental implantology and the aesthetic dentistry,

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2. Professor & Head

Removable prosthetic reconstruction
Fixed prosthodontics
Implants
Aesthetic dentistry
Dental laboratory procedure
LASERS IN REMOVABLE PROSTHODONTICS

HARD TISSUE APPLICATION

- TREATMENT OF UNSUITABLE ALVEOLAR RIDGES: Soft tissue laser surgery exposing the bone may be performed with the soft tissue lasers (CO2, diode, Nd:YAG); Hard tissue surgery may be performed with the erbium family of wavelengths.

- TREATMENT OF IRREGULAR AND UNDERCUT ALVEOLAR RIDGES: with the erbium family of lasers.

- SURGICAL TREATMENT OF UNSUPPORTED SOFT TISSUES: found in the anterior maxilla opposite mandibular anterior teeth with an edentulous posterior mandible. (HYPERTROPHIC MAXILLA): CO2, diode, Nd:YAG lasers used.

- THE ENLARGED TUBEROSITY: An erbium laser is the laser of choice for the osseous reduction.

- SURGICAL TREATMENT OF TORI AND EXOSTOSES: Soft tissue lasers may be used to expose the exostoses, and erbium lasers may be used for the osseous reduction.

SOFT TISSUE LESIONS:

Hyperplastic fibrous tissue may be formed at the junction of the hard and soft palate as a reaction to constant trauma and irritation from the posterior-dam area of the denture; done with soft tissue lasers.

- EFFECT OF LOW-ENERGY LASER APPLICATION IN THE TREATMENT OF DENTURE-INDUCED MUCOSAL LESIONS: They are primarily used to relieve pain, reduce inflammation, edema and accelerate healing.

USES OF LASER IN FIXED PROSTHODONTICS

- CROWN PREPARATION: because anesthetics were not permitted, the laser was used for the procedure. A setting of 6 W with 90% air and 75% water was used to “anesthetize” the tooth. This laser anesthesia creates a cold sensation often equated to a “brain-freeze” on the tooth.

- THE USE OF LASER IN DEFINING THE EMERGENCE PROFILE OF ABUTMENT AND PONTIC SPACE IN A COMBINED NATURAL TOOTH/IMPLANT-SUPPORTED FIXED PROSTHESIS: Nd:YAG Lasers are used; especially in preparing site for ovate pontics.

- THE USE OF A QUARTZ FIBER DELIVERY LASER WAVELENGTH AS ADJUNCTIVE TO GINGIVAL CUFF RETRACTION DURING IMPRESSION TAKING: 320-lm fiber and especially the 200-lm fiber used in the diode and the Nd:YAG.

- GINGIVAL MANAGEMENT; Intrusive gingival tissue relative to restorative margins are removed to enhance the aesthetics of a pontic space, or to establish increased clinical crown length electively.

- CROWN LENGTHENING AND UPPER LABIAL FRENECTOMY; done with carbon dioxide laser.

- SOFT TISSUE MANAGEMENT ADJUNCTIVE TO CROWN PLACEMENT: use of 810-nm diode laser treatment in removing gingival ingrowth relative to a projected finishing margin for a full-veneer crown is done.

- REMOVAL OF GINGIVAL OVERGROWTH BEFORE RECEMENTATION OF BRIDGE: following infiltration local anesthesia (2% lidocaine, 1:80,000 epinephrine), the excess soft tissue can be excised with soft tissue lasers i.e. CO2, diode, Nd:YAG

LASERS IN AESTHETIC DENTISTRY

Used for SMILE DESIGNING: Aids in the determination of proper gingival contour, symmetry, gingival gradation, axial inclination,
and zenith; Discolored front teeth and failing restoration; Gingival hyperplasia secondary to orthodontic treatment and a partially unerupted maxillary second molar; Short, wide upper teeth and a gummy smile; Gingival Recontouring and Veneering.

**LASERS IN DENTAL IMPLANTOLOGY**

**INDICATIONS**: The potential benefits of using lasers to repair ailing implants, Uncovering Implants, Implant Placement, Laser use in peri-implantitis, Surface decontamination using laser applications; CO2, Nd:YAG, Erbium: yttrium aluminum- garnet (Er:YAG) laser

**LASER APPLICATIONS IN THE DENTAL LABORATORY**

Laser holographic imaging used for storing topographic information, such as crown preparations, occlusal tables, and facial forms.

**STERILIZATION AND INFECTION CONTROL**

Steam sterilization is the standard of care.

Small flexible optic fibers, hand pieces, or tips must be steam sterilized in separate sterilization pouches after each use.

**ADVANTAGES AND LIMITATIONS OF LASERS**

The ability to precisely interact; elimination of microfractures and lowering of pulpal temperature as compared to conventional high speed handpiece; faster healing; reduction of the amount of bacteria and other pathogens in the surgical field; good hemostasis can be achieved along with reduced need for sutures and surgical packing; postoperative scar formation is minimized; improved visualization of the surgical field; post-operative discomfort and swelling is reduced

**DISCUSSION**

Dentistry has changed tremendously over the past decade to the benefit of both the clinician and the patient. New materials and technologies have improved the efficiency and predictability of restorative dentistry for clinicians. The computer has increased its influence in the dental field with digital radiography and photography, and CAD-CAM restoration fabrication.

Laser was initially introduced as an alternative to the traditional halogen curing light. Now it has become the instrument of choice in many applications.  

**CONCLUSION**

The speciality of prosthodontics takes all concepts of dentistry and integrates effective comprehensive treatment planning. These include individuals who are highly fearful of dentistry and have long-term neglected care and those who have complex medical histories and require more specialized, advanced procedures. Some also have phobias or allergies to anesthetics. Lasers have become an integral part of treatment for these patients.

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Management of Temporomandibular (TMD) disorders
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ABSTRACT
Temporomandibular joint (TMJ) diseases and disorders refer to a complex and poorly understood set of conditions, manifested by pain in the area of the jaw and associated muscles, and limitations in the ability in speaking, facial expressions, eating, chewing, and swallowing. It has been estimated that 25% of the general population suffer from TMJ related symptoms. General joint and muscle diseases, psychological and psychosocial factors, and local influences such as occlusal disturbances, emotional stress, parafunctional activities, that is, clenching, bruxism and trauma can affect the condition of the TMJ. This article describes the etiology, epidemiology and management of this condition.

Key Words: Temporomandibular joint (TMJ) disorders, self care, occlusal splints

Introduction:

Temporomandibular disorders (TMD) comprise a spectrum of conditions affecting the temporomandibular joints and muscles of mastication. These musculo-skeletal conditions have similar signs and symptoms including pain, limitation of movement, joint noises (clicking and crepitus), in coordination, headaches and occasionally tinnitus. In recent years, specific diagnostic criteria for sub-diagnoses of TMD have been introduced. Over the years many functional disturbances have been identified by a variety of terms.¹

In 1934 James Costen² described a group of symptoms that centered on the ear and temporomandibular joint (TMJ). Because of his work the term Costens syndrome developed, later the term temporomandibular joint disturbances became popular. In 1959 Shore³ introduced the term Temporomandibular joint dysfunction syndrome. Later came the term functional temporomandibular joint disturbances, coined by Ash and Ramjford.⁴

Some terms described the suggested causes, such as occluso mandiblar disturbance⁵ and myoarthrography of the temporomandibular joint.⁶ others stressed pain, such as pain dysfunction Student¹, syndrome⁷,myofacial pain dysfunction syndrome,⁸ temporomandibular pain dysfunction syndrome⁹. Because the symptom are not always isolated to the TMJ, some authors believe the forgoing terms are too limited and that a broader, collective term should be used, such as
craniomandibular disorders. Bell suggested the term temporomandibular disorders (TMD’s) which has gained popularity.

According to the American Academy of Orofacial pain, temporomandibular disorders are defined as ‘a collective term embracing a number of clinical problems that involve the masticatory muscles, the TMJ, and associated structures, or both.’

Epidemiologic studies carried out demonstrated particular features which Helkim has enumerated as follows: Symptoms of dysfunction of the masticatory system appear to be very common in unselected material and to occur more often than previously assumed. There are no great differences in the frequency of dysfunction for men and women in the general population. TMD is seen most commonly in people between the ages of 20 and 40 years, and occurs more often in women than in men. Symptoms of mandibular dysfunction have been found in persons of all age groups. The slight differences in age distribution indicate that symptoms occur most frequently in older individuals. The incidence of mandibular dysfunction in elderly patients, especially those who wear dentures, appears to be very high. Circumstantial evidence supports the speculation that parafunctional activity and its adverse effects are prevalent in elderly persons. No predominant etiologic factor of dysfunction of the masticatory system has been found in the populations' studied.

Different types of functional malocclusion have been shown to be partly responsible for signs and symptoms of TMD. The functional unilateral posterior crossbite (FUPXB) might be a contributing factor for mandibular dysfunction. The habitual body posture (HBP) during sleep is also speculated as being one of the possible reasons for disc displacement. A study conducted by Hibi and Ueda suggests that HBP allows the ipsilateral condyle to displace posteriorly and this posterior position causes anterior disc displacement. Juvenile chronic arthritis, a chronic arthritis in childhood with an onset before the age of 16 years and duration of more than 3 months, is also reported as a TMD risk factor.

The six most frequent symptoms of the temporomandibular joint syndrome in order of occurrence as reported by Posselt are clicking of the temporomandibular joint in connection with one or more other symptoms, decreased joint mobility, pain in or around the ears, pain especially during mandibular movement, headache, tenderness of the joint to palpation. The most frequent symptoms in this study in order of occurrence were: clicking, headache, vertigo, nasopharyngeal symptoms, pain on mandibular movement, and limited movement. A high comparative incidence of vertigo was present in the most recent study.

**Treatment options for Temporomandibular joint disorders**

Despite the large percentage of the population having signs and symptoms of TMD, it has been estimated that only 2% or less of the general population seeks treatment for a TMD symptom. Treatment methods according to Zarb selected to obtain symptomatic relief are, patient counseling, pharmacologic therapy, (non steroidal anti-inflammatory drugs, muscle relaxants, tricyclic anti depressants, anxiolyics), use of topical and/or local anesthetics, occlusal adjustment, bite plane treatment, physical therapy (mandibular exercises, trigger point therapy (spray and stretch))
Self care:

Rest and avoiding extreme jaw movements, taking medications, applying moist heat or cold packs, eating soft foods are other ways that may keep the disorder from worsening.22

Physical therapy:

Physical therapy 23represents a group of supportive actions in usually instituted in conjugation with definitive treatment. It is an important part of the successful management of many TMD’s. It falls into two general categories

1) Modalities
2) Manual techniques

Physical therapy modalities:

They are of following types:

Thermotherapy, coolant therapy, ultrasound, photophorosis, iontophoresis, EGS therapy, Transcutaneous electrical nerve stimulation (TENS), acupuncture, laser.

2) Manual techniques:

They are the hands on therapies provided by the physical therapist:

1) Soft tissue mobilization
2) Joint mobilization
3) Muscle conditioning

Management of derangements of the condyle disc complex i.e. disc displacements and disc dislocation with reduction and disc dislocation without reduction.

Definitive treatment of disc displacement and disc dislocations with reduction:

The goal of treatment is to reduce intra capsular pain, not to recapture the disc. A stabilization appliance is used because adverse long term affects are minimized. When this appliance is not affective anterior repositioning appliance should be fabricated.

Supportive therapy for disc displacement and disc dislocation is to decrease loading of the joint whenever possible, soft foods, slow chewing and smaller bites should be promoted.

Disc dislocation without reduction:

It is a clinical condition in which the disc is dislocated, most frequently anterio medially, from the condyle and does not return to normal position with condylar movement.

The definitive treatment includes initial therapy should include an attempt to reduce or recapture the disc by manual manipulation.

Supportive therapy:

Begins with education of the patient about the problem, decrease hard biting. If pain persists, hard heat or ice may be used. Joint distraction and phonophoresis over the joint area may be helpful.

Structural incompatibility of the articular surfaces:

Deviation:

Supportive therapy:

Stabilization appliance is indicated to decrease muscle hyperactivity, if pain is associated, analgesics may be necessary to prevent the development of secondary central excitatory effects

Adherences and adhesions

Definitive therapy:

Because adhesions are associated with prolonged static loading of the articular surfaces, definitive therapy is directed towards decreasing loading to these structures. Loading is related to clenching and it is best managed by patient awareness and PSR techniques

It should be noted that since surgery is aggressive, definitive treatment for adhesions should be performed only when it is necessary.

Inflammatory disorders of the TMJ

Synovitis and capsulitis

When the cause is microtrauma, the condition is self limiting because the trauma is no longer present. Therefore no definitive treatment is indicated for the inflammatory condition

Supportive therapy:

Patients complaining of constant pain should
be treated with mild analgesics like NSAIDS.

Thermotherapy of the joint area is helpful and patient is instructed to apply moist heat for 10 minutes, 4-5 times throughout the day. Ultrasound therapy can be helpful for these disorders, and it is instituted 2 to 4 times per week.

**Splints:**

Principles of full occlusal splint design must incorporate four main principles:

1. The splint should allow uniform, equal-intensity contacts of all the teeth against smooth splint surface when the joints are completely seated in centric relation.
2. The splint should have an anterior guidance ramp angled as shallow as possible for horizontal freedom of mandibular movement.
3. The splint should provide immediate disclusion of all posterior teeth in all excursive jaw movements from centric relation.
4. The splint should fit the arch comfortably and have good stable retention.

Splints are custom made acrylic appliances that fit over the upper or lower teeth. They prevent muscle overuse, including bruxism and lessening the effects of clenching or grinding the teeth.

Posselt and Wolff evaluated the effects of hard acrylic resin splints, resilient acrylic resin splints, and modified Hawley plates. However, there was a tendency toward better results when a hard acrylic resin splint was used. The splint should be worn till all related pain is gone, the joint structure is stable and the bite structure is stable.

The splints also correct the bite by positioning the teeth in their most correct and least traumatic position. Dental management of TMD treatment often involves occlusal splints and occlusal adjustment. A critical review has found that occlusal splints may be of benefit in TMD, but there is little evidence for the use of occlusal adjustment. Occlusal splints are usually designed to cover the occlusal surfaces of the teeth and many consider the resulting change in occlusion to be responsible in part or in total for the therapeutic effect.

Some of the common occlusal splints used in clinical practice are:
- Stabilization splint
- Anterior positioning splint
- Anterior bite plane
- Posterior bite plane
- Pivoting appliance
- Soft or resilient splint

**Stabilization splint:**

It provides an occlusal relationship in the masticator system that is considered optimal, i.e., condyles are in the most stable position and at the same time, the teeth are contacting simultaneously. This splint is indicated in muscle pain disorders, parafunctional activity accompanied by stress, local muscle soreness or chronically mediated myalgia. It is used for night-time wear, over a period of approximately 4 weeks.

**Anterior repositioning splint:**

Also called as pull forward splint or mandibular orthopedic repositioning appliance
MORA). It is used in joint sounds, disc derangement procedures, intermittent or chronic locking of the joint, retrodiscitis.  

If the disc is partially displaced and the condyles have been destabilized on the posterior aspect of the disc, it may benefit by moving the condyle forward to a more centered position on the disc. This splint is worn at all times except during meals. It is used temporarily for a period of 4-6 weeks.

**Anterior bite plane**

It is indicated in treatment of muscle disorders related to orthopedic instability or acute change in the occlusal condition and parafunctional activity.

**Posterior bite plane:**

It is advocated in cases of severe loss of vertical dimension of occlusion or for anterior repositioning of the mandible. Its use can also be indicated for certain disc interference disorders.

**Soft or resilient splint:**

These are fabricated from a resilient material (such as poly vinyl chloride). They are usually indicated to prevent sports injuries and are worn to achieve even and simultaneous contacts with the opposing teeth and act as cushion to prevent traumatic contact of the opposing teeth.

Okeson demonstrated that nocturnal masseter electromyographic (EMG) activity was increased in 5 of 10 subjects with a soft appliance; in the same study, 8 of the 10 subjects had significant reduction of the nocturnal EMG activity with a hard stabilization appliance.

Other studies evaluating the effectiveness of hard and soft appliances on symptoms showed that although soft appliances can reduce symptoms, hard appliances seem to reduce symptoms more quickly and effectively. Hard appliances seem to reduce the EMG of the masseter and temporalis muscle more than soft appliance, while controllably clenching the teeth.

The stabilization appliance is generally indicated for TMD related to muscle hyperactivity and joint pain whereas the anterior repositioning splint is generally indicated for disc displacement disorders resulting in clicking and intermittent locking of the TMJs. In randomly controlled studies Dao reported no difference between splints, whereas Rubinoff stated a minor difference whereas Ekberg stated that the stabilizing splint was significantly better.
Recently, the NTI tension suppression system (NTI TSS) is under clinical trial. By preventing the nocturnal parafunctional occluding of the canine and molar teeth, which is required to generate significant muscle contraction intensity and jaw joint strain, the NTI-TSS device prevents and reduces the muscular triggering component.27

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Introduction
Smile design refers to the many scientific and artistic principles that considered collectively can create a beautiful smile. These principles are established through data collected from patients, diagnostic models, dental research, scientific measurements, and basic artistic concepts of beauty. From the patient’s perspective, beauty measures that individual’s perception of beauty as noted in the saying: “Beauty is in the eye of the beholder.” That perception of beauty may also be influenced by cultural, ethnic, or racial concepts of beauty. A comprehensive dental examination should include dental radiographs, mounted diagnostic models, photographic records, and a thorough clinical examination and patient interview. The clinical examination should include a smile analysis and evaluation of teeth, temporomandibular joints, occlusion, existing restorations, periodontal tissues, and other soft tissues of the oral cavity.

In addition to the esthetics, the function component of the anterior teeth must be considered in treatment planning. Anterior guidance in harmony with healthy joint positions is key in establishing a stable occlusal scheme.

Components of smile
The principles of smile design require an integration of esthetic concepts that harmonize facial esthetics with the dental facial composition and the dental composition. The dental facial composition includes the lips and the smile as they relate to the face. The dental composition relates more specifically the size, shape, and positions

ABSTRACT
Facial expressions mirror our emotional states and serve as crucial non-verbal communication tools. A beautiful smile seems to reflect a patient’s personality and the enhancement of facial beauty is one of the primary goals of patients seeking elective dental care. The lower third of the face has a major impact on the perception of the facial esthetic, and the role of a beautiful smile is therefore, undeniable. An understanding of golden proportion that has long stood for beauty may provide us with useful guidelines that can be combined with our existing knowledge and applied to our dental work for restoring dental esthetics with reasonable assurance of success.

Key Words: esthetics, golden proportion, smile analysis, dentofacial esthetics
of the teeth and their relationship to the alveolar bone and gingival tissues. Therefore, smile design includes an evaluation and analysis of both the hard and soft tissues of the face and smile. This article focuses on the dental-facial and dental composition involved in smile design.

**Dento Facial Composition**

Facial beauty is based on standard esthetic principles that involve the proper alignment, symmetry, and proportions of the face. Facial features in smile design include facial height, facial shape, facial profile, gender, and age. In classical terms, the face height is divided into three equal thirds: from forehead to brow line, from brow line to the base of the nose, and from the base of the nose to the base of the chin. The facial features related to gender and age involves the soft tissues and includes the texture, complexion, and tissue integrity of the epithelial tissues.

Facial features that have a particularly important impact on the dental, facial composition are those that relate the interpupillary plane with the commissural line and the occlusal plane. The interpupillary line should be parallel with the horizon line and perpendicular to the midline of the face. In addition, the interpupillary line should be parallel with the commissural line and occlusal plane.

**Types of smile**

Depending on the direction of elevation and depression of the lips and the predominant muscle groups involved, Rubin classified three smile styles into commissure, cuspid and complex types. In commissure smile, the corners of the mouth turn upwards due to the pull of the zygomaticus major muscles. Commissure smile is characterized by the action of the zygomaticus major muscles, drawing the outer commissures outward and upward, followed by a gradual elevation of the upper lip. In cuspid smile, the upper lip is elevated uniformly without the corners of the mouth turning upward i.e. the entire lip rises like a window shade. (Figure-1) The cuspid smile is characterized by the action of all the elevators of the upper lip. In complex smile, the upper lip moves superiorly as in the cuspid smile but the lower lip also moves inferiorly in a similar fashion. (Figure-2) The complex smile is characterized by the action of the elevators of the upper lip and the depressors of the lower lip acting simultaneously. Patients with complex smiles tend to display more teeth and gingiva.¹⁹

**Analysis of lips**

Lip analysis is another important soft tissue feature helpful in evaluating the dental-facial composition and establishing a smile design. Understanding lip morphology and lip mobility can often be helpful in meeting patients’ expectations. The upper lip is more arched and wider than the lower lip. The lower lip is beneath the upper lip approximately 30° in relation to the upper lip when the arches are properly aligned. There are three aspects of the lip morphology that should be considered: width, fullness, and symmetry.

Wide lips make for a wide smile. In general terms, a smile that is at least half the width of the face, at that level of the face, is considered esthetic.
The fullness and symmetry of the upper and lower lips—should also be documented. The fullness of the lip, or lip volume, can be categorized as full, average, or thin. Lip symmetry involves the mirror image appearance of each lip when smiling.3 The upper and lower lips should be analyzed separately and independently of one another. Recognizing the etiology of lip asymmetries is helpful in determining if there is a dental solution for improvement or if plastic surgery is necessary.

Lip Line

When smiling, the inferior border of the upper lip as it relates to the teeth and gingival tissues is called the lip line. The amount of tooth exposure during a smile depends on a variety of factors, such as the degree of contraction of the muscles of expression, soft tissue level, skeletal makeup, tooth shape, or tooth wear.

Three types of lip lines are classified, relating the height of the upper lip relative to the maxillary central incisors, low lip line, middle lip line, or high lip line (Fig.6).

An average lip line exposes the maxillary teeth and only the interdental papillae. A high lip line exposes the teeth in full display as well as gingival tissues above the gingival margins. A low lip line displays no gingival tissues when smiling. In most cases, the lip line is acceptable if it is within
a range of 2 mm apical to the height of the gingiva on the maxillary centrals.5

**Smile Line / Smile Arc:** an imaginary line drawn along the incisal edges of the maxillary anterior teeth. In an ideal tooth arrangement, that line should coincide or follow the curvature of the lower lip while smiling. Another frame of reference suggests that the centrals are slightly longer than the cuspids. In a reverse smile line, the centrals appear shorter than the cuspids along the incisal plane and create an aged or worn appearance. The degree of curvature of the incisal line is more pronounced for women than for men. The incisal display refers to the amount of visible tooth displayed when upper and lower jaws are in the rest position. Therefore, the amount of incisal display is an important factor in a youthful smile.

**Upper Lip Curvature:**

In smiling, the position of the upper lip height relative to the teeth has been ideally located at the gingival margin of the maxillary central incisors and appears as an important factor of attractiveness. The upper lip curvature that is expected to run upward from this central position to the corners of the mouth, depending on the sequence and degree of implication of facial muscles in the development of smile, has been found to be straight and even downward in a certain number of people, affecting the attractiveness of these smiles.

**Negative Space:** the dark space that appears between the jaws during laughter and mouth opening. The area between the corners of the mouth during smile formation and the buccal surfaces of the maxillary teeth (particularly the bicuspids and molars) form a space known as buccal corridor. The greater and more pronounced this negative space becomes, the more these posterior teeth are concealed, restricting the full breadth of the smile. A full and symmetric buccal corridor is an important element of an esthetic smile.

Several factors influence the appearance of the buccal corridor like the width of smile, and tonicity of facial muscles.

**Dental Components**

**Dental mid line:** refers to a vertical line formed by the contact of the maxillary central incisors. The midline should be perpendicular to the incisal plane and parallel or coincident to the midline of the face. The philtrum of the lip is considered to be one of the most accurate of anatomical guidelines as it is always in the center of the face. With exceptions of surgery, accident, and cleft-lip cases. The center of the philtrum is the center of Cupid’s bow and it matches the papilla between the centrals. This places the central papilla directly over the dental midline. Using the lip philtrum as a reference guide, that the maxillary midline coincide precisely with the facial midline in 70% of cases.6

**Golden Proportion:** 3, 6, 12-16

This concept was first given by - Lombardi and later developed by Levin.

Golden proportion suggests an ideal mathematical proportion of 1:1. The smaller to the larger is equal to the sum of the whole related to the larger. Recently, the “recurring esthetic dental proportion” concept was introduced. It states that the proportion of the successive widths of the teeth, as viewed from the frontal aspect, should remain constant as one moves distally.16

**Axial alignment and Gradation**

A key element in smile design pivots around the midline as it unites the face and its features with dentition and the anterior teeth in particular. From a frontal view, the axial inclination of the anterior teeth tends to incline mesially toward the midline and become more pronounced from the central incisors to the canines. This inclination is least noticeable with the centrals and becomes more pronounced with the laterals and even more so with the canines. The axial inclination of the posterior teeth from the frontal view exhibits the
same mesial inclination toward the midline as the cuspid. There is a direct relationship between the pleasing effect that these smiles can generate and the equilibrium in the balance of lines of tooth inclination. A distally inclined lateral incisor should be compensated by a slight increase in the inclination of the canine or premolars on the opposite side. Deviations beyond a certain degree of equilibrium are invariably rated as unattractive and must be corrected accordingly. This also creates a natural visual gradation, making the teeth appear to diminish in size as they progress.

**Dental morphology**

The anatomy of the anterior teeth plays an important role in a natural appearance and the individuality and personality of a smile. Some anterior teeth are flat and some are convex. These and other distinctive contours give each patient's smile individuality. The labial contour of these teeth should exhibit three planes when viewed from a lateral profile. The surface texture can also add personality to the appearance of the teeth.

**Contact Point:**

An open space is formed between the proximal surfaces of incisal edges from the contact points. This area is called an incisal embrasure. The contact areas of both centrals are located at the incisal third of the crowns. Therefore, the incisal embrasure space between the centrals is slight. The contact point between the central and lateral incisor approaches the junction of the middle and incisal thirds of each crown, making it slightly deeper than the junction between the centrals. The contact point of the lateral incisor and the cuspid is approximately at the middle third. Therefore, the incisal embrasure spaces of the anterior teeth display a natural and progressive increase in depth from the central to the cuspid.

**Gingival level and harmony**

Establishing the correct gingival levels for each individual tooth is the key in the creation of harmonious smile. The cervical gingival height (position or level) of the centrals should be symmetrical. It can also match that of the canines. It is acceptable for the laterals to display the same gingival level. However, the resultant smile may be too uniform and it is preferable to exhibit a rise and fall in the soft tissue by having the gingival contour over the laterals located toward the incisal compared to the tissue level of the centrals and canines. The gingival margin of the lateral incisor is 0.5-2.0 mm below that of the central incisors. The gingival shape on the mandibular incisors and the maxillary laterals should exhibit a symmetrical half oval or half circular shape. The maxillary centrals and canines should exhibit a gingival shape that is more elliptical. Thus, as mentioned earlier, the gingival zenith is located distal to the long axis of the maxillary centrals and canines and coincides along the long axis of the maxillary lateral incisors.

**Gingival components**

i) Gingival Morphology

ii) Gingival contour

**Gingival Morphology**

A feature of smile design that is often overlooked yet very significant is the health, symmetry, and architecture of the gingival tissues. These tissues frame the teeth and add to the symmetry of the smile. The health and subsequent color and texture of these gingival tissues are paramount for long-term success and the esthetic value of the treatment.

Healthy gingival tissues are pale pink and can vary in degree of vascularity, epithelial keratinization, and pigmentation, and in the thickness of the epithelium. The papillary contour should be pointed and should fill the interdental spaces to the contact point. The texture of the tissues should be stippled (orange-peel-like appearance) in most cases.

**Gingival contour**

The gingival contours should be symmetric and the marginal gingival tissues of the maxillary anterior teeth should be located along a horizontal line extending from cuspid to cuspid. Ideally, the laterals reach slightly short of that line. It is also
acceptable, although not ideal, to have the gingival height of all six anterior equal in gingival height on the same plane. In such cases, however, the smile may appear too uniform to be esthetically pleasing. A gingival height of the laterals that is more apical the centrals and cuspids are considered unattractive. The gingival zenith point is the most apical point of the gingival tissues along the long axis of the tooth.

**Conclusion**

An ideal esthetic treatment plan should be minimally invasive, preserving as much of the natural structures as possible and attempts to achieve perfection in every way. It should also realign the ideal form and function of the teeth and tissues while enhancing the esthetics and should never compromise the patient’s oral health or the stability of his or her teeth.

Conducting a patient interview is helpful in determining the patient’s expectations and limitations of treatment. In establishing a treatment plan, goals must be set as a way to measure the success of that treatment. All the above points are to be kept in mind while making proper diagnosis for smile designing.

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Introduction- Occlusal splint therapy may be defined as “the art and science of establishing neuromuscular harmony in the masticatory system by creating a mechanical disadvantage for parafunctional forces with removable appliances” 1. Occlusal splint is a diagnostic, relaxing, repositioning and reversible device. According to the Glossary of Prosthodontic Terms [8th ed.], “occlusal splint is defined as any removable artificial occlusal surface used for diagnosis or therapy affecting the relationship of the mandible to the maxilla. It may be used for occlusal stabilization, for treatment of temporomandibular disorders, or to prevent wear of the dentition.” A properly constructed splint supports a harmonious relation among the muscles of mastication, disc assemblies, joints, ligaments, bones, teeth and tendons. It provides a relatively easy, inexpensive and non-harmful way to make reversible changes in the occlusion.

ABSTRACT
Occlusal splint therapy has been used for many years for the diagnosis and treatment of various disorders of the masticatory system. Occlusal therapy is considered to be any treatment that is directed towards altering the mandibular position and/or occlusal contact pattern of the teeth. Occlusal appliances are also used to protect the teeth and supportive structures from abnormal forces that may create breakdown and/or tooth wear. Appliance therapy has several favorable qualities that render it helpful for the management of many temporomandibular disorders (TMD). The success or failure of occlusal appliance therapy depends on the selection, fabrication, and adjustment of the appliance and on patient cooperation. This article will familiarize the reader with basic splint designs and explain how to use these effectively.

Key words: occlusal splint, occlusal device, occlusal appliance, temporomandibular dysfunction, temporomandibular joint disorder
Main reasons for occlusal splint therapy
Occlusal splint therapy has been shown to be useful for the diagnosis and management of various masticatory system disorders. A common reason for prescribing an occlusal splint is to protect the teeth from excessive wear in patients with bruxism. Splints are also used frequently to treat patients with internal derangement and other TMDs with associated symptoms, such as tension headache and cervical, neck and oral/facial pain. A common goal of occlusal splint treatment is to protect the TMJ discs from dysfunctional forces that may lead to perforations or permanent displacements. Other goals of treatment are to improve jaw-muscle function and to relieve associated pain by creating a stable balanced occlusion.

Occlusal splint therapy can be recommended for the following purposes:
• To protect oral tissues in patients with oral parafunction
• To stabilize unstable occlusion
• To promote jaw muscle relaxation in patients with stress related pain symptoms like tension headache and neck pain of muscular origin
• To eliminate the effects of occlusal interferences
• To test the effect of changes in occlusion on the TMJ and jaw muscle function before extensive restorative treatment

How do splints work?
There is no general agreement about if or why splint treatment may have a beneficial effect. Following are few concepts, which explain how occlusal splints can help.

1. Preventing the patient to close in maximal intercuspal position: By occlusal splint, the patient is obliged to place his mandible in a new posture, thus resulting in a new muscular and articular balance. The patient, disturbed in his habits will not clench his teeth any more, like before and protect his TMJ and teeth.  
2. Distribution of forces: The forces generated during bruxism can be as much as six times the maximal force generated by normal chewing. The splints distribute these forces across the masticatory system. These appliances can decrease the frequency of bruxing episodes but not the intensity.

3. Normalizing periodontal ligament proprioception: Proprioceptive fibres contained in the periodontal ligament of each tooth send message to central nervous system, triggering muscle patterns that protect them from overload. An occlusal splint functions to dissipate the forces placed on individual teeth by utilizing a larger surface area covering all teeth in the arch. Thus a splint balances the load and allows for muscle symmetry.

4. Relaxing the muscles: Tooth interferences to the CR arc of closure hyperactivate the lateral pterygoid muscles and posterior tooth interferences during excursive mandibular movements cause hyperactivity of the closing muscles. A muscle that is fatigued through ongoing muscle hyperactivity can present with pain. If the hyperactivity is stopped, the pain caused by it will usually disappear. A splint with equal intensity contacts on all of the teeth, with immediate disclusion of all posterior teeth by the anterior guidance and condylar guidance in all movements, will relax the elevator and positioning muscles.

5. Allowing the condyles to seat in centric relation: For the condyles to seat completely under the disc in anterosuperior position, the superior belly of lateral pterygoid should obtain its full extension. When the lateral pterygoid is triggered to hyperactivity through occlusal stimuli, the disc is pulled anteromedially toward the origin of muscle, resulting in displacement. Overloading of condyle/disc assembly when not in normal physiologic position contributes towards TMJ disorders. A properly balanced splint results in an occlusion associated with relaxed positioning and elevator muscles, allowing the articulator disc to obtain its antero-superior position over the condylar head.
6. Increase in the vertical dimension of occlusion: Occlusal splints can be adjusted with a vertical height that exceeds the physiologic interocclusal distance. Temporary use of occlusal splints with a vertical height exceeding the physiologic rest position does not cause increase in tonus or hyperactivity of jaw muscles. Studies have shown that elongation of elevator muscles to or near the vertical dimension of least electromyographic activity by means of occlusal splint are effective in producing neuromuscular relaxation\textsuperscript{11,12}.

7. Cognitive awareness theory: According to this theory, the presence of the splint as a foreign object in the mouth would likely change the oral tactile stimuli, decrease the oral volume and space for the tongue and make the patient conscious about the position and potentially harmful use of their jaw. As cognitive awareness is increased, factors that contribute to the disorder are decreased. The result is a decrease in the symptoms.

8. Placebo effect: A positive placebo effect may result from the competent and reassuring manner in which the doctor approaches the patient and provides the therapy. This favorable doctor-patient relationship, accompanied by an explanation of the problem and reassurance that the appliance will be effective, often leads to a decrease in emotional stress experienced by the patient, which may be the significant factor responsible for the placebo effect.

9. Increased peripheral input to the central nervous system: Nocturnal muscle hyperactivity appears to have its source in the CNS. When an occlusal splint is placed between the teeth, it provides a change in peripheral input and thus decreases CNS-induced bruxism. All these concepts overlap and are not mutually exclusive.

**Stabilization appliances**

Sometimes called **muscle relaxation appliance**, because it is primarily used to reduce muscle pain. It is generally fabricated for the maxillary arch, and provides an optimum functional occlusion for the patient. When the appliance is in place, the condyles are in their most musculoskeletal stable position at the time that the teeth are contacting evenly and simultaneously. The treatment goal of the stabilization splint is to eliminate any orthopedic instability between the occlusal position and the joint position, thus removing this instability as an etiologic factor in the TMD.

Stabilization splints are full coverage hard acrylic resin appliances that can be constructed to fit on either the maxillary or mandibular arch. It is adjusted to have stable simultaneous occlusal contact on all opposing teeth.

These splints are typically constructed to occlude in a position of comfortable mandibular closure. This position is slightly anterior to an unstrained centric relation jaw position. If the patient has significant muscle splinting then some initial centric relation guidance may be necessary to approach this position.

**Indications**-

1. Treatment of masticatory dysfunction signs and symptoms such as muscular pain, TMJ pain, clicking, crepitus, limitation of motion, incoordination of movement.
2. Bruxism
3. Local muscle soreness or chronic centrally mediated myalgia
4. Patients experiencing retrodiscitis

The stabilization splint can be used in either arch, but maxillary placement is more advantageous. It is more stable and covers more tissue, which makes it more retentive and less likely to break. With the mandibular appliance it is easier for the patient to speak and it is less visible, thus more aesthetic. The construction of anterior and lateral canine guidance is usually easier with a maxillary stabilization splint, especially in cases with severe overjet.
LOCATING THE MUSCULOSKELETALLY STABLE POSITION

For the stabilization appliance to be optimally effective, the condyles must be located in their most musculoskeletal stable position – centric relation. Relation of mandible to cranium that exists when the condyles articulate with the thinnest avascular portion of their respective discs in their most anterior superior position against the posterior slopes of the articular eminence regardless of tooth contact.

Two techniques for finding the centric relation:

1. Bilateral manual manipulation technique
   In the musculoskeletal stable position, the discs are properly interposed between the condyles and the mandibular fossa. If either disc is functionally dislocated, the mandibular guiding technique seats that condyle on retrodiscal tissues. When mandibular guidance produces pain in the joint, an intracapsular disorder is likely present. In such cases, an anterior positioning appliance is more appropriate.

2. In the second technique, a stop is placed on the anterior region of the appliance, and the muscles are used to locate the musculoskeletally stable portion of the condyles. In a reclined position, the patient is asked to close on the posterior teeth, which causes only one mandibular incisor to contact on the anterior stop of the appliance. The stop should provide a thickness that maintains the anterior teeth 3-6mm apart. The mandibular posterior teeth should not contact on any portion of the appliance.

   The contact on the anterior stop is marked and adjusted so that it provides a stop that is perpendicular to the long axis of the mandibular teeth being contacted. This anterior stop should not create a retrusive force to the mandible. It should also not be mesially inclined so as to create a forward shift or slide of the mandible. When the anterior stop is flat and the patient closes on the posterior teeth, the functional pull of major elevator muscles seats the condyles in their most superoanterior position at the base of the posterior slopes of the articular eminences.

Developing the occlusion

When the centric relation has been located, the patient should become familiar with it by wearing the appliance. Instructions are given to tap on the anterior stop. This is helpful in influencing the neuromuscular control system that has coordinated muscle activities as related to the existing occlusal conditions. Since the anterior stop eliminates the existing occlusal conditions, any muscle engrams associated with neuromuscular protection are eliminated, thus promoting stabilization and allowing more complete seating of the condyles in their musculoskeletally stable positions. The appliance is removed from the mouth and self curing acrylic is added to the remaining anterior and posterior regions of the occlusal surface. The acrylic is trimmed, preserving it only anterior and labial to each mandibular canine. These areas will create the desired contact during mandibular movement. The acrylic prominences labial to the canines are smoothed in such a way that it exhibits about 300-450 angulation to the occlusal plane and allow the canines to pass over in a smooth and continuous manner during protrusive and laterotrusive excursions.

Design:-

1. Appliance must accurately fit the maxillary teeth, with total stability and retention when contacting the mandibular teeth.

2. It must be unobtrusive in its appearance yet have adequate strength and rigidity to prevent breakage.

3. Vertical dimension should be established using the posterior teeth approximately 2mm in molar region.

4. In centric relation all posterior mandibular buccal cusps must contact on flat surfaces with even force.

5. During protrusive movement, the mandibular canines must contact the appliance with even force.
6. In any lateral movement only the mandibular canines should exhibit laterotrusive contact on the appliance.
7. The mandibular posterior teeth must contact the appliance only in centric relation closure.
8. In the alert feeding position, the posterior teeth must contact the appliance more prominently than the anterior teeth.
9. The occlusal surface should be as flat as possible with no imprints for mandibular cusps.
10. The occlusal appliance is polished so that it does not irritate any adjacent soft tissue.
11. For retention ball clasp may be placed between canine and 1st premolar and between 2nd premolar and 1st molar.

For most normal occlusal scheme, the canines and incisors should be the only teeth in contact during a protrusive jaw movement, and the angle of disocclusion should be gradual and slightly concave.

Instructions and adjustments- Finger pressure is used to align and seat it initially. Once it has been pushed onto the teeth, it may be stabilized with biting force. Removal is most easily accomplished by catching it near the first molar area with the fingernails of the index fingers and pulling the distal ends downward.

The patient is instructed to wear the appliance according to the disorder that is being treated. When a patient reports muscle pain on awaking, bruxism is suspected and nighttime use is essential. When a patient reports late-afternoon pain, diurnal muscle activity associated with emotional stress, ergonomics, and fatigue may be more important. When the symptoms are relieved by the appliance, it is likely that the proper diagnosis has been made and treatment is apparently successful.13,14

Conclusion- Before commencing any appliance therapy for a TMD, the clinician should be confident that the patient will benefit from the therapeutic approach. If the symptoms are reduced they will provide additional diagnostic information. Properly made occlusal splints are an important and practical treatment modality when used for specifically designed purposes. The basis for their utilization should be a clear understanding of how the splint affects the position and condition of the TMJs and/or the suppressive effect on muscle hyperactivity.

List of references:


INTRODUCTION

In complete denture prosthodontics, an attempt to preserve alveolar bone by retained non-vital, vital roots and more recently submerged roots that contribute support. A proper design of removable partial denture in concert with a well thought out and properly executed treatment plan to prepare the oral cavity for receiving the prosthetics will contribute to the preservation of remaining natural teeth, osseous structures and gingival tissues. In the practice of fixed prosthodontics, all the procedures should be carried out from start to finish with total preventive concept in mind. The preservation of the supporting tissues, periodontium, and pulpal tissues in prosthodontic practice is a sacred trust that cannot be ignored. The discussion and application of the preventive concepts will offer a long serviceable prosthesis without any complications and compromise.

ROLE OF NUTRITION IN PREVENTION OF ORAL DISEASES

Prosthodontists are more truly “Gerodontologists” than any other group of health professionals and providing dietary guidance for these patients can be a very rewarding aspect of a dental practice. The essential nutrients are proteins, fat, carbohydrates vitamins and water.

Proteins: As the patient becomes older, the amount of protein required increases. One of the major reasons for protein deficiency is low economic status. Deficiency results in lower antibody production, reduced resistance to infection, anaemia, and decrease in muscle volume. Patients with protein deficiency should be advised to take chopped meat and powdered dry milk.

ABSTRACT

The aim of prosthodontics should be an attempt to converge to the dictum of DeVan “Perpetual preservation of what remains, rather than meticulous restoration of what is lost”. Today with greater stress on preventive measures, the dental profession has expanded this preventive concept into prosthodontics. Preventive prosthodontics emphasizes the importance of any procedure that can delay or eliminate the future prosthodontics problem.

Key Words: nutrition, complete denture, impression, occlusion, overdenture, resin retained prosthesis, implants.
Vitamins: Vitamins are generally classified as water-soluble vitamins (B & C) and fat-soluble vitamins (A, D, E & K). Deficiency develops rapidly and these must be supplied daily.

Importance of Minerals: Calcium loss contributes to bone fragility. Since calcium and Vitamin C require a strong acid environment for optimum absorption, deficiencies of this type are common in aged persons. Excessive ridge resorption may be related to a negative balance of calcium, which contributes to the development of osteoporosis.4

PREVENTIVE PHILOSOPHY IN REMOVABLE PROSTHODONTICS:

The Role of impression technique in preservation and prevention in complete denture prosthodontics:

1. Mucostatic impression in which soft tissues should be registered in an unstrained rest position – this leads to dislodgement of the denture because mucoperiosteum cannot be compressed and dentures will be displaced.

2. Mucocompressive impression- Dentures made from pressure impression, will subject osseous tissue to continuous stress; displaced mucosa has a steady urge to return to rest position. Such displacement results in tensile and shear forces to osseous tissue continuously.5

The Role of occlusion in preservation and prevention in complete denture prosthodontics:

The natural tooth form with its cusp inclines usually functions in harmony. In edentulous mouths, these same cusps can cause trauma, discomfort, and instability to the bases, because of the horizontal components they generate. Even if this is accomplished by meticulous records on an adjustable articulator, it cannot exist for long when transferred to the mouth. The problem of unmodified, cusped teeth for complete dentures can be summed up as follows:

1. Mesio-distal interlocking cannot provide for settling

2. Unacceptable for Class II, III, jaw relationships.

3. Carefully balanced lateral positions become unbalanced with settling. So the results are short-lived.

4. The bases need prompt and frequent refitting to keep the occlusion harmonious.

5. The presence of cusps generates more horizontal force during mastication. This could speed up the resorption of residual ridge

6. It is mandatory to use an adjustable articulator.

7. Eccentric records must be made for articulator adjustments

Unless the denture foundation is firm and well-formed, unless the ridge relationship is normal, unless an adjustable articulator used, it is dangerous and damaging to place unmodified cusps on complete dentures.3

Problem of using Non-anatomic teeth

The major objective of this special occlusal form is to prevent the destruction and to preserve the integrity of supporting ridge. The problem of non-anatomic teeth can be summed up as follows:

1. They occlude only in two dimensions (length and width) but the mandible has an arcuate path. Three-dimensional movement due to its condylar behavior.

2. Less shearing efficiency

3. Bilateral and protrusive balance is not possible with a purely flat occlusion

4. The flat teeth do not function efficiently unless the occlusion surface provides cutting ridges and generous spillways

5. They appear dull and unnatural

6. Occlusal adjustments, though minor as compared to other schemes, are harder to do due to presence of compensatory curves.3

RATIONALE FOR THE OVERDENTURE CONCEPT

Preventive prosthodontics emphasizes the importance of any procedure that can delay or
eliminate further prosthodontic problems. The overdenture is a logical method for the dentist to use in Preventive Prosthodontics. Even though positive aspects predominate, great care must be taken while determining if overdentures are indicated for the patients.¹

Apart from the periodontal condition, prognosis, distribution of remaining teeth, oral hygiene, condition of the residual ridge, neuromuscular function there are a number of non-clinical factors which argue either for or against selection of overdenture. Overdentures with their combination of periodontal and mucosal support have a significant number of advantages compared with complete dentures. The most important are.

1. Retention of roots of overdenture offers several advantages from functional and biologic standpoint. Proprioception is foremost amongst them.
2. Greater functional stability due to preservation of residual ridge contours near abutment teeth.
3. Greater chewing efficiency because of better stability and retention
4. Better retention especially when retentive attachments are used in mandibular prosthesis.
5. Less pressure on the mucosa
6. Reduced extension of the denture base in the maxilla. The palate needs to be only partially covered when retentive elements are used. This is very important psychologically for the patient.
7. Ease in making measurements when teeth are retained for immediate insertion of an overdenture, the vertical dimension can be maintained.
8. Fewer trauma to supporting tissue.
9. Excellent patient acceptance and psychological advantage
10. It serves as a training or transitional denture in preparing the patient for receiving complete denture.¹

Disadvantages
The list of advantage is countered by two principal disadvantages when compared with complete dentures.

1. Greater expense, directly related to the extent of pre-prosthetic treatment, the use of retentive attachment and the post placement course.
2. Greater effort on the part of both patient and dentist is required to maintain the prostheses.
3. Other disadvantage includes,
4. Cannot be used in cases of severe undercut and reduced interarch space
5. More bulkier than F.P.D and R.P.D
6. Chances of fatigue failure of the overdenture in cases where acrylic resin is used to fabricate bases
7. Uncooperative and under motivated patients.
8. Psychologically some patient cannot accept any type of removable denture.
9. Mentally and physically handicapped patients
10. In those conditions where periodontal consideration do not permit retaining of teeth.

Metal Denture Bases in Preventive Prosthodontics:
Faber⁶ (1957) listed the following advantages of gold bases; greater accuracy, greater thermal conductivity, less warpage, less porosity, and hence less plaque retention, less deformation of the bases under function, less tissue changes. The factors listed above will result in better tissue health under metal bases than with acrylic resin denture bases.⁶,⁷

PREVENTIVE PHILOSOPHY IN FIXED PROSTHODONTICS:
Preservation of tooth structure by designing fixed partial denture:

One of the basic tenets of restorative dentistry is to conserve as much tooth structure as possible consistent with the mechanical and esthetic principles of tooth preparation. Tooth
structure is conserved by using the following guidelines:

1. Use of partial coverage rather than complete coverage restorations
2. Preparation of teeth with the minimum practical convergence angle between axial walls.
3. Preparation of the occlusal surface so that the reduction follows the anatomic planes to give uniform thickness in the restoration.
4. Preparation of the axial surfaces so tooth structure is removed uniformly; if necessary teeth should be orthodontically repositioned.
5. Selection of conservative margin compatible with the other principles of tooth preparation.

**Partial coverage restorations:**

An extra coronal metal restoration that covers only part of the clinical crown is considered as partial coverage restoration (or) partial veneer crown. Whenever feasible, a partial–coverage restoration should be selected rather than a complete veneer because it preserves more of coronal tooth structure. It results in less pulpal and periodontal insult. The supragingival margin provides easy access for oral hygiene maintenance.

**Resin Retained Fixed Partial Dentures:**

Resin retained fixed partial dentures have had variable popularity since the technique for splinting mandibular anterior teeth with perforated metal casting was described by Rochette in 1973. The primary goal of missing teeth and maximum conservation of tooth structure.

The advent of electrolytic etching of the metal surface to provide micromechanical retention for metal adhesion to enamel led to the technique's broad application. The restoration is simple in concept and consists of one or more pontics supported by thin metal retainers bonded lingually and proximally to the enamel of the abutment teeth. These conservative prostheses depend on bonding between etched enamel and the metal casting and require precise and defined metal engagement of the abutment.

**Fiber Reinforced Composite Fixed Prostheses:**

Fiber reinforced fixed prostheses are an innovative alternative to traditional metal ceramic restorations. They should be considered for certain patients because they provide a conservative approach to replace missing teeth and overcome some of the drawbacks of conventional prostheses. The restoration consists of fiber reinforced composite substructure veneered with particulate composite material. It requires minimal removal of crown structure and provides no nickel allergy due to lack of any metal substructure. It results in less wear of opposing tooth structure.

**PROTECTION OF PERIODONTIUM:**

One of the prime goals of restorative therapy is to establish a physiologic periodontal climate and facilitate the maintenance of periodontal health. Crown contour, margin placement, and pontic design all affect periodontal health.

The four guidelines to contouring crowns with emphasis on access for oral hygiene will be described.

1. Buccal and lingual contours–flat, not fat. Reduction or elimination of the infrabulge would reduce plaque retention.

2. Open embrasures: If plaque is a primary etiologic factor in gingivitis, then every effort should be made to allow easy access to the interproximal area for plaque control. Open embrasure spaces will allow for this easy access. An overcontoured embrasure will reduce the space intended for the gingival papilla. The result is a broadening of the col area, causing pressure and irritation on the papilla. This also inhibits effective oral hygiene.

3. Location of contact areas: Contacts should be high (directed incisally) and buccal in relation to the central fossa (except between maxillary first and second molars).
4. Furcation involvement: Furcations that have been exposed owing to loss of periodontal attachment should be “fluted” or “barreled out”. The concept of fluting into molar furcations is based on the desire to eliminate “plaque traps” and facilitate plaque control.  

**MARGIN PLACEMENT**

Plaque accumulation, inflammation, and gingivitis are reported to occur more frequently in teeth with subgingival crown margins than in those with supragingival margins. Oral hygiene instructions do not seem to alter this pattern.

Based on the findings of research, subgingival margins should be avoided except for the following specific situations: (1) esthetic demands, (2) caries removal, (3) subgingival tooth fracture, (4) to cover existing subgingival restorations, (5) to gain needed crown length, and (6) to provide a more favorable crown contour (that is, furcation involvement).

**PONTIC DESIGN**

The design of pontics for fixed partial dentures has been clouded by empirical judgment. The so-called “sanitary pontic” is not new to dentistry. The “bullet-shaped” pontic has been advocated by some authors as a desirable design to reduce food accumulation. Nearly all authors agree that the “ridge-lap” pontic is undesirable from the point of view of tissue health.

Stein’s classic article on pontic design was largely responsible for a change in philosophy from a “sanitary” or “bullet-shaped” design to what is now commonly called a “modified ridge-lap” design. The modified ridge-lap design in the posterior region and the ridge-lap facing design in the anterior region offer minimal tissue contact, acceptable cosmetic value, proper cheek support, and accessibility for adequate oral hygiene. It has now been established that the design of the pontic may be the most important factor in preventing inflammatory reactions, not the material used in the pontic.

In addition to properly designing the undersurface of pontics, it is imperative to open embrasure spaces adjacent to abutments to allow room for interproximal tissue and access for oral hygiene. The occlusal surface should not be narrowed arbitrarily since this may create a food impaction and/or plaque retention situation similar to that of malposed teeth. The embrasure space between two adjacent pontics usually is closed to provide added strength, reduce food and plaque retention, and facilitate oral hygiene procedures under pontic areas.

Basic guidelines for the access-for-oral-hygiene theory of crown contour, margin placement, and pontic design can be applied to nearly all fixed restorative procedures. These guidelines apply to full porcelain coverage restorations precision attachments, and coping reconstructions. Occasionally tooth preparations must be modified to allow for the added bulk needed for attachments, occlusal porcelain, and copings. If proper tooth reduction is achieved, physiologic crown contours can be developed easily, regardless of the prosthesis being used.

**RATIONALE FOR DENTAL IMPLANTS:**

The use of dental implants to provide support for prostheses offers a multitude of advantages compared with the use of removable prostheses or a fixed partial denture using natural teeth as an abutment.

A primary reason to consider dental implants to replace missing teeth is the maintenance of alveolar bone. The dental implant placed in to the alveolar bone serves not only as an anchor for the prosthetic device, but also as one of the better preventive maintenance procedures in dentistry. An endosteal implant can maintain bone width and height as long as the implant remains healthy. As with the tooth, periimplant bone loss may be measured in lengths of a millimeter and may represent more than a twenty-fold decrease in lost structure compared with the resorption that occurs with the removable prosthesis.

The receptors in the periodontal membrane of the natural teeth help determine its occlusal
position. Although endosteal implants do not have periodontal membrane, they provide greater awareness than complete dentures. The decrease in horizontal forces that are applied to implant restorations improve the local parameters and help preserve the underlying soft tissues and hard tissues. In the partially edentulous patient, independent tooth replacement with implants may preserve intact adjacent natural teeth as abutments, further limiting complications such as decay or porcelain fracture and poor esthetics, which are most common causes of fixed prosthesis failure.13 The current trend to expand the use of implant dentistry will continue until every restorative practice uses this modality for the abutment support of fixed and removable prostheses.

**Role of Maintenance & Recall in Prevention:**

“The dentist of the future will not be judged by the excellence of his margins, but by how well he motivates his patients to practice correct oral hygiene. The dentist's success will be favourable only if the patient returns in six months, and then regularly, and returns each time with an absence of plaque.” - Boitel.

A special effort should be made to avoid the careless handling or dropping of a removable prostheses. If it is distorted, it may result in destructive pressure on the teeth. Sometimes, appliance itself can be damaged. Proper maintenance of the prostheses using various physical and mechanical methods will keep the prostheses free of plaque, there by ensuring better tissue health.14 A caries susceptible individual should follow an adequate control program in an attempt to arrest this condition. This program should include both professionally applied treatments, and intensive program of daily treatment administrated by the patient at home.1 Frequent rebasing of an extension base prosthesis will maintain adequate support. Patient should be instructed in special plaque control measures, especially around pontics and connectors of fixed partial denture.8

**SUMMARY**

The aim of preventive prosthodontics should at least stop further progression of oral disease and prevent the loss of remaining tissues. The supporting structures such as alveolar bone, teeth, periodontium is as normal as other tissues of the body and its loss is occasioned by three conditions: Systemic factors, disuse atrophy, and abuse atrophy. Among the many recognized systemic influences, which affect the resistance and resorption of bone, calcium deficiencies and calcium – phosphorous imbalances have been specifically implicated as contributing factors in the pathogenesis of alveolar bone destruction and osteoporosis. Correction of nutritional deficiencies and elimination of systemic disorders like osteoporosis will reduce the further resorption.

When considering impression procedures in complete denture prosthodontics; mucosa should be firm and healthy, the impression material should be of low viscosity, and pressure used to seat and hold the impression material should be kept to minimum. Application overdenture in preventive prosthodontics is not a new concept. Literature reviewed reveals that overdenture results in less resorption of alveolar ridge, increased occlusal awareness and psychological well-being of patients.

Designing of fixed partial denture should allow a patient to more effectively remove dental plaque from the area and prevent recurrent caries and plaque accumulation. Whenever possible, restorations which require minimal amount of crown structure, should be used. All precautions should be taken to preserve and protect the vitality of dental pulp. The use of dental implants to provide support for the prostheses offers multitude of advantages; it maintains alveolar bone, patient can regain proprioception, avoid unnecessary removal of sound natural teeth, provides increased stability and retention of the prostheses.

**REFERENCES:**


Decoding the Etching Conundrum
Dr. Geeta Maruti Dodamani 1, Dr. Joe Mathew, MDS 2, Dr. Venkatesh Garla 3, Dr Kenneth Tan 4

INTRODUCTION
Esthetics has been an indispensable element in human life for centuries. The elimination of esthetic problems substantially aids in confident self expression. In addition to the different departments dealing with esthetics in medicine, orthodontists also make arrangements to eliminate various esthetic and functional concerns. These arrangements include the correction of skeletal and dental anomalies. Dental arrangements mostly involve use of fixed orthodontic attachments. Previously, orthodontic treatments with fixed attachments had been performed by soldering brackets onto bands. Pitch-fit bands were used in full- mouth banding techniques, followed by the use of prefabricated stainless steel bands for orthodontic treatment. However, full – mouth banding techniques had some disadvantages, including increased chair time, diastema resulting from removal of bands at the end of treatment, unaesthetic appearances and soft tissue irritation.1

With the advent of acid etching technique direct bonding of attachment became a clinical reality overcoming the disadvantages of banding with combined research in concise of acid etching materials and protocols, the bond reliability have been improved more than satisfactory levels, not only on that natural enamel surfaces but also on various artificial substrates such as ceramic, metal etc. the present article intend to give an overview of different materials and concepts in the light of varying clinical situations.

ETCHING PROCEDURES;
Phosphoric acid application
Phosphoric acid is used to eliminate oxidation of metal surfaces and enhance adhesion of dyes to

ABSTRACT
Etching is an important aspect of orthodontic bonding and it has a long history of evolution. Understanding the ramifications of philosophy and procedural variance can be made possible by compilation of the present day body of knowledge. The article intends to give an overview of different materials and concepts to deal with various clinical orthodontic bonding challenges.

Key Words: Acid Etching, enamel conditioning, self etch, laser etch

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2. Senior Lecturer
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metal surfaces in metal and dye industry. In light of this information, phosphoric acid to obtain as effective an adhesion on enamel surface as on metal surfaces. The concentration of the first phosphoric acid solution used was 85% and it was applied for 30 seconds. Buonocore adhered acrylic materials onto the non-etched teeth surfaces and etched surfaces. Although acrylic materials adhered onto the etched surfaces were bonded with enough strength that they needed debonding procedures, failures were observed on non-etched surfaces. This technique was an important advance in directly bonding orthodontic attachments to the tooth surface by means of micro retention. However, honey combed structures were not obtained in enamel prisms after etching with 85% phosphoric acid, and successful results in terms of retention were not achieved.

Today, 35-38% orthophosphoric acid is effectively used to change enamel surface characteristics and to provide micromechanic bond strength by means of an opaque appearance where micro mechanic retention areas occur. An etching time of 15-30 seconds is accepted as the optimum working time. It has been reported that etching times of less than 10 seconds and more than 60 seconds do not produce enough shear bond strength. Ten seconds of etching time does not produce enough tagged areas on the enamel, and etching time of 60 seconds or more than 60 seconds impair the integrity of honeycombed prismatic structures on the enamel, which negatively affects bond strength.

Phosphoric acid is produced in a liquid or gel form, and neither form demonstrated any negative effects on bond strength. However, only the intended area is etched when using a gel. A more extended area beyond the bracket base is etched by the liquid form due to the displacement of the acid by gravitational force.

SELF-ETCHING APPLICATION.
(Figure 1)

Self etching primers which combine acid and primer, carry out bonding procedures by simultaneously etching and infiltrating the enamel surface. They ease the bonding procedures by reducing chair time and eliminating side effects of etching. The main feature of single step acid/primer bonding systems is that no separate acid etching of the enamel and rinsing with water and air drying are necessary. The liquid has a component that conditions the enamel surface. The active component of SEPs is the methacrylated phosphoric acid ester that dissolves calcium from hydroxyapatite. The removed calcium forms a complex when the primer polymerizes. Etching and monomer penetration to the exposed enamel rods are simultaneous and the depth of penetration is equal. Transbond plus self etching primer is most commonly used in orthodontics.

The single use package consists of three compartments. The first one contains methacrylated phosphoric acid esters, photo sensitizers and stabilizers. The second contains water and soluble fluoride, and the third compartment contains an applicator micro brush. Squeezing and folding the first compartment over to the second compartment activates the system. The mixed component is passed to the third compartment to wet the applicator tip. Transbond plus self etching primer is applied by rubbing for at least 3 seconds.

LASER ETCHING APPLICATION.

Use of light for diagnosis or treatment has continued since ancient history. The ancient Greeks and Romans used sunbath and Solarium. The ancient Egyptians, Chinese and Indians treated rickets, psoriasis, skin cancer and even psychological disorders by taking advantage of the treatment effects of light.

Laser used in etching has increased in recent years. Lasers also reported honey comb like field similar to type conventional method of etching pattern on the surface of enamel. However to obtain this pattern, appropriate power, frequency and time setting planning should be performed. Otherwise, although the amount of water and organic matrix in the enamel tissue are less than those in dentin, vaporization will occur in the hydroxyl appetite matrix, and irregular heterogeneous micro etching patterns will be observed due to the irreversible damage from microexplosions. To minimize these effects lasers should be used with appropriate power output and air water rates.
PORCELAIN, AMALGAM AND COMPOSITE SURFACE ETCHING APPLICATIONS.

Today orthodontic treatment is frequently preferred by adults to overcome esthetic considerations, however, different types of restorations such as porcelain prosthesis or laminate veneers, are encountered in an adults mouth. A mechanical or chemical method different from etching procedures on the enamel surface must be followed in individuals thought to be treated with fixed orthodontic appliances to support these restorations.

To ensure adequate bond strength, removal of the glaze layer on a porcelain surface and a suitable mechanical retention area are needed. Therefore, bonding to glazed ceramics with a coupling agent (silane) and a chemical preparation of ceramics with acid, such as hydrofluoric acid (HFA) or acidulated phosphate fluoride are used. Silane coupling agents enhance bond strength by increasing the chemical bond between the resin composite and ceramic material.

Etching procedure on amalgam restoration varies depending on the size of amalgam restoration. If amalgam restorations are present in a limited area, enamel around the restoration can be conditioned with 37% ortho phosphoric acid following by sandblasting with 50 m aluminum oxide powder for 3 seconds. If there are large amalgams restoration covering the area to be bonded a metal primer is applied on to the amalgam restoration following sandblasting with 50 m aluminum oxide powder for 3 seconds and a 30 second waiting period.

Bonding to composite restoratives; previous composite restoration is removed with the help of a rotary instrument and sealant application onto a dry composite surface is completed with single bonding procedure. Clinical failures in these restorations are not frequently observed.2

Conclusion:

Surface conditioning is the first and critical step for orthodontic bonding. The knowledge of enamel structure & composition, structural variations in deciduous and permanent dentition and the nature of enamel in various enamel pathologies have significant clinical implications that demand customization of the materials used and procedures adopted.

The present day orthodontics aims at reducing the chair side time, adequate bond strength, and minimal enamel surface alterations or damage. With increase in adults seeking Orthodontic treatment, Orthodontists encounter difficulties in bonding on to artificial surfaces, with alternate methods we are able to deal with bonding on to artificial dental surfaces.

Figure 1: Self etch primer (Prompt L- pop)

References:


Legends
In recent years there has been a steady increase in the number of inmates in Bengaluru central jail. Some of them were admitted more than once, so it is very difficult to evaluate the total number of people admitted in the jail. Jail inmates are more likely than the general public to have oral health care problems ranging from periodontitis, pulpitis to missing teeth. The oral health status of the Indian population has steadily improved over the past, but there has been no study on a prison population. Factors which have contributed to improvement includes the fluoridated toothpaste, better diet, education, improved personal oral hygiene, increase in regular dental care, improved dental technology and treatment options.\(^1\)

Providing to dental health services in prison presents a number of challenges with security concerns varying with the need to provide effective oral health care to inmates. Within the Bengaluru central jail system, specialist care is also available to inmates. When receiving dental care, the rule is that at least one custodial officer be present in the clinic.

The procedure for seeing a dentist at the time survey was for inmate to visit at a specific day of the week to visit the prison clinic. Treatment was restricted to emergency dental care, restorations, root canal treatment, removable partial dentures and complete denture prosthodontics.

The prosthodontic treatment status of prison inmates has not been previously described. We report the results of a survey of prison inmates regarding prosthodontic treatment needs.

**METHODS**

**SAMPLE**

Inmates who came to the prison clinic over a period of 2 years from 2012-2014 were included in this study. Prosthodontic treatment included removable partial dentures and complete dentures.

**Oral Examination**

A total of 1787 prison inmates were examined for prosthodontic treatment needs over the said period. Information was collected regarding the number of visits, last treatment visit and treatment received. Clinical assessment included present complete denture and removable partial denture needs. In the year 2012-2013, the total number of
patients reported to the clinic was 787 and in 2013-
14 was 1000.

**STATISTICAL METHOD**

Logical traction analysis was used to evaluate the treatment needs.

**RESULTS:**

Table 1 depicts the number of inmates examined, gender, prosthesis present and treatment rendered.

**Table 1**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of inmates</th>
<th>Males/females</th>
<th>Prosthesis present</th>
<th>Prosthetic need</th>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2012-2013</td>
<td>787</td>
<td>700/85</td>
<td>Edentulous: 5</td>
<td>Complete denture</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>prosthesis: 32</td>
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<tr>
<td></td>
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<td></td>
<td>Rpd: 12</td>
<td>Rpd: 40</td>
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<td></td>
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<td>Fpd: 10</td>
<td></td>
</tr>
<tr>
<td>2013-2014</td>
<td>1000</td>
<td>975/25</td>
<td>Edentulous: 6</td>
<td>Complete denture</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>prosthesis: 40</td>
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<td>Rpd: 15</td>
<td>Rpd: 59</td>
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</table>

Results showed that there was an increase of 11.91% in the number of prison inmates examined over the said period. Only 4.3% of the total inmates had access to any prosthodontic treatment. A total of 72 subjects were given prosthodontic treatment in 2012-13 as compared to 99 patients in 2013-14, an overall increase of 15.7%.

All cases with prosthesis were re treated because the prosthesis were of bad quality

**DISCUSSION**

There have been very few studies carried out on oral health status of prisoner population. Overseas studies reports indicate that the oral health status of prison inmates is worse than the general population. Regular oral health care is likely to enable the individuals to become more knowledgeable regarding their health. Understanding the prosthodontic health needs can help us to direct our service for the presence of a specialist dental surgeon.

Over the said period there was an increase of 11.91% in the number of prisoners reporting for dental health checkup indicating the increased oral health awareness in the prison population. Of the total inmates, 78 inmates had some kind of prosthesis in the mouth. But the quality of prosthesis was not good and was present for an extended period of time indicating improper access to the dental health practitioner.

Coming to the treatment imparted, a total of 72 complete dentures and 99 removable partial dentures were administered to the prison inmates. In the 1st year of survey, 32 complete denture prosthesis and 40 removable partial dentures were given. While in the 2nd year, 40 complete dentures and 59 removable partial dentures were given. This indicates a total increase of 15.7% in the prosthodontic treatment needs.

Lifestyle diseases are closely related to oral diseases and it is important to consider the wider social determinants of health when looking at the treatment options. Oral health and prosthetic needs should be seen in the context of a population health approach. So, working in collaboration with correction health centers and old age homes; helps to identify health for those populations, which can identify the health gains in a population, which can be the most at risk. There are groups of prison inmates whose social experience is different, often leading to a negative impact on their general health or a reduced potential for health gain.2
In conclusion, visiting a prison dentist should be the one where he gets acquainted with the various prosthodontic treatment modalities. The initial visit would be a time to allow the plan for future care and to introduce preventive care. Prison represent an important opportunity for public health care to improve oral as well as general health of the population.

CONSENT TO DENTAL EXAMINATION

Prisoner's I.D. no.

I consent to………………………(qualified dentist) carrying out a dental examination of my mouth. The purpose and procedure have been explained to me and I have had the opportunity to discuss them.

SIGNATURE

Signed...................................
Date..................................
ABSTRACT

OBJECTIVE- The aim of this in vivo study was to assess whether the variation in taper during canal preparation has any influence on reduction of the bacterial load and to check the efficiency of sodium hypochlorite (NaOCl) and chlorhexidine (CHX) as irrigants in the root canal.

MATERIALS AND METHODS- Sixty patients with single rooted mandibular teeth with pulpal necrosis and periapical radiolucency requiring endodontic treatment were divided into two groups 1 and 2 based on irrigants used that is 3% NaOCl and 2% CHX respectively.

Each group was further divided into two sub groups A and B based on cleaning and shaping to apical size 30 4% taper and size 30 6% taper respectively.

Following disinfection protocol, samples were taken using sterile paper point after access cavity preparation and again after chemomechanical preparation. They were tested for both anaerobic and aerobic bacterial growth.

RESULTS- There was no significant difference among different groups except when both the factors were considered, the irrigants (NaOCl and CHX) and taper (4% and 6%). There was statistically significant difference in the bacterial reduction in root canals prepared to 6% taper with 3% NaOCl as an irrigant.

Conclusion – There was no difference in bacterial load reduction between taper 4% and 6% and for irrigants NaOCl and CHX.
INTRODUCTION

Microbial control within the pulpal tissue and root canal space is a prerequisite for the prevention and treatment of pulpal and periapical breakdown.1

The primary objective of the root canal treatment is to reduce the microbial load in the root canals of infected teeth.2 This is achieved by shaping and cleaning of the root canals which is an essential step in treatment. Unfortunately, the endodontic instruments are unable to reach some areas of the root canals due to their anatomical complexities.3 Hence a chemical irrigating solution is needed to aid in canal debridement 4 and for its antimicrobial activity5

Sodium hypochlorite(NaOCl) is the most frequently used irrigant in endodontic practice however it is known for its cytotoxic effects6 and the more biocompatible Chlorhexidine(CHX) has been recommended as an alternative.

The depth of irrigant penetration into the apical one third of canals and removal of debris are dependent on the final size of the instruments used in the canals.7 Larger apical preparations allow better removal of infected dentin,8 enhance the flushing action of irrigants in the apical region,9 and significantly reduce the bacterial load in the canal system.10 The drawbacks of larger apical preparation sizes include undesirable deviation from the original shape of the canal; weakening of the root; and procedural complications like ledge formation, transportation, and perforations.11 The conservation of tooth structure and the prevention of the extrusion of obturating materials have been cited as primary advantages of minimal apical enlargement.12

Therefore, our ultimate goal should be to preserve as much tooth structure as possible without compromising disinfection and eradication of bacteria from the root canal system. This means enlarging the canal to the smallest size and taper possible that will still allow for sufficient volume of irrigant.13

The objective of the present in vivo study was:
- To quantify the bacterial load before and after preparation of root canals to taper 4% and 6% respectively following disinfection of the canal.
- To quantify the bacterial load before and after preparation of root canals following disinfection of the canal with 3%NaOCl and 2%CHX respectively.

METHODOLOGY

Sixty patients aged between 18-65 years with single rooted mandibular teeth with pulp necrosis and periapical radiolucency requiring endodontic treatment were selected for the study following ethical clearance. In the initial consultation, the nature of the investigation and the potential risks and benefits associated with the study were explained to each patient, and an informed consent was taken. Patients with general disease, secondary infection (retreatment cases) and patients on antibiotics were excluded from this study.

For each patient, the tooth was isolated from the oral cavity with a rubber dam. The operative field, including the tooth, clamp, and surroundings, were cleaned with 3% hydrogen peroxide until no further bubbling of the peroxide occurred. All surfaces were then disinfected by vigorous swabbing of 3% NaOCl solution. Subsequently 5% sodium thiosulfate was used as a neutralizer.

Access preparation was done with a sterile Endo access bur (DentsplyMaillefer, Ballaigues, Switzerland.) under sterile saline irrigation. Just before reaching the pulp chamber the second stage of disinfection was done for the operative field and the surrounding structures by the above mentioned procedure.

After access cavity preparation three sterile paper point were placed in the canal consecutively to a level approximately 0.5 mm short of the root apex (based on diagnostic radiographs), to soak up the fluid in the canal. Each paper point was left in the canal for at least 1 minute. Paper points were then transferred aseptically to tubes containing reduced transport fluid.
The patients were divided into two groups: 1 and 2 (30 each). Irrigant used was 3% NaOCl and 2% CHX respectively. Each group was further divided into two sub groups: A and B where cleaning and shaping was done to apical size 30 and 4% taper and 6% taper respectively.

The coronal two thirds of the root canals were enlarged with Gates-Glidden instrument. Working length was measured by preoperative radiographs and #15 file was inserted into the root canal 0.5 mm short of the root apex and was verified using electronic apex locator (Raypex 5 VDW Endodontic Synergy, Munich, Germany) Apical preparation was completed to the working length using k flex hand files to #25 followed by RaCe rotary files to size #25 taper 4%, # 30 taper 4% (subgroup A) or to # 30 taper 6% (subgroup B).

3% NaOCl along with 17% EDTA in Group 1 and 2% CHX in Group 2 was used during cleaning and shaping. Irrigants were used throughout the chemomechanical preparation using using 27 gauge disposable needle. Finally the irrigants were left in the canal for 5 minutes and then agitated with master gutta percha cone for one minute. NaOCl was neutralized with 10 ml of 5% sodium thiosulfate and CHX was neutralized with 10 ml of 0.1% tween 80 to avoid false-negative results.

Then a second sample (s2) was taken from the root canal in the same manner as s1. The samples collected were immediately transferred to the transport media (sodium thioglycollate) and transferred to the lab. The samples were tested for both anaerobic and aerobic bacterial growth.

Serial dilution of the sample was done in saline and 100 microlitres was spread on to the tryptone soy agar under anaerobic condition and incubated in the anaerobic jar. Plates were incubated anaerobically (80% N2, 10% H2, 10% CO2) at 37°Celsius for 3-7 days for the growth of facultative and obligate anaerobes. Also 100 microlitres of the same was plated on tryptone soy agar and incubated at 37°Celsius for 24 to 48 hours under aerobic conditions.

The total bacterial count as CFU (colony forming units) for both aerobic and anaerobic bacteria was carried out in each sample to test the efficacy of each treatment.

Results and Statistical Analysis

Comparison of four groups (Group 1A, Group 1B, Group 2A and Group 2B) with respect to log CFU counts before and after and their difference was done by Kruskal Wallis ANOVA. Pair wise comparison amongst the groups (inter group) was done by Mann-Whitney U test. The level of significance was set at 0.05 for all the analyses (p<0.05).

At s1, no statistically significant difference was found between any of the mean CFU values found in all groups.

At s2, statistically significant differences were found between all the mean CFU values (p<0.05) when compared to samples s1 but still all the canals were not rendered 100% free of bacteria.

The comparison of the mean log reduction between the different groups showed that the most effective group was 1B which is NaOCl group with canals prepared to size 30 and taper 6% with a mean log reduction of 3.33 (70.4%) followed by group 1A (3% NaOCl #30.04) with a mean log reduction value of 2.91 (64.38%). Whereas group 2B (2% CHX size 30.06) showed a mean log reduction of 2.81 (62.86%) and the least amount of reduction was seen in group 2A (2% CHX 30.04) with a mean log reduction of 2.32 (55.5%).

Pair wise comparison done amongst the groups by Mann-Whitney U test showed that there was no significant difference in the effectiveness of different groups except for 1B (3% NaOCl 30.06) and 2A (2% CHX 30.04) where the difference was 0.0213 (p<0.05).

Table 2: Comparison of four groups-Group 1A (NaOCl 30.04), Group 1B (NaOCl 30.06), Group 2A (CHX 30.04) and Group 2B (CHX 30.06) with respect to log CFU counts at before and after and their difference by Kruskal Wallis ANOVA and Mann-Whitney U test
DISCUSSION

Chemo-mechanical preparation is one of the most important phase of root canal treatment. It includes both mechanical instrumentation as well as canal irrigation with chemical agents that is principally directed towards the elimination of microorganisms from the root canal system.14

Single rooted mandibular teeth were selected to minimize anatomical variations and there by standardize the anatomy of root canal to a certain extent.

It is almost impossible to get sterilized canals because bacteria cannot be completely removed from the canals irrespective of the size of the file or preparation technique used. However with proper instrumentation and irrigation a significant decrease in bacterial load is achievable. This also prevents the thriving of residual pathogens in sufficient numbers to cause endodontic failure.15

Neutralizing agents namely sodium thiosulphate and tween 80 were used to inactivate the antibacterial activity of NaOCl and CHX respectively, to prevent the potential carry-over effect of the irrigants giving false negative result.16

Culture procedure rather than contemporary techniques (molecular methods,)17 is a reliable method as it evaluates the antimicrobial efficacy of root canal procedures, due to its capacity to detect viable bacteria. Additionally studies done in the past have shown a correlation between non-cultivable bacteria and a favorable treatment outcome.18

The s2 samples taken post instrumentation and irrigation showed a decrease in bacterial numbers in the canals. Good percentage of bacterial reduction was seen in all the cases with highest being 70.4% in group 1B (NaOCl # 30.06) followed by 64.38% in group 1A (NaOCl # 30.04), 62.86% in group 2B (CHX # 30.06) and 55.5% in group 1B (CHX # 30.04). This indicates that keeping the taper constant, 3% NaOCl (Group 1) showed better antimicrobial reduction compared to 2% CHX (Group 2) even though it was not statistically significant which is in agreement with the previous studies.19 It is also clear that the in vivo20 effectiveness of NaOCl in the root canal against the infecting microflora is somewhat disappointing compared to the more promising invitro21 results, which show killing of practically all microorganisms in a few seconds, when concentrated solutions are used. One natural explanation to poorer in vivo performance is root canal anatomy, in particular the apical region, because of the difficulty in delivering of large volumes of fresh irrigant.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Before procedure</th>
<th>After procedure</th>
<th>Difference between before and after</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Median</td>
</tr>
<tr>
<td>Group 1A</td>
<td>4.52</td>
<td>1.18</td>
<td>4.62</td>
</tr>
<tr>
<td>Group 1B</td>
<td>4.73</td>
<td>1.12</td>
<td>4.72</td>
</tr>
<tr>
<td>Group 2A</td>
<td>4.18</td>
<td>1.13</td>
<td>4.58</td>
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<tr>
<td>Group 2B</td>
<td>4.47</td>
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<tr>
<td>H-value</td>
<td>1.4374</td>
<td>1.1094</td>
<td>6.7444</td>
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<tr>
<td>P-value</td>
<td>0.6968</td>
<td>0.7748</td>
<td>0.0805</td>
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</table>

Pair wise comparison by Mann-Whitney U test

<table>
<thead>
<tr>
<th>Pair wise comparison</th>
<th>H-value</th>
<th>P-value</th>
</tr>
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<tbody>
<tr>
<td>1A vs 1B</td>
<td>0.6783</td>
<td>0.6783</td>
</tr>
<tr>
<td>1A vs 2A</td>
<td>0.4429</td>
<td>0.5069</td>
</tr>
<tr>
<td>1A vs 2B</td>
<td>0.9010</td>
<td>0.6936</td>
</tr>
<tr>
<td>1B vs 2A</td>
<td>0.2717</td>
<td>0.3095</td>
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<tr>
<td>1B vs 2B</td>
<td>0.6041</td>
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<tr>
<td>2A vs 2B</td>
<td>0.4429</td>
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</tr>
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</table>

*p<0.05
Results of this study indicate that group 2A (NaOCl #30.06) showed more reduction in mean log bacterial counts compared to group 1A (NaOCl #30.04). Group 2B (CHX size 30.06) showed more reduction in mean log bacterial counts compared to group 2A (CHX #30.04). Hence this study showed that using the same irrigant in the canals that were prepared to taper 6% showed more reduction in the bacterial count when compared to the canals prepared to 4% taper. However there was no statistical significance between them, which is in agreement with the previous studies.13

The antibacterial action of NaOCl is due to Chlorine (a strong oxidant) which inhibits bacterial enzymes leading to an irreversible oxidation of SH groups (sulphydryl group) of essential bacterial enzymes.22 Also the high pH of sodium hypochlorite interferes with the cytoplasmic membrane integrity23 with an irreversible enzymatic inhibition causing biosynthetic alterations in cellular metabolism and phospholipid degradation observed in lipidic peroxidation.22

Chlorhexidine is highly effective against several gram-positive and gram-negative oral bacterial species as well as yeasts.24 Chlorhexidine crosses the microbial cell wall and attacks the cytoplasmic membrane causing leakage of intracellular constituents. At high concentration Chlorhexidine congeals the cytoplasmc by attacking the phosphate entities with resultant reduction in leakage.25

Comparing different groups and subgroups, showed there was no significant difference in the effectiveness of different groups or subgroups except for 1B (3% NaOCl #30.06) vs 2A (2%CHX #30.04) where the difference was 0.0213 (p< 0.05). It implies that when both the factors were considered i.e. taper(0.04 and 0.06) and the irrigant( 3% NaOCl and 2% CHX) there was a significant amount of difference in the reduction seen in bacterial counts in canals prepared to 0.06 taper using NaOCl as an irrigant.

The limitations of this study are that since the culture methods were used in this study the prevalence of some oral pathogens could have been underestimated by culture based techniques as the approaches may fail to grow certain bacteria, especially fastidious anaerobic micro-organisms such as spirochetes or Tannerella forsythia.

**Conclusion**

1) 3% NaOCl is more effective in reducing bacterial counts in the root canals compared to 2% CHX even though not statistically significant.

2) Canals prepared to taper 6% were more effective in reducing bacterial counts in the root canals compared to canals prepared to taper 4% even though not statistically significant.

3) When both the factors were considered i.e the irrigants (NaOCl and CHX) and taper( 4% and 6%) there was a statistically significant amount of difference in the reduction seen in bacterial counts in canals prepared to 6% taper and NaOCl was used as an irrigant.

**Bibliography**


An In Vitro Evaluation Of Shear Bond Strength Of Two Resin Based Root Canal Sealers To Root Dentin After Using Various Chelating Agents As Final Irrigant

Subramanya M¹, Sreekha A², Jayshree Hegde³, Kusum B⁴

Abstract

Aim: The aim of this study was to evaluate the shear bond strength of AH plus and Adseal root canal sealers to dentin after using 17% EDTA, 10% citric acid and 18% 1-hydroxyethylidene-1,1-bisphosphonate (HEBP) as final irrigant.

Materials and Methods: One hundred and twenty maxillary central incisors were prepared using different irrigants (n=30). All the groups had 3% sodium hypochlorite as initial rinse, followed by specific final rinse for each group: G1- 17% EDTA, G2- 18% HEBP, G3- 10% citric acid and G4- saline. Polyethylene tubes of 3mm long were placed on the prepared samples and filled with root canal sealers. Bonding between the sealers and root dentin surface was evaluated using shear bond testing. The obtained values were statistically evaluated using one way ANOVA test followed by t- test.

Results: AH plus and Adseal revealed good shear bond strength to root canal dentin with no statistical significant difference (p<0.05). 17% EDTA and 10% citric acid showed highest bond strength with no significant difference (p<0.05), followed by 18% HEBP which showed lesser bond strength with statistically significant difference (p<0.05).

Keywords:

Root canal sealers, chelating agents, ethylenediaminetetraacetic acid, Citric acid, 1-hydroxyethylidene-1,1-bisphosphonate, smear layer, shear bond strength.
Introduction

Adhesion of root canal sealers to dentin is important for maintaining the integrity of the seal. Adhesion depends on multiple interacting factors including the surface energy of the adherent (dentin or gutta percha); the surface tension of the adhesive (sealer), the adhesives ability to wet the surfaces, the cleanliness of the adherent surface and the cohesive strength of the sealer. Adhesion may be widely distinguished into chemical bonding and mechanical bonding; Good chemical bonding can be achieved even with smooth surface, while micro mechanical bonding, requires the presence of irregularities on the surface of the adherent into which the adhesive can penetrate.1,2,3

The success of endodontic therapy depends on reduction of microbes to an uncultivable level.4 This is achieved by proper shaping, three dimensional disinfection and obturation. During shaping procedure, smear layer is formed on the dentinal walls of the root canal, removal of which is preferred.

15-17% ethylenediaminetetraacetic acid (EDTA) is most commonly used. 10% Citric acid is more biocompatible than 17% EDTA. Major disadvantages of EDTA and citric acid is that they interact with sodium hypochlorite.5 18% 1-hydroxyethylidene-1, 1-bisphosphonate (HEBP) is a soft chelator and has shown no short-term reactivity with sodium hypochlorite (NaOCl).6,7,8

AH plus is the widely used root canal sealer because of its desirable physical properties.9 Adseal is another epoxy resin based sealer where very less studies are conducted on it.

No studies are performed comparing the effect of EDTA, citric acid and HEBP when used as final irrigant on the shear bond strength, of AH plus and Adseal. Hence the aim of this study was to evaluate the shear bond strength of two endodontic sealers to root dentin after using various chelating agents as final irrigant.

Materials and Methods

One hundred and twenty maxillary central incisors were collected without caries and samples were stored in distilled water. Teeth samples were decoronated at the cemento-enamel junction level using a water-cooled diamond impregnated disc. Root canals were prepared up to ISO size 45 using k files under copious irrigation. Vertical sections were made to expose inner surface of the radicular dentin. A smear layer was created by abrading the dentin under running water irrigation for 15secs, using 320 grit silicon carbide paper which was run using slow speed hand piece. The root sections were embedded in 2 cms height plastic ring using cold cure acrylic resin with at least 7mm of the coronal surfaces exposed.

The mounted teeth were randomly divided into four testing groups consisting of 30 samples in each group. All samples were subjected to initial rinse using 3% NaOCl for 1 min followed by final rinse with specific irrigant of each group: Group 1 samples were irrigated with 17% EDTA, Group 2 with 18% HEBP, Group 3 with 10% citric acid and Group 4 with saline (control).

The samples were again subdivided into two subgroups of 15 samples each according to the sealer that was used. AH plus was named as subgroup A and Adseal as sub group B.

Plastic straw with 4mm internal diameter and 3mm in height were used to apply the sealers on to the dentin with a constant surface area of 12.57 mm2. To stabilize the plastic cylinder to the dentin and to restrict the sealer to a particular area of dentin, the cylinder was secured by sticky wax. AH Plus is available in two paste form and Adseal is available in dual syringe. The sealers were mixed according to the manufacturer’s instructions. The plastic cylinders were filled with the sealers from the bottom of the cylinder with a plastic instrument and then vibrated for 15 seconds to eliminate air bubbles. After initial setting reaction had taken place, the samples were stored in an incubator at 37oC and 100% humidity for a period of 1 week.

The mounted samples were placed vertically onto the universal testing machine at a speed of 0.5mm/min (Picture No 1). The load at which the tube detached from the substrate was recorded by
a computer attached to the equipment in Newtons (N) for each specimen, which was then divided by the contact surface area to determine the shear bond strength in Mega Pascals (MPa).

Results

AH plus had the greatest values of adhesion than Adseal with no statistical significant difference (p<0.05). Among final irrigants used 17% EDTA showed highest bond strength followed by 10% citric acid with no statistical significant difference (p<0.05), and 18% HEBP showed lesser bond strength with statistical significant difference (p<0.05) in comparison with 17% EDTA and 10% citric acid. All the experimental chelating agents showed statistical significant (p<0.05) results compared to control groups.

Table No 1: Comparison of AH Plus subgroup and Adseal subgroup respect to shear bond strength (MPa) in all four groups i.e. EDTA, HEBP, Citric acid, Saline by t test

<table>
<thead>
<tr>
<th>Main groups</th>
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<th>n</th>
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<th>SD</th>
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<th>p-value</th>
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<td>HEBP</td>
<td>AH Plus</td>
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<td>2.62</td>
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<td>1.2255</td>
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<td></td>
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<td>2.46</td>
<td>0.32</td>
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<tr>
<td>Citric acid</td>
<td>AH Plus</td>
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<td>3.91</td>
<td>0.20</td>
<td>0.3831</td>
<td>0.7045</td>
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<td>Saline</td>
<td>AH Plus</td>
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<td>15</td>
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<td>0.23</td>
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</tbody>
</table>

Discussion

Most previous studies have investigated the ability of endodontic sealers to prevent apical microleakage. However, it has been shown that different leakage evaluation methods may exhibit different results on the same sealer. In addition, specification of the exact interface responsible for the leakage (dentin – sealer or gutta percha – sealer) is not possible when using leakage studies. The interaction (eg. Wetting) of the materials with dye may influence the penetration of the dye. Moreover, the filler content of the sealers varies and may cause differential dye penetration. Dye penetration methods can also be influenced by entrapped air. Considering the disadvantages of leakage studies and the fact that greater adhesion of sealers to dentin can prevent apical leakage, the present study was conducted to investigate the adhesive ability of epoxy resin based sealers to dentin and to compare them by measuring their sealer bond strengths.

Coronal part of the radicular dentin was used for bonding in this study. Vertical sections were made to expose the inner surface of the radicular dentin. This inner surface was flattened to produce flat intra radicular dentin. This provides advantage of easy standardization of the specimens. The bonded surface areas in vitro have to be relatively large to obtain a strong enough bond to permit handling without inadvertent fracture. The bonded surface areas of endodontic sealers in this study were 12.57mm².

AH plus (Group 1A) showed highest bond strength after using 3% NaOCl followed by 17% EDTA (Group 1) as final irrigant for 1min. The bond strength obtained was 4.13MPa (Table 1)
after using 17% EDTA as final irrigant. The result obtained may be associated with its ability to react with any exposed amino groups in collagen to form covalent bonds between the resin and collagen when the epoxide rings open. It has been suggested that AH Plus penetrates better into the micro irregularities because of its long setting time, low solubility and disintegration, and through its prolonged capacity to flow may be able to compensate for shrinkage stresses thus making a tight seal.17 Similar results are seen with study done by Kandaswamy et al where AH Plus showed highest bond strength when 17% EDTA was used as final irrigants.18

AH Plus (Group 3A) also showed good bond strength that is 3.91Mpa (Table 1) when 3% NaOCl followed by 10% citric acid (group 3) was used as final irrigant. However no statistical significant difference (p<0.05) was seen between 17% EDTA and 10% citric acid. Reis et al observed that 10% citric acid opened all the dentinal tubules as effectively as that of 17% EDTA.19

Bond strength of AH Plus (Group 2A) obtained that is 2.62 Mpa (Table 1) after using 3% NaOCl followed 18% HEBP (group 2) was significantly (p<0.05) lesser than that of both group 1 and group 3. 18% HEBP is a weak chelator and the decalcifying effect is much lesser than 17% EDTA and 10% citric acid.7 Garcia-godoy et al showed that the EDTA created demineralized dentin zone of about 2-4microns deep.20 As epoxy resin sealer depend mainly on adhesion, HEBP, a soft chelator created a shallow demineralized dentin zone compared to EDTA which resulted in lesser bond strength.

AH plus (Group 4A) showed least bond strength that is 1.49 Mpa (Table 1) with saline (Group 4), with statistically significant difference (p<0.05). Saline does not have any chelating property. Hence the bond strength obtained was least when compared to other irrigants.

A comparative study of physical properties of AH plus and Adseal by Marina et al did not show statistically significant difference in solubility, flow and film thickness between these sealers. However a statistically significant difference was found in setting time and radiopacity. The setting time of Adseal is 45mins at 37oC while that of AH Plus is 8hrs at 37oC as claimed by the manufacturers.21 Since all the physical properties are similar to each other, the bond strength obtained is not statistically different in our study.

### Conclusion

Within the limitations of this study, following conclusion was drawn: When epoxy resin based sealers like AH plus or Adseal are used, then 17% EDTA or 10% citric acid can be used as final irrigant.

### References


INTRODUCTION

Biomechanical preparation plays a mammoth role in determining the success of endodontic treatment. The complex anatomy of the root canal system, even after adequate mechanical instrumentation leaves many portions of the root canal, untouched acting as a harbor for the growth of microorganisms. Hence, disinfection of the root canal system with irrigants is necessary to supplement mechanical preparation.

Historically countless number of compounds have been introduced as endodontic irrigants. Till today no single irrigant has been able to satisfy all the requirements of an endodontic irrigant. Sodium hypochlorite (NaOCl) since its introduction in endodontics by Walker in 1936 has been widely used. Numerous studies have been conducted to find a replacement for NaOCl. The compounds being tested include herbal compounds like Neem and Curcumin. Due to their antimicrobial properties, herbal compounds have shown potential to be used as endodontic irrigant.

Abstract

Aim: To evaluate the antimicrobial efficacy of Curcumin, Neem and 3% sodium hypochlorite (NaOCl) against biofilms of E. faecalis and C. albicans formed on the tooth substrate.

Materials and Methods: Forty premolars were biomechanically prepared, vertically sectioned and placed in tissue culture wells containing E. faecalis and C. albicans for the formation of biofilm respectively. After three weeks, the tooth samples were divided into groups and treated with herbal irrigants (neem and curcumin) and 3% NaOCl for 10 minutes. The biofilm on the root canal portion was scraped, inoculated on Brain heart infusion (BHI) agar plates and incubated for 24 hours at 37°C for quantitative analysis. ANOVA and post hoc Tukey test was used for analysis.

Results: Curcumin and Neem showed moderate antimicrobial activity compared to Sodium hypochlorite

Conclusions: Among the two herbal irrigants, Curcumin showed significant antimicrobial property against E. faecalis and C. albicans.

Keywords: Curcumin; Neem; Enterococcus faecalis; Candida albicans
used as an irrigant. Sodium hypochlorite solutions require careful handling and many factors are associated with its safety concerns.

Since ancient time plants have been good source of medicines and serve as a reservoir of chemical agents with therapeutic properties. Curcumin is the principle curcuminoid of the popular Indian spice turmeric. It is an important medicinal plant with excellent anti-microbial, anti-fungal, anti-inflammatory and anti-oxidant properties. The active constituents of turmeric are the flavonoid curcumin (diferuloylmethane) and various volatile oils, including tumerone, atlantone, and zingiberone. Other constituents include sugars, proteins, and resins all of which has a wide spectrum of biological actions.

Another medicinal plant, Azadirachta indica commonly known as Neem has also shown potent antimicrobial, antifungal, antiviral and anti-inflammatory properties.

Neem contains Nimbin (anti-inflammatory, antihistamine and antifungal properties), Nimbidin (provides antibacterial, analgesic, and antifungal properties), Quercetin (antioxidant, anti-inflammatory and antibacterial properties)

The most common organisms isolated from root canals with secondary apical periodontitis are C. albicans and E. faecalis. These facultative anaerobes are resistant to most anti-microbial agents used in endodontics.

E. faecalis survive in harsh conditions with scantily available nutrients even in well instrumented and obturated root canals through biofilm formation. Biofilm consist of one or more communities of microorganisms, embedded in a glycocalyx, that are attached to a solid surface. Biofilms facilitate processing and uptake of nutrients, as well as the development of an appropriate physicochemical environment. Both E. faecalis and C. albicans have the ability to bind and invade dentine to various degrees and survive starvation.

Most in-vitro studies evaluating the efficacy of irrigants of plant origin have been on microorganisms grown in a planktonic state. The planktonic state does not represent the actual in vivo growth condition in infected root canal where microorganisms grow as biofilm adhering to dentinal walls. Hence the aim of the study was to evaluate the efficacy of Neem, Curcumin and NaOCl as irrigants against biofilm of E. faecalis and C. albicans formed on tooth substrate.

**MATERIALS & METHODS**

Curcumin capsules (Kerala Remedies) containing 3 grams of Curcumin powder each was used for the study. The powder has been extracted with ethyl acetate followed by vacuum drying and has 89% to 90% turmeric oleoresin. Neem leaf powder was procured from All-Season Herbs Private Limited. The powder has been obtained by crushing and powdering mature dry leaves which was dissolved in an aqueous solvent to obtain the concentrated Neem leaf extract. 50 grams each of Curcumin powder and Neem powder was mixed separately in 100 ml of 10% Dimethyl sulphoxide (DMSO) to get the two solutions to be used as irrigants.

A pure culture of E. faecalis (ATCC 292122) and C. albicans (MTCC 7315) was grown separately on BHI Agar plates (Himedia, Mumbai, India), then inoculated into respective BHI Broth (Himedia, Mumbai, India) and incubated at 37°C overnight. The growth concentration was adjusted to 10^5 organisms/ml by using 0.5 McFarland's turbidity standard.

Forty human mandibular premolars with single root with fully formed apex were selected for the study. The teeth were cleaned with ultrasonics scaler to remove the superficial debris and calculus and further stored in normal saline. Radiographs were taken for each tooth to confirm the presence of a single canal. Each tooth was decoronated with a diamond disc below the cemento-enamel junction to obtain a standardised length of 9 mm.

Using the Crown down preparation technique, instrumentation of each canal was done using Hyflex (Coltene Whaledent) to size # 40 with 0.04
taper using 3% sodium hypochlorite as an irrigant. All the teeth were sectioned vertically into two equal halves using a diamond disc. The inner portion of each sectioned half was minimally ground to obtain a flat surface for easy placement in tissue culture wells for formation of a biofilm. The sectioned teeth were sterilised by autoclaving at 121°C for 20 min.

The root sections were divided into 2 main groups containing 40 samples each and placed in tissue culture wells and was inoculated with broth containing 2ml of E.faecalis in Group I and 2ml of C.albicans in Group II respectively and incubated at 37°C for three weeks. Every alternate day the culture medium was replenished to avoid nutrient depletion & accumulation of toxic end products. The samples were taken from each well, inoculated onto BHI agar plates and incubated at 37°C for 24 hours to check for the cell viability and purity of culture.

At the end of the third week, all the teeth were divided into 4 subgroups (Group A, Group B, Group C, Group D) of 10 samples each and subjected to 3ml of four different types of irrigants for 10 minutes as follows

**Group A** - Neem dissolved in 10% DMSO

**Group B** - Curcumin dissolved in 10% DMSO

**Group C** - 3% sodium hypochlorite which served as the positive control

**Group D** - saline which served as the negative control.

The biofilm on the root canal portion was scraped, from all root sections and inoculated separately for each subgroup, for quantitative analysis. All procedures were carried out under aseptic conditions.

**RESULTS**

Descriptive statistical analysis was carried out and significance was assessed at 5 % level of significance. Analysis of variance (ANOVA) was used to find the significance of study parameters between the four groups. Post-hoc Tukey test was used to find the significance group wise.

**Table 1: Comparison of Colony Forming unit (CFU) in four irrigants studied for E.faecalis.**

<table>
<thead>
<tr>
<th>E.faecalis</th>
<th>Mean ± SD(CFU)</th>
<th>95%CI(CFU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A-Neem</td>
<td>818.33±13.18</td>
<td>811.03-825.63</td>
</tr>
<tr>
<td>Group B-Curcumin</td>
<td>434.47±22.56</td>
<td>421.92-446.96</td>
</tr>
<tr>
<td>Group C-NaOCl</td>
<td>208.73±6.44</td>
<td>205.17-212.30</td>
</tr>
<tr>
<td>Group D-Saline</td>
<td>1232.33±24.31</td>
<td>1218.87-1245.79</td>
</tr>
</tbody>
</table>

Significance F=9222.385; P<0.001**

**E.faecalis Difference in CFU P value**

| Group A-B | 383.87 | <0.001** |
| Group A-C | 609.60 | <0.001** |
| Group A-D | 414.00 | <0.001** |
| Group B-C | 225.73 | <0.001** |
| Group B-D | 797.87 | <0.001** |
| Group C-D | 1023.60 | <0.001** |

**Table 2: Group wise Comparison of Colony Forming unit (CFU) in four irrigants studied for E.faecalis**

**Table 3: Comparison of Colony Forming unit (CFU) in four irrigants studied for C.albicans**

<table>
<thead>
<tr>
<th>C.albicans</th>
<th>Mean ± SD(CFU)</th>
<th>95%CI(CFU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A-Neem</td>
<td>538.20±20.85</td>
<td>526.65-549.75</td>
</tr>
<tr>
<td>Group B-Curcumin</td>
<td>519.47±14.11</td>
<td>511.66-527.27</td>
</tr>
<tr>
<td>Group C-NaOCl</td>
<td>156.53±14.18</td>
<td>148.68-164.38</td>
</tr>
<tr>
<td>Group D-Saline</td>
<td>1229.20±13.64</td>
<td>1221.64-1236.76</td>
</tr>
</tbody>
</table>

Significance F=11799.115; P<0.001**

**C.albicans Difference in CFU P value**

| Group A-B | 18.73  | 0.011* |
| Group A-C | 381.67 | <0.001** |
| Group A-D | 691.00 | <0.001** |
| Group B-C | 362.93 | <0.001** |
| Group B-D | 709.73 | <0.001** |
| Group C-D | 1072.67 | <0.001** |

**Table 4: Group wise Comparison of Colony Forming unit (CFU) in four irrigants studied for C.albicans**
* Moderately significant (P value: 0.01 < P < 0.05)

** Strongly significant (P value: P < 0.01)

The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data.

Table 1 shows the E. faecalis count in all the four groups. Table 2 shows the groupwise comparison among all the four groups against E. faecalis. The bacterial count was maximum in the group treated with normal saline where as NaOCl group least growth compared to all the four irrigants. Curcumin showed better antimicrobial action compared to Neem.

Table 3 shows the C. albicans count against all the four groups. Table 4 shows the groupwise comparison among all the four groups against C. albicans. The bacterial count was maximum in the group treated with normal saline where as NaOCl group least growth compared to all the four irrigants. Curcumin and Neem showed nearly similar antibacterial action against C. albicans.

DISCUSSION

Medicinal plants form the backbone of umpteen traditional systems of medicine. Many plant tissues contain a variety of compounds called “secondary” plant compounds (metabolites) grouped as glucosides, saponins, tannins, alkaloids, essential oils, organic acids and others. Phytoalexins, another group of compounds are typically synthesized in response to environmental stress, has shown to have both antimicrobial and antifungal properties interfering with the cell membrane associated functions.

3% sodium hypochlorite was chosen for this study in accordance with the methodology followed by Madhu Pujar et al.[25] Sodium Hypochlorite has been the most widely used root canal irrigating solution for several decades due to its excellent properties of tissue dissolution and antimicrobial activity. But it has several undesirable characteristics such as tissue toxicity, risk of emphysema when overfilling, allergic potential, disagreeable smell and taste and inability to remove the smear layer.

Biofilms consist of one or more communities of microorganisms, embedded in a glyocalyx, that are attached to a solid surface. The resistance of the microorganisms is increased by the formation of biofilm as compared to that of planktonic cells. The biofilm-forming capacity and its structural organization are influenced by the chemical nature of the substrate.[10] Hence in this study, microbial biofilms on the dentin block model has been used to simulate the chemical and microanatomical environment of the tooth and the root canal system.[11] An interval of 3 weeks for biofilm formation was selected to get sufficiently thick biofilm. [12] The agar diffusion test measures only bacteriostatic activity while in endodontics, a bactericidal effect of an irrigant is more important than a bacteriostatic effect.

C. albicans and E. faecalis was selected in this study as these organisms are commonly found in recalcitrant infections after endodontic treatment.

Dimethyl sulfoxide (DMSO ) was used as a solvent for Curcumin and Neemas as it is clean, safe and has an excellent solvating power that dissolves both polar and non-polar compounds. The latter helps in bringing out the pure properties of all the components of the herb. DMSO was found to be efficient vehicle for curcumin to exert photokilling of gram positive bacteria.[13] Most studies have employed ethanol as solvent for herbal products but ethanol itself has substantial antimicrobial properties of its own unlike DMSO.[12]

Higher concentration of herbal solution was used as sessile bacteria present on surface or within biofilm are much less readily activated than planktonic cells.

In this study Curcumin showed better result than neem in its antimicrobial activity. The curcumin used in this study contained 40% turmeric oleores which also possess good antioxidant[14] and antimicrobial[15] property. The resin fraction have shown to affect the protein and DNA synthesis of gram positive organism.[16]
In a study done by Prasanna Neelakantan, Curcumin exhibited similar anti-bacterial activity as NaOCl against E.faecalis.[17] Studies done by many authors have also shown favourable results of curcumin against E.faecalis and C.albicans.16,18,19,20,21

The main active component of Neem leaf is azadirachtin (1-3%) in addition to nimbidin, cyclic trisulphide & cyclictetrasulphide. They all are responsible for neem's antibacterial, antifungal, antiviral and antiinflammatory properties.[22]

In comparison to saline group neem exhibited significant antimicrobial activity against E.faecalis and Calbicans. This may be due to the anti-adherence activity of neem which affects bacterial adhesion and ability of organism to colonize.[22] Favourable antimicrobial activity against E. faecalis and C. albicans has been reported.[23,24]

Use of curcumin and neem as an endodontic irrigant might be advantageous because it is biocompatible antioxidant and thus not likely to cause severe injuries following extrusion of the irritant periapically. The disappearance of yeasts but not E. faecalis in the root canals may be a result of different biofilm characteristics and dentin penetration by these species.

Herbal alternatives offer many advantages like easy availability, costeffectiveness, increased shelf life, low toxicity and lack of microbial resistance reported so far.

However, further studies in vitro and clinical trials are needed to evaluate biocompatibility and safety concerns before turmeric and neem can conclusively be recommended as an intracanal irrigating solution, but in vitro observation of turmeric and neem effectiveness appears promising.

CONCLUSION

Within the limitations of this study, Curcumin showed significant anti-microbial activity against the 3-week E.faecalis and C.albicans biofilm formed on the tooth substrate than Neem. The anti-microbial property of Curcumin and Neem was significantly less compared to NaOCl.

REFERENCES


A SIMPLIFIED RELINING TECHNIQUE TO FABRICATE A CUSTOM FIT OCULAR PROSTHESIS - A CASE REPORT

Dr. Shah Bhavin, Dr. Roy Sunitha M

ABSTRACT: Maxillofacial prosthetic (MFP) rehabilitation can be especially challenging in a young, uncooperative, or behaviourally compromised child presenting with an enucleated eye. Retinoblastoma is the most common intraocular malignancy in childhood and is one of the most common paediatric cancers. Treatment consists of enucleation (or removal of the entire globe) followed by placement of orbital implants. Unrestored anophthalmic sockets exhibit growth retardation and can lead to facial disfigurement. In this report, a 5 year old boy with an anophthalmic socket, who had an ill fitting ocular prosthesis was relined using a simple technique and it showed acceptable cosmetic result and a proper fit of the prosthesis to the socket.

Keywords: ocular prosthesis, retinoblastoma, relining, custom fit

INTRODUCTION

Retinoblastoma is a rapidly developing cancer that develops from the immature cells of a retina, the light-detecting tissue of the eye and is the most common malignant tumor of the eye in children. Enucleation of the eye is the treatment of choice for such cases. Eyes are generally the first feature of the face to be noticed. Eye is a vital organ not only in terms of vision but also being an important component of facial expression. Loss of eye has a psychological effect on the patient. So a prosthesis should be provided as soon as possible for the psychological wellbeing of the patient.

Enucleation in early childhood hinders normal growth process and if the etiology was malignancy, the accompanying radiation treatment further retards development. For psychological, social and aesthetic reasons ocular prosthesis should be fabricated as early in life as possible. To prevent the orbit from shrinking and to promote development of lids and lining soft tissues, a prosthesis of an appropriate size must be fabricated from time to time as the child grows. The socket is fully developed at about twelve years of age, so the need to reline or replace the prosthesis is of relevance.

An ocular prosthesis can be either ready-made (stock) or custom-made. Stock prosthesis comes in standard sizes, shapes, and colours. They can be used for interim or postoperative purposes. Custom eyes have several advantages including better eyelid movements; even distribution of pressure due to equal movement thereby reducing pressure on the lid and reducing discomfort.
the incidence of ulceration, improved fit, comfort, and adaptation improved facial contours, and enhanced aesthetics gained from the control over the size of the iris, pupil and colour of the iris and sclera\textsuperscript{6-8}

CASE REPORT

A five year old patient named Ijaz, was referred to the DEPARTMENT OF PROSTHODONTICS, The Oxford Dental College with a chief complaint of ill fitting prosthesis of the right eye. He was diagnosed with retinoblastoma at the age of 6 months for which he had undergone enucleation of the right eye. After 2 years he was rehabilitated with a prefabricated ocular prosthesis, due to poor aesthetics because it was ill fitting and compromised eye movement, the need to reline the prosthesis to obtain a proper fit was of relevance. (fig.1)

Figure 1

PROCEDURE

The enucleated socket was examined.(fig.2 & 3) Preliminary impression was made using a medium body addition silicon elastomeric impression material. The impression of the enucleated socket was made with the help of an automatic dispensing and mixing gun. The tip was placed in the socket and the impression material was injected. The advantage of using these tips were it provided a uniform mix and there was less air bubbles incorporated in the mix.(fig.4)

While the material was still setting, a needle cap of a syringe was cut and the hollow tube was strategically placed in the set impression material which served as a handle.(fig.5) And this also ensured proper pupil position in relation to the contralateral eye.(fig. 6) Now this set impression was removed and inspected which served as the custom tray to make a secondary impression. (fig.7) About 1mm of the intaglio surface of the regular body was scraped off to provide room for the secondary impression material. Light body elastomeric impression material was used as the secondary impression material which was injected on the regular body impression tray and placed inside the socket. The child was asked to make all eye movements to allow the impression material to flow well into all the extensions. The impression was inspected for accuracy and the cast was poured using a three pour technique.(fig.8,9,10) The impression was removed after the stone was set. Separating media was applied on the mould. Self cure clear acrylic was mixed and relined on to the intaglio surface of the ocular prosthesis and placed on the mould.(fig.11) After the acrylic was set it was removed and the excess flash was trimmed and the intaglio surface was polished to give a smooth finish.(fig.12) It was then inserted into the socket after disinfecting the prosthesis.(fig.13) Necessary instructions for cleaning, placing and taking out the prosthesis was given.

Figure 2
Figure 3 : Enucleated socket

Figure 4
Figure 5

Figure 6
Figure 7
DISCUSSION

Analphthalmous is a condition where no eyeball can be found in the orbit. Retinoblastoma is the most common primary intraocular malignancy of children which arises from immature retinal cells in one or both eyes between the ages of 6 months to five years equally in all races and both genders. Surgical removal of the eye is the management in majority of the patients with unilateral retinoblastoma involving more than half the retina.

Two options are available for artificial eye prosthesis, one is a prefabricated ocular prosthesis and other is custom made. Prefabricated prosthesis carry disadvantages of poor fit, poor esthetics and poor eye movements. The technique to reline an existing eye prosthesis in this case report modifies a prefabricated eye prosthesis to a custom made fit and esthetics. The purpose of this case report is to document a simpler technique for relining an existing ocular prosthesis which helped in providing a better fit and proper eye movements post wearing the prosthesis. The advantage of this technique is it saved a lot of laboratory time and also the close adaptation of the custom made tissue bed provided maximum comfort.

However the limitations of this technique is that the clinician should depend on the availability of the iris and papillary part in the prefabricated eyes. And also the union of the cold cure acrylic resin with the stock eye must be monitored periodically.

REFERENCES

Introduction & Review

Amelogenesis imperfecta (AI) encompasses a heterogeneous group of developmental disorders that demonstrates alterations in the enamel. It is characterized by clinical and genetic heterogeneity in the absence of systemic abnormalities or diseases.\(^1\) - \(^4\) AI is also known by varied names such as, hereditary brown enamel, hereditary enamel dysplasia and hereditary brown opalescent teeth.\(^1,\)\(^5\)

Amelogenesis Imperfecta (AI) encompasses a complicated group of conditions that demonstrate developmental alterations in the structure of the enamel in the absence of a systemic disorder.\(^1,\)\(^5-7\) The prevalence of this condition has been expected to range from 1 in 718 to 1 in 14,000, depending upon the population studied.\(^1,\)\(^4,\)\(^6,\)\(^8-11\) Hypoplastic AI represents 60 – 73% of all cases, hypomaturation AI represents 20 – 40%, and hypocalcification AI represents 7%.\(^1,\)\(^5,\)\(^11\) No racial predilections of the AI have been reported.\(^8\) Both primary and permanent dentitions are usually affected.

AI results due to mutations in genes that control amelogenesis and follows inheritance patterns of autosomal-dominant, autosomal recessive or X-linked modes of
There are also patients for whom a family history cannot be identified but where a mutation is present. The inheritance pattern of X-linked disorders dictates that male to male transmission cannot occur. Conversely, all female offspring’s of the affected male must be affected. Affected females have a 50% of passing on the trait to the offspring of either sex. Mutations in the amelogenin gene (AMELX) cause X-linked amelogenesis imperfecta, while mutations in the enamelin gene (ENAM) cause autosomal-inherited forms of amelogenesis imperfecta. Recent reports reveal that kallikrein-4 (KLK4), MMP-20 and DLX3 genes are the etiologies of some cases.

This paper describes various dental manifestations, the functional and esthetic rehabilitation of AI patient. It also emphasizes that radiology plays an important role in diagnosing such conditions.

**CASE REPORT:**

A 16-year-old girl presented with a chief complaint of discolored teeth since childhood along with unpleasant esthetics, sensitivity and chipping of teeth since few months. Medical history was non-contributory. She did not report any major illness or prolonged hospitalization and medication. Her dental history revealed similar brown discoloration of her primary teeth. A detailed family history revealed that no other family members had the same dental problem.

The patient resided in a non-fluoridated area since her birth. Her maternal and postnatal history was not significant and there was a history of consanguineous marriage between the parents.

Extra-oral examination did not reveal any relevant findings. The patient’s hair, skin and nails were normal.

Intra-oral examination revealed, opaque-white pitting type of enamel on the labial aspect of all the teeth interspersed with a brown pigmentation with normal complement of teeth. This pitting pattern with brown pigmentation was also seen on occlusal surfaces of posterior teeth of both the arches leading to chipping of incisal and occlusal surfaces of all the teeth. The surfaces of the teeth were rough and hard in consistency. The emergence pattern and timing of teeth seemed to be within the normal range. Fig 2,3,4

**Fig 2: Labial surface of teeth showing opaque-pitting enamel**

**Fig 3: Maxillary occlusal view showing chipping of incisal and occlusal surfaces**

---

**Fig 1: Pedigree chart:**

- Unaffected Male
- Unaffected Female
- Affected Female
Fig 4: Mandibular occlusal view showing pitting pattern with brown pigmentation

The patient’s oral hygiene was good with mild calculus deposition. Gingiva was pale pink and pigmented. Based on history, clinical presentation, a **provisional diagnosis** of hypoplastic-pitted type amelogenesis imperfecta was proposed along with a differential diagnosis which include

1) Dental fluorosis
2) Dentinogenesis Imperfecta.

Intra-oral periapical radiographs of mandibular posterior teeth did not show any changes in enamel thickness. Fig 5

Fig 5 IOPAR not showing changes in enamel thickness

**Histopathological features revealed** discontinuous enamel rods along with loss of scalloping of DEJ suggestive of Amelogenesis imperfecta. Fig 6,7

Fig 6: Ground section showing discontinuous enamel rods.

Fig 7: Loss of scalloping of DEJ

Based on history, clinical presentation, radiographic examination and histopathological ground section a final diagnosis of “Type I A Hypoplastic-Pitted Amelogenesis Imperfecta” was proposed.

**Treatment**

Patient was educated and motivated; oral prophylaxis; improvement of esthetics and prevention of further deterioration of the remaining dentition. Patient was also advised for ceramic restoration of maxillary and mandibular anterior teeth.
Discussion

Amelogenesis imperfecta is a developmental, often inherited disorder, affecting dental enamel. It usually occurs in the absence of systemic features and comprises of diverse phenotypic entities. Compared with Dentinogenesis imperfecta the patient does not usually complaint of sensitivity since the dentin is intact. However in the present case patient was having sensitivity due to chipping of enamel surfaces associated with unpleasant appearance.

The prevalent clinical manifestations of affected individuals include enamel hypoplasia (enamel is seemingly correctly mineralized, but thin), hypomineralization(sub divided into hypomaturation and hypocalcification), or a phenotype combination, which is seen in most cases. The trait of AI can be transmitted by an autosomal dominant, autosomal-recessive, or X-linked mode of inheritance.

Clinical presentation of the AI varies according to its type. In the hypomaturation variety, the involved teeth exhibit mottled, opaque white-brown yellow enamel discoloration, which is softer than normal. In roentgenographs, the thickness of enamel is normal, but the density is the same as that of the dentin. The hypocalcified category shows pigmented, softened, and easily detachable enamel. Radiographically, enamel thickness is normal, but its density is even less than that of the dentin. In hypoplastic type, the enamel is well-mineralized but its amount is reduced. Radiographs exhibit a thin peripheral outline of radiodense enamel, and low or absent cusps. Clinical appearance of the teeth of our case was harmonious with rough pattern hypoplastic type of AI.

There are three main questions to ask when trying to decide whether this is AI.

- “Does anyone else in the family have this or something like it”?
- “Are all the teeth affected equally”?

Witkop and Sauk classified AI based on

<table>
<thead>
<tr>
<th>Type I hypoplastic</th>
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</thead>
<tbody>
<tr>
<td>IA Hypoplastic, pitted autosomal dominant</td>
</tr>
<tr>
<td>IB Hypoplastic, local autosomal dominant</td>
</tr>
<tr>
<td>IC Hypoplastic, local autosomal recessive</td>
</tr>
<tr>
<td>ID Hypoplastic, smooth autosomal dominant</td>
</tr>
<tr>
<td>IE Hypoplastic, smooth X-linked dominant</td>
</tr>
<tr>
<td>IF Hypoplastic, rough autosomal dominant</td>
</tr>
<tr>
<td>IG Enamel agenesis, autosomal recessive</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type II hypomaturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIA Hypomaturation, pigmented autosomal recessive</td>
</tr>
<tr>
<td>IIB Hypomaturation</td>
</tr>
<tr>
<td>IIC Snow-capped teeth, X-linked</td>
</tr>
<tr>
<td>IID Autosomal dominant?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type III hypocalcification</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIIA Autosomal dominant</td>
</tr>
<tr>
<td>IIIB Autosomal recessive</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type IV hypomaturation hypoplastic with taurodontism</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVA Hypomaturation hypoplastic with taurodontism, autosomal dominant</td>
</tr>
<tr>
<td>IVB Hypoplastic hypomaturation with taurodontism, autosomal dominant</td>
</tr>
</tbody>
</table>

whether the abnormality lies in a reduced amount of enamel (hypoplasia), deficient calcification (hypocalcification), or imperfect maturation of the enamel (hypomaturation), and also recognized the combine defects.

Table 1 : Classification of Amelogenesis Imperfecta (Witkop and Sauk)

Clinically, AI appears as an alteration of enamel formation resulting in hypoplasia, hypocalcification, and hypomaturation. Enamel hypoplasia results in a decreased quantitative enamel formation. In hypocalcification type the enamel appears normal but poorly mineralized while hypomaturation results in an abnormal mineralization in the final stages of tooth formation. The most common form, the hypoplastic type, is deficient in normal enamel. The crowns of
the teeth appear blanched, snow-capped, yellow-brown, pitted or grooved. Radiographic examination usually show a full accompaniment of teeth, but the crowns of the teeth either have very thin enamel or lack enamel completely.

AI is associated with other dental features such as quantitative and qualitative enamel deficiency, pulpal calcifications, taurodontism and root malformed, impacted permanent teeth, progressive root and crown resorption, hypodontia and anterior and posterior open bite occlusion.

Diagnosis involves exclusion of extrinsic environmental or auxiliary factors, formulation of a likely inheritance pattern, recognition of phenotype and correlation with the dates of tooth formation to exclude a chronological developmental disturbance. Also dental radiography in form of OPG & full mouth intraoral radiographs plays a vital role in diagnosing the difference in density of enamel in AI patients and normal patients along with thickness of dentin, length of the pulp canal and root.

Treatment planning for patients with amelogenesis imperfecta is related to many factors: the age and socioeconomic status of the patient, the type and severity of the disorder, and the intraoral status. An interdisciplinary approach is necessary to assess, diagnose and resolve esthetic problems using a combination of prosthodontic, orthodontic and restorative treatment.

Clinically, skeletal anterior open bite is seen in approximately 50% of patients with AI of either X-linked or autosomal inheritance type. Non enamel dental anomalies like taurodontism, elongation of pulp chamber due to apical displacement of root furcation and pulp calcifications occur with increased frequency in these patients. Along with this, congenitally missing teeth (partial anodontia), high arched palate is also seen.

Diagnosis is based on the family history, pedigree plotting, meticulous clinical and radiological observation. Pedigree chart was constructed for present case which did not show any family history. This indicates sporadic changes in the genes causing amelogenesis imperfecta.

Radiographic examination of AI teeth provides imperative information to the clinician with respect to the degree of enamel mineralization to design an appropriate treatment plan. Evaluation of enamel density changes in AI teeth are generally made by contrasting the enamel with the dentin; enamel that has a radiopacity similar to or less than that of dentin is considered mineral deficient.

### Table 2: Differential diagnosis

<table>
<thead>
<tr>
<th>Amelogenesis Imperfecta</th>
<th>Dental Fluorosis</th>
<th>Dentinogenesis Imperfecta</th>
</tr>
</thead>
<tbody>
<tr>
<td>development disorder</td>
<td>developmental disturbance</td>
<td>developmental disorder</td>
</tr>
<tr>
<td>1 in 718 to 1 in 14,000</td>
<td>29 per cent in normal fluoride area and 77 per cent in high fluoride area</td>
<td>1 in 8,000</td>
</tr>
<tr>
<td>Mutations in the amelogenin gene</td>
<td>overexposure to fluoride</td>
<td>Mutations in the DSPP gene</td>
</tr>
<tr>
<td>Both dentitions are affected</td>
<td>Depends on the time of exposure</td>
<td>Deciduous teeth more affected than permanent teeth</td>
</tr>
<tr>
<td>Sensitivity of teeth</td>
<td>Depends on the severity of fluorosis</td>
<td>Attrition with pulpal exposure</td>
</tr>
</tbody>
</table>

Amelogenesis imperfecta presents with problems of socialization, function and discomfort which may be managed by early vigorous intervention, both preventively and restoratively. The permanent dentition may be protected by use of full cast crowns on posterior teeth and veneers on anterior teeth. Root canal treatments and esthetic crown replacement for decayed teeth should be done to achieve the Jackson's triad of esthetic harmony, structural balance and functional efficiency. A multidisciplinary approach consisting of an orthodontist, prosthodontist and endodontist should be planned.

**Conclusion**

Amelogenesis imperfecta is a heterogeneous developmental disorder presenting with severe dental anomalies. The dentist has to diagnose the condition as early as possible to balance the decision for early intervention and long-term survival of
the restorations. Dental practitioners should also consider the social implications for these patients and intervene to relieve their discomfort. Thus, this article emphasizes to improve the clinician’s knowledge about the clinical & radiographic diagnosis as well as intervention required for such a condition.

References


INTRODUCTION

Candida (yeast organisms) are a part of normal oral flora. These microorganisms do not cause any discomfort or symptoms because they are limited in number. However, when there is overgrowth of these normal organisms, their presence becomes a problem. There is a definite association between increase in number of candida organisms with how well a person’s diabetes is controlled. The increased level of blood sugar in diabetes affects the whole body, not just the blood.18 People who don’t keep good control of their blood sugar may develop complications related to the constantly high sugar levels. One of the complications is difficulty in fighting off infections, either bacterial or fungal. This paper presents the case report of a 55 years old female patient who was diagnosed with uncontrolled diabetes based on the fungal infection present in her oral cavity.

CASE REPORT

A 55 year old lady named Gowramma walked into the Department of Oral Medicine with a c/o burning sensation in the mouth on consuming spicy food. Her past dental history revealed that she was an RPD wearer for past 4 years and had poor oral hygiene practice. She was otherwise moderately built and nourished, with vital signs within normal limits. Extra orally angular chelitis was seen bilaterally (Fig 1).

Patient gave a negative history of diabetes, hypertension or any other systemic disease. Intra oral examination showed missing 11, 12, 21 and 22 for which the patient was wearing a removable denture. Severe calculus, moderate stains and generalized attrision of the teeth were noted.

The denture was unhygienic and ill maintained by the patient (Fig 2). Soft tissue examination of tongue showed that the central part of the dorsum of the tongue was smooth, atrophic and...
depapillated (Fig 3). Lateral borders showed curdy white non scrapable patch. The tip of the tongue was fissured (Fig 4).

Anterior part of the hard palate and gingiva in the region of 11, 12, 21, 22 was erythematous confirming to the area of RPD placement(Fig 5). Gingiva was found to be erythematous, smooth with shiny surface, swollen and edematous with loss of stippling. Bleeding on probing of gingiva with generalized gingival recession was seen. Salivary flow appeared reduced, thick and ropy in consistancy.

Based on the above findings a provisional diagnosis of atrophic candidiasis involving tongue, anterior part of hard palate and angle of the mouth was given. Differential diagnosis considered were anaemic glossitis and generalized mucositis.

Chair side investigations performed were Modified schimmers test to assess xerostomia and Candidal smear test for the scrapings collected from the dorsum of the tongue. Lab tests for random blood sugar, Complete haemogram were carried out. Inference drawn from the investigations confirmed xerostomia, presence of candidal hyphae and increased random blood sugar level (207 mg/dl). Based on the clinical and lab findings the final diagnosis of Atrophic candidiasis involving tongue, anterior part of hard palate and angle of the mouth due to uncontrolled diabetes was arrived.

Oral prophylaxis and discontinuation of RPD was advised. She was also advised to apply 2% clotrimazole mouth paint on the mucosa three times a day for 2 weeks and was referred to physician for evaluation and management of diabetic status.

Follow up after 3 months, the fasting blood sugar (82 mg/dl) and post prandial blood sugar (134 mg/dl) were well within the normal limits. The normal papillation of the tongue was restored (Fig 6). The erythema of the gingiva and anterior part of the hard palate disappeared and normal colour and consistency was restored (Fig 7).
Discussion

Primary feature of diabetes mellitus is elevation of blood glucose levels, which affects almost all tissues in the body. Oral soft tissue damage in diabetic patients includes fungal infections (candidiasis), ulcers, denture-sore mouth, and changes in the tongue (such as chronic fissured tongue).

The development of these conditions is due to dry mouth, delayed wound healing and altered immune and inflammatory responses. Vascular compromise has been related to the frequency and severity of certain infections in patients with diabetes. This may be due to an exaggeration of immunologic deficits by proliferative changes in the capillary endothelial basement membrane causing impedance of leukocyte movement and diffusion of necessary nutrients into tissues.

Oral candidiasis is a complication of diabetes and the condition is caused by a fungus called Candida albicans. Denture stomatitis is a term used in the literature to indicate an inflammatory state of the denture bearing mucosa. It is one of the common problems in elders wearing complete or partial dentures. Palatal mucosa is the most common site for the fungi to grow where it is covered by the denture base.

Despite the fact that denture stomatitis is frequently asymptomatic, patients may complain of
halitosis, slight bleeding, swelling in the involved area, burning sensation, xerostomia or taste alterations (dysgeusia). These symptoms occur with variable intensity in 20% to 70% of patients with denture stomatitis. Candida-associated denture stomatitis with angular cheilitis or glossitis often indicates the spread of the infection from the denture-covered mucosa to the angle of the mouth or the tongue respectively.

Inflammatory reaction may be produced by tissue invasion by microorganisms, effect of fungal toxins, hypersensitivity to the fungus, carboxylic acid produced by the micro flora of the denture plaque, poor denture hygiene, poor oral hygiene and reduced salivary flow, as it was seen in the present case.

The predisposition of the diabetic patient to infection by pathogenic fungal species has been explained in terms of enhancement of yeast growth by elevated tissue fluid glucose levels. The complex nature of the defense mechanisms against the Candida organism suggests that functional defects of polymorphonuclear leukocytes or cell-mediated immunity may play an important role in this population.

The most common etiology of oral candidiasis in individuals with diabetes is xerostomia. Xerostomia, or dry mouth, occurs in people with poor diabetes control. It is due to decreased salivary flow rates, an increase in salivary glucose levels, nerve damage (neuropathies) cigarette smoking, more frequent snacking, xerogenic medications. Elevated fasting blood glucose concentrations have also been significantly associated with decreased salivary flow, leading to fulminant growth of candida albicans. Oral cytological smears as a simple, reproducible means of demonstrating a significant increase in frequency of candidal colonization in diabetic patients. Proper glucose control is important in the management of oral candidiasis. The patient should also maintain oral hygiene. Antifungal agents such as azoles and polyenes act by inhibiting pathways necessary for cell membrane synthesis altering the permeability of the cell membrane of the fungal cell. It may also alter RNA and DNA metabolism. Cause Intracellular accumulation of peroxide that is toxic to the fungal cell.

CONCLUSION

Diabetes is a predisposing factor of oral candidiasis, primarily because of decreased random motion of neutrophils, chemotaxis, phagocytosis, and microbial killing. In addition, increased glucose levels in oral tissues enhance yeast adhesion and growth. Most study data indicate that, good control of blood glucose and treatment with an appropriate antifungal agent are important in the management of oral candidal infections in diabetic patients. This paper also emphasizes the role of an oral physician in diagnosing systemic disorders.

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