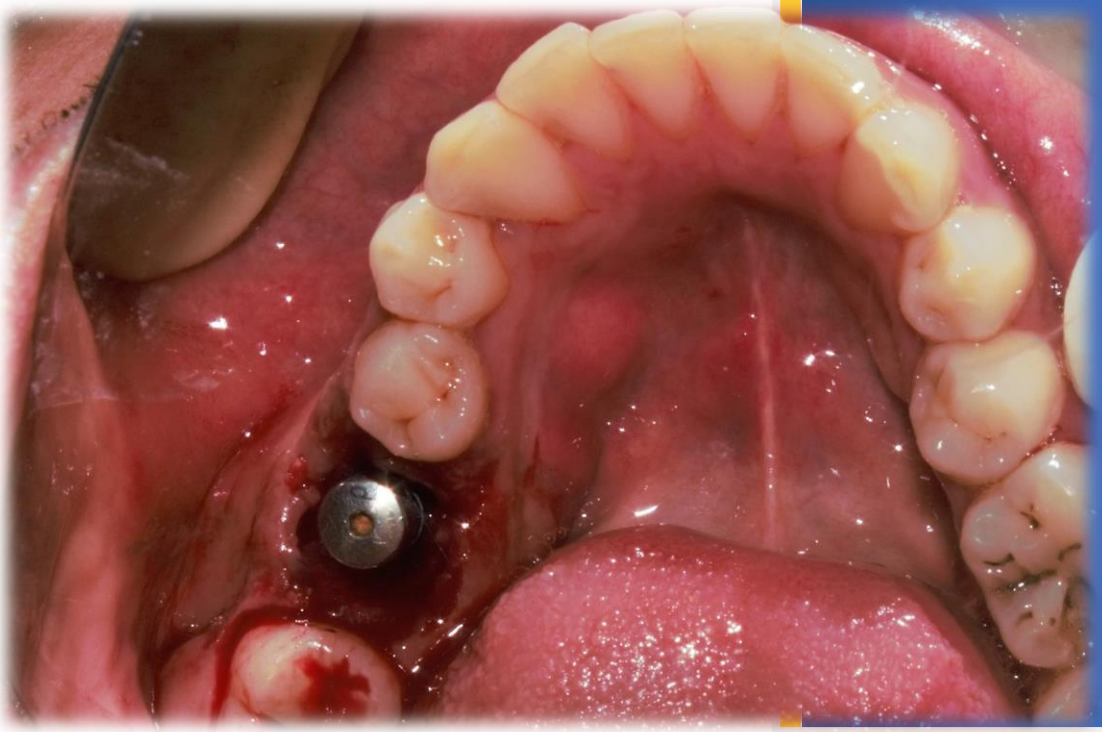
ANNALS OF CLINICAL PROSTHODONTICS

OFFICIAL E PUBLICATION OF IPS KARNATAKA STATE BRANCH



EDITOR:

DR.UMESH Y PAI

Volume 3 Issue 3

EDITORIAL

WHAT CHANGES FOR US POST COVID?

COVID-19 has taken the world by storm and as we read this, the numbers are rising with mortality rates that have the developed countries of the world too grappling to limit the numbers of those affected. In the midst of all the economic implications, dental professionals too are faced with a dilemma of patient care and practice management. Dentists are at the forefront of professions at high risk from COVID as oral environment forms an area of high viral load and the aerosols generated by dental turbines in a closed environment like a dental clinic could pose a zone of high cross transmission and put the dentists, patients and the auxiliary staff at risk.

Practices in developed countries like the united states ,Europe and Australia have stringent protocols laid in place but in a developing country like ours with practices centered on economic realities rather than patient centered outcomes ,this could be testing times. Dental practice has been closed till further orders and even permission for reopening may take a few months to be realistic.Covid in all probability is here to stay, and it's about learning to manage it like any other infections in the dental office which is where the real challenge lies. This could actually be an opportunity for us as dental professionals to introspect and come up with protocols that lay focus on patient centered outcomes rather than looking at only the economic aspects of a dental practice. It is my personal opinion that it is time for us to move to the next level and come up with solid protocols and norms that will separate good practices from the mediocre ones. The Dental associations and specialty bodies along with the regulatory body have to step forward and lay a solid foundation for this thereby making sure that dental healthcare professionals and practices don't become hotspots for cross transmission of this debilitating Pandemic. Onus also lies with each one of us to make sure that we are doing all that it takes to safeguard our profession along with our health concerns.

Hope we all rise above the current situation stronger, safer and better.

Regards,

Dr.Umesh Pai

Editor

CONTENTS

Case Report

Management of Acquired Ptosis of a Patient with Ocular Prosthesis Using Ptosis Crutch Mounted to A Spectacle Frame: A Clinical Report.

Umesh Y Pai*, Varsha Ignatius, Ajay Kudva[+], Nikita Agarwal**, Shubham Agarwala[++]**

ABSTRACT

This paper deals with the Management of a patient with Anopthalmic socket having acquired ptosis following Scleral shell prosthesis placement managed using a ptosis crutch glass.

Introduction

Ptosis is a drooping of the upper lid, which is usually due to weakness, deficient development or absence of the levator palpebrae superioris muscle. The normal upper lid rests approximately 2 mm below the upper limbus when the eye is looking straight ahead. The lower lid normally rests 1 mm above the lower limbus. The palpebral fissure for adult males is between 7 and 10 mm and for females it is 8 to 12 mm. According to **Coles[1]**, ptosis (bilateral or unilateral) may be (i) congenital when it is present at birth, or (ii) acquired when it develops after birth. Acquired ptosis may be a) senile or age related, b) a result of oculomotor (third nerve) palsy, c) due to intracranial tumor, or d) a result of trauma, as in intraocular surgery, e.g., after cataract surgery. Pseudoptosis can be simulated in a small globe due to injury or inflammation resulting in an abnormal Drooping of the upper eyelid (upper eyelid ptosis) may be minimal (1–2 mm), moderate (3–4 mm), or severe (>4 mm), covering the pupil entirely. Ptosis can affect one or both eyes. Ptosis can be present at birth (congenital) or develop later in life (acquired). Ptosis may be due to a myogenic, neurogenic, aponeurotic, mechanical or traumatic cause. Risks of ptosis surgery infrequently include infection, bleeding, over- or under correction, and reduced vision. Immediately after surgery, there may be temporary difficulties in completely closing the eye. Although improvement of the lid height is usually achieved, the eyelids may not appear perfectly symmetrical.

But, in cases where surgery is not preferred or indicated as in elderly patients, a prosthetic device such as a ptosis crutch is often of great value. Till recently, in India, a small semi-circular piece cut from the periphery of an old gramophone record used to be glued to the inside of the upper portion of a plastic spectacle frame to lift and support the drooping upper lid. But the device was not cosmetically appealing and was also not comfortable. Moss[4] reports on

the method of relieving ptosis with the use of a scleral contact lens. Either the superior flange of the shell is built up by increasing the mass, which will move the upper lid and improve ptosis, or a shelf is placed across the upper section of the scleral lens to support the upper lid. Moss also details the making of an improved crutch by utilizing steel orthodontic round wire of spring tempered quality and fixing it to the bridge of a modern plastic spectacle frame to improve cosmesis and give greater movement to the upper lid. The procedure is cumbersome and needs precision. A comparatively easier method of making a ptosis spectacle is by fixing support[5] made of non-conspicuous nylon thread that is sturdy and comfortable, to a plastic frame. Sun et.al also described the use of 3D printing to customize the crutch and reduce the adjustment phase[6].

Case Report

A 26-year-old male patient reported to the Department of Prosthodontics with the chief complaint of a non-motile artificial eye in his right socket (**Fig. 1)**.

Fig. 1

He lost his right eye in a road traffic accident a year ago and has been wearing the scleral shell prosthesis ever since. Examination revealed enucleation of the right eye with a healthy socket mucosa. Evaluation of the socket depth was deemed enough to retain an acrylic orbital implant followed by a scleral shell prosthesis for optimal fit and aesthetics. The Ophthalmologist then carried out the peritomy surgery by opening the conjunctival sac and tenon's capsule under local anesthesia and placement of the 18 mm acrylic implant. The conjunctival sac was then closed with 5-0 vicryl sutures. The eye was then patched up and post-operative antibiotic coverage was prescribed. The patient was then recalled after an 8-week period for the fabrication of the ocular prosthesis. On examination after 8 weeks, the post-operative healing was deemed satisfactory and there were no signs of implant extrusion. The patient was then prepped for the impression procedure for the ocular prosthesis. Petroleum jelly was applied to the eyebrow, eyelashes and skin around the socket to prevent impression material from sticking to them. A thin mix of alginate impression material was mixed and loaded in a 2 ml plastic disposable syringe. Impression material was slowly injected into the socket. The impression was carefully removed from the socket, checked and invested in type III gypsum stone to make a two-part mold. Molten wax was poured in the mold to obtain the scleral wax pattern. It was tried in the patient and checked for proper contour and retention while performing the various eye movements. For iris positioning, the patient was asked to maintain a straight gaze at an object kept 6 feet away. Shade was selected as per the

patient's normal eye sclera. Flasking was done in a two-part metal flask followed by dewaxing, packing and curing. The retrieved prosthesis was trimmed, polished and inserted. Prior to insertion of the finished prosthesis, it was disinfected using 70% isopropyl alcohol and 0.2% Chlorhexidine solution. After thoroughly cleaning the prosthesis with saline solution to prevent chemical irritation, it was inserted and checked for fit, contour and movements.

Fig. 2

The eyelid of the right eye presented with ptosis and the patient was not pleased with his appearance (fig.2).It was then decided to use ocular crutch glasses which are regular eye frames with a nylon wire embedded into the superior rim in a semicircular fashion on the medial and lateral borders (Fig.3).

Fig. 3

Fig. 4

Fig. 5

This contraption would push the eye lid (Fig.4) and thereby create symmetry in the opening position of the eyelids (Fig.5). The limitations of using this crutch is the inability of the patient to be able to blink his eyelid on the affected side.

Discussion

The use of ptosis crutch can correct or provide considerable improvement of ptosis following ocular prosthesis. There is a startling cosmetic improvement with a definite emotional impact for the patient along with the possibility of a prolonged functional improvement because of mechanical stimulation of the eyelid[7].

REFERENCES

1. Coles WH: Ophthalmology – A Diagnostic Text. 1989. Williams & Wilkins, Baltimore, U.S.A.

2. Lyle TK, Cross A G: May & Worth's Manual of Diseases of the Eye. 1959. Bailliere, Tindall and Cox, London, U.K.

3. DeSouza R, Spencer DA, Coe A: Infant's photograph cited in Optometry Today (India), Vol. 18, No. 1, 1992.

4. Moss HL: Prosthesis for blepharoptosis and blepharospasm. J Amer Optom Assoc 1982; 53: 661-667.

5. Ptosis spectacle is made/support is supplied by Optometry Today kumars@vsnl.com

6. Michael G. Sun, Duangmontree Rojdamrongratana, Mark I. Rosenblatt, Vinay K. Aakalu & Charles Q. Yu (2019) 3D printing for low cost, rapid prototyping of eyelid crutches, Orbit, 38:4, 342-346

7. Walsh G, Rafferty PRM, Lapin J. A simple new method for the construction of a ptosis crutch. Ophthal Physiol Optics 2006; 26(4): 404-407.

*Associate Professor, Department of Prosthodontics, Crown and Bridge, Manipal College of Dental Sciences, Mangalore
**Post-Graduate student, Department of Prosthodontics, Crown and Bridge, Manipal College of Dental Sciences, Mangalore
[+] Associate Professor,
Department od Opthalmology,
AJ Institute of Medical Sciences,
Mangalore
[++] Intern, Manipal College of Dental Sciences, Mangalore

Rehabilitation of an acquired auricular defect using adhesive retained silicone ear prosthesis: A Case report

Dr. Manupreet Kaur*, Dr. Shailendra Kumar Sahu**

ABSTRACT: A prosthetic rehabilitation of various facial deformities like of ear, eye and nose are under the scope of maxillofacial prosthodontics. With better understanding of material available for maxillofacial prosthesis its possible to rehabilitate facial deformities with life-like appearance and thus enhance the quality of life. Auricular defect can either be congenital or acquired. This case report is an attempt to rehabilitate ear deformity sustained by burn injury with adhesive retained auricular prosthesis.

KEY WORDS: Ear-prosthesis, **acquired auricular defect**, **adhesive-retained**

Introduction:

Rehabilitation of missing or deformed facial structures has many challenging aspects for a maxillofacial prosthodontist. Maxillofacial defects have profound effect on the quality of life of a patient. Auricular defects can be congenital, manifesting in forms of deformity of an ear, or acquired due to accidental trauma, burns or malignant diseases. [1,2]
Surgical reconstruction of such defects has a limited role and are complex and presents with many challenges. This article presents a procedure to rehabilitate auricular defect due to burn injury. Auricular prosthesis is a removable maxillofacial prosthesis that artificially restores part or the entire natural ear. [3]
Auricular prosthesis can be retained by various means namely adhesives, implants, spectacles, magnets & clips etc. [4]
Auricular prosthesis not only imparts esthetic benefits but also helps in function by enhancing the hearing ability and have a profound psychological benefit to the patient. [5]

CASE REPORT:

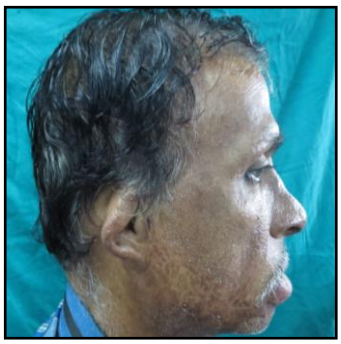


Figure 1: Pre-Operative

A 50-year-old male patient reported, complaining of ear deformity resulting from burn injury 8 years ago. History revealed that the patient had diabetes for 10 years and under medication for the same. He had suffered burn injuries on right side of his face 8 years back. On examination on the right side of the face, patient had sustained burn injuries with scar formation and right ear with helix and lobe part of external ear being deformed with intact tragus and external auditory

meatus (Figure: 1). Patient's hearing capability was intact on the effected side. As per patient's preference and based on clinical examination, a silicone auricular prosthesis to be retained with adhesive was decided for the patient to fulfill his wishes for the esthetic correction of the right ear.

TECHNIQUE:

Impression:

For making impression, hydrocolloid impression material was selected. A wax mold was fabricated to contain the impression material while making impression. The surrounding area around ears was lubricated with Vaseline, to prevent adhesion of impression material with skin and external auditory canal was blocked with cotton plugs to prevent impression material from entering the canal.
Impressions of both ears (healthy & deformed ear) was taken. A positive replica of both the ears was obtained by pouring the impression with Type III dental stone.

Wax Pattern


Figure 2: Stone cast with wax pattern

Taking healthy ear (left side) as guide the wax pattern for the ear of effected side (right side) was sculpted using modeling wax. To impart a prosthesis with natural looking appearance, ear of healthy side (left side) of patient himself was taken as a guide instead of sculpting the ear by donor technique that is taking reference from patient's kin or sculpting from scratch free hand.

Flasking & Dewaxing

Trial of wax pattern was done; the wax pattern was sealed to the cast model and the edges of the wax pattern was thinned so that it merges with the skin when prosthesis is placed. The wax pattern was flasked using three pour technique.


Figure 3: Flasking

De-waxing was done by placing the flask in boiling water (100°) for 30 minutes to ensure complete elimination of wax material. Separating media was applied while the gypsum material was warm, and mold was allowed to dry completely.

Shade Matching & Packing

Figure 4: Silicone pigmentation & Packing

Under natural day light, in patient's presence shade matching was done and photographs were also taken. A medical grade heat temperature vulcanizing (HTV) silicone (Cosmesil) was packed in mold cavity obtained after de waxing procedure. The base color was dispensed, color pigments and flocks were mixed in intrinsic coloration. Small amount of silicon of different skin shade was placed over outer margins to mimic natural skin colors, then main skin shade was applied over entire mold area. After packing of silicone material, flask was placed in boiling water for an hour for polymerization.

Finishing

Figure 5: Auricular prosthesis after curing

Completely polymerized silicone ear prosthesis was retrieved, cleaned and excess flash was trimmed. Extrinsic coloring agents (Cosmesil) were applied wherever required.

Final Placement

Figure 6: Final placement of prosthesis

Final prosthesis was tried on patient, necessary adjustments were done. Margins of prosthesis were sealed using adhesive (Telesis-5 Silicone adhesive). Maintenance instructions given to the patient, instructions regarding application of adhesive and cleaning of prosthesis were explained to the patient in detail. Follow-up was done after a week. The patient was able to use the prosthesis comfortably and was satisfy with the prosthesis.

DISCUSSION:

Auricular defects can be rehabilitated either surgically or prosthetically. In majority of cases, prosthesis reconstruction is a preferred choice, given many disadvantages of surgical reconstruction. In the recent past techniques have been introduced for fabrication of auricular prosthesis like rapid prototyping, stereolithography, CAD-CAM technique, CT Scan imaging, MRI etc.

Retention of prosthesis plays a pivotal role in patient acceptance and compliance of prosthesis. Craniofacial implants provide effective retention along with good esthetic result. However, for placement of implants prerequisites like presence of healthy bone, surgical placement, time, cost is matter of concern.

Other retentive modes like utilization of mechanical undercuts, mechanical tools like (Spectacle frames, headbands etc.) or skin adhesives can also be successfully employed in retention of auricular prosthesis. **[6]**

Adverse tissue reactions, discoloration, marginal deterioration of the prosthesis, loss of adhesion because of perspiration are disadvantage of skin adhesives.

Craniofacial implants are excellent mode of retention as well as auricular prosthesis fabricated using CAD CAM technology, but these modalities are expensive.

In this case adhesive retained prosthesis was preferred considering patient's medical history and patient's desire to opt for non-surgical option and is cost effective and has yielded a satisfactory outcome.

CONCLUSION:

Surgical intervention, patient choices and patient's medical status may contraindicate placement of craniofacial implants in patient's with auricular defect. In such cases adhesives and utilization of mechanical undercuts serves as a good mode of retention for the prosthesis. Rehabilitation of patient with auricular defect not only yields esthetically pleasing results but also renders great psychological benefit to the patient and helps to live life of normalcy in the society.

REFERENCES:

1. Mohamed K, Vaidyanathan A, Mani U, Bhatia Y, Veeravalli PT. Rehabilitation of an auricular defect using spectacle retained silicone ear prosthesis and ear stent. Int J Prosthodont Dent 2012;2(1):29-33.
2. Chinnasamy A, Gopinath V, Jain AR. Ear prosthesis for postburn deformity. Case Rep Otolaryngol. 2018 Apr 29;2018:2689098. doi: 10.1155/2018/2689098. eCollection 2018.
3. The glossary of prosthodontics terms. J Prosthet Dent. 2017May;117(5S):e1-e105.
4. K. F. Thomas, *Prosthetic Rehabilitation*, Quintessence Publishing Co., Ltd., London, UK, 1st edition, 1994.
5. K. Storck, R. Staudenmaier, M. Buchberger et al. Total reconstruction of the auricle: our experiences on indications and recent techniques. *BioMed Research International*, vol. 2014, Article ID 373286, 15 pages, 2014.
6. Yenisey M, Kaleli N, Ergün Kunt G. Prosthetic Reconstruction of Auricular Defects with an Adhesive-Retained Epithesis: A Clinical Report. Reconstructive Surgery and Anaplastology 2016;5:163,1-3.

* Senior Lecturer,
Chhattisgarh dental college & research institute
Chhattisgarh, India
** Professor and Head

Chhattisgarh dental college & research
institute
Chhattisgarh, India

Tooth Supported Overdenture

Dr. Aroma Reji*, Dr. Bibi Fathima*, Dr. Sunil Dhaded**

ABSTRACT

Overdenture is a favoured treatment modality for elderly patients with few remaining teeth. Roots maintained under the denture base preserve the alveolar ridge, provide sensory feedback and improve the stability of the dentures. This clinical report describes a novel method of fabricating a tooth supported overdenture for a medically compromised patient without any attachments.

Introduction

An overdenture is a complete denture supported by both soft tissue and a few remaining natural teeth. The natural teeth have been altered to permit the denture to fit over them. Historically, this technique was an attempt on the part of a few innovative dentists to provide their patients with retention and stability beyond that which could be achieved with a regular complete denture.

The overdenture technique helps preserve the bone in that the remaining natural teeth are used to withstand some of the occlusal forces. Since all the teeth are not extracted, vertical bone height is maintained. Stability of the denture is enhanced by the retained natural teeth. Since the denture will only seat in one exact position and may even be retained by an attachment, denture retention is improved. The periodontal membrane around the remaining teeth improves the denture patient's tactile sense.

Overdenture is one of the most practical measures used in preventive dentistry. In a 4 years study by Renner *et al*., it was found that 50% of the roots used as overdenture abutments remained immobile.

Overdentures should not be used as a substitute for a fixed or removable partial denture. They are indicated for the patient normally considered for full-mouth extraction because of caries or advanced periodontal disease. Invariably there are a few teeth that could be used with an overdenture. In the past, if fewer than six teeth remained, a complete denture was indicated. This is no longer true. We can retain teeth for use with an overdenture that are not capable of supporting a removable partial denture.

Need to Use an Overdenture

A complete denture patient goes through a sequel of events like:

1) loss of discrete tooth proprioception,
2) progressive loss of alveolar bone,
3) transfer of all occlusal forces from the teeth to the oral mucosa
4) the most depressing sequel is the loss of patient's self-confidence.

An overdenture:

1) delays the process of resorption,
2) improves denture foundation area and increases masticatory efficiency
3) helps preserve the bone in that the remaining natural teeth are used to withstand some of the occlusal forces. Since all the teeth are not extracted, vertical bone height is maintained.
4) Stability of the denture is enhanced by the retained natural teeth. Since the denture will only seat in one exact position and may even be retained by an attachment, denture retention is improved.
5) The periodontal membrane around the remaining teeth improves the denture patient's tactile sense.

Indications:

1) patients with few remaining retainable teeth in an arch.
2) patients with malrelated ridge cases;
3) patients needing single denture;
4) patients with unfavourable tongue positions, muscle attachments, and high palatal vault, which render the stability and retention of the prosthesis difficult

Contraindications:

Patients with questionable oral prophylaxis, systemic complications, and inadequate interarch distance.

CASE REPORT- 1

A 65-year-old male patient reported to the department of Prosthodontics to replace his missing teeth. The patient was partially edentulous with respect to the upper arch (Kennedy's class 1) with the remaining endodontically treated teeth 11,21 and 22 (fig 1 and 2) with no mobility or periapical pathology on clinical radiographical examination. Medical examination revealed that he's a known diabetic for 20 years and is on medication for the same. Patient was not willing for any long appointments, so the use of copings and attachments were ruled out.

Treatment Plan

The primary impressions were made using irreversible hydrocolloid material and special tray was fabricated on the same.

Fig. 1

Fig. 2

The border moulding was carried out using a low fusing compound and final impression was made using polyvinyl siloxane (Fig.3). The master cast was obtained (Fig. 4) followed by jaw relation and teeth arrangement. The try in was

carried out to evaluate the occlusion with the lower existing dentition and was later processed.

Fig.3

Fig.4

In the span of one year the patient was frequently recalled for the denture assessment.

Intra-Oral

Pre-Operative

Post- Operative

CASE REPORT – 2

A 62-year-old female reported to the Department of Prosthodontics with a chief complaint of missing teeth and had difficulty in chewing food. She wanted to get her missing teeth replaced. There was no relevant medical history to affect the course of prosthodontic treatment. Extraoral examination revealed no abnormality. Intraoral examination with maxillary arch revealed only 13 and 23 were present showing Kennedy's class 2 modification 1. In mandibular arch, 31,32,41,42 were missing showing Kennedy's class 4 condition (Fig 1). It was planned to construct maxillary tooth supported over denture and mandibular removable partial denture.

Treatment plan:

Post space preparation was done with 13 and 23 with the peso reamers after the endodontic treatment. Post space impression was made, and wax patterns were fabricated with a customized ball attachment (Fig 2). The wax patterns were casted, trimmed and finished and later tried in the patients mouth to check for the

Fig 1: Intraoral view

Fig 2: Wax patterns

fitting. Later, it was polished and cemented with type I GIC cement (Fig 3).

Fig 3: Customized ball attachments

Fig 4: Alginate Impression

Fig 5: Diagnostic cast

Fig 6: Final Impression

Primary impressions were made with alginate and poured with type I gypsum (Fig 4 and 5). Spacer was attached and custom tray was fabricated with self-cured acrylic resin. Border moulding was done with low fusing compound and final impression was made with regular bodied elastomer (Fig 6). Master cast was prepared by pouring the impression in type IV gypsum. Copings over the master cast was covered with wax and cold mould seal was applied and dentures base was fabricated with self-cured resin. Placement of the wax over the copings prevents the fracture of the master cast during retrieval of the denture base from the cast.

Occlusal rims were fabricated, and jaw relation was recorded and mounted in the articulator. Teeth arrangement was done and try-in was performed in the patient's mouth (Fig 7). Curing of the final denture was done in heat cured acrylic resin using the conventional acrylization procedure and denture insertion was completed.

Fig 7: Try-in

*Post Graduate student, Department of Prosthodontics, AME Dental College, Raichur

**Professor and HOD, Department of Prosthodontics,
AME Dental College, Raichur

Fig 8: Pre-treatment `

Fig 9: Post-treatment

Esthetic and Functional Rehabilitation of a Case of Amelogenesis Imperfecta With A Multidisciplinary Approach Using an Innovative Sequentially Staged Technique –A Case Report

Dr. Karthik Shetty*, Dr. Mranali K Shetty**

Introduction:

Amelogenesis imperfecta (AI) presents with a rare abnormal formation of the enamel [1] or external layer of the crown of teeth. Enamel is composed mostly of mineral that is formed and regulated by the proteins in it. Amelogenesis imperfecta is due to the malfunction of the proteins in the enamel: Ameloblastin, Enamelin, Tuftelin and Amelogenin.

Amelogenesis imperfecta can have different inheritance patterns depending on the gene that is altered. Mutations in the ENAM gene are the most frequent known cause and are most commonly inherited in an autosomal dominant pattern. This type of inheritance means one copy of the altered gene in each cell is sufficient to cause the disorder.

About 5% of Amelogenesis imperfecta cases are caused by mutations in the AMELX gene and are inherited in an X-linked pattern. A condition is considered X-linked if the mutated gene that causes the disorder is located on the X chromosome, one of the two sex chromosomes. In most cases, males with an X-linked form of this condition experience more severe dental abnormalities than affected females. Amelogenesis imperfecta represents an inherited group of anomalies of enamel formation with an incidence of 1:718 to 1:14,000.[2]

The clinical features distinguish the three types.[1, 3]

• Hypoplastic—The enamel does not form in normal thickness.

• Hypocalcified—Enamel thickness on newly erupted teeth closely approaches that of normal teeth, but the enamel is soft, friable and can be easily removed from the dentin.

• Hypomaturation type—Develop enamel of normal thickness. The Hypomaturation type differ from Hypocalcification in that enamel is harder, with a mottled opaque white to yellow brown to a red brown color and tend to chip from the underlying dentin rather than wear away. Treatment planning for patients with Amelogenesis imperfecta is multifactorial: the age and socioeconomic status of the patient, the type and severity of the disorder, the intraoral situation at the time of treatment planned.[5] If teeth affected with Amelogenesis imperfecta are not detected and treated early; further deterioration of the existing condition will occur with damage to the periodontal tissues, thus further complicating the treatment plan and prognosis of the patient.

The common restorative problems associated with AI are sensitivity, loss of vertical height, dysfunction and esthetics. Restoration of these defects is important in meeting the esthetic, functional, and

psychological concerns of the patient. Recent materials and improved clinical procedures have enabled esthetic and functional rehabilitation for patients with such severely worn out dentition.[2] The following clinical report demonstrates a multidisciplinary approach in treating a patient who presented with Hypomaturation type (Type III) of Amelogenesis Imprefecta along with malocclusion.

Case Report:

The patient reported to the clinic with the chief complaint of esthetic concern along with malpositioned teeth and expressed her desire for correction of the same. On examination it was seen that the patient required orthodontic correction before any concrete restorative procedures were planned. All radiographs were taken, and preliminary impressions made using alginate. Vertical dimension was evaluated clinically. Diagnostic wax up was planned at the existing vertical dimension and it was seen that there was no clinical loss of vertical dimension.

Face bow recording was done and wax up was achieved on a semi adjustable Arcon articulator. Patient's informed consent was taken before proceeding with the treatment. The treatment planning was done with a multidisciplinary approach with all concerned specialists coming together for a consensus on the desired approach.

Orthodontic treatment was initiated. The case was planned as a non-extraction case as it was desirable for an esthetic outcome. Orthodontic treatment was done with Beggs technique. The patient was scheduled on regular monthly appointments till completion of treatment.

This was followed by esthetic periodontal procedure where recontouring of the gingival zenith was done to enhance the gingival contour.

Diagnostic wax up was completed with the vertical dimension maintained (Figure). The wax up helped in assessing the outcome of the final prosthesis and it also helped in fabricating the temporary restorations [5]. The maxillary and the mandibular first molars were prepared and temporized in one appointment.in the subsequent appointment, the permanent crowns were cemented with the same teeth and the rest of the posterior teeth were prepared. This method was adopted to maintain the vertical dimension of occlusion of the patient. The third appointment consisted of permanent cementation of the remaining posterior final crowns along with preparation and temporization of the anterior teeth. The final appointment consisted of permanent cementation of the final crowns on the mandibular and maxillary anteriors. A group function type of occlusal scheme was provided to the patient (Figure 11) and regular follow-up with good oral hygiene maintenance was advised (Figure 12). This approach which was sequentially staged helps in rehabilitating the patient quickly and predictably. The limitations of this technique of rehabilitation is that it is applicable only in cases that do not involve a raise in vertical dimension of occlusion.

Discussion

The clinical presentation of AI varies with the type. The Hypoplastic type shows well mineralized enamel, but its amount is reduced as seen in the radiograph. Clinical management of AI can range from preventive interventions to complete rehabilitation depending on severity of the case [4-7.] In this case, the patient presented with a decreased vertical dimension and a freeway space of 5 mm, hence it was decided to increase the vertical dimension by 3 mm.[8, 9] The severe wear of anterior teeth facilitates the loss of anterior guidance, which protects the posterior teeth from wear during excursive movements. Collapse of posterior dentition results in loss of normal occlusal plane and decreased vertical dimension. The choice of restoration in this case was porcelain fused to metal as this would double the mechanical durability, recover esthetics, and protect the residual dentin.[9, 10] the rehabilitation was carried out using an innovative sequential approach where segmental preparation and temporization along with permanent rehabilitation was simultaneously carried out in different segments to enable speedy rehabilitation. This approach also helped in maintaining the vertical dimension of occlusion throughout the entire treatment as the keys of occlusion i.e. the first molars were rehabilitated first.

Conclusion

Amelogenesis imperfecta is multi-factorial and clinical symptoms variable. The treatment of such cases involves a thorough analysis of the relationship between natural teeth and the stomatognathic system[10].Rehabilitation of a patient presenting with this condition was carried out using an innovative sequential approach.

Clinical significance

The above case reflects the importance of the use of prosthodontic principles and strategic planning in addition to a multidisciplinary approach in managing a young female patient of Amelogenesis imperfecta.the clinical approach adopted in this case also helps in speedy rehabilitation along with maintenance of vertical dimension of occlusion.

Bibliography:

1)Sengun A, Ozer F (2002) Restoring function and esthetics in a patient with amelogenesis imperfecta: a case report. Quintessence Int 33: 199-204.

2)Gokce K, Canpolat C, Ozel E (2007) Restoring function and esthetics in a patient with amelogenesis imperfecta: a case report. J Contemp Dent Pract 8: 95-101.

3) Seow WK Clinical diagnosis and management strategies of amelogenesis imperfecta variants. Pediatr Dent 15(6):384–393

4) Nel JC, Pretorius JA, Weber A, Marais JT. Restoring function and esthetics in a patient with amelogenesis imperfecta. Int J Periodontics Restorative Dent 1997;17:478-83.

5) Bouvier D, Duprez JP, Pirel C, Vincent B. Amelogenesis imperfecta-A prosthetic rehabilitation: A clinical report. J Prosthet Dent 1999;82:130-1.

6) Pulgar Encias R, Garcia-Espona I, Navajas Rodriguez de Mondela JM. Amelogenesis imperfecta: Diagnosis and resolution of a case with hypoplasia and hypocalcifi cation of enamel,dental agenesis, and skeletal open bite. Quintessence Int 2001;32:183-9.

7) Greenfi eld R, Iacono V, Zove S, Baer P. Periodontal and prosthodontic treatment of amelogenesis imperfecta: A clinical report. J Prosthet Dent 1992;68:572-4.

Coffield KD, Phillips C, Brady M, Roberts MW, Strauss RP, Wright JT (2005) The psychosocial impact of developmental dental defects in people with hereditary amelogenesis imperfecta. J Am Dent Assoc 136(5):620–630

5)Dawson P: Functional occlusion from TMJ to smile design, Mosby , St. Louis , 2007

6) Greenfield R, Iacono V, Zove S Periodontal and prosthodontic treatment of amelogenesis imperfecta: a clinical report. J Prosthet Dent 68:572–574

8) Banerjee S, Chakraborty N, Singh R, Gupta T, Banerjee A. Full mouth rehabilitation of a patient with severe attrition using hobo twin stage procedure. Int J Prosthodont Restor Dent 2011;1(3):177-81.

9) Moslehifard E, Nikzad S, Geraminpanah F, Mahboub F. Full-mouth rehabilitation of a patient with severely worn dentition and uneven occlusal plane: A clinical report. J Prosthodont 2012;21(1):56-64.

10)Williams WP, Becker LH (2000) Amelogenesis imperfecta: functional and esthetic restoration of a severely compromised dentition. Quintessence Int 31:397–403

*Professor and Head,
Department of Conservative Dentistry and Endodontics,
Manipal College of Dental Sciences, Mangalore.

** Associate Professor,
Department of Periodontology,
Manipal College of Dental Sciences, Mangalore.

Review Article

Casting Alloys for Prosthodontic Restorations- A Review

Dr. Vidya Shenoy K*, Dr. Shobha Rodrigues, Dr Sharon Saldanha+, Dr. Madhu Keshava Bangera++**

Introduction

There is a dramatic increase in the number and types of alloys for application in prosthodontic restorations over the past few years. For the longevity of a restoration proper selection and manipulation of the alloys is imperative. The most important factors in alloy selection are the cost, strength and biocompatibility. Since dental casting alloys are widely used in applications that place them in contact with oral tissues for many years, biocompatibility of casting alloys is paramount. Certain base metal alloys like nickel, cobalt have high potential to cause allergy, other elements like chromium are known mutagens and still others like beryllium and cadmium are known carcinogens in different chemical forms.[1-4] Although documented allergies have also been reported for, gold, platinum, palladium and other high noble alloys the incidence has been very rare.[5] Despite all these facts, there is little evidence that support concerns of casting alloys causing systemic toxicity, mutagenic or carcinogenic effects and most researchers in this area would agree that the benefits far outweigh the risks for many alloys currently used in dentistry.[4]

This article is a review on casting alloys for prosthodontic restorations and important physical properties in clinical practice.

Clinically and biologically relevant properties of dental alloys

All casting alloys must first be biocompatible and exhibit physical and mechanical properties to ensure adequate function and structural durability over long periods of time. It is paramount to understand the following clinically relevant properties for patient safety and to minimize the risk of medico legal situations.

Grain Size

An alloy is a metallic material formed by combination of two or more metals or one or more metals with a non-metal.[6]When a molten alloy cools to the solid state, crystal form around tiny nuclei. As the temperature drops, these crystals grow until crystal boundaries meet each other in the solid state. Each crystal is called a grain and boundaries between the crystals are grain boundaries [7]

Small grains have been found to improve the elongation and tensile strength of the cast gold alloys.[8] For base metal alloys small, dispersed secondary phases are critical to the strength of the alloys. In other base metal alloys, the grains are large and may approach 1mm in diameter. [9] A grain size 30microns or less has been reported to be desirable in dental alloys.[10] Grain sizes vary from 10-1000 microns and determined by cooling rate of the solidifying alloy, the presence of special

grain-refining elements in the alloy composition such as iridium or ruthenium, heat treatment after casting, and the composition of the alloy.[11]

Phase structure

The components of the alloy will have varying degrees of solubility in each other. Alloys can be either single phase or multiple phase depending on the solubility of the alloy elements.[12] Alloys will be single phase when all the elements are completely soluble in each other (e.g. gold, palladium and copper) and has homogenous composition throughout. If one or more elements are not soluble in each other, the alloys are multiple phase. (e.g. gold & platinum) Multiple phase alloys are prone to higher corrosion rates because of galvanic effects between the microscopic areas of different composition .[13,14] However, the presence of multiple phase allows alloys to be etched for bonding and makes them stronger than single phase alloys. The effect of phase structure on strengthening depends on the nature of the phase II, its composition and dispersion throughout the other phases. [15] Single phase alloys are easier to manipulate in the laboratory, have more consistent properties and are less technique sensitive. Phase structure of an alloy is not discernible by the naked eye and one must rely on manufacturer's instructions to know the alloy's phase structure.

Strength, hardness and elastic modulus:

The mechanical properties important for good clinical performance include yield strength, hardness and modulus of elasticity. Alloys with tensile yield strengths above 300 MPa are strong enough to resist permanent intra oral deformation in most clinical situations.[16] The most common site for the permanent deformation is between pontics in a long span FPD. Yield strength is defined as the stress required to permanently deform a small standardized amount of an alloy expressed as a percentage of length of the specimen being tested.

The hardness of the alloy must be enough to resist wear from opposing teeth or restoration and not so hard as to wear enamel or porcelain. Alloys with a Vickers hardness of less than 125 kg/mm^2 are susceptible to wear and alloys that are harder than hardness of enamel i.e. 340 kg/mm^2 can cause wearing of opposing teeth. [15, 16]

The modulus of elasticity is a measure of the stiffness or rigidity of an alloy. The higher the elastic modulus better is the flexural strength. This is important with metal ceramic restorations where any flexure will cause fracture of the porcelain. In long span metal-ceramic restoration or RPD, Ni or cobalt based alloys, which have moduli of 180-230 G pa may be more appropriate. [17]

Color:

In the past yellow colored alloys were associated with high gold content, high cost and high social value. The color of the alloy is often described as being yellow or white. Color should never be the sole basis to judge the clinical performance. Alloys that contain more than 10 wt. % palladium will be white, regardless of the gold content [18] and alloys with no gold present may have a yellow color (Pd-In-Ag). Though the color may be of

esthetic consideration to the patient clinical performance of alloys is related to its physical property[19] except the color and cost can be influenced by the cost of palladium, platinum and silver.

Corrosion:

Corrosion of alloys occurs when elements in the alloy ionize.[20] Corrosion may compromise the strength of the restoration, leading to catastrophic failure [21] or the release of oxidized components may discolor natural teeth, ceramic restorations or soft tissues in severe cases [4]. Corrosion is measured visually by observing the alloy surface, electrochemical tests that measure elemental release indirectly through the flow of released electrons[22] or by tests that measure the release of the elements directly by spectroscopic methods.[23]

The presence of multiple phases in a solder and high percentage of non-noble elements may enhance corrosion or the presence of pits or crevices in a single alloy may enhance corrosion .[24-27] Corrosion is related to biocompatibility because the release of elements from the alloy is always necessary for adverse biologic effects and response to released elements depends on which element is released, the quantity, duration of exposure and other factors.

Corrosion resistance of a material is derived from components being too noble to react in the oral environment (gold or palladium) or by forming passivating surface film by components which inhibit surface reaction. (e.g. chromium).

Porcelain bonding properties:

The properties of the alloy to be considered are color and thickness of alloy, expansion between the metal and ceramic, melting range of the alloy.

For reliable bonding of the porcelain to the alloy an adequate oxide layer is required and if these oxides are not completely masked, they will impart a lower value to the porcelain shade. The properties of the oxide layer such as oxide color, thickness, and strength vary among the alloy types and are critical to the esthetics and strength of the restoration.[28]

High gold alloys have a relatively light-colored oxide because of their noble character and require additions of trace elements like tin, gallium, indium etc. to promote oxide formation and even after additions oxide layer are thinner.[29] This oxide layer is easier to mask with opaque porcelain. Base metal alloys have darker, gray oxides because these alloys contain elements that form oxides easily during the initial oxidation step. This oxide layer requires thicker layers of opaque porcelain to mask. Generally, there is an increased risk of metal ceramic bonding failure with thicker oxides as oxides are brittle and weaker than either porcelain or the alloy. In addition, stress may be induced in the oxide layer due to occlusal load.[30]

Casting alloys containing high amounts of silver and copper may cause porcelain discoloration due to release of elemental vapor during the application of porcelain and is termed greening.[31]

Coefficient of Thermal expansion

Both alloys and porcelain expand when healed and contract when cooled. If porcelain contracts less than the alloy, then the porcelain will have residual compressive stresses at room temperature and if porcelain contracts more than the alloy, then the porcelain will have residual tensile stress at room temperature. Porcelain will not tolerate tensile stress well as it is brittle and subject to failure by crack propagation. Therefore, it is critical to select porcelain for a given alloy which has coefficient of thermal expansion less than that of the alloy. However, it cannot be too small as the failure may occur as a result of compressive stresses. Generally, a 0-$5\times10^{-6}/^{0}C$ difference in coefficients is desirable.[32]

Melting Temperature

Each alloy has lower solidus temperature at which melting begins and a higher liquidus temperature at which the entire alloy is melted. The firing temperature of the porcelain should be below the solidus temperature of the alloy by at least $50^{0}C$[33] to prevent distortion of the alloy substructure at high temperature. This distortion is referred to as sagging and is exacerbated by thin metal substructures or long spans. During soldering operations after porcelain application, the solder must have a liquidus temperature at least $50^{0}C$ below that of the porcelain sintering temperature and the solidus temperature of the alloy.

Alloy solidus and fit

When a molten alloy solidifies from the liquid state to solid state a large amount of shrinkage occurs. Because of this the final casting will be smaller in dimension and the risk of ill-fitting restoration is much greater. Therefore, the shrinkage must be compensated by die expansion, application of the die spacer, use of special expanding investment mechanisms, or increasing the burn out temperature of the investment. The amount of shrinkage is proportional to the solidus temperature of the alloy. For the high gold alloys with solidi of about $950^{0}C$, shrinkage values range from 0.3%-0.5% and nickel-based alloys with solidi of about $1300^{0}C$ -$1400^{0}C$ the shrinkage value is 2.5%.[34]

Biocompatibility and Allergic Components

Biocompatibility is related to how an alloy interacts with or affects biologic system. It is attributed to release of elements from the alloy into the oral cavity.[4, 19]Therefore it is important to select the proper alloy and manipulate it properly in the laboratory as many of procedures can alter the corrosion properties of casting alloys. Beryllium has been considered as potentially toxic under uncontrolled conditions. In certain nondental industrial applications and environmental conditions, nickel and its compounds have been implicated as potential carcinogens and as sensitizing agents. Therefore, proper precautions must be used when these alloys are used.[35]

Currently available alloys*:*

Current classification of alloys is based on American Dental association compositional classification system. The ADA system divides casting alloys three groups based on wt.% composition and into four groups based on physical properties of yield strength and elongation.

Table I

Current ADA definitions for alloy classification by composition[36]

Class	**Composition**
High noble	**Au content ≥40 wt%** **Noble metal content≥60 wt%**
Noble	**Noble metal content >25 wt%**
Predominantly Base metal	**Noble metal content <25wt %**

Table II

Current ADA definitions for alloy types by physical properties[37]

ADA Type	Hardness	Clinical use	Yield strength (MPa)	Elongation (%)
I	Soft	Low stress, no occlusion, inlays	<140	18
II	Medium	Moderate stress, light occlusion, onlays and inlays	140-200	18
III	Hard	High stress, full occlusal load, crowns, short span FPD's	201-340	12
IV	Extra-hard	Very high stress, thin veneer crowns Long span FPD, RPD	> 340	10

High noble alloys:

These include gold platinum (Au-Pt), gold palladium (Au-Pd), gold copper silver (Au-Cu-Ag). Gold platinum alloys are used for

full cast or metal ceramic applications. They are multiple phase alloys containing zinc or silver as hardeners. Gold palladium is also used for metal ceramic applications and contains tin, indium or gallium as oxide forming elements to promote porcelain adherence When palladium or platinum contents are above 10% weight the solidus temperatures of the alloys are higher and the alloys are white in color.[16] Gold copper silver alloys are used exclusively for full cast restorations because of the low melting range and high silver and copper content. They are yellow in color and have moderately high yield strengths and hardness but only moderate elastic moduli. They are single phase alloys which makes them easy to cast and solder.

Noble alloys:

They have no stipulated gold content but must contain at least 25% noble metal. This includes gold-copper-silver, palladium copper gallium, palladium silver, silver palladium. Gold –copper-silver are single phase alloys and are used for full cast restorations and porcelain applications. The color varies from yellow to reddish yellow to silver depending on how the reduced gold is compensated for. Palladium-copper-gallium alloys are used for full cast or metal ceramic applications. They have high melting ranges and must be cast using induction-casting and special high temperature investments.[21] The gallium lowers the liquidus temperature, can provide porcelain adherence and contributes to strength.[38,39] They are multiple phase alloys[40] and have the highest elastic modulus among the gold and palladium based systems. Palladium silver or silver palladium are multiple phase. The Pd-Ag alloys are far more common in dentistry and are far superior in strength, corrosion resistance, modulus and hardness. The high silver content of the Ag-Pd alloys makes them usable only for full cast restorations.

Base metal alloys:

The base metal alloys can be grouped into Ni-Cr-Be, Ni-Cr, Ni-high –Cr, and Co-Cr. They contain less than 25% wt. noble metal according to ADA classification, but in practice most contain no noble metal. Nickel-chromium is used for full cast and metal ceramic restorations and RPD frameworks. They contain > 60% nickel and are multiple phases. They may contain >20% wt. chromium, <20%chromium with no beryllium or with 1-2%wt beryllium. Beryllium is added to reduce the liquidus temperature so that the investing and casting are easier[34], but it increases the corrosion.[41] They may or may not contain approximately 0.1% wt. carbon which hardens the alloy via the formation of carbides. Cobalt chromium alloys contain 60% wt. cobalt and 30 wt.% of chromium. Carbon is added to strengthen the alloy. They are multiple phase. Cobalt chromium alloys have the highest melting ranges and laboratory manipulation of these alloys is difficult. Base metal alloys are used for full cast, metal ceramic or R.P.D. Base metal alloys have the highest modulus of elasticity. They are difficult to solder because of their propensity for formation of surface oxides and form thick oxide layer which is difficult to mask during porcelain application. Base metal alloys have superior mechanical properties and reduced cost as compared to

the gold alloys. However, its potential nickel allergy may be a cause of concern.

Titanium alloys have been proposed for full cast, metal ceramic and RPD frameworks. Their use is limited because of need for special casting machines and investment and expertise required for the casting process. Base metal alloys have elastic moduli twice as high as those of other systems and superior mechanical properties. They can be etched for resin bonding. Drawbacks of these alloys include higher corrosion, difficulty in polishing, dark thick oxides, risk of allergy and difficulty soldering. Their liquidus temperature is the highest among all prosthodontic alloys making it harder to cast and ensure proper marginal fit.

Summary

In conclusion, important physical and biologic properties of dental casting alloys have been reviewed. Corrosion is one property that is most relevant to biocompatibility because the release of elements from the alloy is always necessary for adverse biologic effects and response to released elements depends on which element is released, the quantity, duration of exposure and other such factors. Although carcinogenic effects of dental casting alloys have not been demonstrated, the clinician must avoid alloys containing known carcinogens. Although selection of an alloy must be made on an individual basis using relevant corrosion and biologic data from manufacturers, the goal may be achieved by using high noble or noble alloys with single phase microstructure. The evolution of titanium as an alloy with the least potential for eliciting adverse reaction in individual hypersensitive patients therefore a non-toxic biocompatible replacement for existing alloys for fixed and removable prosthesis may renew interest in this metal.

References:

1. Jones TK, Hansen CA, Singer MT, Kessler HP. Dental implications of nickel hypersensitivity. J Prosthet Dent 1986;56:507-509.
2. Bezzon OL. Allergic sensitivity to several base metals: a clinical report. J Prosthet Dent 1993;69:243-244.
3. Sjogren G, Sletten G, Dahl JE. Cytotoxicity of dental alloys, metals, and ceramics assessed by Millipore filter, agar overlay, and mtt tests. J Prosthet Dent 2000;84:229-236.
4. Wataha JC. Biocompatibility of dental casting alloys: a review. J Prosthet Dent 2000;83:223-234.
5. Namikoshi T, Yoshimatsu T, Suga K, Fujii H, Yasuda K. The prevalence of sensitivity to constituents of dental alloys. J Oral Rehabil 1990;17:377-81.
6. Craig RG. Restorative dental materials 10th ed. St.Louis: Mosby; 1997 p.383.
7. Philips RW. Science of dental materials 7th ed. Philadelphia: WB Saunders, 1973; p 250-3.
8. Neilson JP,Tuccillo J. Grain size in Cast alloys J Dent Res 1966; 45: 964-9.

9. Baran GR, Cast and wrought base metal alloys .In: Craig RG, Powers JM, editors, Restorative dental materials .11th edition .St.Louis: Mosby; 2002.p.479-513.
10. Phillips RW.Science.of dental materials 7th ed Philadelphia: WB Saunders; 1973 p.384.
11. Flinn RA, Trojan PK .Metallic structures: Engineering materials and their applications.3rd edition. New York: Houghton Mifflin: 1986.p.21-60.
12. Craig RG, Powers JM. Restorative dental materials. 11th ed. St. Louis: Mosby 2002. p. 170-3.
13. Wataha JC,Craig RG, Hanks CT. The release of elements of dental casting alloys into cell culture medium. J Dent Res 1991; 70:1014-8.
14. Bumgardner JD, Lucas LC. Corrosion & cell culture evaluations of Ni Chromium dental casting alloys. J Appl Biometer 1994;5:203 -213.
15. Craig RG, Powers JM. Restorative dental materials 11th ed. St.Louis Mosby; 2002 p 481-5.
16. Craig RG, Powers JM. Restorative dental materials. 11th ed. St Louis: Mosby; 2002 p 105.
17. Moffa JP, Lugassy AA, Guckes AD, Gettleman L. An evaluation of nonprecious alloys for use with porcelain veneers. Part I. Physical properties. J Prosthet Dent 1973; 30; 424-31.
18. Craig RG, Powers JM. Restorative dental materials 11th ed St.Louis: Mosby; 2002. p 453.
19. Wataha JC. Principles of biocompatibility for dental practitioners. J Prosthet Dent 2001; 86:203-9.
20. Craig RG, Restorative Dental materials. 10th ed. St.Louis: Mosby; 1997.p 146-53,387-9.
21. Wataha JC. Noble alloys and solders. In: Craig RG, Powers JM, .Restorative dental materials.11th edition. St.Louis: Mosby; 2002.p.449-78.
22. Fontana MG. Corrosion engineering. 3rd ed. New York Mc Graw Hill; 1986.p165-200.
23. Brune D. Metal release from dental biomaterials. Biomaterials 1986; 7:163-75.
24. Reclaru L.Meyer IM. Study of corrosion between a titanium implant and dental alloys. J Dent 1994; 22:159-68.
25. Shigeto N, Yanagthara T, Murakami S, Hamada T. Corrosion properties of soldered joints. Part II .Corrosion pattern of dental solder and dental nickel-chromium alloy J Prosthet Dent 1991:66;607-10 .
26. Wataha JC, Lockwood PE, Vuilleme MN, Zorcher M.H .Cytotoxicity of Au based dental solders alone and on a substrate alloy. J Biomed Mater Res 1999; 48; 786-90.
27. Wataha JC, Malcolm CT, Hanks CT. Correlation between cytotoxicity and the elements released by dental casting alloys. Int J Prosthodont 1995; 8:9-14.
28. O'Brien WJ. Dental Porcelain.In:O'Brien WJ, editor. Dental materials: Properties and selection.Chicago: Quintessence; 1989.p.397-418.
29. Craig RG, Powers JM, Restorative Dental Materials. 11th Ed. St Louis: Mosby; 2002, p 578.

30. Craig RG, Powers JM. Restorative dental materials 11th ed St. Louis Mosby 2002 p 580.
31. Wataha JC. Alloys for Prosthodontic restorations.J Prosthet Dent 2002; 87:351-83.
32. Fairhurst CW, Anusavice KJ, Hashinger DT, Ringle RD, Twiggs SW. Thermal expansion of dental alloys and porcelains. J Biomed Mater Res 1980; 14:435-46.
33. Anusavice KJ. Phillips science of dental materials 10th ed. Philadelphia WB Saunders 1996 p 439.
34. Wataha JC. Casting and soldering .In: Craig RG, Powers JM, editors.Restorative dental materials.11th edition.St.Louis: Mosby; 2002.p.515-50.
35. Report on base metal alloys for crown and bridge applications: benefits and risks. Council on dental materials, Instruments and Equipment.JADA 1985; 111:479-483.
36. Classification system for cast alloys .Council on Dental materials, Instruments and equipment .J Am Dent Assoc 1984; 109:766.
37. Revised ANSI/ADA specification no 5 for dental casting alloys .Council on dental materials, Instruments and equipments .J Am Dent Assoc 1989; 118:379.
38. Papazoglou E, Brantley WA, Carr AB, Johnston WM. Porcelain adherence to high palladium alloys. J Prosthet Dent 1993; 70:386-94.
39. Wu Q, Brantley WA, Mitchell JC, Vermilyea SG, Xiao J, Guo W. Heat treatment behavior of high palladium dental alloys. Cells Mater 1997;7:161-74.
40. Vermilyea SG, Cai Z, Brantley WA, Mitchell JC. Metallurgical structure and micro hardness of four palladium- based alloys. J Prosthodont 1996; 5:288-94.
41. Wataha JC, Lockwood PE, Khajotia SS, Turner R.Effect of pH on element release from dental casting alloys. J Prosthet Dent.1998; 80:691-8.

* Professor and Head,
Department of Prosthodontics
AJ Institute of Dental Sciences,
Mangalore

** Professor and Head
Department of Prosthodontics
Manipal College of Dental
Sciences, Manipal Academy of Higher Education
Mangalore, India

+ Associate Professor,
Department of Prosthodontics,
Manipal College of Dental Sciences,
Manipal Academy of Higher Education
Mangalore, India

++ PhD Research Scholar
Department of Dental Materials
Manipal College of Dental Sciences,
Manipal Academy of Higher Education
Mangalore, India

Author for Correspondence:

Shobha J Rodrigues,

Professor and Head,
Department of Prosthodontics

Manipal College of Dental Sciences,
Light House Hill Road
Mangalore – 575001
Karnataka, India
Ph: +918242428716, Extension: 5661 – (O)
E Mail: Shobha.J@Manipal.Edu

Single Tooth Replacement with Implant Supported Prosthesis Using Composite Grafting Technique.

Authors: Dr. Nivya John*, Dr. Manoj Shetty**

For an implant to be successful there must be adequate bone structure surrounding the implant three dimensionally. An implant must be protected by the cocooning effect of the bony wall. Unfortunately tooth loss and aging cause inevitable bone loss.
Graft less procedures such as osseodensification and ridge splitting have been successfully done for cases with border line defects. However, in order to get soft tissue contour, additionalbone grafting would be paramount to achieve the desired results. (1)

Various grafts are available at our disposal with osteogenic (new bone formation), osteoinductive (induction of bone formation) osteoconductive (scaffolding) properties. Autografts remains the gold standard. However, auto- grafts have higher resorption rates and other drawbacks like donor site morbidity (2,3).

50:50 ratio of particulate autogenous versus allografts have been used successfully. The osteogenic potential of the autogenous grafts and the low resorption rate of the allografts isan ideal combination to promote growth of bone architecture required for optimum aesthetics. (4)

The following case report presents rehabilitation of missing anterior teeth with implant supported prosthesis. A ridge splitting procedure and lateral augmentation with particulate allograft with autograft mixture also was done. A one year follow up showed sustained bone level around implants.

Case Report:

Preoperative Stage:

A male patient aged 30 years, presented to the department of Oral Implantology with missing upper front tooth due to trauma.

Fig. 1

(fig 1) Preoperative procedures such as facial profile analysis, intra oral examination and radiographic analysis were performed. The following were the findings.

Intra oral examination: 21 was missing ,11 had periapical lesion.
Smile line: The patient had a low smile line and a toothy smile. There was also a marked shift in the midline.

Patient expectations: Patient was co-operative and had moderate expectations of outcome.
Radiographic analysis; (fig 2)
OPG AND CBCT analysis indicated 16 mm bone height and bone width of 4 mm with a bucco- palatal hourglass shaped bone defect wrt 21.
Treatment planning: ridge splitting and immediate implant placement with lateral augmentation

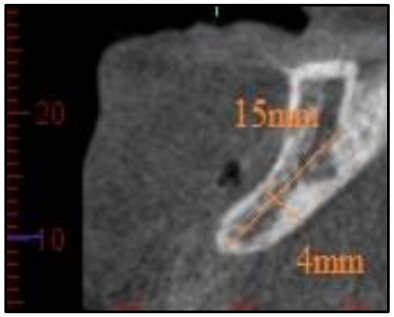


Fig. 2

Patient was advised oral prophylaxis, there after a root canal treatment wrt 11. Diagnostic impressions were made, occlusion and vertical dimensions were established.

Surgical phase: Antimicrobial prophylaxis was obtained with the use of 500 mg of Amoxicillin thrice daily for 5 days, starting 1 day and 1 hour before surgery. 0.2% Chlorhexidine Gluconate mouth rinse was also prescribed one week and one-hour prior surgery. Perioral disinfection of the patient was done with 5% w/v Povidone Iodine solution.

The surgery began with the administration of local anaesthesia (2% lignocaine hydrochloride). A full thickness flap was elevated A sharp bone chisel was then positioned midcrestally and tapped using a mallet to create a minor split. Care was taken to manoeuvre the instruments as gently and firmly as possiblein order to avoid any inadvertent fractures. Ridge splitting was done using ridge expanders (ankylose set ridge expanders/Dentsply). Sequential splitting resulted in progressive increase of the diameter. Ankylose straight osteotomes was then used to finalize the split (fig 3). Sequential osteotomy and reaming were done and Implant (ANKYLOS C/X A 11) was prosthetically driven 1mm sub-crestally.

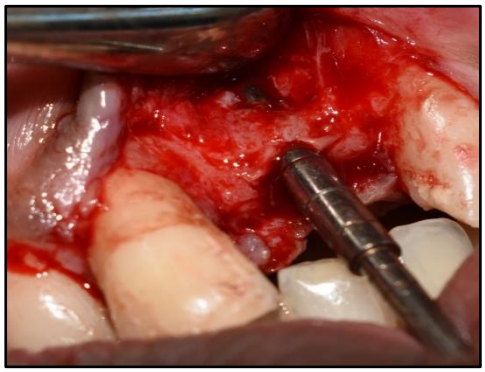


Fig. 3

Lateral augmentation was done with autogenous bone collected from the patient's osteotomy site and mixed with patient`s blood periosteal blood AND Ringer`s Lactate.

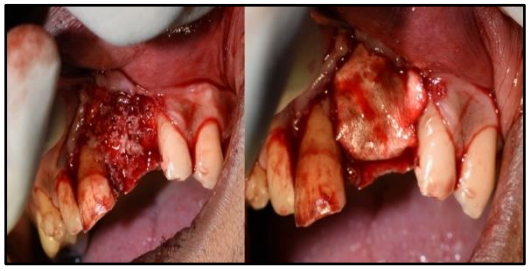


Fig. 4

Allograft also was mixed with this to make an osteogenic rich composite graft. A collagen membrane was then placed to cover the graft (fig 4)

A primary closure with everted edges was achieved with Vicryl 3.0 sutures. Immediate post-operative x-ray was taken. (fig 5)

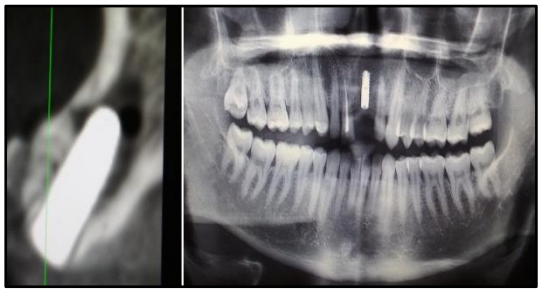


Fig. 5

Post operative care: Postsurgical analgesic treatment was performed using 100 mg of aceclofenac twice daily for five days along with the antibiotics and mouth rinse. Oral hygiene instructions were provided. Patient was advised to return for suture removal and be on soft diet for 6 weeks

Prosthetic Phase: Patient was recalled for second stage surgery four months post-operative. Cover screw was retrieved noninvasively. A 3.0 wide diameter sulcus former was placed for 15 days and a provisional restoration with an ovate pontic design was delivered subsequently.

Patient was recalled for implant level impression. Regular non angulated abutments were selected (Regular C/X 3.0/A0). An orientation jig was used to confirm the placement of the abutment. Finally, the abutment was torqued(15Ncm) and sealed with Teflon and composite. The PFM crown was then cemented using Zinc Phosphate. (Fig. 6)

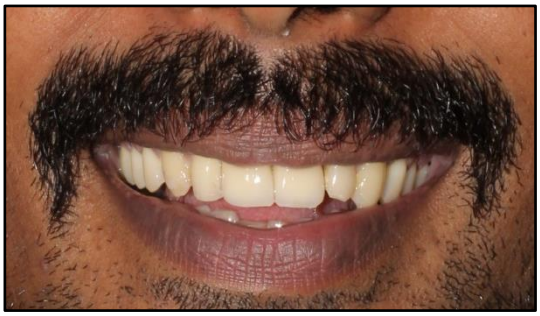


Fig. 6

A post cementation X-ray was taken to evaluate the abutment connection and the presence of excess cement.

Follow up: patient was advice peri implant care and given proper advice on oral health care. A one year follow up x-ray revealed intact crestal bone levels.

Discussion:

Implant placement in the aesthetic area comes with many challenges and is dependent on various factors. Therefore, a thorough diagnosis of the existing factors (anatomic and host response) and customised treatment planning (surgical, materials used and prosthetic philosophies) is imperative.

In the above-mentioned case, the CBCT revealed 4-5mm of Buccolingual width. Although there was enough bone to place an implant, it would not guarantee an optimal prosthetic placement. It is also crucial to have 1mm of bone surrounding the implant in order to have successful (short and long term) outcome. A 2mm facial bone would be ideal. (5) Ridge splitting and bone expansion methods have been used with wide success

rates. Splitting has to be done in cases there is adequate cancellous bone and residual ridge heights. It should be also noted that the thereinto excessive facial inclination of the bone. Inorder to recreate and follow the contour of the adjacent teeth, horizontal augmentation was also done.

Autologous bone is considered to be the gold standard due to its osteogenic, osteoinductive, and osteoconductive properties including lack of immunogenicity(6,7) However, autologous bone grafts may show a number of disadvantages, such as increased operation time, donor site morbidity, post-operative discomfort, limitations in bone quantity and volume, unpredictable bone quality, reduced volume stability, and fast resorption rate.

Furthermore, the intraoral amount of autologous bone collection from an osteotomy site is limited thus allograft are the next best choice. Demineralized freeze-dried bone allografts have osteoinductive properties as well that helps attract bone forming cells and ectopic bone formation. (7)

The combination of collagen membranes with autologous bone and a superficial layer of deproteinized bovine bone mineral (DBBM) is a widely used guided bone regeneration (GBR) technique(8)Thus the choice was made to use a mixture of autograft and allograft in the site.Autogenous bone shavings collected in the reamer was also mixed with the allograft along with the patient `s blood and ringer`s Solution collected from the osteotomy (periosteal blood) site .

In a study done by Aspurahova et al, Significant quantities of TGF-β1 ($2.1\ ng \cdot mL^{-1}$, $P < 0.001$) were measured in BCM prepared with Ringer's solution (RS) within 10 minutes (8)Bone conditioned medium harvested for minutes induces genes encoding bone matrix proteins, but does not contribute to matrix mineralization, whereas BCMs prepared over days contribute to the progression osteogenesis. However, the autogenous bone chips collected were placed in the Ringers solution for 10 minutes. Meanwhile a slow resorbable membrane was used as barrier membrane was packed against the soft tissue a pocket was created to receive the conditioned composite graft material.

Resorbable sutures were then placed making sure no membrane was impregnated during the procedure. This is done to protect the membrane from contamination.

After four months of healing period, the site showed well-formed soft tissue and sustained crestal
Bone levels. Thus, an if factors like patient expectations, defect morphology, adjacent teeth morphology 3D implant positioning and post operative care are favourable, hard tissue grafting would bring forth a successful outcome.

Conclusion:

Failure to achieve functional and aesthetic results in dental implants can have disastrous effect that could potentiate un necessary and additional waste of surgical and prosthetic interventions.It is therefore vital for a clinician to have proper understanding of the science that deals with implants and also

tailor an effective treatment best suited for the individual.

References

1. Misch CE, Degidi M. Five-year prospective study of immediate/early loading of fixed prostheses in completely edentulous jaws with a bone quality-based implant system. Clin Implant Dent Relat Res. 2003;5:17-28.
2. Sbordone L, Toti P, Menchini-Fabris GB, Sbordone C, Piombino P, Guidetti F. Volume changes of autogenous bone grafts alveolar ridge augmentation of atrophic maxillae and mandibles. Int J Oral Maxillofac Surg. 2009;38(10):1059-65.
3. Kloss FR, Offermanns V, Kloss-Brandstätter A. CEComparison of allogeneic and autogenous bone grafts for augmentation of alveolar ridge defects-A 12-month retrospective radiographic evaluation [published online ahead of print, 2018 Oct 10]. *Clin Oral Implants Res*. 2018;29(11):1163–1175. doi:10.1111/clr.13380
4. Buser D, et al. Long-term stability of early implant placement with contour augmentation. J. Dent. Res. 2013;92:176S–182S. doi: 10.1177/0022034513504949.
5. Jamjoom A, Cohen RE. Grafts for Ridge Preservation. J FunctBiomater. 2015;6:833–848.
6. Rogers GF, Greene AK. Autogenous bone graft: basic science and clinical implications. J Craniofac Surg.
7. Miron RJ, Sculean A, Shuang Y, Bosshardt DD, Gruber R, Buser D, Chandad F, Zhang Y. Osteoinductive potential of a novel biphasic calcium phosphate bone graft in comparison with autographs, xenografts, and DFDBA. Clin Oral Implants Res. 2016;27:668–675.(10)
8. Asparuhova MB, Caballé-Serrano J, Buser D, Chappuis V. Bone-conditioned medium contributes to initiation and progression of osteogenesis by exhibiting synergistic TGF-β1/BMP-2 activity. *Int J Oral Sci*. 2018;10(2):20. Published 2018 Jun 12. doi:10.1038/s41368-018-0021-2

*Associate Professor,
Department of Oral Implantology,
AB Shetty Memorial Institute of Dental Sciences
** Prof and HOD,
Department of Oral Implantology,
AB Shetty Memorial Institute of Dental Sciences
Derlakatte, Mangalore

Case Report

Obstructive Sleep Apnea And It's Management: A Prosthodontic Perspective

Ann Sales[*], Akshar Bajaj[*], Kushan Kishore Dhawan[*], Umesh Pai[+], Shobha Rodrigues[++]

Abstract

Obstructive sleep apnea (OSA) is repetitive cessation of breathing during sleep. It is characterized by loss of airway patency accompanied by simultaneous respiratory effort. Patients with undiagnosed sleep apnea represent a major public health problem. Prosthodontists have a unique role in recognizing the sleep disorder and co-managing the patients along with a physician or a sleep specialist. Oral appliance therapy is an important adjunct for treatment of sleep apnea patients. This review paper aims to explain the etiology, clinical features and management of Obstructive Sleep Apnea with special reference to a prosthodontic treatment approach.

Keywords: **obstructive sleep apnea**, **polysomnography**, **mandibular repositioning appliance**, **tongue retaining devices**, **soft palate lifters**.

Introduction

The vast increase in sleep related research over the past two decades has led to sleep medicine being recognized as a separate specialty.[1] Dental sleep medicine is a subset of sleep medicine where the dentist plays an important role in screening for patients who present with sleep-disordered breathing (SDB) and works with a variety of specialists to provide the best treatment possible. Some studies have found a correlation between SDB, parafunction, movement disorders related to sleep orofacial pain sleep interactions.[2] A better understanding of these can help the formulation of a holistic treatment plan for each patient.

Sleep Disordered Breathing

Sleep disordered breathing (SDB) is a common medical disorder associated with important morbidities.

It can be divided into obstructive and non-obstructive breathing disorders. (Fig 1)[3]

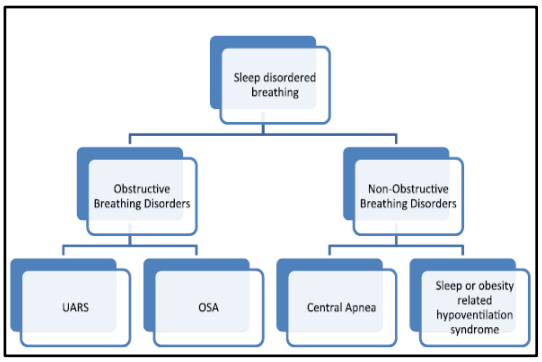


Fig. 1 Classification of SDB. UARS, upper airway resistance syndrome

Obstructive Sleep Apnea

Obstructive sleep apnea (OSA) is a sleep disordered breathing disease involving repeated obstruction of the upper airway during sleep.

Etiology and Pathogenesis Of OSA

The main feature of OSA is the collapse of the tongue backwards on the pharynx during sleep. Due to this, breathing gets restricted leading to a decreased O_2 and increased CO_2 levels in the blood which alerts the receptors in the carotid sinus, thereby causing the patient to wake up in order to breathe normally. Alcohol is a

common co-factor because of its depressant influence on respiratory muscles.[4] Due to a structurally compromised airway, these patients are predisposed to malocclusion. In a few patients, abnormal pharynx, adeno-tonsillar hypertrophy, retrognathia and macroglossia could be the reason for the structural compromise. This structural defect is a subtle reduction in airway size that can be identified in most patients as pharyngeal crowding which can be confirmed with imaging techniques. Obesity often leads to reduced size of upper airway by increased fat deposition or a compressed pharynx due to superficial fat in the tongue.[4]

Role of edentulism in pathogenesis of OSA

Edentulism has a significant effect on the prosthodontic implications of sleep medicine and is associated with the treatment outcome of OSA. Loss of teeth can lead to the following anatomical changes:

- Decrease in vertical dimension of occlusion
- Change in position of mandible
- Change in position of hyoid bone
- Impaired function of oropharyngeal musculature such as loss of tone in soft palate and pharynx, macroglossia etc.

Diagnosis

For an OSA syndrome to be diagnosed, a comprehensive sleep history, presence of specific clinical features and an objective demonstration of SDB is required.[5] High-risk patients for OSA can be identified based on[6]:

- Obesity (body mass index [BMI] >35)
- Type 2 diabetes
- Treatment refractory hypertension
- Pulmonary hypertension
- Nocturnal dysrhythmias
- Congestive heart failure
- Stroke
- High-risk driving populations

Systemic health evaluation can include questionnaires which are to be filled by patients at their regular appointments. The most widely used questionnaires are the Berlin Questionnaire[7] and the Epworth Sleepiness Score. The STOP-Bang questionnaire is shown to have a greater clinical utility for identifying the pretest probability of apnea.[8] If three or more items are positive, the patient is considered to be at high risk for OSA and further questions can be asked.

<u>STOP-Bang questionnaire items</u>

1. **S**noring
2. **T**iredness
3. **O**bserved apneas
4. Elevated Blood **P**ressure
5. **B**MI >35
6. **A**ge >50 years old
7. **N**eck >40 cm
8. Male **G**ender

<u>Characteristic symptoms and clinical features</u>

Nocturnal symptoms:

- Snoring
- Insomnia
- Witnessed apneas by bed partner
- Nocturnal reflux
- Nocturnal choking, snorting, or gasping
- Bruxism

- Other nocturnal symptoms: enuresis, nocturia, frequent arousals, diaphoresis, impotence

Daytime symptoms:

- Excessive daytime sleepiness
- Other daytime symptoms: fatigue, memory impairment, personality changes, morning nausea, morning headaches, depression
- Physical characteristics/examination: Obesity: neck size >17 inches (men), >16 inches (women); BMI >35
- Craniofacial anatomy: retrognathia, micrognathia, tonsillar hypertrophy, macroglossia, inferior displacement of the hyoid bone, narrowing of oropharyngeal airway
- Hypertension: especially drug-resistant hypertension

Along with medical history, self-questionnaires, and presence of clinical features[9], the diagnosis of OSA syndrome also requires demonstration of abnormal respiratory events with polysomnography (PSG) or home apnea testing.

Objective Testing

Before a dentist starts treatment, overnight sleep studies need to be conducted and interpreted by a qualified sleep physician. Polysomnography (PSG) is the "gold standard" for diagnosis of OSA. The following physiologic signals are monitored and recorded by a trained professional[9-11]:

- Electroencephalogram
- Electromyogram
- Nasal pressure
- Electrocardiogram
- Respiratory effort
- Electrooculogram
- Oxygen saturation
- Oral or oronasal thermistor
- Audio, video

AHI (apnea-hypopnea index) is the total number of apnea and hypopnea events divided by total sleep time in hours observed on an electroencephalogram. Respiratory disturbance index (RDI) is the sum total of apnea, hypopnea and RERA (respiratory effort related arousal) events divided by total sleep time in hours. Insomnia, hypersomnia, fatigue and other neurocognitive problems are comorbidities that can reduce the threshold for treatment .[12]

Grading of OSA based on AHI

Mild OSA - AHI 5 and <15 per hour of sleep with symptoms or comorbidity factors

Moderate OSA - AHI 15 and <30 events per hour of sleep

Severe OSA - AHI 30 events per hour of sleep

Mallampati Classification

Screening for sleep apnea should include the modified Mallampati score according to the American Academy of Sleep Medicine (AASM).[6] With the patient in the upright position, the base of the uvula and the appearance of the soft palates are observed and scored accordingly. A high score (class 3 or 4) is indicative of sleep apnea.[13,14]

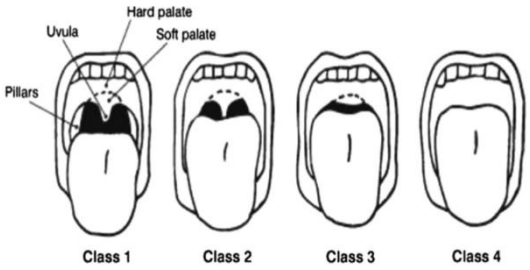


Fig. 2 Mallampati Classification

Treatment Options for OSA

Treatment indications and objectives with oral appliance therapy	
Indications	**Objectives**
Primary snorers without features of OSA	Reduce snoring to a subjectively acceptable level
Mild to moderate OSA with a preference for oral appliances, demonstrated intolerance to CPAP, poor candidates for CPAP, or failure to comply with behavioral changes	Resolution of clinical signs and symptoms of OSA Normalization of the AHI and oxyhemoglobin saturation levels
Severe OSA with initial trial of nasal CPAP Upper airway surgery may precede oral appliance therapy	Resolution of clinical signs and symptoms of OSA Normalization of the AHI and oxyhemoglobin saturation levels

A long-term, multidisciplinary management is needed for a chronic disease like OSA. Treatment includes medical, dental, behavioral and surgical options. Adjunctive treatment modalities can be used along with a primary treatment therapy to manage the condition. The patient needs to be educated regarding the severity, risk factors, modes of treatment of the disease and their role in the treatment process.[6]

Options for Treatment:

1. Positive airway pressure (PAP)
2. Upper airway surgical procedures
3. Pharmacologic treatment
4. Oral appliances
5. Behavioral modification: weight loss, alcohol avoidance, alteration of sleeping position

Initially reported in 1981, PAP provides pneumatic splinting of the upper airway and remains the standard treatment for OSA.[15,16] Various forms of PAP include Continuous PAP (CPAP), bilevel PAP, or auto titrating PAP modes. Nasal masks are often used but the effectiveness can be hampered by mouth leaks.[17] Full face masks (oronasal masks) facilitate nasal and oral breathing but if the mandible gets displaced when the interface is tightened, the tongue can be pushed posteriorly thereby worsening the apnea. Effects of PAP include alleviation of symptoms, reduced risk of traffic and workplace accidents, decreased cardiovascular comorbidities. CPAP is an effective modality for reduction of AHI. However, it has a few drawbacks such as expense, side effects with regard to the nose or face, or mask discomfort.[18] Adjunctive treatment modalities include lifestyle modification, prevention of supine sleep position, exhalation pressure valves applied nasally, oral appliances, and upper airway surgery.[19]

For patients with mild to moderate OSA who are not comfortable with a CPAP device, or those with a snoring problem oral appliance therapy is a good alternative. According to studies[20-24], even though CPAP is more effective than mandibular repositioning appliances (MRAs), patients usually prefer oral appliances over CPAP in cases where both are effective.

AASM Practice Parameters[25]

Mechanism of Action of Oral Appliances

In oral appliance therapy, the tongue and the mandible are repositioned anteriorly and inferiorly which prevents the airway from collapsing. This reduces snoring and OSA by enhancing the patency of the airway by widening the lateral aspects of the upper airway.[26] The upper airway has three parts: the velo-pharynx (hard palate to tip of uvula), oro-pharynx (tip of uvula

to tip of epiglottis), and hypo-pharynx (tip of epiglottis to vocal cords). The most common site of primary pharyngeal collapse in OSA is the velo-pharynx.[27,28]

Types of Oral Appliances

Examples of oral appliances		
Somnomed	Aveo-TSD	Adjustable Soft Palate Lifter
The silencer	Tongue-locking appliance	Silent night
Klearway	Snore guard	Snore EX
NAPA	Silent night	TPE
TAP	TheraSnore	Esmark
Herbst	Snore-no-more	HAP
SNOAR	PM positioner	Tessi
SUAD	TheraSnore	Respire

Tongue retaining devices (TRD), MRAs and soft palate lifters are the three main categories of oral appliances used. Out of these, MRA is the most commonly used. The MRA covers the upper and lower teeth and positions the mandible anterior to the mandibular resting position. TRD incorporates an anterior bulb that creates a suction effect on the tongue which advances the tongue increasing the upper airway space. TRDs are preferred in cases of hypodontia, edentulism, and significant periodontal disease since these devices do not require support from teeth.

MRAs are classifies as into titratable (2-piece appliance) and non-titratable (1-piece appliance) or custom-made appliances and prefabricated appliances. Studies evaluating the efficiency of various types of MRAs reveal that all custom-made devices have a comparable outcome. However, the treatment response with custom-made designs are significantly better when compared with prefabricated designs.

MRAs are usually designed like a conventional orthodontic appliance, either a 1- or 2-piece type that is retained by one or both dental arches.[23]

Advantages of oral appliances

1. Nonintrusive
2. Simplicity
3. Lack of noise
4. Smaller and more portable than CPAP devices
5. Comfortable: fits inside the mouth
6. Potentially lower cost of treatment
7. Reversible treatment modality
8. No need for power source

Patient Selection Criteria for MRA

Prior to treatment with MRA, the degree of sleep-related respiratory problems should be confirmed with a PSG and the dentist should be referred. Incorrect diagnosis and subsequent treatment can make the patients' condition worse. Effectiveness of MRA in children is yet to be studied conclusively, thereby limiting use of MRAs to adults only. It is not possible to tell if a patient will respond positively to oral appliance therapy.[29] Success in MRAs is associated with variables such as mild OSA, supine dependent OSA, females, and non-obesity patients.[30] Selecting ideal patients for oral appliance therapy will require further research.

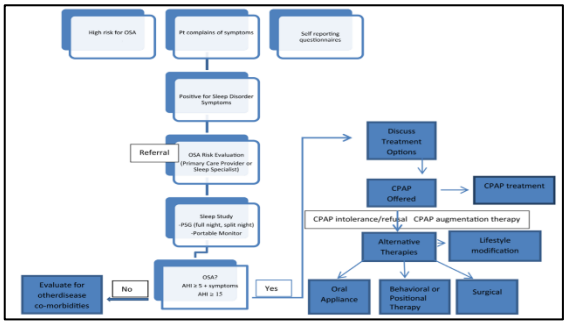


Fig. Flow chart for evaluation and treatment of patients suspected of having OSA patient

Contraindications and Side Effects of Oral Appliance Therapy

Relative dental contraindications to oral appliance therapy

Condition	Concern	Risk
Periodontal disease	Status: active or stable Concern: mobility of teeth	Reduced anchorage potential with appliance Increasing degree of mobility, and bite change with MRA Optional use of TRD
Temporomandibular dysfunction	Need to assess degree of TMD	Concern with potential aggravation of TMD and limitation of advancement potential with MRA
Number of remaining teeth	If <6–10 teeth per arch, or uneven distribution	Reduced anchorage
Protrusive capacity of the mandible	If <6 mm	Potential contraindication due to limitation of efficacy of MRA treatment
Bruxism	Patterns of wear	Early damage to appliance from overload or increase in pain with rigid appliance holding them in a fixed position
Occlusion	Number of tooth-to-tooth contacts, horizontal and vertical overjet	Reduced initial contacts will decrease patient awareness of bite change with MRA
Maximum vertical opening	If <25 mm	Inability to seat MRA
Exaggerated gag reflex	Poor adaptation potential	Inability to wear MRA

Side effects can be grouped into 2 broad categories[31-35]:

1. Minor in severity and temporary: they are either tolerable or tend to resolve with a short adaptive period of 6 to 8 weeks.
    - TMJ pain
    - Gingival irritation
    - Morning after occlusal changes
    - Salivation
    - Tooth pain
    - Loss of crown or restorations
    - Myofascial pain
    - TMJ sounds
    - Dry Mouth
    - Bad taste or odour
2. Moderate to severe and continuous: these occur at any stage during treatment and may cause intolerance and discontinuation of the appliance.
    - TMJ pain
    - Dry mouth
    - Tooth movement: decrease in overbite and overjet, mobility of teeth, intrusion, retrusion effects
    - Gingival pain
    - Myofascial pain
    - Tongue pain (with TRDs)
    - Tooth pain
    - Gagging (mostly with soft palate lifters)
    - Salivation
    - Skeletal changes: change in vertical condylar position, change in arch width

Conclusion

Dentistry has a vital role to play in the identification and management of obstructive sleep apnea. It is important that when indicated, the patients be evaluated for snoring, daytime sleepiness and other signs and symptoms of OSA. American Sleep Disorders Association recommends oral appliance therapy as a treatment option for selected patients. Together with a physician and a sleep specialist, the dentist forms part of the treatment team which can effectively manage a patient with OSA.

References

1. Kryger MH, Roth T, Dement WC, editors. The principles and practice of sleep medicine. St Louis (MO): WB Saunders; 1989. p. 739.
2. Moldofsky H. Sleep and pain. Sleep Med Rev 2001;5:385–96.
3. Barewal RM, Hagen CC. Management of snoring and obstructive sleep apnea with mandibular repositioning appliances: a prosthodontic

approach. Dental Clinics. 2014 Jan 1;58(1):159-80.

4. Eliot A Phillipson. Sleep Apnea Harrison's Priciples of Internal Medicine 16th Edition, McGraw Hill Medical Publishing division ; 2005; Vol II :1573-1576.
5. Endeshaw Y.W., Katz S., Ouslander J.G., Bliwise D.L. Association of denture use with sleep-disordered breathing among older adults. J Public Health Dent. 2004;64:181–183.
6. Epstein LJ, Kristo D, Strollo PJ, et al. Clinical guideline for the evaluation, management and long-term care of obstructive sleep apnea adults. J Clin Sleep Med 2009;5(3):263–76.
7. Netzer NC, Stoohs RA, Netzer CM, et al. Using the Berlin Questionnaire to identify patients at risk for the sleep apnea syndrome. Ann Intern Med 1999;131: 485–91.
8. 9. Chung F, Subramanyam R, Liao P, et al. High STOP-Bang score indicates a high probability of obstructive sleep apnoea. Br J Anaesth 2012;108(5):768–75.
9. McNicholas WT. Diagnosis of obstructive sleep apnea in adults. Proc Am Thorac Soc 2008;5(2):154–60.
10. Practice Committee of the American Sleep Disorders Association. Practice parameters for the indications for polysomnography and related procedures. Sleep 1997;20:406–22.
11. Iber C, Ancoli-Israel S, Chesson AL, et al. The AASM manual for the scoring of sleep and associated events: rules, terminology and technical specifications. Westhester (IL): American Academy of Sleep Medicine; 2007.
12. American Academy of Sleep Medicine. International classification of sleep disorders. 2nd edition. Diagnostic and coding manual. Westchester (IL): American Academy of Sleep Medicine; 2005.
13. Nuckton TJ, Glidden DV, Browner WS, et al. Physical examination: Mallampati score as an independent predictor of obstructive sleep apnea. Sleep 2006; 29(7):903–8.
14. Friedman M, Tanyeri H, La Rosa M, et al. Clinical predictors of obstructive sleep apnea. Laryngoscope 1999;109(12):1901–7.
15. Sullivan CE, Issa FG, Berthon-Jones M, et al. Reversal of obstructive sleep apnea by continuous positive pressure applied through the nares. Lancet 1981;1: 862–5.
16. Elshaug AG, Moss JR, Southcott AM, et al. Redefining success in airway surgery for obstructive sleep apnea: a meta analysis and synthesis of the evidence. Sleep 2007;30(4):461–7.
17. Beecroft J, Zanon S, Lukic D, et al. Oral continuous positive airway pressure for sleep apnea: effectiveness, patient preference, and adherence. Chest 2003; 124:2200–8.
18. Giles TL, Lasserson TJ, Smith B, et al. Continuous positive airway pressure for obstructive sleep apnoea in adults. Cochrane Database Syst Rev 2006:CD001106.

19. Lavigne G, Cistulli P, Smith M. Sleep medicine for dentists: a practical overview. Chicago: Quintessence Publishing; 2009.
20. Ferguson KA, Ono T, Lowe AA, et al. A randomized crossover study of an oral appliance vs nasal continuous positive airway pressure in the treatment of mildmoderate obstructive sleep apnea. Chest 1996;109:1269–75.
21. Ferguson KA, Ono T, al-Majed S, et al. A short-term controlled trial of an adjustable oral appliance for the treatment of mild to moderate obstructive sleep apnoea. Thorax 1997;52:362–8.
22. Randerath WJ, Heise M, Hinz R, et al. An individually adjustable oral appliance vs. continuous positive airway pressure in mild to moderate obstructive sleep apnea syndrome. Chest 2002;122:569–75.
23. Clark GT, Blumenfeld I, Yoffe N, et al. A crossover study comparing the efficacy of CPAP with anterior mandibular positioning devices on patients with obstructive sleep apnoea. Chest 1996;109:1269–75.
24. Engleman HM, McDonald JP, Graham D, et al. Randomized crossover trial of two treatments for sleep apnea/hypopnea syndrome: continuous positive airway pressure and mandibular repositioning splint. Am J Respir Crit Care Med 2002; 166:855–9.
25. Kushida CA, Morgenthaler TI, Littner MR. Practice parameters for the treatment of snoring and obstructive sleep apnea with oral appliances: an update for 2005. Sleep 2006;29:240–3.
26. Kyung SH, Park YC, Pae EK. Obstructive sleep apnea patients with the oral appliance experience pharyngeal size and shape changes in three dimensions. Angle Orthod 2005;75:15–22.
27. Isono S, Tanaka A, Tagaito Y, et al. Pharyngeal patency in response to advancement of the mandible in obese anesthetized persons. Anesthesiology 1997;87: 1055–62.
28. Morrison DL, Launois SH, Isono S, et al. Pharyngeal narrowing and closing pressures in patients with obstructive sleep apnea. Am Rev Respir Dis 1993;148: 606–11.
29. Sutherland K, Deane S, Chan A, et al. Comparative effects of two oral appliances on upper airway structure in obstructive sleep apnea. Sleep 2011;34(4):469–77.
30. Chan AS, Sutherland K, Schwab RJ, et al. The effect of mandibular advancement on upper airway structure in obstructive sleep apnoea. Thorax 2010;65: 726–31.
31. Marklund M, Franklin KA, Persson M. Orthodontic side-effects of mandibular advancement devices during treatment of snoring and sleep apnoea. Eur J Orthod 2001;23:135–44.
32. Pantin CC, Hillman DR, Tennant M. Dental side effects of an oral device to treat snoring and obstructive sleep apnea. Sleep 1999;22:237–40.
33. Fritsch KM, Iseli A, Russi EW, et al. Side effects of mandibular advancement devices for sleep apnea treatment. Am J Respir Crit Care Med 2001;164:813–8.
34. Robertson CJ. Dental and skeletal changes associated with long-term

mandibular advancement. Sleep 2001;24:531–7.
35. Ferguson KA, Cartwright R, Rogers R, et al. Oral appliances for snoring and obstructive sleep apnea: a review. Sleep 2006;29:244–62.

*-Postgraduate student
+-Associate Professor
++-Professor and HOD

Department of Prosthodontics and Crown & Bridge
Manipal College of Dental Sciences, Mangalore
Manipal Academy of Higher Education

'Evaluation and Comparison of The Retention of Full Cast Metal Crowns Cemented on Extracted Natural Teeth with And Without Auxiliary Retentive Features - An In Vitro Study'

Dr. Lakkappa Shivappa Ganiger*, Dr. Shivamurthy Shadakshari[+], Dr. Sanjayagouda B Pati[#], Dr. Renuka Prasanna, Dr. Ashmi Sebastian***

Abstract

To evaluate and compare of the retention of full cast metal crowns cemented on extracted natural teeth with and without auxiliary retentive features.

Materials and Method: 30 extracted non carious maxillary 1st premolars were selected and were prepared to receive full cast metal crowns. These prepared samples were randomly grouped into three groups Group A, Group B and Group C; with 10 samples each. Group A consisted teeth that were prepared conventionally. In Group B, two auxiliary grooves that run parallel to each other were prepared on mesial and distal proximal surfaces. In group C, two auxiliary boxes were placed in the mesial and distal proximal surfaces. An elastomeric impression material was made and poured with Type IV gypsum material. The wax patterns for full metal cast crown were carved on die and were invested and casted in Ni-Cr dental alloy using induction casting machine. All thirty samples were luted using Type I glass ionomer cement using firm finger pressure. The samples were tested for retention after 24 hours with the help of a universal testing machine. The force of dislodgement for all the thirty samples were recorded in MPa.

Results: The results showed that there was a statistically significant increase in the retention of the complete cast crowns on teeth with incorporation of retentive features in the tooth preparation compared to the conventional preparations. The increases in retention obtained by the incorporation of proximal boxes were more significant compared to incorporation of proximal grooves and the conventional preparations.

Conclusion: Complete cast crowns on teeth with auxiliary retentive features produced significant increase in retention of complete cast crowns.

Key words: Extracted non carious maxillary 1st premolars, Tooth preparation, Proximal grooves and boxes, Full cast metal crowns, Luting cement.

Introduction

Prosthodontics is a branch of dentistry which is related to the rehabilitation of any of the oral and facial structures to provide function, comfort and prevent any further degradation of health while maintaining the natural appearance and giving a psychological relaxation.[1] Healthy natural dentition plays a vital role in mastication, speech and esthetics. When enamel or dentin is lost as a result of caries, trauma or wear, restorative

materials must be used to re-establish the normal form and function.[1-3]

Fixed partial denture is one of the most commonly used treatment modalities for partial edentulism in which the replacement and/or restoration of teeth are done using artificial substitutes that are not readily removable from the mouth.[4]

Tooth preparation should follow certain mechanical, biological and esthetic principles. However, the availability of adhesive luting cements which bond the restoration to the tooth surface chemico-mechanically offers the possibility of increased crown retention independent of preparation geometry.[5,6] Loss of retention is most commonly attributed to reduced crown height or lack of tooth structure which have always been a challenge to the dental professionals.

Whenever maximum retention and resistance are needed on short clinical crowns or when high displacement forces are anticipated, such as for the retainer of long-span FPD, then additional auxiliary retentive features should be included like grooves and boxes. Retention form of a tooth preparation prevents the removal of the restoration along the path of insertion whereas resistance form prevents dislodgement of the restoration under occlusal forces.[7, 8] The mechanical properties of the cement can influence stress distribution within the interposed cement layer, the bonding efficacy of cement to both surfaces and durability of cement, including the long term resistance to mechanical deterioration[9].

The findings of different authors regarding enhancement of retention by provision of retentive features are at variance. A few studies have been done on molar teeth. This study for retention using premolar teeth is not frequently observed in literatures so the purpose of this in vitro study was to evaluate and compare retention of full cast metal crowns cemented on extracted natural teeth with and without auxiliary retentive features.

Materials and Method

Non carious maxillary 1st premolar teeth extracted for orthodontic treatment were selected and were treated with hydrogen peroxide and were stored in normal saline (0.9%). Thirty samples with approximately similar dimensions were selected for this study and mounted onto auto polymerizing acrylic resin block 2 mm (DPI India) (Fig. 1).

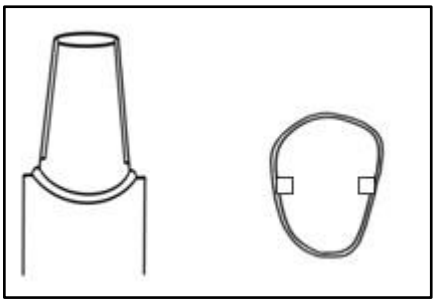


Fig.1

A high speed airotor hand piece (1,00,000 to 2,00,000 rpm) was attached to the vertical arm of a dental surveyor (Dentalfarm, Italy) using lockable joint (Fig.2).

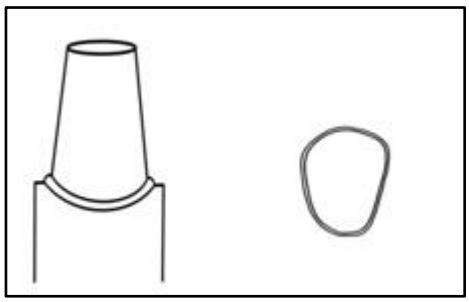


Fig.2

Tooth preparation was carried out to achieve uniform chamfer margin of 0.75 mm and overall taper of 6°. Approximately 1mm to 1.5 mm of axial tooth structure was removed by preparation. Gingival finish line of each tooth was maintained 0.5 mm above the cemento-enamel junction. The occlusal surfaces of the samples were sectioned flat with the help of a small wheel diameter bur. The teeth were prepared to a constant height of 3.5 mm as measured at the mid buccal surface. The prepared surfaces were refined using SF 102R diamond bur.

These prepared samples were randomly grouped into three groups-Group A, Group B and Group C with 10 samples each (Fig.3).

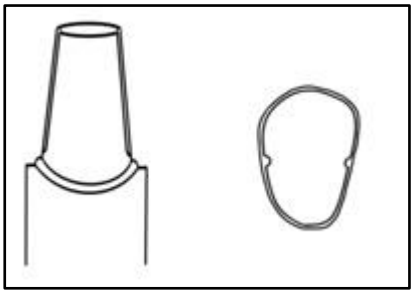


Fig.3

Each group consisted of 10 samples. Group A consisted of teeth that were prepared conventionally served as the control group. In Group B, two auxiliary grooves that run parallel to each other were placed on mesial and distal proximal surfaces. For group C, two auxiliary boxes were placed in the mesial and distal proximal surfaces.

Depth of each groove equaled to half the diameter of the tapered carbide fissure bur of 1mm width. The proximal grooves were terminated 0.5 mm above the chamfer finish line and both the grooves were prepared parallel to each other. Depth of the auxiliary box 0.5 mm and its width was 2 mm. The gingival wall of the box was terminated 0.5 mm above the chamfer finish line. Both mesial and distal boxes were placed parallel to each other.

Impressions for each group of the prepared teeth were made using multiple mix single stage technique with polyvinylsiloxane (PVS) impression material (Flexeed, GC, Japan) following manufacturer's instructions. The impressions were removed and checked for the defects. After half an hour impression were poured using Type IV gypsum material (Shruti, Ultra Real). The gypsum was mixed in vacuum mixer (Whip mix, USA) according to manufacturer's instructions and poured to obtain master dies for the study purpose.

After die examination, die hardener (Hartebad, Renfert, Germany) was applied followed by one coat of die spacer (Pico-Fit, Germany). Die lubricant (isolit) was painted on the master die. Wax pattern (Inlay wax Type II, Crowax, Renfert, Germany) for full metal cast crown was carved on the die using PKT wax instrument (Fig.4) (GDC, India).

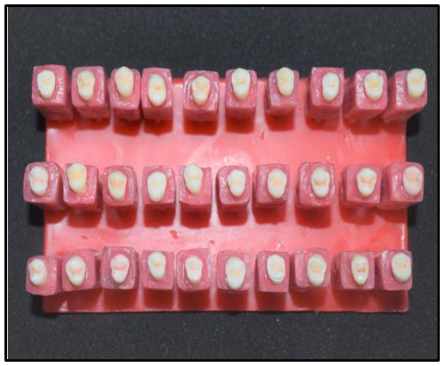


Fig.4

The wax patterns were sprued (Renert, Germany) and sprayed with debubblizer solution (Aurofilm, Bego, Germany). Then the investment material was added to the casting ring under mechanical vibration. The invested casting ring was set aside for 1 hour to allow complete setting of investing material. The burnout procedure was then carried out in a burnout furnace at 950°C (Miditherm, Bego, Germany)

After the burnout procedure, the casting was carried out in an electrical induction casting machine (Fornax, Bego, Germany). After the casting procedure, the metal crowns were retrieved from the investment. A sandblasting unit was used to remove all residual investment materials using 80µ Al_2O_3 particles and then metal trimming and finishing were performed using tungsten carbide burs and finishing stones at low speed. The metal crowns were then polished using metal polishing cakes in a polishing unit. The fit of the castings was again verified on the preparation. All the castings were cleansed in the ultrasonic cleaning unit for 15 minutes.

All thirty samples were luted using Type I glass ionomer cement (GC, Gold label, Japan). The luting agent was manipulated according manufacture's recommendation. The powder and the liquid of the GIC were mixed by hand on a paper pad using an agate spatula. 1.8 g of powder was mixed with 1.2 ml of the liquid. Both powder and liquid were mixed, and the mix was completed within 30 sec. Each casting was then filled with sufficient cement to evenly cover the inner surface, seated on the tooth using firm finger pressure. These all cementations were done on the same day by same operator. Care was taken to see that excess cement was flown all around. Using explorer excess cement was carefully removed. Marginal gap was seen before and after cementation to verify complete seating of the casting. The samples were then stored for 24 hours in normal saline at 37 degree at 100% humidity before mechanical testing. The samples were subjected to a vertical dislodgment force until failure on a universal testing machine (Lloyds, UK). Atensile load of 500 KN at cross head speed of 0.5 mm per minute was applied and the castings were pulled along the apico-coronal axis of each tooth using a "J" hook attached to the upper member of the testing machine (Fig.5).

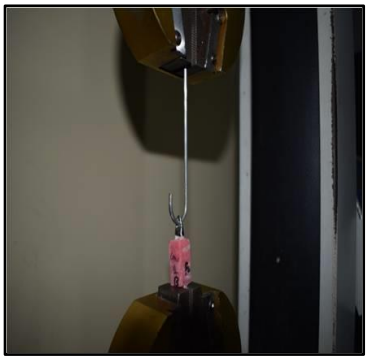


Fig.5

The force of dislodgement for all the thirty samples were recorded in Newton (N). Data were collected and subjected to statistical analysis.

Statistical analysis and Results:

The data was analyzed using Microsoft excel 2007 & SPSS version 20 and using descriptive, one-way ANOVA with Schiff's Post hoc test. (Table 1, Table 2, Table 3) The tensile bond strength (MPa) for Group A, Group B and Group C using ANONA were 5.50 MPa $\pm$ 0.611 MPa, 8.80 MPa $\pm$ 0.566 MPa and 9.95 MPa $\pm$ 0.825 MPa respectively. The results showed that there was a statistically significant increase in the retention of the complete cast crowns on teeth with incorporation of retentive features in the tooth preparation compared to the conventional preparations. The increases in retention obtained by the incorporation of proximal boxes were more significant compared to incorporation of proximal grooves and the conventional preparations.

Discussion

Fixed partial denture is most common treatment modality for the partially edentulous conditions. A steadily increasing demand for restorations of edentulous regions with fixed partial dentures has directed attention to the effectiveness of retention of fixed partial denture retainer on abutment teeth.[10, 11] Management and maintenance of various factors are important for a fixed partial denture to serve successfully. These factors include careful analyzation from the initial patient history taking, through the treatment planning phase and following mechanical and biological principles during treatment procedures.[3,4]

In clinical practice, we often come across teeth with clinical crown height less than that suited ideally for complete coverage restoration, more so if the crown has to serve as bridge retainer. Crown lengthening procedures are considered for increasing the clinical height of the tooth for enhancing the retention of the retainer. A feasible alternative in such a situation is the incorporation of various auxiliary retentive features such as pins, grooves or boxes in the preparation design.[1-5, 9, 11, 12]

One of the most important features for providing adequate bulk of metal and strength to restoration is occlusal clearance. For all metal crowns functional cusp reduction of 1.5 mm and nonfunctional cusp reduction of 1.0 mm are enough. Also, functional cusp bevel given on lingual inclines of maxillary palatal cusps and the buccal inclines of maxillary premolar buccal cusps provide space for an adequate bulk of metal in an area of heavy occlusal contact.[13,14] An axial reduction plays an important role in securing space for adequate thickness of restorative material. Inadequate axial reduction will result in over contoured restorations.[15]

However, in certain clinical situations like tooth with reduced height, crowns cannot depend entirely on geometric form of the tooth preparation for retention. In such cases, modifications of tooth preparations with proximal grooves and boxes have been advocated as auxiliary retentive measures. **Potts RG et al** [14] concluded in their study that addition of grooves provided small increase in

retention value but marked increase in resistance value. They also stated incorporation of boxes will improve the retention of the complete cast crowns. The increased retention may be attributed to the fact that lateral walls of the boxes will help tensofrictional resistance and will limit the freedom of displacement. These results were confirmed in studies by **Kishimoto et al** [16] and **Durey KA et al** [17] on resin bonded bridges. **Proussaefs et al** [18] concluded that placing auxiliary retentive features such as grooves and boxes into a compromised tooth preparation (2.5 mm occlusocervical dimension and 20-degree TOC) was not effective when these retentive features possessed the same 20-degree TOC as the prepared axial walls.

When there is increased Total Angle of Occlusal Convergence, multiple path of insertion will be present which will reduce the retention. Placement of auxiliary grooves and boxes in such situations will enhance retention by limiting the path of insertion to a single direction.[12]

Resistance to lateral forces commonly is the determining factor in a crown's resistance to dislodgment. Horizontal components to masticatory cycles and par functional habits direct forces on single crowns that were faciolingual in character. Therefore, consideration should be given to the most appropriate location for auxiliary retentive features. The basic requirement of the grooves and boxes are that the groove should be parallel to the path of insertion.

A major advancement in the current practice of dentistry is the restoration of teeth with tooth colored, adhesive materials. The success and longevity of a dental restoration depends on the sealing of the cavity walls as well as the retention to the tooth surface.

According to **Marchiori M et al** [19] the self-adhesive resin cements and higher preparation height improved crown retention. Even though conventional glass ionomer cement has been plagued by several negative characteristics like, Prolonged setting time that restricts finishing and polishing for approximately 24 hours, sensitivity to moisture during initial hardening, dehydration, rough surface texture, opaqueness, low fracture toughness, and poor wear resistance, it was used in present study because unmodified glass ionomer cement has the maximum use in daily clinical practice.

The present study demonstrated that a clinically compromised complete coverage tooth preparation including reduced occlusocervical dimension, increased Total angle of Occlusal convergence (TOC) the placement of proximal grooves and a reduced occlusocervical to buccolingual dimension ratio offered greater retention with proximal grooves and boxes along with the adhesive cement.

An attempt has been made in this study to evaluate the effect of auxiliary retentive features on retention on cast crowns.

Within the limitations of the present study it was inferred that whenever the principles of parallelism, length and surface area in a tooth are compromised in the clinical situation incorporation of auxiliary retentive grooves and boxes helps

in improving the retention of complete coverage of the cast restorations.

The limitations of present study are that it was not performed under any condition to simulate clinical situation and the forces used to evaluate tensile bond strength was much higher than forces acting intraorally.

Conclusions

Based on the analysis of the results obtained and within the limitations of the study, the following conclusions were drawn:

1) Cementations of complete cast crowns on extracted maxillary 1st premolar teeth with auxiliary retentive features produced a significant increase in retention.

2) Incorporation of proximal groove on the mesial and distal side of the natural tooth produced an increased retention compared to conventional tooth preparation.

3) Incorporation of proximal boxes (mesial and distal) in natural tooth produced the highest retention of complete cast crowns.

4) Among the auxiliary retentive features, incorporation of proximal boxes produced more retention compared to incorporation of proximal grooves and conventional tooth preparation respectively.

References

1) Vinay K, Rakshith H, Prasad DK, Manoj S, Sunil M and Naresh S. To evaluate and compare retention of complete cast crown in natural teeth using different auxiliary retentive features with two different crown heights- An vitro study. Int J Biomed Sci 2015;11(02):99-106.

2) Sreeramulu B, Suman P and Ajay P. A comparison between different luting cements on the retention of complete cast crowns- An in vitro study. Int J Healthcare and Biomed Research 2015;03(04):29-35.

3) Shekar CS, Giridhar K and Rao KS. An vitro study to evaluate the retention of complete crowns prepared with five different tapers and luted with two different cements. J Ind Prosthodont Soc 2010;10(02):89-95.

4) Ayad FM, Johnston MW and Rosenstiel FS. Influence of tooth preparation taper and cement type on recementation strength of complete metal crowns. J Prosthet Dent 2009;10(02):354-61.

5) Ayad MF, Rosenstiel FS and Salama M. Influence of tooth surface roughness and type of cement on retention of complete cast crowns. J Prosthet Dent 1997;7(07):116-21.

6) Naik VA and Jurel S. Comparative analysis of auxiliary retentive factors affecting retention of complete cast metal crown. J Stomat Occ Med 2010;3;195–199.

7) Chand P, Jurel SK and Agrawal KK. An in vitro study to evaluate retentive

property of resinous dental adhesives and other dental luting cements. Int J Med and Dent Sci 2015;4(01):554-59.

8) Amarnath GS, Pandey A, Prasad H and Hilal M. Comparative evaluation of enhancing retention of dislodged crowns using preparation modifications and luting cements- An vitro study. J Int Oral Health 2015;7(08):47-51.

9) Zidan O and Ferguson GC. The retention of complete crowns prepared with three different tapers and luted with four different cements. J Proshet Dent 2003;89:565-71.

10) Kaufman EG, Colin L, Schlagel E and Coelho DV. Factors Influencing The Retention Of Cemented Gold Castings. J Prosthet Dent 1966;16(04):731-39.

11) El-Mowafy OM, Fenton A, Forrester N and Milenkovic M. Investigated the effect of varying crown preparation taper and height on the retention of metal ceramic crowns cemented with resin cements. J Prosthet Dent 1996;76(05):524-9.

12) Lorey RE and Myers GE. The retentive qualities of bridge retainers. J Am Dent Assoc 1968;76:568-72.

13) El-Ebrashi MK, Craig RG and Peyton FA. Experimental Stress Analysis Of Dental Restorations. J Prosthet Dent 1969;22:292-346.

14) Potts RG, Shillingburg Jr HT and Duncanson Jr MG. Retention and resistance of preparations for cast restorations. J Prosthet Dent 1980;43(03):303-308.

15) Chan KC, Abbas A, Hormati and Boyer DB. Auxiliary retention for complete crowns provided by cement keys. J Prosthet Dent 1981;45(02):152-5.

16) Kishimoto M, Shillingburg Jr HT and Duncanson MG. Influence of preparation features on retention and resistsnce. Part II: Three quarter crowns. J Prosthet Dent 1983;49(07):188-92.

17) Durey KA, Nixon PJ, Robinson S and Chan MF. Resinn Bonded Bridges: Technique for success. BMJ 2011;211(03):113-118.

18) Proussaefs P, Campagni W, Bernal G, Goodacre C and Kim J. The effectiveness auxiliary features on a tooth preparation with inadequate resistance form. J Prosthet Dent 2004;91(05):33-41

19) Marcelo Marchiori. Influence of preparation height and luting agent type on crown retention in molars. Braz J Oral Sci, Vol. 9, No. 2, April-June, 2010, pp. 89-93

*Post Graduate
Department of Prosthodontics,
Sri Hasanamba Dental College and Hospital, Hassan, Karnataka.

+Professor
Department of Prosthodontics,
Sri Hasanamba Dental College and Hospital, Hassan, Karnataka

#Professor and HOD
Department of Prosthodontics,
Sri Hasanamba Dental College and
Hospital, Hassan, Karnataka.

**Reader
Department of Prosthodontics,
Sri Hasanamba Dental College and
Hospital, Hassan, Karnataka.

Case Report

Prosthetic Rehabilitation Following Partial Maxillectomy With Immediate Surgical Obturator: A Case Report

Kushan Kishore Dhawan[*], Akshar Bajaj[*], Ann Sales[*], Umesh Pai[+], Shobha Rodrigues[++]

Abstract

Prosthodontists in general face different problems during the construction of a pre and post-surgical obturator. This clinical report describes the comprehensive prosthodontic treatment of an elderly patient diagnosed with Squamous Cell Carcinoma of the maxilla. The treatment procedures included surgical removal of the tumor and placement of Immediate Surgical Obturator following resection. An immediate surgical obturator is necessary in maxillectomy procedures to minimize functional disabilities in speech, swallowing, and egress of food and liquid into the surgical defect.

Keywords: Maxillofacial Prosthesis, **Immediate Surgical Obturator**, **Maxillectomy**

Introduction

The most frequent malignant tumor of the oral cavity (97%) and the adjacent parts of the pharyngeal region and paranasal sinuses is the squamous cell carcinoma[1]. It occurs in the oral cavity, in the maxilla as well as the mandible however it is more prevalent in the maxilla. Prognosis of maxillary tumors is poor as it goes undetected in the initial phase but eventually becomes invasive and aggressive.

Treatment modalities of a malignant tumor in the maxilla are varied according to many factors such as size, type, severity, etiology and location of the tumor. Treatment modalities include radiotherapy, chemotherapy, and surgical resection alone or in combination. Surgical removal of the affected area resulting in a large defect with oro-nasal/antral communication is the most common modality of treatment[2].

The term maxillectomy is used to describe the partial or total removal of the maxilla in patients suffering from benign or malignant neoplasms. Maxillectomy defects can be categorized as Limited, Partial, Medial, Subtotal, Total, Radical, or Extended[3].

The hard and soft palates are anatomical structures that have widely recognized roles in speech and deglutition. When these structures are removed, partially or completely, because of malignancies, a team approach is critical. A surgical approach alone without reconstruction or obturation of the surgical defect will result in air, liquid, and food escaping into the nasal apparatus, causing severe speech and swallowing

dysfunction with significant reduction in quality of life[4].

The immediate postoperative restoration with an Immediate Surgical Obturator shortens recovery time in the hospital and speeds up patient's return to the community as a functioning member[4]. Soft tissues after surgery supported by immediate surgical obturator minimize scar contracture and disfigurement, providing with a positive effect on the patient's psychology. Replacement of the palate helps in maintaining speech, mastication and patient's morale. In this article, we present a case report describing the fabrication of an Immediate Surgical Obturator.

Case Report

A 73-year-old female patient reported to the Department of Prosthodontics and Crown and Bridge, Manipal College of Dental Sciences, Mangalore. She was referred from Wenlock Hospital, Mangalore after a diagnosis of squamous cell carcinoma of right maxilla. Surgical resection of the tumor was carried out with partial maxillectomy of inferior, middle and superior portions of the maxillary bone till the midline sparing the floor of the orbit superiorly followed by placement of immediate surgical obturator stabilized with sutures passed through holes made in the stent for a period of 2-3 weeks post-surgery. The surgery was carried out by the Department of ENT, Wenlock Hospital, Mangalore.

Procedure for Fabricating Immediate Surgical Obturator: The maxillary and mandibular impressions were made in irreversible hydrocolloid impression material and casts were poured using die stone based with dental stone (Figure 1) .

Fig. 1

Markings were taken by the surgeons regarding the potential extent of surgical resection. The tumor bulk present on the right side of hard palate and alveolus was reduced to the anatomical contour on the working cast (Figure 2).

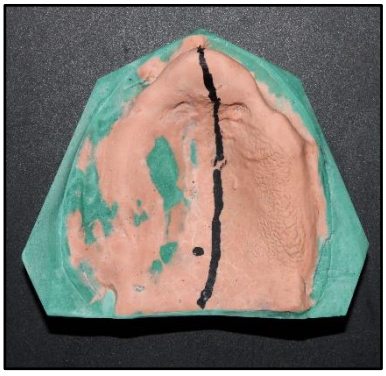


Fig. 2

The removal of this tumor bulk was representative of the surgical resection to be carried out. After smoothening the trimmed portions on the working cast, a layer of separating medium was applied. The immediate surgical obturator was fabricated directly on the working cast using clear auto-polymerizing acrylic resin using a

pressure pot. The obturator was adapted onto the hard palate and the alveolus, extending 1-2 mm short of the sulcus depth. It extended from the affected side onto the contralateral side which would later help in the stabilization of the obturator as it would gain some retention from the intact tissue surfaces. Once the auto-polymerizing acrylic resin was cured, it was removed from the cast and the edges were trimmed and polished thoroughly (Figure 3).

Fig. 3

Any remaining sharp points on the edges or the intaglio surface were removed and polished well. After polishing,

3 holes were placed on each side of the obturator, corresponding to incisor, canine and molar region (Figure 4). These holes

Fig. 4

would help in passing the sutures through the obturator and attaching it to the adjoining buccal mucosa and thus, aid in the stabilization of the surgical obturator post-surgery. The obturator was finished and polished according to conventional protocol. Prior to the surgery, the obturator was sterilized in activated glutaraldehyde solution. During the surgery (Figure 5).

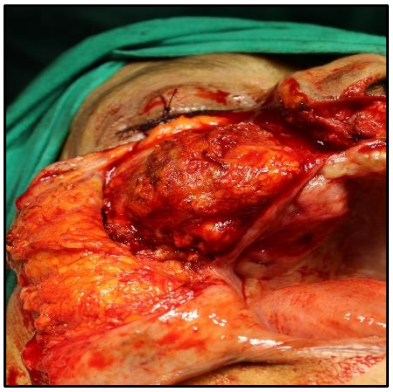


Fig. 5

Surgical resection of the tumor was done on the right maxillary bone and affected adjoining tissues were also resected (Figure 6).

Fig. 6

The floor of orbit remained intact superiorly. On completing the surgical resection, the obturator was tried in the patient's mouth and checked for proper fit. Upon satisfactory

fit of the obturator, sutures were passed through the holes provided and attached to the adjoining buccal mucosa for stabilization of the obturator (Figure 7).

Fig. 7

The patient was instructed to wear the obturator for a period of 2-3 weeks and recalled after the aforementioned period for fabrication of interim obturator and subsequently a permanent definitive obturator prosthesis after 6 months.

Discussion

Squamous cell carcinoma of the maxilla and the paranasal sinus is quite rare compared with other localizations in the oral cavity. The main problem of squamous cell carcinoma of the maxilla and the paranasal sinuses is that it is very often asymptomatic for a long time due to an invasive growth into the maxillary sinus or the retro-maxillary region.

The infiltrative nature and pattern of squamous cell carcinoma in the maxilla makes it difficult to remove completely, which poses a challenge for rehabilitation with definitive advanced prosthetic options immediately after resection, as there are high recurrence rates. In developing countries, the economic factor plays an important role which should be considered during treatment decision[1-2].

Rehabilitation of acquired prosthetic defects with obturators are categorized in 3 types- surgical obturator, interim obturator and definitive obturator. Immediate surgical obturator has definitive advantages which include - (1) providing immediate closure between the oral and nasal cavity following resection of tumor, (2) suture holes provided in the obturator aid in retention and enhanced bracing effect, decreasing its movement in the horizontal plane, (3) it acts as a stable base for packing of a surgical dressing, and (4) cost effective. However, it poses certain disadvantages such as - (1) Since it is merely a plate and doesn't contain teeth, the masticatory efficiency of the patient is decreased, (2) Compromised esthetics, (3) Use of sutures to stabilize the obturator hampers the oral hygiene maintenance during the initial healing phase acting as a potential nidus for infection.

Conclusion

In conclusion, this case necessitated the surgical removal of right maxilla followed by insertion of an immediate surgical obturator for surgical closure of the resection site which would help in the maintenance of speech, swallowing, breathing and deglutition during the initial healing phase. It would also support the soft tissues after surgery and minimize scar contracture and disfigurement and thus may have a positive effect on the patient's psychology.

References

1. Kermer C, Poeschl P, Wutzl A, Schoppe C, Klug C, Poeschl E, Surgical Treatment of Squamous Cell Carcinoma of the Maxilla and Nasal Sinuses. Journal of Oral and Maxillofacial Surgery, 66(12), 2449-2453.
2. Alhajj MN et al. Maxillary obturator prosthesis for a hemimaxillectomy patient: A clinical case report, The Saudi Journal for Dental Research (2016), http://dx.doi.org/10.1016/j.sjdr.2016.03.0012.
3. Spiro RH, Strong EW, Shah JP. Maxillectomy and its classification. Head Neck 1997:309-14.
4. Jacob FJ. Clinical management of the edentulous maxillectomy patient. In: Taylor TD (editor). Clinical maxillofacial prosthetics. Chicago: Quintessence; 2000. p. 85-7.
5. Minsley GE, Warren DW, Hinton V. Physiologic responses to maxillary resection and subsequent obturation. The Journal of Prosthetic Dentistry 1987; 57(3):338-44.

*-Postgraduate student
+-Associate Professor
++-Professor and HOD

Department of Prosthodontics and Crown & Bridge
Manipal College of Dental Sciences, Mangalore
Manipal Academy of Higher Education

Full Mouth Rehabilitation of a Patient with Amelogenesis Imperfecta Using Pankey Mann Schuyler Technique: A Case Report

Dr Nikita Agarwal*, Dr. Prashanth Bajantri*, Dr. Sandipan Mukherjee*, Dr. Deeptimoyee Ghosh*, Dr Shobha Rodrigues+, Dr Umesh Y Pai++

Abstract: Amelogenesis Imperfect (AI) is a hereditary disorder of tooth development, which causes alterations in the development of enamel. This disorder has adverse impact on the overall oral health of the patient. Treatment of such patients with multidisciplinary approach may prove advantageous. Corrections of sensitivity, or severely worn dentition may require extensive restorative treatment to achieve appropriate result. It is imperative to identify the causative factors that contribute to the present conditions. In majority of such cases the full mouth rehabilitation is the choice 9f treatment to re-establish the esthetics, function and comfort. Following case report presents a multidisciplinary systematic approach in full mouth rehabilitation using Pankey – Mann- Schuylar technique.

Keywords: **Amelogenesis Imperfecta**, **Vertical Dimension**, **Full Mouth Rehabilitation**, **Pankey – Mann- Schuylar**

Introduction

Amelogenesis Imperfecta is a hereditary disorder that affects both enamel and oral soft tissues [1.] Most common symptoms include sensitivity due to incomplete formation of enamel and wear of enamel, leading to exposure of dentinal tubules, and loss of vertical dimension, dysfunction and aesthetics

These problems result in pulpal pathology, occlusal disharmony, impaired function and esthetic disfigurement. Correcting these problems, thus becomes imperative with multidisciplinary approach in order to restore the oral health, function and esthetics [2]. Oral rehabilitation is, thus, a complex process of restoring the functional integrity of the oral structures using various means. Hence, this case report shall attempt to give a report on the interdisciplinary approach on full mouth rehabilitation of a patient with amelogenesis imperfecta, following Pankey - Mann – Schuylar technique.

Case Report

A 29-year-old female patient reported to the Department of Prosthodontics with a complaint of discolored teeth, generalized sensitivity, and difficulty in chewing.

No abnormality was detected in temporomandibular joint movements. Intraoral examination revealed unaesthetic appearance. Radiological examination revealed generalized loss of enamel. Based on the above features, the patient was diagnosed with AI hypoplastic type. (Fig1)

Fig. 1

Pankey Mann Schyuler philosophy of full mouth rehabilitation was planned for this patient.[3, 4] Diagnostic casts were obtained. Following this a facebow transfer was completed. The centric relation position was recorded using aluwax and the casts were mounted on a semi adjustable articulator.

Since there was no loss of vertical dimension, diagnostic wax up was completed at the same vertical dimension. The diagnostic wax up helped in assessing the outcome of the final prosthesis and it also helped in fabricating the temporary restorations (Fig 2).

Fig. 2

The maxillary and mandibular teeth were restored with provisional restorations, without tooth preparation [5]. The provisional restorations helped in assessing the esthetics and establishing the customized anterior guidance (Fig 3).

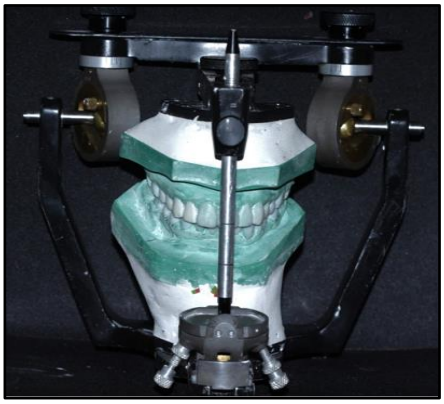


Fig. 3

After 6 weeks, patient recalled to evaluate the anterior guidance and aesthetics. After the patient's esthetics and guidance were satisfactorily evaluated, the rehabilitation was carried out.

Mandibular anteriors were prepared and restored with E-max crowns followed by maxillary anteriors and the pre- and post-operative views can be appreciated (Fig 4).

Fig. 4

The fabricated maxillary and mandibular anterior final restorations were etched intaglio surface with hydrofluoric acid and etching of tooth surface with phosphoric acid was done before luting in the patient's mouth. (Fig 5,6)


Fig. 5


Fig. 6

The next step was the restoration of the mandibular posterior teeth for which the occlusal plane was established using a Broadrick's Occlusal Plane Analyzer. (Fig 7)

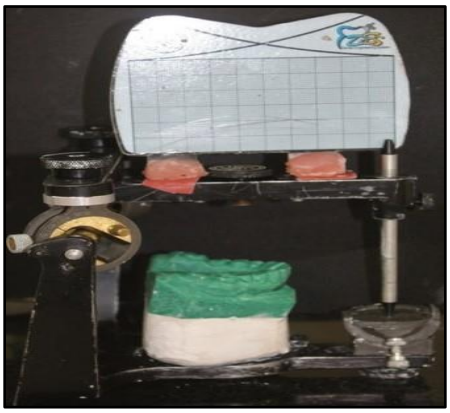


Fig. 7

Mandibular posterior teeth were prepared and impression was taken using elastomeric impression material, wax pattern was prepared and metal copings trial was done and then ceramic build-up was done. The crowns were cemented with luting GIC.

Maxillary posterior tooth preparation was done and restored like the mandibular posterior crowns. After correcting the interferences, the restorations were glazed and luted.

A group function type of occlusal scheme was provided to the patient (Fig 8)


Fig. 8

and regular follow-up with good oral hygiene maintenance was advised. The final outcome can be appreciated when the pre- and post- operative views are compared (Fig 9).


Fig. 9

Discussion

The clinical presentation of AI varies with the type. The hypoplastic type shows well mineralized enamel, but its amount is reduced as seen in the radiograph.[1] In this

case, the patient presented without decrease in vertical dimension and a freeway space was approximately 4 mm, hence it was decided not to increase the vertical dimension .[7, 8] The severe wear of anterior teeth facilitates the loss of anterior guidance, which protects the posterior teeth from wear during excursive movements. Collapse of posterior dentition results in loss of normal occlusal plane and decreased vertical dimension.[5] The choice of posterior restoration in this case was porcelain fused to metal as this would double the mechanical durability, recover esthetics, and protect the residual dentin.[9, 10]

Conclusion

Amelogenesis imperfecta is a hereditary disorder affecting mainly the enamel causing enamel hypoplasia, severe sensitivity. Such cases require careful and meticulous diagnosis and treatment planning in order to re-establish the balance of the stomatognathic system.

Clinical Significance

The above case reflects the importance of the use of prosthodontic principles and strategic planning in addition to a multidisciplinary approach in managing a patient of AI.

References

1. Canger EM, Celenk P, Yenísey M, Odyakmaz SZ. Amelogenesis imperfecta, hypoplastic type associated with some dental abnormalities: A case report. Braz Dent J 2010;21(2):170-4.

2. Hedge C, Krishna DP, Jacob SJ, Shetty M. Full mouth rehabilitation of a severely worn out dentition to functional harmony. J Indian Prosthodont Soc 2009;9(3):164-6.

3. Dawson PE. Evaluation, Diagnosis and Treatment of Occlusal Problems, 2nd ed. St. Louis: C.V. Mosby Co.; 1989.

4. Agarwal HS, Agarwal NH, Shah RJ. Full mouth rehabilitation of a patient with enamel hypoplasia using hobo's twin tables technique for occlusal rehabilitation: A case report. J Adv Oral Res 2012;3(2):23-9.

5. Song MY, Park JM, Park EJ. Full mouth rehabilitation of the patient with severely worn dentition: A case report. J Adv Prosthodont 2010;2(3):106-10.

6. Nayar S, Aruna U, Hussain S, Bhuminathan S, Jayesh R. Full mouth rehabilitation of a patient with severly attrited dentition. Indian J Multidiscip Dent 2011;1(3):157-60.

7. Banerjee S, Chakraborty N, Singh R, Gupta T, Banerjee A. Full mouth rehabilitation of a patient with severe attrition using hobo twin stage procedure. Int J Prosthodont Restor

Dent 2011;1(3):177-81.

8. Moslehifard E, Nikzad S, Geraminpanah F, Mahboub F. Full-mouth rehabilitation of a patient with severely worn dentition and uneven occlusal plane: A clinical report.

J Prosthodont 2012; 21(1):56-64.

9. Mizrahi B. Combining traditional and adhesive dentistry to reconstruct the excessively worn dentition. Eur J Esthet Dent 2008; 3(3):270-89.

10. Nam J, Raigrodski AJ, Heindl H. Utilization of multiple restorative materials in full-mouth rehabilitation: A clinical

report. J Esthet Restor Dent 2008;
20(4):251-63.

* Post Graduate

+Professor and HOD

++Assistant Professor

Department of Prosthodontics and Crown & Bridge

Manipal College of Dental Sciences, Mangalore, MAHE