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EDITORIAL

Emerging technologies in Dentistry

A good and competent professional always seeks to improve his knowledge and skills and hence is not averse to research of methods, techniques or materials. Research provides a means to enhance one's knowledge, to broaden the intellectual horizon, to provide objective basis for the professional activity and to develop new techniques and technologies to tackle unsolved problems. Technology being the practical application of knowledge helps to decrease treatment time and makes it more comfortable for the patient. It boldly tells us to step aside, to lead or to follow. Over the past decade newer material processing techniques and technologies have markedly improved the dependability and predictability of dental materials for clinicians. Use of nanotechnology has improved the mechanical characteristics of materials for clinical use and will definitely prolong their clinical life. In the material field achievement of high-strength durable bonds between tooth structure and restorative materials has resulted in universal application of minimally invasive dentistry.

A range of new caries detection systems like Diagnodent Laser device, Digital imaging fibre-optic trans-illumination and Quantitative light induced flourescence are available for early detection of dental caries. New techniques and instruments are revolutionizing the field of oral and maxillofacial surgery. New modalities like powered periotome, piezo-surgery, physics forceps and lasers have been successfully used for the extraction of teeth, especially impacted teeth. Newer haemostatic materials like floseal, ostene and actcel have been introduced into the field. Dental radiology has got a rapidly expanding array of imaging modalities. The recently introduced CBCT (Cone beam computed tomography) has offered dentists a view of all angles of the area of concern by three dimensional imaging.

Dental implants and cranio-facial reconstruction are fields progressing exponentially. Implants have revolutionized prosthetic rehabilitation, providing a reliable, stable and aesthetic option for dental reconstruction. Another technological advance is the use of lasers in dentistry. Lasers are used in all aspects of dentistry including operative, periodontal, endodontic, orthodontic and oral and maxillo-facial surgical fields. Salivary diagnostics is a dynamic emerging field utilizing nanotechnology and molecular diagnostics as saliva contains biomarkers for cancers, autoimmune and renal diseases and diabetes.

The recently introduced technologies to orthodontic therapy for both children and adults are geared toward reduced orthodontic time, minimal postoperative pain and enhanced periodontium. They include self-ligating brackets, lingual braces, Invisalign and SureSmile. Computer-aided design (CAD) and computer-aided manufacturing (CAM) have become increasingly popular. The technology can be used in dental laboratory and dental office for the fabrication of restorations. The recently introduced technologies aimed at early detection of oral cancer are chemiluminescence using acetic acid and tolonium chloride, and direct fluorescence visualization. Application of new technology and good science to assess effectiveness and long term outcome should always go hand in hand. Although there is an opportunity to deliver cutting edge dental care to patients, there is the added responsibility of closely monitoring the outcomes as well. Further, there continues to be a need for innovation and collaboration with other scientific disciplines to reach the ultimate goals in dental care!!

ORIGINAL ARTICLE

A comparative evaluation of transverse strength of heat-cure denture base resin repaired by heat-cure, self-cure and light-cure resins

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Abstract

Background: Acrylic resin has been used successfully for almost sixty years in prosthetic dentistry and continues to be the material of choice for fabricating removable prosthesis. Fracture of denture acrylic resin has been a longstanding problem, and can be due to the low resistance to impact and fatigue failure. Broken dentures are usually repaired with heat-cure resins, auto-polymerizing resins (self-cure resins) or visible light-cured denture resins. **Objective:** To investigate and compare the transverse strength of acrylic resin repaired using heat-cure, auto-polymerizing and visible light-cure resins. **Materials and Method:** Forty-five specimens repaired with heat-cure, self-cure and light-cure resins were tested for transverse strength on Hounsfield Tensometer, and broken specimens were evaluated under stereo-zoom microscope. **Observations and Results:** The mean transverse strength of specimens repaired by heat-cure resins gave better results than those repaired by self-cure and light-cure resins. About 80% failures were cohesive for heat-cure and self-cure, and 80% adhesive for light-cure. **Conclusion:** The transverse strength of heat-cure repair resin is comparatively much higher than that of self-cure and light-cure repair resins. The poor transverse strength of light-cure resin is attributed to the poor bond strength between the heat-cure and light-cure resins. Further research using heat-cure monomer surface treatment of different timings is required for recommending light-cure alternative to self-cure and heat-cure repair resins.

Key words: Denture acrylic resin, Heat-cure, Light-cure, Self-cure, Transverse strength

Introduction

Acrylic resin has been used successfully for more than half a century in prosthetic dentistry especially for the fabrication of complete dentures and partial dentures. Fracture of acrylic removable prosthesis is a problem commonly encountered in everyday practice. Broken dentures can be repaired with heat-cure resins, auto-polymerizing resins or visible light-cured resins. The objective of the study was to investigate and compare the transverse strength of acrylic resin repaired using heat-cure, auto-polymerizing and visible light-cure repair resins.

The average transverse bending of specimens repaired by heat-cure was 80% of the original strength, and with self-cure it was 60%[1]. It has been found out that the rounded repair site is clearly superior to the butt joint[2]. Greater strength was obtained when the original denture base material was used for the repair, and with not more than 1.5 mm gap[3]. It has been demonstrated that the interface of the old and new materials is the location of stress concentration during transverse strength testing, regardless of the technique used[4]. A roughened repair surface increases the transverse strength[5]. The tensile bond strength of the visible light-cured resin to acrylic resin with triad bonding agent was approximately half of heat-cured acrylic

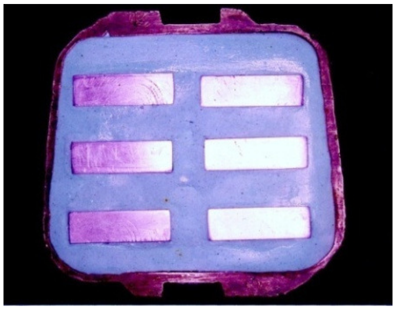

Fig.1: Rectangular aluminium blocks prepared

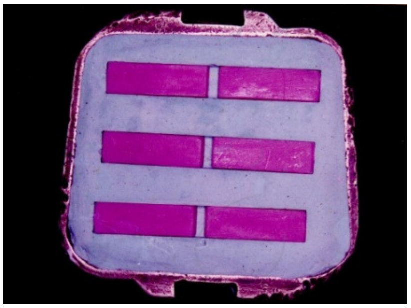

Fig. 2: Test specimens placed in the mould

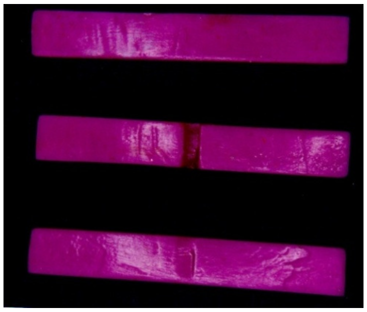

Fig. 3: Repaired specimens

resin[6]. It was found that the transverse bend strength of the butt joint was significantly less than that of the rounded or 45° bevel joint[7]. The effect of three different chemical surface modifications on the bond strength of light activated denture repair resin was compared to a heat cured resin. Evaluation was done with a Triad bonding agent, unreacted Lucitone monomer and 1:1 mixture of methylene chloride and monomer, using two different application times (two and four minutes). Under this three point bending study, the four minute monomer treatment showed the highest estimate of bond strength[8]. The use of monomer pretreatment for two minutes appears to increase the transverse bond strength of the heat cured samples repaired with visible light cure (VLC)[9].

Materials and Method

This study was conducted to evaluate the transverse strength (TS) of denture base material repaired by heat-cure, self-cure and visible light-cure resins. Ten aluminum rectangular blocks of dimensions 2.5x10x65 mm were fabricated according to American Dental Association (ADA) specification no: 12. Six of these specimens were cut into two equal parts of 2.5x10x31 mm with a bevel on one side, and with a gap of three millimetres between them. Kavo flask was used for preparing the smaller die specimens (Fig. 1). The flasks were immersed in boiling water for four minutes and then separated to remove the dies and then cleaned with household detergent. Tin foil substitute was painted and heat-cure denture base material was packed in the dough stage. The flask with the acrylic resin was allowed to bench-cure for one hour, after which it was immersed in a 73±1°C water bath for 90 minutes, and then in boiling water for 30 minutes. The intact master dies of dimension 2.5x10x65 mm were invested for preparation of the repair indices. One hour from the second pour the flask was opened and the dies were tapped out. After applying tin foil substitute, the two test specimens were placed in the mould with the bevel ends facing the centre, and such that there was a gap of three millimetres between the specimens (Fig. 2).

Subsequently, out of the 45 specimens made, 15 were repaired with heat-cure, 15 with self-cure and 15 with light-cure resins. For repair with heat-cure, stellon type 1 was packed into the gap in dough stage and allowed to bench-cure for one hour, after which it was immersed in a 73±1°C water bath for 90 minutes and transferred to boiling water for 30 minutes. For repair with self-cure, Stellon type 2 was added into the space by sprinkle on technique and kept under pressure for two hours to ensure complete polymerization. For repair by light-cure the intact master dies of dimension 2.5x10x65 mm were invested in polyvinyl siloxane heavy consistency. Once the material was set, the dies were removed, thus forming the repair indices. Two test indices were placed in the mould with the bevel ends facing the centre and with a gap of three millimetres. Beveled ends were treated with heat-cure monomer for two minutes for the 15 specimens to be repaired with light-cure resin to facilitate the bonding of visible light-cure resin to heat-cure resin. Triad VLC resin was packed into the space and the whole assembly was placed in a curing unit for four minutes. The specimens were retrieved and coated with air barrier coating and cured for ten minutes in the curing unit. The repaired specimens were then finished and polished and stored in water until the test could be carried out (Fig. 3).

Transverse strength testing

Specimens thus obtained were tested for TS on Hounsfield Tensometer (Tensometer Ltd, England) by applying a tension cross head speed of 0.254 mm/minute till fracture occurred. The ends of the spring beam are carried on rollers and any pull in the specimens is transmitted through the tension head of the spring beam. The deflection of the spring beam is proportional to the load, and is measured by the movement of the mercury in the glass tube.

Before starting the test, the mercury level on the scale was adjusted to zero. The 31¼ kg spring beam with the corresponding load scale was first mounted on the Tensometer. The specimens were then placed on the Universal Bend Test attachment such that there was a three-point contact on the specimens. Tensile

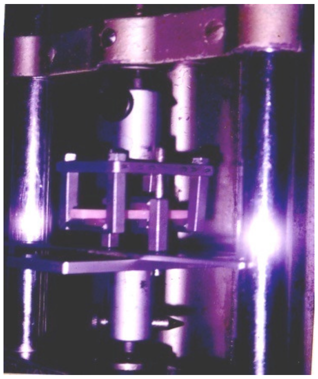

Fig. 4: Hounsfield Tensometer

loading was increased gradually by increments of 500 gm, and the breaking load was noted in kilograms, which was later converted into Mega-pascals (MPa). The fractured ends of the specimens were then viewed under stereo zoom microscope at 2.4 times magnification to investigate the type of failure, whether of the cohesive or adhesive type.

Data analysis

Data was fed into the computer in D-base and analyzed using the statistical package SPSS. Mean transverse strengths (MTS) in different groups were compared using one-way analysis of variance. Multiple comparisons between the groups were done using Kruskal Wallis test. Results were expressed in terms of mean, standard deviation (SD) and 95% confidence interval (CI). P value < 0.05 was considered significant.

Observations and results

A total of 45 specimens were prepared for TS testing with each group containing 15 specimens. The mercury reading at the time of fracture indicates the transverse repair strength in kilograms by the formula $S= 3PL/2bd^2$ where S= Transverse strength, P= load at fracture, L= length between the end beams, b= width of the specimen, d= thickness of the specimen. The transverse strength in kg/mm^2 is multiplied by 9.8 for conversion to Megapascals (MPa). The TS of all specimens repaired by heat cure resin had maximum value of 59.98 MPa and minimum value of 13.52 MPa. The TS of specimens repaired by self-cure resin had maximum of 46.45 MPa and minimum of 17.05 MPa. The TS of specimens repaired by light-cure resins had maximum of 43.51 MPa and minimum of 9.41 MPa. Heat cure group had a MTS of 46.37 MPa, SD of 14.74 and 95% confidence interval of 37.86-54.88 as shown in Table 1. Self cure group had a MTS of 31.01 MPa, SD of 8.59 and 95% confidence interval of 26.25-35.77. Light cure group had a MTS of 23.17 Pa, SD of 9.12 and 95% CI of 18.82-28.21.

The study also revealed that the heat-cure repair resin group showed 85.71% cohesive failure and 14.29% adhesive failure. The self-cure repair resin group showed 80% cohesive failure and 20% adhesive failure, while light-cure group showed 20% cohesive failure and 80% adhesive failure.

Table 1: *Descriptive comparison of three groups*

Transverse strength	Heat cure	Self cure	Light cure
Mean & SD	46.37 (14.74)	31.01 (8.59)	23.17 (9.12)
95% CI	37.86 - 54.88	26.25 - 35.77	18.82 - 28.21
Max - Min	13.52 - 59.98	17.05 - 46.45	9.41- 43.51

Kruskal-Wallis Test Statistic: 16.358; p= 0.000

Discussion

Major cause of fracture of acrylic dentures is fatigue failure during mastication or more frequently by being dropped down. For these reasons the transverse bend test was selected as the most relevant method to simulate the clinical condition of fatigue failure. The strength of the repair resin depends on the flexural characteristics, and its adhesive properties to the denture base. This study was done to determine the TS of denture base repaired by heat-cure, self-cure and light-cure using ADA specification no: 12 as the guideline. The study assumes that the strength of a properly made joint is on par with the geometric mean of the strength of the repair material and the strength of the material being repaired.

The results of this study showed that, heat-cure repair material recorded the maximum TS. This finding suggests that since heat-cure resin remains in the dough stage under flasking pressure until the heat is applied, the monomer of the dough will continue to soften the non-cross linked polymer component of the fractured surface. It would form a penetrating network across the interface of the parts to be joined. The MTS in Group I was 46.37 MPa, which was 66.25% the strength of the original heat-cured materials. This was less than the value observed by Ware and Docking[10] who reported TS of up to 75%. The study also recorded a TS of 75-80% for 50% of the heat-cure repaired specimens. This was in accordance with the study conducted by Anderson[11] who reported TS up to 85%. The lower TS of heat-cure repaired specimen in the present study as compared to other studies can be attributed to the difference in the materials, curing cycles and experimental protocol. When viewed clinically, 85.71% showed cohesive fracture and 14.29% showed adhesive type. When adhesive failure specimen was viewed under stereomicroscope with magnification 2.4, it showed specks of dental stone, which would act as areas of stress raiser. Ward JE *et al.,* had concluded that 45 bevel joint was significantly stronger than the butt joint due to an increase in the interfacial bond area, and a shear stress pattern was generated[7].

The TS of specimens repaired by self-cure was found to be 42.87% of the TS of original heat-cure material. Skinners[12] postulated that this lower strength of self-cure resin was owing to the lower degree of polymerization attained and to the residual monomer content. When the fractured ends were viewed clinically it was concluded that 85.71% were cohesive failures and 14.29% were adhesive failures.

The light-cure specimens showed a MTS of 23.17 MPa, which was only 33.1% of the value of the original heat-cure resin. Andreopoulos and Polyzois[13] reported that specimens repaired by Triad gel exhibited a MTS of 14.79MPa, which was less than that reported in this study. The high value of transverse strength in this study could be due to the two minutes heat-cure monomer surface treatment, which was done instead of using the triad bonding agent. This was in concordance to the work done by Lewinstein *et al.,* in the field[9]. In that study about 20% of the total specimens showed a cohesive type of failure, with a maximum TS of 43.51MPa, which was similar to the values obtained for self-cure. From this it was inferred that the transverse strength of the visible light-cure resin was higher than that of self-cure, but its bond strength did not meet the ADA specification of 31MPa.

From the present study it was inferred that if light-cure was to be used as repair material, its other physical properties such as dimensional stability have to be evaluated. Furthermore other means to improve the bond strength in a repaired joint should be advocated. Modulus of rupture of resin was increased on incorporating PMMA [polymethyl methacrylate] fibers to the heat-cure resin, as observed by D. C. Jagger and his associates[14]. Hiroyuki Minami *et al.,* reported that self-cure repair resins reinforced with stainless steel wires or Co-Cr-Ni [cobalt-chromium-nickel] wires resulted in significantly higher loads to fracture when compared to specimens without reinforcement[15]. Increased transverse strength has been observed by many authors when resins reinforced with glass fibers was tried.[16,17,18,19]

Conclusion

This study evaluated the TS of denture base repaired by heat-cure, self-cure and light-cure repair resins, and the following conclusions were drawn. Heat-cure acrylic resin exhibited the maximum transverse strength. The 80% cohesive type of failure for self-cure indicates that sufficient bonding between the repair surfaces, and a marked improvement in the strength can be achieved by upgrading the strength of the self-cure repair material. Light-cure acrylic resin had the least TS but showed marked improvement in the present study when heat-cure monomer surface treatment was done. Further investigation into the physical properties of the visible light-cure materials, longitudinal clinical data, and advanced research using heat-cure monomer surface treatment for different timings are required before visible light-cure material can be recommended as an alternative to self-cure as a repair material.

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ORIGINAL ARTICLE

The effect of topical fluoride application combined with Nd:YAG laser irradiation, on demineralization of enamel - An *in vitro* study

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Abstract

Background: Fluoride varnishes and laser treatment of enamel have been shown to increase its resistance to acid dissolution. **Objective:** To evaluate the effect of fluoride varnish and Nd:YAG laser separately, and both combined on the demineralization of enamel. **Study design**: The resistance of enamel to acid solubility was measured by analysis of calcium ions released into the medium after an acid challenge. **Materials and methods:** Enamel discs prepared from molars were divided into four groups. Group I: No treatment, Group II: Fluoride varnish applied on enamel surface, Group III: Enamel surface treated with Nd:YAG laser, and Group IV: Fluoride varnish applied enamel surface irradiated with Nd:YAG laser. The specimens were immersed in lactic acid for 24 hours. The calcium dissolved was determined using Flame Photometry. **Results:** Calcium dissolution was significantly reduced by fluoride varnish application on enamel (Group II). Nd:YAG laser irradiation (Group III) gave a significantly lesser calcium dissolution than Group II. Dissolution was least when Nd:YAG laser irradiation was done on fluoride varnish applied enamel (Group IV). **Conclusions:** Application of fluoride varnish on enamel significantly increased its resistance to acid solubility. Nd:YAG laser irradiation of enamel increased its resistance to acid solubility better than topical fluoride varnish application alone. Least demineralization of enamel occurred when fluoride varnish applied enamel was subjected to Nd:YAG laser irradiation.

Key words: Enamel demineralization, Flame photometry, Nd:YAG laser.

Introduction

Dental caries is perceived to be a prolonged imbalance in the oral cavity between factors favouring demineralization of enamel and dentine *versus* factors favouring re-mineralization and repair of these tissues. Prevention of demineralization of tooth material and promotion of re-mineralization have been the dreams of dental researchers from the very beginning of dentistry. Even with all the advancements in materials and armamentarium, this still remains far from reality. Use of fluoride for caries prevention have been tried in different forms and ways in dentistry, which include topical fluorides like gels, varnishes, solutions, fluoride dentifrices, mouth rinses, fluoride tablets, fluoridation of water, milk, salt, etc. To enhance the caries inhibiting property of topical fluorides experiments were carried out aiming at developing methods for prolonging the contact of solutions with tooth enamel, leading to not only deeper penetration of fluoride in enamel but also a more permanently bonded form of fluoride. Consequently the use of fluoride containing varnishes has become the choice method in caries prevention.

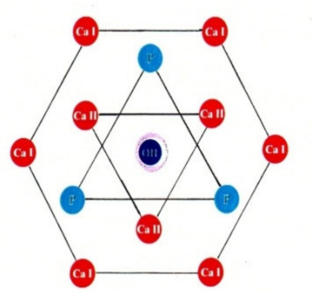

Fig. 1: Hydroxyapatite molecule viewed down the C-axis

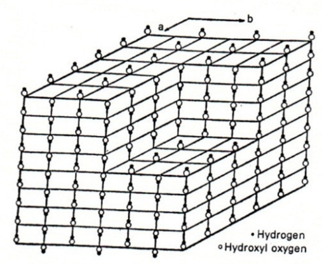

Fig. 2: Packing of unit cells to form an apatite crystal

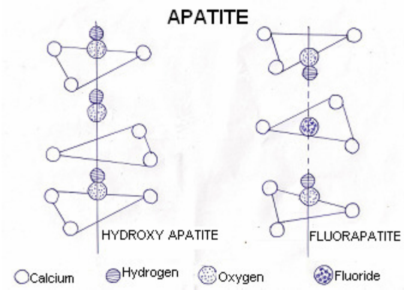

Fig. 3: Fluoride ions entering cross over points

Laser treatment of dental enamel has been shown to increase its resistance to acid by enhancing the fluoride uptake in enamel, and promotes the conversion of hydroxyapatite to fluorapatite. The resultant reduced surface area of enamel lessens the acid dissolution[1]. Laser causes loss of water as well as carbonate in enamel[2]. Laser irradiation also destroys the organic content, and the decomposition products block the diffusion pathways in enamel[2]. Nd:YAG laser developed by Guesic in 1964 refers to Neodymium, Yttrium-Aluminum Garnet Laser. The advantage of Nd:YAG laser is that the beam can be brought through a fibre and delivered.

When salivary pH falls below the critical value of 5.5, demineralization of tooth material occurs[3]. Both Nd:YAG and Er:YAG lasers can be effective tools for enhancing deciduous enamel acid resistance[4]. Resistance of enamel to acid solubility is measured by determining the Ca^{++} ions released into the lactic acid medium after a 24 hours acid challenge, using Flame photometry technique.

The effect of application of topical fluoride varnish and low energy Nd:YAG laser separately, and both combined, on enamel demineralization was evaluated, subjecting it to 0.1 M lactic acid challenge at 4.8 pH[5].

Materials and Methods

Forty non-carious recently extracted molars were selected. The teeth were stored in normal saline to prevent dehydration. All teeth were cleaned using pumice slurry and bristle brush. Buccal surfaces of teeth were selected to prepare an enamel disc of uniform size.

Enamel disc dimensions: Mesio distal: 05 mm and Occluso-gingival: 04 mm

Enamel disc preparation: Enamel disc of the above dimensions were cut using a diamond coated cutting disc under constant saline irrigation. The resultant cubes were measured using vernier calipers to standardize the specimen preparation. The prepared enamel discs were mounted on acrylic blocks of 01 cm length, 01 cm width, and 02 cm height. The mounting was necessary for holding the specimens during further procedures. The enamel discs were mounted on acrylic in such away that enamel surfaces were 02 mm above the acrylic surface. This was done to prevent accidental flow of acrylic monomers over the enamel surface during the procedure.

Materials used

Fluoride varnish: Fluor protector (vivadent) Lot No. E55843, 0.1% silane fluoride varnish

Laser Unit: Unilite Continuum Model E355/266

Lactic acid: at pH 4.8 and 0.1Molarity; Lot No.k2 E520120, Merck Ltd. Mumbai

Flame photometer: Sherwood Model 420

Specimen preparation: Enamel blocks mounted in acrylic were divided into groups of ten each.

Group I: No treatment was done

Group II: Enamel surface of each specimen was dried with an air syringe. A thin layer of Fluorprotector was applied on the enamel surface using a viva brush. The varnish was evenly distributed using an air syringe and left undisturbed for four minutes.

Group III: After drying with an air syringe enamel specimens were subjected to Nd:YAG laser at 9.6 µm wavelength (twenty five pulses, each with 1000 µsec pulse duration).

Group IV: After air-drying the enamel surface, fluoride varnish was applied on the surface as in group II. The enamel surface with varnish was irradiated with Nd:YAG laser at the same parameters as in Group III.

Demineralization procedure: Each specimen was immersed in 2.5 ml of 0.1 M lactic acid at pH 4.8, for 24 hours[6]. After this exposure the specimens were stored in a water bath with a controlled temperature of 37ÚC. At the time of testing the specimens were taken out

Table 1: *Calcium dissolved in the acid (mg/L)*

	Group I	Group II	Group III	Group IV
No. of cases	10	10	10	10
Minimum	1353.2	1217.9	1172.8	1082.5
Maximum	1533.6	1217.9	1263.0	1263.0
Median	1353.2	1353.2	1172.8	1172.8
Mean	1407.3	1321.6	1217.8	1181.7
SD	63.1	67.3	47.4	79.1

Table 2: *Decrease in calcium dissolution*

Group	Mean	% Decrease
I	1407.31	-
II	1221.63	6.08%
III	1217.8	13.46%
IV	1181.79	17.94%

and the calcium content of the solution was determined using flame photometer [5].

Results

The amount of calcium in dissolved in the acid in the different groups, and the mean and SD of calcium content is given in table 1.

The mean values of calcium dissolution in the different groups and the decrease in values (in percentage) with treatment in the study groups, as compared to the control (Group I) was calculated (Table 2).

Observations and results

On comparing the results from the four groups, the following observations were made:

a. The amount of calcium dissolved was the maximum in the untreated samples (group I).

b. Calcium dissolution was significantly reduced by fluoride varnish application (group II)

c. Nd:YAG Laser irradiation (group III) gave a significantly lower dissolution than group II.

d. Value was least when laser irradiation was done on the enamel upon which fluoride varnish was applied (group IV).

The results can be summarized as *Group I > Group II > Group III > Group IV.*

e. Statistically significant difference was obtained between all groups (p>0.05) except III and IV.

Discussion

Dental caries is a dynamic process. The disease can be conceptualized as an imbalance between mineral loss and mineral gain, in which over the time there is net mineral loss, leading to cavitations[7]. Since the discovery of the effect of fluoride on enamel by Mckay (1901), and studies by Dean (1931) and associates on the cariostatic potential of fluoride, it has become an integral part of the armamentarium of dental professionals to combat dental caries[7].

Mechanism of demineralization and remineralization: Enamel is an active chemical system that participates in a variety of reactions, including solute and ion transport from saliva to dentin, ion exchange reactions with saliva and demineralization-remineralization. As plaque pH drops, a point is reached where the mineral phase of enamel begins to dissolve. This is referred to as critical pH and is estimated[7] to be in the range of 05 to 06, with an average of 5.5.

The dissolution of enamel can be linked to the crystallographic structure of enamel. The organization of mineral in enamel follows a hierarchy of structural elements from the macroscopic, down to the atomic. The largest elements are the rods, which are composed of millions of elongated crystallites. The mineral component of crystallite is calcium hydroxy apatite [$Ca_{10}(PO_4)_6(OH)_2$]. The shape of the unit cell of hydoxyapatite is also characteristic of apatite crystals in general. The shape is termed hexagonal in that *'a'* and *'b'* axes of the cells intersect at an angle of 120º, have equal lengths, and the axis is perpendicular to both *a* and *b,* as shown in Fig. 1. The hydroxyapatite forms in a direction parallel to the C-axis making a column of hydroxyl ions. The Ca^{2+} ions are shared between three adjacent hexagons, forming a series of repeating hexagonal units. Each apatite crystal is an ordered aggregate of many unit cells as shown in Fig. 2.

One of the notable features of enamel dissolution is its relation to the enamel rods. The dissolution process is most advanced in the head region of the rods; the tail regions and periphery of the head regions are relatively more resistant to acid attack. This is correlated with the orientation of the C-axis. Crystallites in the head region of a rod are aligned with their C-axis nearly parallel to the rod axis and hence roughly perpendicular to the enamel surface. The access of acid to the hydroxyl groups is also an important factor in dissolution. When C-axis is perpendicular to the enamel surface the hydroxyl groups are exposed to acid attack and dissolution will proceed along the C-axis. The calcium triangles are stabilized by interaction with hydroxyl groups. So the acid reaction of the hydroxyl groups will destabilize the whole crystallite. The crystallites away from the head fan out in increasing degrees of oblique, and they are most resistant to acid dissolution[9].

There are other reasons also for the increased demineralization of the central cores of crystallites. The cores are relatively unstable than outer surfaces because they contain higher proportions of dislocations and imperfections. Moreover the enamel crystals are formed by lateral growth and this may entrap irregularities in the core. Since lateral growth is a slow process, it is likely that outer regions are more highly ordered, and thus less susceptible to acid dissolution. For the demineralization to proceed there should be sufficient concentrations of acids in the plaque fluid to diffuse into enamel, and the plaque fluid should be under-saturated with respect to hydroxyapatite to allow outward diffusion of dissolved minerals.

Effects of fluoride: The replacement of some of the hydroxyl groups of hydroxyapatite by fluoride is of special importance to dentistry. The substituted fluoride ions occupy positions along the columns of hydroxyl groups within the channels formed by the calcium triangles. The fluoride ions in contrast to the hydroxyl groups are situated in the planes of the calcium triangles equidistant from the three calcium ions. The relatively small fluoride ions form stronger coulomb interactions with the calcium ions than the hydroxyl groups can form. This results in shrinkage of calcium triangles. The substituted fluorides also establish hydrogen-bonding interactions with neighbouring hydroxyl groups. This hydrogen bonding also increases stability of fluoride-substituted apatites.

Fluoride ions enter the voids in the hydroxyapatite called crossover points, which are caused by the repulsion between two H^+ when placed near each other as shown in Fig. 3. The net result of these substitutions is that F^- ions may act as "plugs" in the other wise reactive hydroxyl columns. Acid attack down a given channel, and the resulting destabilization of its surroundings would be relatively unimpeded till a fluoride ion is the C-axis channels. Fluoride ions are expected to impede acid demineralization and hence caries attack[10].

ormation of fluorapatite can be represented as

$$Ca^{2+} + HPO_4^{2-} + OH \xrightarrow{F} Ca_{10}(PO_4)_6(OH.F) \text{ or } F_2$$

Effects of Laser: Laser irradiation of enamel has been proven to inhibit demineralization. Laser pulses are primarily absorbed by proteins and lipids localized between the enamel prisms resulting in effectively etching the enamel. This increases surface permeability and provide increased surface area for bonding of ions including fluoride and calcium. Laser irradiation also removes the carbonate content of enamel crystals[11]. The presence of carbonate in the hydroxyapatite tends to disrupt a number of interactions that are responsible for stabilizing the apatite structure. The carbonate-substituted apatite is considerably less stable than normal apatite. This carbonate is removed by laser irradiation there by stabilizing the enamel structure. It is also seen that the decomposition products of organic components destroyed by laser, blocks the diffusion paths of H^+ ions in the enamel, thereby inhibiting acid dissolution[12]. Also acid resistance of laser treated enamel is attributed to a slight contraction of C-axis of the apatite crystals as a result of reduction in water and carbonate content[13].

To determine the demineralization of enamel samples, a simple methodology was employed. Calcium being a product of demineralization of hydroxyapatite crystals, quantification of calcium dissolved in an acid after 24-hour immersion would indicate the extent of demineralization of enamel. Since lactic acid is a major acid produced by bacterial metabolism in the oral cavity this acid was selected for the study. It was done at pH 4.8, well below the critical pH of 5.5 for enamel dissolution,.

Flame photometry was used to study the amount of calcium dissolved in 0.1 M lactic acid at pH 4.8 after 24-hour immersion. The results indicate that there is a statistically significant difference between the four groups studied. Group IV (Laser and fluoride) showed the least demineralization and Group I (control) showed the highest. The results obtained in this study show a 6.08% decrease in acid solubility of enamel compared to the control when fluoride varnish alone was done.

The reduction in acid solubility was 13.46% when Nd:YAG laser irradiation was done on enamel. This is due to improved crystallinity of laser-irradiated enamel resulting from the following three effects of laser irradiation:

i. It destroys the organic component of enamel and the decomposition products block the diffusion pathways of H^+ ions[12].
ii. Unstable carbonate content of the hydroxyapatite is removed[11].
iii. C-axis of hydroxyapatite is slightly contracted, thus increasing its stability[13].

The maximum reduction in solubility (17.94%) was obtained when Nd:YAG laser and fluoride varnish application were combined. This could be due to increased uptake of fluoride into laser-irradiated enamel. Laser irradiation leads to etching of enamel surface due to removal of organic content, thereby increasing permeability of enamel. This promotes better penetration of fluoride into enamel and provides increased surface area for binding of fluoride ions.

Conclusion

From this study it was concluded that application of topical fluoride varnish on the enamel significantly increased its resistance to acid solubility. Also it was shown that Nd:YAG laser irradiation of enamel increased its resistance to acid solubility better than topical fluoride varnish application alone. The least demineralization of enamel occurred when fluoride varnish applied enamel is subjected to Nd:YAG laser irradiation.

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ORIGINAL ARTICLE

An *in vitro* evaluation of Resin adhesive Prime & Bond 2.0 (DENTSPLY) and Light cure glass ionomer liner/ base, Vitrebond (3M), in bonding amalgam

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Abstract

Aim: To compare the retentive bond strength of simulated bonded amalgam restorations in Class V cavities using a fifth generation dentin bonding agent (Prime & Bond 2.0), and light cure glass ionomer liner/ base (Vitrebond) as the adhesive intermediary. **Materials and Method:** Sixty extracted non-carious human molars were selected, the crowns separated and mounted in autopolymerising resin to expose a flat enamel surface. A non-retentive Class V cavity was prepared and the teeth were randomly divided into three groups. Group A was the resin intermediary group and Group B, the glass ionomer intermediary group; both groups consisting of 25 teeth. Group C, comprising of 10 teeth, and restored without the use of intermediary, served as control. The bond strength was determined by loading the specimen to failure in tension using the Hounsfield Tensometer, and the force in kilograms required to dislodge the amalgam restoration was recorded. **Results:** The mean retentive bond strength for Group A, restored with prime and bond as the intermediary was 9.83 kg and Group B, where glass ionomer line/base Vitrebond was used, showed a value of 9.28 kg. Group C, with no intermediary, had mean bond strength of 4.05 kg. **Conclusion:** The use of adhesive intermediary significantly enhanced the retentive bond strength of amalgam restoration. There was no significant difference in bond strength of amalgam restoration when Prime & Bond 2.0 and light cure glass ionomer liner/ base, Vitrebond, were used as the adhesive intermediary.

Keywords: Adhesive intermediary, Prime & Bond 2.0, Light cure glass ionomer liner/ base, Vitrebond, amalgam restoration.

Introduction

Dental amalgam is a restorative material of relatively low cost, good clinical longevity, good wear resistance, self-sealing ability and an amazing tolerance of manipulative variables. However the major drawback of amalgam is that it lacks the ability to bond to tooth structure. Evidence suggest that microleakage, in addition to establishing an environment for the development of caries, may result in pulp pathology and post operative tooth sensitivity,and contributes to corrosion, dissolution and discoloration of certain restorative materials[1]. Advancement in adhesive dentistry provides an obvious clinical advantage in having a universal adhesive system (i.e., one that simultaneously and successfully treats enamel and dentin), and hence for bonding all restorative materials, including amalgam. Such adhesive systems would minimize microleakage at the tooth restoration interface and enhance retention, without sacrificing sound tooth structure by preparation of undercuts or insertion of pins[2,3,4].

Even restorations with adhesive materials always have microscopic spaces between them and the cavity walls. It would be sensible with bonded restorations to aim not only at minimizing microleakage but also at providing

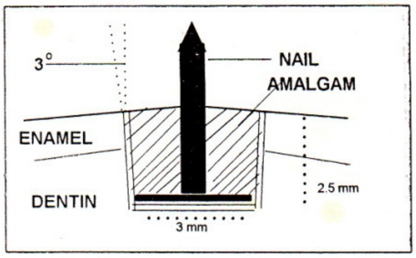

Fig. 1: Cross section of sample restored class V preparation

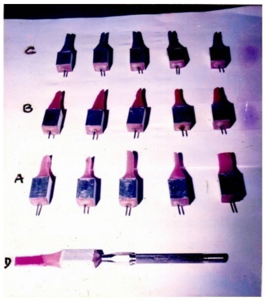

Fig. 2: Prepared teeth samples
A: Pink - resorted with Prime & Bond 2.0
B: Red - restored with Vitrebond
C: Green - control samples
D: Fastened to pin vise

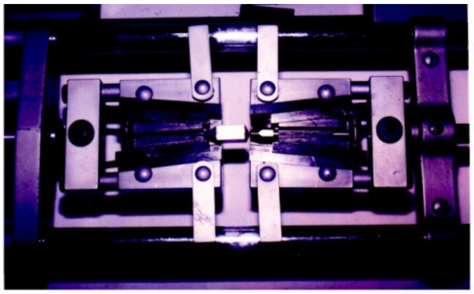

Fig. 3: Samples mounted on Tensometer

anti-cariogenic property. The glass ionomer cement seems particularly suitable due its ability to bond to enamel and dentin. It produces a good seal and is known to possess a low coefficient of thermal diffusivity[5,6]. The light cured glass ionomer liners have the added advantage of achieving their near maximum strength almost immediately after placement. In addition, light cured glass ionomer liner (Vitrebond) has been shown to have a relatively high surface pH value as compared to several chemical curing brands[7].

Significant benefit can be envisaged, not only in terms of the saving of tooth structure, but also in the strengthening effect that would be expected from the use of adhesive intermediaries, vis-à-vis amalgam. This study was undertaken to assess the retentive bond strength of simulated bonded amalgam restorations in class V cavities in extracted teeth, using light cure glass ionomer liner/ base Vitrebond, or adhesive resin Prime & Bond 2.0 as intermediaries. Restorations placed without any intermediary served as control.

Aims and Objectives

The study aimed at evaluating the retentive bond strength of simulated bonded amalgam restorations in class V cavities using Prime & Bond 2.0, light cure glass ionomer liner/ base, Vitrebond, and both resin adhesive (Prime & Bond 2.0) and light cure glass ionomer liner/ base (Vitrebond) as the adhesive intermediary.

Materials and Method

Sixty extracted non-carious, human molars devoid of developmental defects were selected for the study. The teeth were cleaned of debris by hand scaling and stored in saline at room temperature after extraction, and between restoration and testing procedures. The crowns were separated from the roots at the level of the cemento-enamel junction, using a carborundum disk in a micromotor handpiece, under a constant stream of water. They were mounted in autopolymerizing resin in aluminium tubes, to expose a flat facial, lingual or proximal enamel surface. Each specimen was mounted on a bench vise, and a non-retentive class V cavity was prepared with a carbide crosscut fissure bur (#557, Ash, England), in a high-speed dental handpiece with a water spray. Each bur was used to prepare only ten cavities.

The preparation (Fig. 1) was 2.5 mm deep and 03 mm wide, with slightly divergent lateral walls, which ensured that the cavities had no undercuts. The main advantage of this method was that it utilized a clinically relevant preparation that included both enamel and dentin. The prepared teeth were randomly divided into three groups, A, B and C (Fig. 2).

Group A: Consisted of 25 teeth, colour coded pink, and received Prime & Bond 2.0 (Dentsply Ltd, Surrey UK) as the adhesive intermediary to bond the amalgam restoration. It contains elastomeric dimethacrylate resin, dipenta-erythritol penta-acrylate monophosphate (PENTA), photoinitiators, stabilizers and acetone. The cavity surface was etched for 20 seconds with 37% phosphoric acid, rinsed with water for 30 seconds, and dried with gentle blast of oil free air, taking care to avoid dessicating the dentin. Prime & Bond 2.0 was dispensed onto disposable brush tip and applied immediately to the treated cavity surfaces to wet the exposed dentin and enamel thoroughly, and then left undisturbed for 30 seconds. It was then light cured for 10 seconds using LITEX 680, light curing unit (DENTAMERICA, California, 91744). A second coat of Prime & Bond 2.0 was then applied, and light cured for 10 seconds.

Group B: This group of 25 teeth, coded red, received light cure glass ionomer liner/ base, Vitrebond (3M, Dental Products, USA) as the adhesive intermediary for bonding amalgam to the tooth. Vitrebond consists

Table 1: *Mean retentive bond strength & SD of amalgam restoration*

Groups	Mean ± SD
A	9.83 ± 0.54
B	9.28 ± 0.43
C	4.05 ± 0.22

Table 2: *Statistical analysis of resin adhesive, glass ionomer liner/ base and control*

	't' value	P value	Significance
Group A *vs* C	12.18	P<0.01	Highly significant
Group B *vs* C	13.61	P<0.01	Highly significant
Group A *vs* B	1.13	P>0.05	Insignificant

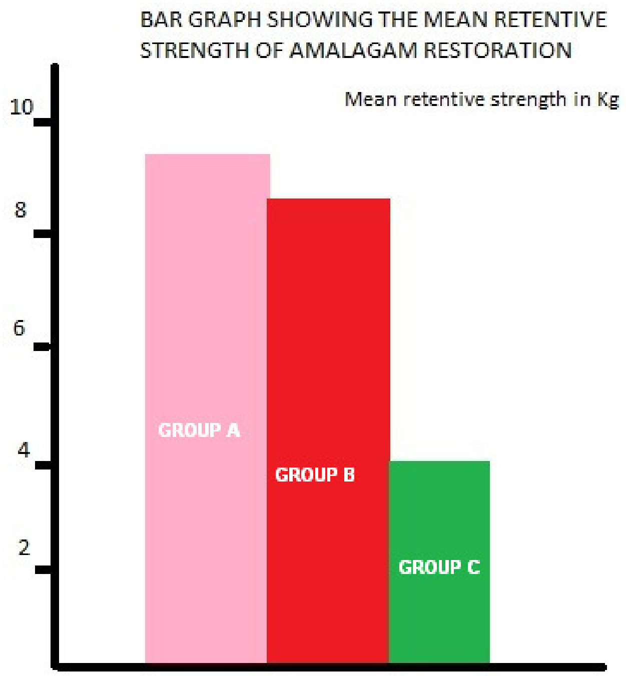

Fig. 5: Retentive bond strength of amalgam restoration

of a powder and a liquid component. The powder is radiopaque ion-leachable fluoroaluminosilicate glass, and is photosensitive. The liquid consists of a light sensitive, polyalkenoic acid, HEMA (2-hydroxyethyl methacrylate) and water. The liner was prepared by rapidly mixing (10-15 seconds) one level scoop of powder with two drops of liquid on a mixing pad with a small plastic spatula. The mix was applied to the cavity surface in a thin layer using a ball applicator, and left uncured.

Group C: Ten teeth were allotted to this group and restored with amalgam, without the use of an intermediary and served as control. This group was given green colour.

Following the preparations, a half-inch, 18-gauge, flat-headed nail was placed into the cavity, with the head resting on the pulpal floor. A thin layer of cavity varnish (Nouava Dental Varnish, Mumbai) was applied to the nail head to prevent it from bonding to the resin adhesive or glass ionomer liner/ base, Dentfilloy (DENTFILLS, Mumbai, India) was triturated in an amalgamator and the amalgam triturate was immediately condensed into the preparation, and around the head of the nail, manually, with a small condenser using a standard clinical technique. The restoration was carved flush with the cavosurface. Light was applied to the margins of the restoration in Group B to cure the intermediary that may have flown to the cavosurface during condensation of the amalgam. The specimens were stored in saline for 24 hours at room temperature.

The amalgam restorations were polished after 24 hours with pumice and rubber cup in a slow speed handpiece. All 60 specimens were thermally stressed by placing them in a water bath between 50 to 55°C. After thermocycling the specimens were stored in saline. The retentive strength of amalgam restorations was determined by using the Hounsfield Tensometer (Tensometer Ltd, Croydon, England). Each specimen was placed in one of the grips of Tensometer. The nail projecting from the restoration was fastened into a pin vise, and inserted into the other grip (Fig. 3).

The specimens were loaded to failure in tension at a crosshead speed of 2mm/ min. Load in kilograms required to dislodge the restoration was tabulated, and the retentive bond strength compared statistically using unpaired *'t' test.*

Results

The values force in kilograms required to dislodge the amalgam restoration were tabulated and mean retentive bond strength calculated for the three groups. Group A, restored with Prime & Bond 2.0, as the adhesive intermediary, showed a mean bond strength of 9.83 kg. Group B, where glass ionomer liner/ base Vitrebond, was used as the bonding agent, showed mean bond strength of 9.28 kg. Group C, with no intermediary had mean bond strength of 4.05 kg. This clearly showed that the use of adhesive intermediary agents contributed to producing restorations that are statistically more retentive than those which had no intermediary (Table 1).

Table 2 shows that when *'t' test* is applied for comparing Group A *vs* Group C, *'t' value* of 12.18 is obtained, which is highly significant (P<0.01). Similarly when Group B is compared to Group C, *'t' value* obtained is 13.61, which is again highly significant (P<0.01). When *'t' test* is used for comparing the adhesive intermediary groups, Group A *vs* Group B, value of 1.13 is obtained which is insignificant (P>0.05). The effects of adhesive intermediaries on retentive bond strength of amalgam restoration are highlighted (Fig. 5).

Discussion

Amalgam alloy remains the most widely used filling material in restorative dentistry. Although it possesses excellent physical properties, lack of adhesion to the tooth structure has been the major drawback of amalgam. Consequently researchers have been looking for dental amalgam bonding alternatives. In 1983, Zardiackas *et al.,* established the concept of bonding amalgam to tooth structure. Since then various materials have been used to bond amalgam to tooth. The consensus seems to be that adhesive resins are the materials of choice. Glass ionomer cements not only minimize microleakage but also provide cavity walls with the more desirable anticariogenic property.

This study was undertaken to evaluate the retentive bond strength of simulated bonded amalgam restorations in class V cavities in extracted teeth using a resin adhesive, Prime & Bond 2.0, and a light cure glass ionomer liner/base, Vitrebond, as the adhesive intermediary. Restorations placed without any intermediary served as the control. After thermocycling, the retentive strength of amalgam restoration was determined using a Hounsfield Tensometer. The specimens were loaded to failure in tension at a crosshead speed of 02 mm/ minute, and the load in kilograms required to dislodge the restoration was recorded as the retentive strength value.

Many researchers[4,8,9,10,11] have shown that it is possible to bond amalgam triturate through adhesive intermediary to the cavity wall. This would minimize microleakage at the tooth-restoration interface, enhance retention and allow an increase in bulk (and hence the strength) of amalgam without removing additional tooth structure. Micromechanical bonding has been proposed as the bonding mechanism between amalgam and adhesive resin[12]. Glass ionomers are being increasingly used as liner/ base under amalgam restorations as they leach fluoride, bond to dentine, and have a low coefficient of thermal expansion.[2,13,14,15]. Previous work in this field has been concerned with the bonding of amalgam to initially set chemical curing glass ionomers, using poly (acrylic acid), or adhesive resin cement, as an intermediary[3,10]. It was also found that bonding amalgam with an adhesive resin liner resisted the forces of displacement more effective than adding proximal grooves or dovetails in the proximal box form preparation.[16]

The light cured glass ionomer liners appear to be more suitable for bonding amalgam, as they achieve close to their maximum strength almost immediately after placement. In addition, the light cure glass ionomer liner/ base, Vitrebond, used in the present study has been reported to have a relatively high surface pH value[7] and exhibits higher bond strengths to tooth structure, compared with chemically curing brands. This may be of clinical relevance, especially in view of the concern that have been expressed recently regarding postoperative sensitivity that might have risen as a result of acid pH during the setting of these materials. The glass ionomer liners provide additional thermal insulation for the dental pulp, potential for fluoridation of the tooth structure, increasing its resistance to recurrent caries, particularly if the restoration fails[10].

Statistical analysis of the bond strength values obtained showed a mean retentive strength of 9.83 Kg for group A, 9.28 Kg for group B and 4.05 Kg for group C. The results clearly show that under the conditions of this study the adhesive technique resulted in highest resistance to dislodgement by the amalgam restoration. This is in agreement with previous reports which demonstrated that significantly stronger bonds could be achieved between amalgam and tooth structure by using an adhesive intermediary[10,17,18].

When the retentive bond strength value of group A (9.83 Kg) was compared with group B (9.28 Kg) using the unpaired 't' test the result obtained (1.13), showed no significant difference (p>0.05). This shows that there is no significant difference, in the retentive bond strength between resin adhesive Prime & Bond 2.0, and glass ionomer liner/ base Vitrebond, when used as the adhesive intermediary in amalgam restorations. Similar findings were reported by Aboush & Elderton[6], Covey and Moon[19] and Al Moayad *et al*[17] who found no significant difference in bond strength of amalgam restoration using resin adhesive and glass ionomer liner/ base. Wieczkowski *et al*[18] using 'v' shaped cavities for testing the effectiveness of various adhesive base materials reported similar bond strength for Vitrebond and resin adhesive. This is in agreement with the present study.

The result of the present study show that light cure glass ionomer liner/ base, Vitrebond, has the potential for being an effective amalgam adhesive. From the observations of the study, it can be stated that the use of adhesive intermediary agents enhanced the retention of amalgam restorations. So also the resin adhesive Prime & Bond 2.0 and glass ionomer liner/ base Vitrebond, showed no significant difference in retentive bond strength of amalgam restoration when used as adhesive intermediary. The bond strength obtained in this study only indicates short-term thermally stressed values. Normal masticatory stresses may have an entirely different effect on the adhesive bond, which has not been simulated in this study. Because of the short duration, any deterioration of the bond over time, that may occur, was not observed. Moreover, in the present study bond strength was analyzed in class V preparations. Therefore, further studies in stress bearing areas, i.e., in class I and class II preparations are needed to shed better light into the behaviour of bonded amalgam restoration. However, the early researches and the known properties of the materials involved offer promise for the concept of adhesive amalgam restorations.

Conclusion

The results of the present study show that both the resin adhesive Prime & Bond 2.0 and light cure glass ionomer liner/ base Vitrebond, have the potential for being effective amalgam adhesives. However, the inherent properties of fluoride release and anti-cariogenicity gives the glass ionomer liner/ base, an obvious advantage.

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REVIEW ARTICLE

Diabetes and the periodontium: The bi-directional relationship

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Abstract

An increased prevalence and severity of periodontitis is typically seen in diabetic patients especially in those with poor metabolic control. This has led to the designation of periodontal disease as the sixth complication of diabetes. The most significant change in uncontrolled diabetes is a reduction in the defence mechanism and increased susceptibility to infections, leading to destructive periodontal disease. The presence of a systemic infection causes insulin resistance, preventing glucose from entering the target cell. Presence of chronic gram-negative periodontal infections may also result in increased insulin resistance and poor glycemic control.

Introduction

The association between diabetes and inflammatory periodontal diseases has been studied extensively for more than fifty years. Evidence suggests that diabetes is associated with an increased prevalence, extent and severity of gingivitis and periodontitis[1]. Inflammation plays an obvious role in periodontal diseases and it is a major component in the pathogenesis of diabetes and its complications. Research suggests that, as an infectious process with a prominent inflammatory component, periodontal disease can adversely affect the metabolic control of diabetes. This review highlights the relationship between diabetes mellitus and periodontitis.

Effects of diabetes mellitus on the periodontium

Diabetes does not cause gingivitis or periodontitis, but there are indications that it alters the response of the periodontal tissues to local factors. A variety of periodontal changes have been described, including a tendency toward enlarged gingiva, sessile or pedunculated gingival polyps and polypoid gingival proliferations. Recent studies suggest that uncontrolled or poorly controlled diabetes is associated with a greater loss of attachment, increased bleeding on probing, increased alveolar bone loss, increased tooth mobility and retarded post-surgical healing of the periodontal tissues. Periodontal abscesses appear to be an important feature of periodontal disease in diabetes mellitus.

Several studies revealed that the degree of glycemic control is an important variable in relationship between diabetes and periodontitis. A large-scale analysis showed that significantly more periodontal attachment loss and alveolar bone loss was seen in type I diabetic patients who had poor glycemic control, than those who were well-controlled or non-diabetic patients[2]. Similarly in a longitudinal study of 362 subjects, poorly controlled type II diabetic subjects showed almost eleven-fold increase in the risk for alveolar bone loss over a two-year period compared to non-diabetic control subjects[3]. Tooth loss in Pima Indians with type II diabetes was reported to be fifteen times higher than in those without diabetes[4]. This finding has been confirmed in meta-analysis of studies in various diabetic populations[1]. However, no significant risk of longitudinal bone loss has been found in well-controlled type II diabetic patients as compared to non-diabetic controls. Same phenomenon has been pointed out by other researchers[5,6,7].

Significantly higher values of glycosylated hemoglobin, or HbA_{1c} are reported in children and adolescents with periodontitis[8,9,10]. Large body of evidence shows that types I and II diabetes increase the risk and severity of periodontitis, leading to designation of periodontal disease as the sixth complication of diabetes.

Mechanism

Despite extensive research, mechanism underlying the association of periodontitis and diabetes mellitus is not clear. However, while investigating the mechanism relating the link between these two chronic diseases, several studies have been focused on microbial flora of the dental plaque, which is the primary etiologic agent of the periodontal disease. Anaerobic gram-negative pathogens *Actinobacillus actino mycetomcomitans, Bacteriodes forsynthus, Porphyromonas gingivalis*[11] and *Prevotella intermedia, Treponema denticola,* and *Eikenella corrodens*[12,13] are found to be associated with development and progression of periodontal disease. Due to the accumulation of dental plaque, an inflammatory reaction occurs in the gingiva. In susceptible individuals, as the plaque matures, clinical attachment loss, gingival enlargement or recession, loss of alveolar bone and periodontal pocket formation occur, and if remain untreated ultimately leads to tooth loss. In case of diabetic patients, concentration of oral microbial flora is increased due to higher concentration of glucose in saliva and gingival crevicular fluid. In literature, an enormous presence of *Staphylococcus epidermidis* and Strains of *Capnocytophaga* has been reported in diabetic *vs* non-diabetic subjects[14]. Similarly, Mandell *et al.,* (1992) found that diabetic patients have higher than normal levels of periodonto-pathogenic bacteria *Prevotella intermedia, Prevotella melaninogenica, Bacteroides gracilis, Eikenella corrodens, Fusobacteriurn nucleatum* and *Campylobacter rectus* [l5].

All the evidences regarding the biologic link between diabetes and periodontal disease supports the view that diabetes and persisting hyperglycemia leads to an exaggerated immune-inflammatory response to the periodontal pathogens,[16,l7] resulting in a more rapid and severe periodontal tissue destruction. Certain bacterial strains are found to be capable of producing proteolytic enzymes or leukotoxins, which facilitate the invasion into host tissues[l8]. *A. actinomycetomcomitans* and *P. gingivalis* produce proteases and metabolic byproducts that can degrade surrounding issue,[19] and it has also been suggested that bacterial lipopolysaccharide can induce bone resorption[20]. Matrix metallo-proteinases (MMPs) like collagenases, gelatinases, and elastases of periodontal tissue play a role in collagen degradation of osseous and connective tissue[21]. Bacterial toxins, endotoxins and cell membrane products challenge the host thereby activating an inflammatory cascade with the synthesis of some effective mediators such as TNF alpha, IL-6 and IL-1 beta[22]. Another hypothesis proposed is that in diabetes, hyperglycemia is associated with the disturbances in carbohydrates, fat, and protein metabolism,[23] and persistent hyperglycemia results in alteration of circulating, and immobilized proteins. Exposure of proteins (collagen) and lipids to the aldose sugars leads to non- enzymatic glycation and oxidation of proteins and lipids, and the subsequent formation of advanced glycation end products (AGEs), which have the tendency to accumulate in the plasma and tissues[24]. It is also suggested that glucose-derived cross links can contribute to reduced collagen solubility and turnover rate in diabetic patients[25]. Cell surface binding sites or receptors for AGEs (RAGE) have been identified on cell surfaces of several cell types such as mononuclear phagocytes, endothelial cells, fibroblasts, smooth muscle cells, lymphocytes, podocytes and neurons, exhibiting a maximum inflammatory response and involved with the pathogenesis of complications of diabetes. Elevated levels of AGEs are reported in gingival tissues of diabetic patients[26]. It has been postulated that AGE-RAGE interaction induces an oxidant stress that may be responsible for monocytic up regulation, activation of NF-kB and subsequent expression of mRNA and secretion of pro-inflammatory cytokines (such as TNF-alpha, IL-1beta and IL-6) by monocytic phagocytes involved in periodontal tissue inflammation and destruction[27]. Blockade of RAGEs resulted into suppression of alveolar bone loss and of markers of inflammatory tissue destruction in diabetic mice infected with periodontal pathogens[28]. Hyperglycemia results in imbalance in lipid metabolism generally characterized by increased in low-density lipoproteins and triglycerides and fatty acids in diabetic patients. Changes in lipid metabolism are correlated with impaired function of monocytes and/ or macrophages in successive *in vitro* and *in vivo* studies ultimately leading to the overproduction of inflammatory cytokines[29]. Several researchers have reported decreased functions of polymorphonuclear leukocyte (PMN) such as chemotaxis and phagocytosis in patients with periodontal disease[30].

Along with inflammatory cytokines (TNF alpha, IL-1beta and IL-6), C-reactive protein levels are also found to be raised in periodontal patients with diabetes mellitus[31]. Various mechanisms mentioned above may contribute individually or synergistically but eventually leads to periodontitis occurring as a complication to diabetes. Although the exact mechanism of action is not fully understood, diabetes, poor oral health habits, heredity, old age, decreased immunity of the host play a leading role as main risk factors. Combination of these factors may contribute to various mechanisms underlying the association between periodontal disease and diabetes, including glucose level changes, subgingival flora components, blood perfusion, host response and metabolism of periodontal tissue[32].

Periodontitis and diabetic complications

Diabetic patients with periodontal disease have increased risk of complications, similar to inflammations in any other site of our body. Severe periodontitis has been reported to have a high prevalence rate in diabetic patients, succumbing to cardio-renal disease[33]. Type I diabetic patients with ketoacidosis, retinopathy and neuropathy also have been reported to have a higher incidence of periodontitis[34]. A case controlled study at baseline reported that diabetes with severe periodontitis has a close association with complications like proteinuria, stroke, transient ischemic attack, angina, myocardial infarction and heart failure[35].

In a longitudinal study of patients with type II (non-insulin-dependent) diabetes, severe periodontitis was associated with significant worsening of glycemic control over time[36]. Individuals with severe periodontitis at the baseline examination had a greater incidence of worsening glycemic control over a two to four year period, than did those without periodontitis at baseline. In this study, periodontitis is implicated to have preceded the worsening of glycemic control.

Underlying mechanism

Acute bacterial and viral infections have been shown to increase insulin resistance and aggravate glycemic control[37,38]. This occurs in individuals with diabetes and also in non-diabetics. Systemic infections increase tissue resistance to insulin, preventing glucose from entering target cells, causing elevated blood glucose levels, and requiring increased pancreatic insulin production to maintain normoglycemia. Insulin resistance may persist for weeks or even months after the patient has recovered clinically from their illness. In the individual with type II diabetes, who already has significant insulin resistance, further tissue resistance to insulin induced by infection may considerably exacerbate poor glycemic control. In type I patients, normal insulin doses may be inadequate to maintain good glycemic control in the presence of infection-induced tissue resistance. It is possible that chronic gram-negative periodontal infections may also result in increased insulin resistance and poor glycemic control[39]. In patients with periodontitis, persistent systemic challenge with periodontopathic bacteria and their products may act in a way similar to well-recognized systemic infections. This mechanism would explain the worsening of glycemic control associated with severe periodontitis.

Impact of Intervention on glycemic control

In diabetic patients with periodontitis, periodontal therapy may have beneficial effects on glycemic control[40,41]. This may be especially true for patients with relatively poor glycemic control and more advanced periodontal destruction prior to treatment[42]. Forty years ago, the potential benefits of periodontal therapy were first described in young adults with diabetes and severe periodontitis[43]. Treatment with mechanical debridement, surgery, selected tooth extraction, and systemic antibiotics resulted in decreased insulin demand. In a more recent evaluation of scaling and root planing combined with systemic doxycycline therapy for 2 weeks, type 1 (insulin-dependent) diabetic patients with improved periodontal health also had significant improvement in glycemic control[44]. Conversely, those individuals who demonstrated little beneficial clinical effect from periodontal treatment had no change in glycemic control. In a placebo-controlled study of poorly controlled individuals with type II diabetes and severe periodontitis, nonsurgical mechanical debridement combined with systemic doxycycline for 14 days was compared with similar mechanical treatment combined with systemic placebos[45]. All patient groups had significant improvements in periodontal status, with reduced probing depths and bleeding on probing. Those treated with doxycycline had a greater reduction in the prevalence of *P. gingivalis*, which was more sustained over time. The doxycycline-treated patients also demonstrated significant improvement in glycemic control three months after treatment, which gradually reverted to baseline levels at six months. Placebo-treated subjects had no significant improvement in glycemic control. These studies suggest that the combination of subgingival mechanical debridement and systemic doxycycline may result in short-term improvement in glycemia in diabetic patients with severe periodontitis and poor metabolic control. Conversely, moderately or well-controlled individuals with diabetes and periodontitis who are treated by mechanical therapy alone may demonstrate no significant changes in glycemic control, despite improvement in their periodontal condition. In studies of subjects treated by mechanical therapy without adjunctive use of antibiotics, significant changes in glycemic control are less common[46]. Many of the patients in these studies had relatively good glycemic control before treatment, so less benefit on metabolic control might be expected.

Although routine use of systemic antibiotics in treatment of chronic periodontitis is not justified, patients with poorly controlled diabetes and severe periodontitis may constitute one patient group for whom such therapy is appropriate. Of course, antibiotics remain an adjunct to the necessary mechanical removal of plaque and calculus. The mechanisms by which adjunctive antibiotics may induce positive changes in glycemic control when combined with mechanical debridement are unknown at this time. Systemic antibiotics may eliminate residual bacteria following scaling and root planing, further decreasing the bacterial challenge to the host. Tetracyclines are also known to suppress glycation of proteins and to decrease activity of tissue-degrading enzymes such as matrix metalloproteinases. These changes may contribute to improvement in metabolic control of diabetes.

Conclusion

Periodontal disease and diabetes are strongly interrelated and have common pathobiology. Inflammatory events during periodontal disease may play an important role in worsening of diabetes and insulin resistance probably facilitates the progress of periodontal disease. A diabetic patient with untreated severe periodontitis needs care both from the diabetologist and the periodontist. Diabetic patients must be made aware of the need for regular periodontal maintenance.

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REVIEW ARTICLE

LASERS in dentistry

Abstract

Lasers were introduced into the field of clinical dentistry with the hope of overcoming some of the drawbacks posed by the conventional methods of dental procedures. Since its first experiment for dental application in the 1960s, the use of laser has increased rapidly in the last few decades. At present, wide varieties of procedures are performed using lasers. The aim of this review is to describe the application of lasers in dental hard and soft tissue procedures. Lasers are found to be effective in cavity preparation, caries removal, restoration removal, etching, and treatment of dentinal sensitivity, caries prevention, bleaching and several important hard and soft tissue procedures in periodontics. Specific laser technologies are expected to become an essential component of contemporary dental practice over the next decade.

Keywords: Lasers, Dental hard and soft tissue, Dentistry

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Introduction

Based on Einstein's theory of spontaneous and stimulated emission of radiation, Maiman (1960) developed the first laser prototype. Thus, RUBY LASER was created. Forty-five years after their initial experimental use in dentistry, and almost twenty years after their practical introduction into the dental operatory, lasers are becoming more common and even routine, either as adjunctive treatment methodologies, or as standalone additions in the dental armamentarium. Currently, a number of laser wavelengths are used in oral surgery and dentistry, including carbon dioxide (CO_2), Nd:YAG, argon, diode, erbium, potassium titanyl phosphate (KTP).

LASER - the Science behind

Laser is an acronym standing for Light Amplification by Stimulated Emission of Radiations. A laser device has the following components:

- A laser medium that can be solid, liquid or gas. This medium determines the wavelength of the light emitted from the laser; the laser is named after the medium
- Optical cavity/ laser tube: consists of two mirrors, one fully reflective and the other partially transmissive, located at either end of the optical cavity.
- Some form of external power source: excites or pumps the atoms in the laser medium to higher energy levels.

Atoms in the excited state spontaneously emit photons of light, which bounce back and forth between the two mirrors in the laser tube. As they bounce within the laser tube, they strike other atoms, stimulating more spontaneous emissions. Photons of energy of the same wavelength and frequency escape through the transmissive mirror as the laser beam, which can be focused as an extremely small intense beam of energy that has the ability to vaporize, coagulate and cut if a lens is placed in front of the beam.

Laser light is monochromatic and each wave of laser light is coherent. This results in the production of specific form of focused electromagnetic energy. The laser beam usually produced from optical fibers usually diverges at the fiber tip. The diverging beam can be precisely focused and

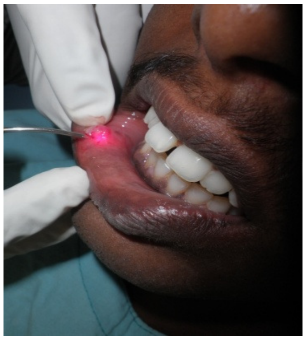

Fig. 1: Mucocele removal using LASER

this monochromatic coherent beam of light energy can be utilized to accomplish the treatment objective.

Effect of laser on tissues

Depending on the optical property of tissue, the light energy from a laser may have four different interactions with the target tissues i.e., reflection, transmission, scattering and absorption. Reflection is simply the beam being redirected off the surface, with no effect on the target tissue. Transmission of laser energy through the tissues is dependent on the wavelength of the laser light. Absorption of laser energy by the intended target tissue is the usual desirable effect. The amount of energy absorbed by the tissue depends upon pigmentation and water-content of the tissue, and on the laser wavelength. The principal laser tissue interaction is photo- thermal. The three primary photo-thermal laser tissue interactions are incision/ excision, ablation/ vapourization and haemostasis/ coagulation. Photochemical effects occur when laser is used to stimulate chemical reactions such as curing of composite resin and production of singlet oxygen radical for disinfection. A laser can be used for bio-stimulation for more rapid wound healing, pain relief, increased collagen growth and a general anti-inflammatory effect.

Diagnostic laser applications

Laser fluorescence systems can be used for detection of dental caries. For detection of dental caries in pits and fissures, laser fluorescence offers greater sensitivity than conventional visual and tactile methods[1,2]. The technique is also well suited to smooth surface lesions on cervical surfaces of teeth[3,4] and to recognition of caries beneath clear fissure sealants[5].

Photo-activated dye disinfection using lasers

Low power laser energy in itself is not particularly lethal to bacteria, but is useful for photochemical activation of oxygen releasing dyes. Singlet oxygen released from the dyes causes membrane and DNA damage to micro-organisms. The PAD technique has been shown to be effective for killing bacteria in complex biofilms, such as subgingival plaque, which are typically resistant to the action of antimicrobial agents[6-8]. Photo-activated dye can be applied effectively for killing Gram-positive bacteria (including MRSA), Gram-negative bacteria, fungi and viruses[9,10]. Major clinical applications of PAD include disinfection of root canals, periodontal pockets, deep carious lesions, and sites of peri-implantitis[11,12]. In such locations, PAD does not give rise to deleterious thermal effects[13] and adjacent tissues are not subjected to bystander thermal injury. Photo-activated dye treatment does not cause sensitization and killing of adjacent human cells such as fibroblasts and keratinocytes[14]. Neither the dye nor the reactive oxygen species produced from it are toxic to the patient.

Tolonium chloride is used in high concentrations for screening patients for malignancies of the oral mucosa and oropharynx[15,16] and does not exert toxic effects at the low concentrations used in the PAD technique. Moreover, residual reactive oxygen species are rapidly dealt with by the enzyme catalase, which is present in all tissues and in the peripheral circulation[17] and by lactoperoxidase, which is a normal component of saliva.

Photodynamic therapy

A more powerful laser-initiated photochemical reaction is photodynamic therapy (PDT), which has been employed in the treatment of malignancies of the oral mucosa, particularly multi-focal squamous cell carcinoma. As in PAD, laser-activation of a sensitizing dye in PDT generates reactive oxygen species. These in turn directly damage cells and the associated blood vascular network, triggering both necrosis and apoptosis[18]. While direct effects of PDT destroy the bulk of tumour cells, there is accumulating evidence that PDT activates the host immune response, and promotes anti-tumour immunity through the activation of macrophages and T lymphocytes[17]. For example, there is direct experimental evidence for photodynamic activation of the production of tumour necrosis factor-alpha,[19] a key cytokine in host anti-tumour immune responses. Clinical studies have reported positive results for PDT treatment of carcinoma-*in-situ* and squamous cell carcinoma in the oral cavity, with response rates approximating ninety per cent[20,21].

Applications of laser in periodontal therapy

Laser-assisted therapy addresses the biofilm of the tissue wall. Lasers are bactericidal. Most non-sporulating bacteria including anaerobes are deactivated at 50°C. At temperatures below 60°C the healthy tissue beneath non-healing granulation is not affected by the low energy produced by the laser[22,23]. Lasers reduce inflammation[24] and have the ability to seal capillaries and lymphatics, thus reducing swelling and post-operative discomfort[25].

Laser photo-biomodulation can activate the local blood-circulation and stimulate proliferation of endothelial cells[26,27]. Wound healing is supported by reducing oedema, increasing fibroblasts and reducing neutrophil infiltrate[28]. Lasers used in phase I periodontal therapy include diode, Nd:YAG, CO_2, and erbium lasers.

Lasers can be used to perform gingivectomy, frenectomy[29], mucogingival procedures (Fig. 1) and crown lengthening procedures. Periodontal flap procedures can be done exclusively or adjunctively with lasers. Incision can be placed and sulcular debridement and de-epithelialization can be done. If root debridement is done, only an erbium laser is recommended because of the thermal damage with diode and Nd:YAG lasers. CO_2 lasers may be used to increase fibroblast attachment to the root surface[30,31]. Osseous recontouring can be done by the erbium laser[22,23].

Lasers in regenerative periodontal therapy

Lasers can be used for root surface biomodification and in promoting periodontal ligament cell re-insertion. Er:YAG would be the laser of choice[32,33].

Lasers in Implant dentistry

Lasers have a therapeutic role in the pre-surgical, surgical, post-surgical and prosthetic phases of implant dentistry. Lasers can be particularly useful in dealing with complications of implant therapy. Decontamination and haemostasis can be achieved using lasers. Soft-tissue lasers (eg. Diode, CO_2) and hard tissue lasers (Er Lasers), both play important roles in implant dentistry. The diode laser and the Nd:YAG laser can be used for uncovering an implant. Diode laser has the advantage of small size and relatively low cost. It is less penetrative than the Nd:YAG laser. The CO_2 laser is also safe around implants[34]. However these lasers should be used with caution on the implant surface[35]. The Erbium laser can be used to treat peri-implantitis as it has bactericidal properties and it will not harm the implant surface[36].

Lasers in Restorative Dentistry

Caries prevention

Several studies examined the possibility of using laser to prevent caries[37,38]. It is believed that laser irradiation of dental hard tissues modifies the calcium to phosphate ratio, reduces the carbonate to phosphorous ratio, and leads to the formation of more stable and less acid soluble compounds, reducing susceptibility to acid attack and caries. Laboratory studies have indicated that enamel surfaces exposed to laser irradiation are more acid resistant than non-laser treated surfaces[39,40]. The degree of protection against caries progression provided by the one-time initial laser treatment was reported to be comparable to daily fluoride treatment by a fluoride dentifrice[41]. The threshold pH for enamel dissolution was reportedly lowered from 5.5 to 4.8 and the hard tooth structure has four times more resistance to acid dissolution. However, the actual mechanism of acid resistance by laser irradiation is still unclear and studies, particularly *in vivo,* to test these claims are required.

Cavity preparation

The Er:YAG laser produced cavities in enamel and dentine without major adverse side effects. The ablation efficiency was about one order of magnitude lower than for soft tissue. It was then concluded that dentine and enamel removal was very effective with no risk to the pulp[42,43]. The ablation rates in enamel were stated to be in the range of 20-50 ìm/ pulse, and in dentine they were reported to be as high at lower energy levels. The Er:YAG laser is equivalent to the air rotor in its ability to make cavity preparations in enamel and dentine and remove caries. The Er:YAG laser is capable of removing cement, composite resin and glass ionomer[44,45]. Lasers should not be used to ablate amalgam restorations, because of potential release of mercury vapour.

Treatment of dentinal hypersensitivity

Dentinal hypersensitivity is one of the most common complaints in dental clinical practice. A comparison of the desensitizing effects of an Er: YAG laser with those of a conventional desensitizing system on cervically exposed hypersensitive dentine[46] showed that desensitizing of hypersensitive dentine with an Er: YAG laser is effective, and the maintenance of a positive result is more prolonged than with other agents.

Bleaching

The objective of laser bleaching is to achieve an effective power bleaching process using the most efficient energy source, while avoiding any adverse effects[47]. The FDA approved standards for tooth whitening has cleared three dental laser wavelengths: argon, CO_2 and the most recent 980-nm GaAIAs diode.

Lasers in Endodontics

The development of new delivery systems, including thin and flexible fibers as well as new endodontic tips, allows laser technology to be applied to the endodontic procedures like pulp diagnosis, pulp capping, pulpotomy, cleaning and disinfecting the root canal system, obturation of the root canal system, endodontic re-treatmentand apical surgery.

Low-Level Laser in Dentistry (LLLT)

Lasers at much lower power than the surgical lasers act as bio-stimulators. These lasers are also called therapeutic lasers or cold lasers. LLLT application to the mucosa before injections results in slight anesthetic effect and also improves healing at the injection site[48-50]. The healing time and pain of aphthous ulcers can be shortened[51,52]. LLLT over lymph nodes decreases oedema. LLLT can stimulate bone formation after endodontic therapy. Intra-operative and post-operative LLLT in peri-apical surgery has huge potential[53,54]. It can be used as an adjunct in pulp capping and pulpotomy[55-58]. It can also be used after extraction to stimulate fibroblasts. LLLT can be used after implant placement to reduce post-operative pain and oedema. It is the most efficient method of treating herpes simplex virus infection[59-61]. It can be used in orthodontics to increase orthodontic movement and to reduce pain. It can also be used in the management of paraesthesia[62-65]. LLLT can accelerate bone regeneration and it can be used in combination with grafts and in GTR[66-72].

Conclusion

LASER technology for caries detection, resin curing, cavity preparation and a number of hard and soft tissue surgeries is at a high state of refinement, having had several decades of development up to the present time. A further area of future growth is expected to be the combination of diagnostic and therapeutic laser techniques in the one device, for example the detection and removal of dental caries or dental calculus. There is a large research effort internationally focused on developing new laser applications for dental practice, and each year several large meetings are held which bring together this research. There appear to be windows of opportunity for the laser technology in a range of dental applications. Looking to the future, specific laser technologies are expected to become an essential component of contemporary dental practice over the next decade.

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TECHNICAL REPORT

Haemostatics in Oral Surgery - *An update*

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Abstract

During oral surgical procedures one might come across unexpected abnormal bleeding which can often be troublesome. Among the various methods of controlling bleeding during dental surgical procedures, the use of local haemostatic agents play a key role. The operator should have a sound knowledge about these agents so as to use them adequately. This article reviews various causes of bleeding associated with dental extraction and the mechanisms of action, advantages and disadvantages of the currently available local haemostatic agents used to arrest bleeding.
Key words: Haemostatics, Drugs, Dentistry

Introduction

Fatal complications following minor oral surgical procedures, though infrequent, have been reported[1-5]. Bleeding can occur during placing incisions, during the procedure or as a delayed complication. Usual sources of bleeding are granulation tissue, nutrient canals within the alveolar bone and perforating vessels from the periosteum. Uncontrolled bleeding may be a likely complication in hypertensive patients, in patients on anti-platelet drugs and those with blood dyscrasias.

One should be familiar with the mechanism of coagulation (Fig. 1) to understand and effectively manage such complications. All haemorrhagic episodes related to dental surgery can mostly be controlled by local measures except when associated with an underlying systemic disorder[1,6]. This emphasizes the importance of taking a proper patient history, recognizing compromised conditions and taking necessary opinions from the medical specialists. These measures would definitely prevent such unwarranted complications. Incomplete history, patients not revealing underlying bleeding disorders, undiagnosed clinical conditions, lack of following post-op instructions and poor patient compliance to medications may impede successful management of uncontrolled bleeding[1,40].

Local haemostatics

1. Gelatin Sponge (Gelfoam[39], Ab Gel, Surgispon, etc.)

Gelatin sponge is commercially available as cubes or sheets of varying sizes. They are quite effective and economical. Gelatin sponge is prepared from dried and sterilized porcine skin gelatin. For best results, Gelfoam has to be made wet with few drops of saline and place into the extraction socket, with suture placed across the socket. In the socket it forms a mechanical matrix[7-9] and facilitates clotting rather than affecting clotting mechanism[7-9]. It liquefies in a week time and is completely resorbed in 4 to 6 weeks. Handling may be messy owing to sticky nature when wet with saline. Rare cases of allergic reactions have been reported[10-15].

2. Oxycel/ Surgicel (by Johnson & Johnson)

It is an oxidized cellulose material, which is fully resorbable. It is available as thin sheets, which are prepared in the form of sterile fabric meshwork. It is more mechanical in its action and swells up into a gelatinous mass, which aids in clotting. Excess amount from the site, if any, has to be

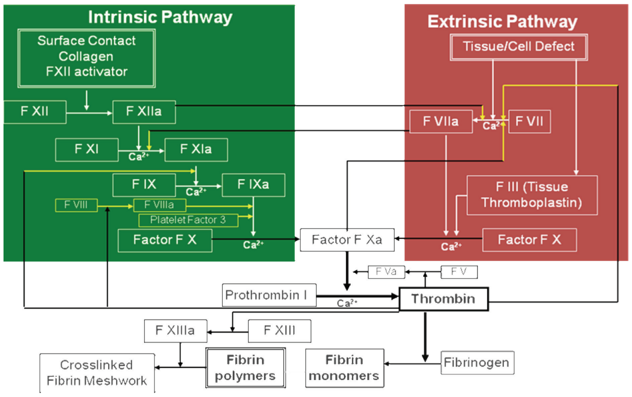

Fig. 1: Clotting cascade

removed, as it may delay healing. It is quite effective in Exodontia and other oral surgical procedures[16], but expensive. Its applications are preferred for soft tissue procedures, but not recommended in contaminated or infected areas[38] as it may facilitate fluid encapsulation and rarely produce foreign body reaction[17-19].

3. Thrombin

Topical thrombin is often bovine derived and available as sterile freeze dried powder, to be reconstituted with saline prior to use. It helps conversion of fibrinogen to fibrin, forms a reinforcing meshwork for platelets and aids in mechanical stabilization of clot. A single dose of 100 IU/ml is usually recommended. It can be applied directly or Gelatin sponge may be used as a carrier [6].

4. Absorbable collagen

It is derived from bovine deep flexor tendons. When used it is completely resorbed in 15-60 days[20]. It acts as a mechanical matrix and in addition, presence of collagen activates intrinsic coagulation cycle[6]. It is held in place till bleeding is arrested and then removed or left *in situ*. e.g., UltraFoam, UltraWrap, Avitene, CollaPlug[37], CollaTape, Heli Stat etc.

5. Tranexamic acid

It is predominantly an anti-fibrinolytic agent, usually used topically for its effect[21]. It usually recommended as 10 ml mouth rinse, four times a day for 5-7 days after surgery. A five percent solution can be diluted with five millilitre water and applied on gauze swab and used as a bite pack. Tranexamic acid improves the tensile strength of the wound and helps to increase the resistance of the blood clot to mechanical disruption[6,22]. It is also available as injections.

6. Bone Wax (Ethicon)

It is recommended for controlling bleeding from vessels within bony canals or 'bone bleeders'. It acts as a mechanical plug and aids in the arrest of bleeding, and is commercially available in sterile foil envelopes. Bone wax[36] is a sterile preparation comprising of Bees Wax, Paraffin and a softening agent Isopropyl palmitate. Required amount of the material is taken and kneaded prior to packing or burnishing into the bony opening from where the bleeding is noticed. Bone wax is non-resorbable, and because of its adverse effects on osteogenesis it should be used with caution where bone regeneration is expected, like an implant site. Bone wax might prevent the clearing of bacteria from the site of application and occasional inflammatory reaction has also been reported[23].

7. Chitosan products

Chitosan is a naturally occurring polysaccharide, prepared by de-acetylation of crustacean chitin. Negatively charged red blood cells are readily attracted by the positively charged chitin, which then together form a strong mechanical barrier, and helps initially in arresting the bleeding. This further promotes the coagulation cascade. Chitosan derived products exhibit mild local anti-bacterial property [24].

8. Fibrin glue (Tissucol)

It is available in two vials as a freeze-dried concentrate of clotting proteins, mainly fibrinogen, factor XIII and fibronectin (the sealant), and freeze dried thrombin (the catalyst). Studies have shown that human fibrin glue[34] is effective in preventing local haemorrhagic complications after surgical procedures, even in patients with concurrent coagulation disorders[30]. Since it is a biological sealant it has excellent local tolerability, and has no undesirable effects or contraindications[30].

9. Astringents and Styptics

They cause superficial and local coagulation e.g., alum, aluminum chloride, zinc chloride (8-20%) and tannic acid. Styptics[35] are the concentrated forms of astringents[33], e.g., ferric chloride and ferric sulfate. Aluminum chloride and ferric sulfate are the agents most preferred in dentistry because they cause minimum tissue damage.

10. Cyano Acrylate Glue

The haemostatic properties of this material have been confirmed in many studies, but it should be used judiciously for the purpose[29]. It is not frequently recommended.

11. Etamsylate

It is believed to bring about its action by increasing capillary endothelial resistance and by promoting platelet adhesion[32]. It is available as tablets and Injections. eg: Hemsyl (Indoco), Dicynene.

12. Styptochrome/ Adrenochrome

It is an oxidation product of adrenaline, and possesses haemostatic property. It is available as injections and tablets.

Recommended management of Post-extraction bleeding

- Give adequate local anaesthetic *with Adrenaline*[25] so as to relieve pain and anxiety, which may worsen the bleeding
- Check BP, bleeding time, clotting time, partial thromboplastin time, International normalized ratio, and platelet count to rule out any systemic disorder
- Clean up the clot and place a fresh pack and re-check after 15-20 minutes
- If bleeding still persists, debride the socket, with copious irrigation, clean up all granulation, loose bone fragments, entrapped calculus etc.
- Observe the site of bleeding and under proper light and continuous suction identify the source of bleeding (arterial, venous or capillary)
- Apply local digital pressure[6,26] especially if the bleeding is from greater palatine or nasopalatine artery
- Use local haemostatics like Gelfoam
- Placing a fresh suture[27] will assist in arresting the bleeding
- Extra-oral ice pack
- Give proper instructions, preferably in printed format

If bleeding still persists after carrying out these local measures, an underlying systemic cause should be suspected and the patient has to be shifted to the nearby hospital for detailed investigations and expert management to avoid further complications including respiratory distress[28]. Blood loss in excess of one litre, or one fifth of the body weight can cause severe impairment in tissue perfusion and precipitate hypovolaemic shock[6,31]. Patients on anticoagulants[41] for whatever the reason may be, has to be taken up for dental surgery *preferably* after consulting the treating Physician and following his/ her recommendations.

Conclusion

Various studies have proven that with a proper patient history and planned surgical procedure, the risk of uncontrolled bleeding and the likely complications arising out of it can be prevented or minimized. Hence a profound knowledge about the coagulation process and the various measures to control bleeding in routine oral surgical procedures is a pre-requisite for any dental surgeon. Adaptation of topical haemostatic agents to oral surgical approach would be valuable and offers an opportunity for novel contributions.

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CASE REPORT

Management of a case of masticatory muscle disorder

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Abstract

Accurately diagnosing and treating masticatory muscle disorders can be difficult and perplexing. In many patients a solitary muscle disorder may ultimately result in chronic disorders or secondary joint pathologies. An attempt should be made to differentiate the primary cause from the secondary effects produced by it. Masticatory muscle disorders are considered to be the most common type of temporo-mandibular joint (TMJ) disorders. This article describes management of a case of chronic masseteric spasm using occlusal splint (stabilization appliance) and supportive therapy.

Key words: Temporo-mandibular disorders, Masticatory muscle disorder, Occlusal splint

Introduction

The predominant complaint of patients with masticatory muscle disorder is usually myalgia. This is commonly reported as having sudden onset and occuring in repeated episodes. It is important for the clinician to be able to distinguish between the different types of these disorders, because the treatment of each is different. They are mainly of five different types: [a] protective co-contraction [b] local muscle soreness [c] myofascial pain dysfunction syndrome [d] myospasm and [e] chronic centrally mediated myalgia.[1,2,3]. Protective co-contraction and local muscle soreness occur and resolve in a short period of time. Myospasm is also an acute local disorder whereas myofascial pain dysfunction syndrome and chronic centrally mediated myalgia are chronic regional disorders. Fibromyalgia is a chronic systemic myalgic disorder[1,2,3]. This clinical report presents the treatment of myospam of right masseter muscle in an elderly male patient, using a centric relation splint (stabilization appliance). This is a reversible therapy advised specifically for patients with parafunctional activities such as bruxism[4,6].

Clinical presentation

A 64-year-old patient reported to TMJ Clinic of Pushpagiri College of Dental Sciences, Tiruvalla with pain in relation to right cheek and right ear for the last one month. The pain was present throughout the day, and was aggravated during chewing. He had consulted an ENT surgeon. The surgeon diagnosed and treated it as acute parotitis. Since the pain was not subsiding as expected, the ENT specialist referred the patient for a dentalconsultation. The patient was intially seen by a maxillofacial surgeon, who recommended a soft diet, analgesics and an anti-inflammatory gel for topical application. As the pain was still not subsiding, the patient was finally referred to the TMJ clinic of Pushpagiri College of Dental Sciences.

Careful elicitation of history revealed that the patient had a habit of bruxism and the intensity of pain was more in the morning. Furthermore, he always had a preference to chew on the right side. In the recent past

Fig 1. Palpation of right masseter

Fig 2.Stabilization appliance

Fig 3. Patient with stabilization appliance

his wife was diagnosed to have ocular cataract and they were planning on a surgical treatment for this problem.

On examination, there was tenderness in relation to right preauricular and right masseteric regions, indicating spasm of the right masseter. (Fig. 1). Also there was severe pain on tryng to open the mouth wide. There was slight deflection of the mandible to the right side on opening due to right masseteric contraction. Intra-oral examination showed that the patient was completely dentulous. Generalized attrition of teeth especially the posteriors was present, indicative of bruxism. Temporo-mandibular joint examination did not reveal any clicking or crepitation and there was no deviation of mandible on opening the mouth. This ruled out the probability of an intracapsular disorder.

Diagnosis and treatment planning

The patient was diagnosed as having acute muscle spasm of right masseter mainly due to bruxism. The masseter of the right side was affected, probably due to his preference to chew on the right side. The increased emotional stress caused by the concern for his wife who was planning to undergo cataract surgery might have precipitated this condition. Since the patient was a bruxer, it was decided to fabricate a stabilization appliance (centric relation splint) in relation to maxillary arch (Fig. 2, 3).

The patient was advised to wear the splint especially at night for about two months. He was also asked to continue with the supportive treatment like topical application of anti-inflammatory gel, massaging and moist heat application over right masseteric and preauricular regions. He was advised to take soft foods, to chew slowly with both sides and to make smaller bites, so as not to open the mouth wide, and to give rest to the muscle[1]. He needed to take sufficient rest, have nutritious food and sleep six to eight hours a day.

When the person was recalled after one week, the muscle pain and earache had subsided markedly. Deflection of mandible to the right on opening the mouth was also not discernable as the spasm of right masseter had been resolved. When the patient returned in four weeks time, he was totally asymptomatic. After six months of follow up, the patient remained symptom free.

Discussion

Myospasm or tonic contraction myalgia is an involuntary CNS-induced tonic muscle contraction, and is usually associated with local metabolic conditions within the muscle tissue. Myospasm may be caused by continued deep pain input, local metabolic factors of the muscle associated with fatigue or overuse and could also be idiopathic. Patients usually report a sudden onset of restricted jaw movement accompanied by muscular rigidity. There is marked restriction in the range of mandibular movements depending on the muscle involved. Muscle pain is present at rest and is increased during activity. The affected muscle is usually firm and tender and there is a feeling of muscle tightness[1].

It has been observed that hard splints were more effective in the treatment of masticatory muscle disorders compared to soft splints[5]. So we decided to give hard stabilization splint, a removable appliance made of hard acrylic that fits over the occlusal and incisal surfaces of the teeth in one arch and creates precise occlusal contact with the teeth of the opposing arch. Occlusal appliances have several uses, one of which is to provide a orthopedically stable joint position temporarily. They can also be used to introduce an optimum occlusal condition that reorganizes the neuromuscular reflex activity, and this in turn reduces abnormal muscle contraction[6,7,8]. Occlusal appliances in effect protect the teeth and supportive structures from abnormal forces that might be creating tooth fracture or wear and tear or both[9,10].

Successful management of a case of masticatory muscle disorder depends on early diagnosis and management. The importance of taking the detailed history carefully is obvious. In this case, the patient's habit of bruxism and preference to chew on the right side might have caused the disease. The emotional stress definitely aggravated the condition. The centric relation splint proved to be effective in providing good pain relief. Supportive therapy aided in the faster recovery of the patient by preventing the masticatory muscles from overworking in the fatigued condition.

Conclusion

Even though the aetiology of temporo-mandibular disorders is multifactorial, by a thorough and careful history taking, examination, diagnosis and timely intervention, the sufferings of these patients can be ameliorated.

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CASE REPORT

Hemisection as an alternative treatment for an advanced endodontic-periodontal lesion: A case report

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Abstract

This case report describes a multidisciplinary approach for the management of a grossly decayed mandibular first molar associated with severe bone loss of the distal root and furcation involvement. Root canal treatment was performed followed by hemisectioning and removal of the distal root. A temporary fixed partial denture was given connecting the crown portion of the mesial root of the sectioned tooth and the tooth adjacent to the edentulous space created by removal of distal root. After six months' follow up, permanent prosthetic rehabilitation with metal ceramic fixed partial denture was done.

Key words: Hemisection, Root canal treatment, Furcation involvement

Introduction

Hemisection procedure can be considered as a dental proof of the old adage "*half a loaf is better than none*". It refers to the sectioning of a molar tooth with the removal of a nonrestorable root which may be affected by periodontal, endodontic, structural or carious defects[1]. One of the most challenging problems in periodontal therapy is the treatment of multirooted teeth with lesions of varying degrees within the inter-radicular spaces[2]. The outcome of such treatment is most likely related to the furcation area interfering with adequate instrumentation. The tooth resection procedures are used to preserve as much tooth structure as possible, rather than sacrifice the whole tooth. Such teeth can be useful as independent units of mastication or as abutments in simple fixed partial dentures[3]. J I Ingle suggested the following indications[4] for root resection procedure; substantial periodontal bone loss not sufficiently improved by periodontal therapy, destruction of a root due to different pathological conditions, surgically inoperable roots, and fracture of one root only. Contraindications for root extraction are lack of necessary osseous support for the remaining root or roots, fused root or roots in unfavorable proximity to each other, remaining root or roots are endodontically inoperable and lack of patient motivation.

Clinical presentation

A 22-year-old female presented to inquire about the options for preserving her lower left first molar (36). Chief complaints were pain and swelling in relation to periapical area of 36. On examination, there were mild diffuse extra oral swelling and class I dental caries on 36 with clinical pulp exposure. Periodontal pocket depth was 11 mm distally and lingually. Pulp vitality test was negative. Diagnostic IOPA radiograph (Fig. 1) showed a well defined circular radiolucency around the distal root of size 7 x 7 mm and mesially it was 5 x 5 mm.

Interdental bone loss of 5 mm was present on the distal aspect. Clinical diagnosis was chronic localized periodontitis associated with pulpal necrosis and chronic apical periodontitis. Extensive bone loss in relation

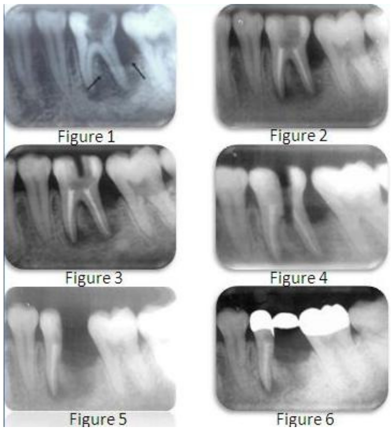

Fig. 1 - Diagnostic radiograph
Fig. 2 - Post obturation radiograph
Fig. 3 - Evaluation of sectioning procedure
Fig. 4 - Sectioned tooth
Fig. 5 - Post extraction radiograph
Fig. 6 - Post operative radiograph

Fig. 10 - Root amputation
Fig. 11 - Bicuspidation
Fig. 12 - Hemisection

to the distal root rendered the tooth non-restorable. However the patient was reluctant to lose her tooth. Instead of extracting 36, it was decided to preserve the tooth by hemisection and restoration of 36 by splinted crown bridging with 37. Preservation of the whole tooth was not realistic because of advanced osteolysis in the distal segment and less chances of periodontal regeneration. The patient was informed about the methods and risks of the treatment and consent was obtained.

Treatment procedure

Root canal therapy was carried out using step back technique for cleaning and shaping and obturation was done by lateral condensation technique with gutta percha (Fig. 2). Access cavity was restored with light cure composite (Durafil VS). Local anesthesia was achieved by giving left inferior alveolar nerve block. A crevicular incision was made from first premolar to second molar region. A full thickness mucoperiosteal flap was elevated to expose the bony crest preparatory

Fig. 7 - Extracted mesial half of tooth
Fig. 8 - Post extraction site
Fig. 9 - Post cementation

to the hemisection procedure The tooth was vertically sectioned at the level of furcation with a tapering fissure diamond bur. The cutting procedure was evaluated with radiographs (Fig. 3,4). The distal root was extracted (Fig. 5,7,8). Extraction socket was irrigated with saline and the flap was closed with simple interrupted sutures (000 black silk).

Surface irregularities on distal surface of mesial root were removed with finishing diamond bur. Post extraction instructions, analgesics and antibiotics were given. Patient was recalled after one week for suture removal and prosthetic rehabilitation with a temporary bridge. Crown preparation was done on the retained mesial component of 36 and 37. A temporary bridge was fabricated, cemented and maintenance instructions were given. The patient was recalled and reviewed after one month, three months and six months. She was asymptomatic and IOPA radiograph showed satisfactory healing. Permanent prosthetic rehabilitation was carried out with a metal fused ceramic bridge (Fig. 6,9).

Discussion

The maintenance of intact dentition for a long time is a main goal of dentistry. Various tooth resection procedures are minor surgical procedures to preserve the impaired teeth for periodontic, endodontic and prosthodontic reasons. These are root amputation, hemisection, radisection, and bisection[5] (Fig. 9). Root amputation refers to removal of one or more roots of multirooted tooth while other roots are retained (Fig.10). Hemisection refers to removal or separation of root with its accompanying crown portion of mandibular molars (Fig.12). Radisection is a newer terminology for removal of roots of maxillary molars. Bisection or bicuspidization is the separation of mesial and distal roots of mandibular molars along with its crown portion, where both segments are retained individually (Fig. 11).

If dental caries or periodontal disease is limited to one root of a tooth, a hemisection procedure may produce a healthy root with adequate bone support. This procedure represents a form of conservative treatment modality, aiming to retain as much of the original tooth structure as possible. The results are predictable and success rates are high if certain basic considerations are taken into account.

Periodontal, prosthodontic and endodontic assessment for appropriate selection of cases is important. The prognosis of endodontic treatment is usually excellent but periodontal outcome is less favourable. Successful treatment of such lesions depends upon their timely and accurate diagnosis[7].

The case presented was a combined endodontic-periodontal lesion wherever any two independent defects have merged into one. Although the root to be amputated requires no canal filling to seal the apex, F S Weine suggested placement of a filling which often facilitates the surgical procedure.

Proper finishing and polishing of the cut surface of the remaining portion of tooth is important to allow proper cleansing and thus to prevent accumulation of plaque[6]. Root fracture is the main cause of failure after hemisection; so occlusal modifications are required to balance the occlusal forces on the remaining root[8].

Conclusion

The use of hemisection to retain a compromised tooth offers a prognosis comparable to any other tooth with endodontic treatment[9]. The factors promoting long term success include accurate diagnosis, good oral hygiene, and careful surgical and restorative management. Hemisection may be a suitable alternative to extraction and implant therapy, and should be considered with top priority among the various treatment options.

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CASE REPORT

Management of a case of hemi-maxillectomy with a definitive obturator

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Abstract

Surgical removal of malignant or non-malignant pathologies from the head and neck region accounts for the majority of jaw defects seen in maxillofacial practice. With the integrity of oro-facial structures compromised, it causes significant functional and social problems, which invariably affect speech and swallowing. When surgical reconstruction is contraindicated, prosthetic rehabilitation must be offered to restore the anatomy, functions and aesthetics. Maxillo-facial prosthodontists play a major role in the intervention to improve the quality of life in such compromised patients. Excessive stress on abutment teeth adjacent to a maxillary resection defect during loading of acrylic partial denture obturator framework can shorten the life of the teeth. This article describes the obturator designed on a cast partial denture framework for maximum longevity.

Key words: Hemi-maxillectomy, Interim obturator, Definitive hollow obturator, Tripodal design,

Introduction

Maxillofacial prosthetic therapy for acquired defects has become more complex and sophisticated with advances in the fields of surgical, physical and rehabilitative medicine. If the prosthesis is fabricated in an acceptable fashion to meet the physiologic, anatomic, functional and cosmetic requirements of the patient, the longevity[1] of the appliance and the comfort of the patient remain assured. It is very much essential that the design of an obturating prosthesis must be carefully considered to reduce and distribute the stress to the abutment teeth, as basal support tissue is minimal or totally absent[2].

The objectives are better achieved with a quadrilateral or tripodal design rather than a linear design, as this would allow a more favorable distribution of functional forces[3] to the supporting structures. The designing of a partial denture in such cases involves principles like a rigid major connector, occlusal rest configuration, guiding planes to facilitate stability, bracing and retention of the tooth to prevent the displacement of the framework palatally or towards the defect[4].

A hollowed bulb portion should be processed so that the weight of the prosthesis may be reduced by up to 33% depending upon the size of the maxillary defect[5]. The degree of extension of the obturator into the defect varies depending upon the configuration of the defect, character of its lining tissue and functional requirement for retention, support and stabilization of the prosthesis[3]. Most clinicians are in agreement that there should be a retentive element as close to and as far from the defect as possible[6]. Studies suggest that splinting two teeth adjacent to a resection improves stress distribution around the roots during loading. This could increase the clinical life of the abutment teeth[7].

In this article, prosthetic rehabilitation in a patient who has undergone hemimaxillectomy for fibrous dysplasia, using a cast partial denture hollow

Fig. 1: Maxillary defect - intraoral view *(mirror image)*

Fig. 2: Processed obturator with tripodization

Fig. 3: Processed obturator with speech bulb

Fig. 4: Obturator with closed defect *(mirror image)*

Fig. 5: Frontal view

bulb obturator is described.

Clinical presentation

A thirty seven year old male patient reported to the department of Prosthodontics, Pushpagiri College of Dental Sciences, Medicity, Tiruvalla for replacement of his existing obturator. His chief complaints were repeated fractures, poor aesthetics and lack of retention of his existing prosthesis. His medical report revealed that he had undergone treatment for fibrous dysplasia on the right side of face. Hemimaxillectomy was done and the lesion was excised, followed by skin graft reconstruction. Intraoral examination revealed a maxillary defect of 6 x 7 cm extending from the midline to the right side posteriorly, which can be classified as Aramany class I maxillary defect (Fig. 1). All walls of the defect were lined by healthy tissue. All teeth on the left side of maxilla were present except for 27 and the mandibular arch was intact. The patient had generalized periodontitis. He was wearing an interim obturator made of acrylic showing multiple repair sites, and with compromised aesthetics, retention and stability. He also had difficulty in speech. Patient also revealed that the obturator had been reconstructed eight times during this period due to repeated fractures.

In order to minimize the problems related to the interim obturator, a definitive obturator was planned. A primary impression was made with alginate and a diagnostic cast poured which was articulated by recording tentative jaw relations. Design principles to enhance retention, stability, load distribution and longevity were taken into consideration and tripod design with anterior teeth clasping and buccal molar clasping was planned. An anterior-posterior palatal strap major connector to enhance rigidity and speech was also included in the design.

Rest seat preparations on 23, 24, 26 and 28 was done to receive circumferential clasps. Final impression was made after border molding and proper extension into the defect with elastomers, and master cast was poured. The design for the cast partial denture was waxed up on a duplicate cast and modifications were done. The cast partial denture framework was fabricated and evaluated for the fit, retention and extension. An occlusal rim was made on the framework and jaw relations were recorded followed by a wax try-in to evaluate aesthetics, occlusion and speech.

The waxed up prosthesis was flasked, dewaxed, acyrlized with heat cure acrylic resin and properly finished and polished (Fig. 2,3). The finished obturator was inserted and evaluated for its function and aesthetics.

The patient was recalled after two days and later at regular intervals to evaluate any problems associated with the obturator (Fig. 4,5). At follow ups he was extremely satisfied with the retention, speech and aesthetics of the newly made obturator. Even after three years of regular use, there were no complaints about this definitive obturator.

Discussion

Patients with acquired maxillary defects differ from those with congenital defects because of the abrupt alteration in physiologic process associated with the surgical resection leading to difficulties in mastication, speech, swallowing and esthetics[8]. In dentate patient primary retention, support and stability of an obturator depends on the number and distribution of the remaining teeth[9]. Engagement of soft tissue undercuts, including the scar band at the skin graft-mucosal junction, may also play an important role in retention and stability of the obturator in edentulous patients[10].

The weight of an obturator can be significantly reduced by hollowing out the bulb[11] and can be further reduced by replacing the acrylic palatal portion of denture base with base metal alloys. Retentive features for an obturator should be designed to resist vertical and near vertical displacing forces, especially during mastication.

Cast clasps are probably the most universally used retentive elements for obturators, yet there is still some disagreement as to whether lingual or buccal retention is appropriate. As the defect approaches the midline, the teeth furthest from the defect become more involved in resisting displacement in an occlusal or upward direction.

The retentive elements planned on the most anterior abutment were designed to release on vertical occlusal movement during mastication and to resist vertical downward forces of displacement and to a lesser degree horizontal rotational movements.

A broad anterior dental arch allows for longer center fulcrum arm with possibility for tripodization and use of conventional buccal molar clasping[12].

Single piece hollow obturator is more hygienic, aesthetic and simple to fabricate. If the defect is large with more soft tissue undercuts, then a two-piece obturator is prefered[13].

Conclusion

Successful rehabilitation of a hemi-maxillectomy case depends on the volume of the defect, positioning of the remaining hard and soft tissues and the weight of the prosthesis. Fabrication of a obturator which satisfies the principles of designing will restore the acquired maxillary defects to normal function, appearance and better patient satisfaction.

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CASE REPORT

A case of solitary plasmacytoma of mandible with a review on plasma cell neoplasms of oral cavity

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Abstract

Plasma cell neoplasms are malignant proliferations of terminally differentiated plasma cells which produce monoclonal immunoglobulins. It is mostly seen in adulthood and usually occurs over the age of fifty. The solitary bone plasmacytoma is a unifocal form of the disease and is believed to be a precursor to multiple myeloma which is the disseminated form. Extramedullary plasmacytoma has also been described in the mucosa of upper aerodigestive tract and has less propensity to develop into multiple myeloma. Histopathology of all forms of plasma cell neoplasms consists of monotypic infiltrates of cells with plasma cell profile. Oral involvement is rare and oral lesions account for only four percent of solitary plasmacytomas. A case report of a 69 year old female patient with solitary plasmacytoma involving the posterior mandibular region is presented here, along with a discussion on the clinical and pathological aspects of plasma cell neoplasms.

Key words: Solitary plasmacytoma of mandible, Plasma cell neoplasms, Osteolytic lesion, Multiple myeloma

Introduction

Plasmacytoma is the unifocal counterpart of multiple myeloma of bone. As with other lymphomas these tumours arise from a single cell type and therefore exhibit monoclonality. Most solitary bone plasmacytomas disseminate into multiple bones whereas only 30% of the extra medullary plasmacytomas do so.Oral manifestations of plasma cell neoplasms are in the form of oral and maxillofacial lesions and are often the first sign of the disease. It may occur in the following three ways: as a consequence of a local manifestation of multiple myeloma, as a solitary bone plasmacytoma, or as an extramedullary plasmacytoma[1,2]. The incidence of plasma cell tumours is 2.6-3.3 per 100,000 inhabitants, and is higher in the black population (4 per 100,000) than in whites (2.1 per 100,000). The onset of these tumours occurs in most patients between the ages of 40 and 70, the mean age being 64 years[1].

Solitary bone plasmacytoma is a tumour of plasma cells which manifests as an osteolytic lesion without plasmacytosis of the bone marrow. It accounts for less than 10% of plasma cell tumours. The disease may affect any part of theskeleton, but is most commonly found in the spinal column, the hips, long bones and skull[3]. Although oral cavity is rarely affected, the common oral site involved is retromolar area of the mandible.

Clinical presentation

A 69 year old female reported to the Department of Oral Pathology with the primary complaint of swelling in right posterior mandible of ten months duration and mobility of lower right molar tooth. She also complained local

Fig.1: Swelling on right side of face

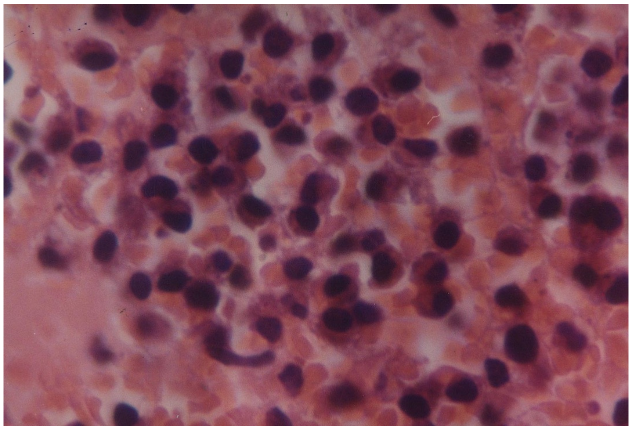

Fig. 2: HPE - diffuse round/ ovoid cells with eccentric nucleus (H&E, 40x)

redness and pain in that region. Medical and dental histories were non-contributory, except for diabetes mellitus.

On clinical examination, a hard, bony swelling of size 4 x 4 x 2 cm extending from the canine to the molar region on the right side of mandible was present. The swelling was covered by normal mucosa. The teeth 44, 45, 47 and 48 were previously extracted, and 46 showed grade III mobility. There was bucco-lingual cortical plate expansion and paraesthesia of lower lip on the right side. Extraorally, a diffuse swelling extending from the angle of the mandible to the symphyseal region was evident (Fig. 1). OPG revealed an osteolytic area with ill-defined borders extending from the premolar to the second molar region. Buccolingual expansion without destruction of the cortical plates was also observed in the occlusal radiograph.

A bone survey was done which excluded involvement of disease in any other bone. Bone marrow puncture and serum electrophoresis were normal. Aspiration cytology showed sheets of plasma cells with abundant cytoplasm and eccentric nucleus. Biopsy was performed and the H & E section consisted of diffuse sheets of plasma cells with eccentric nucleus and typical peripheral beading of the chromatin. Some of the cells showed pleomorphism, mitotic figures and binucleation (Fig. 2). Connective tissue stroma was scanty. Based on clinical and histopathological examination (HPE) findings a diagnosis of plasmacytoma was made.

Discussion

Plasma cells are the basis for our humoral immunity, the arm of the immune system that uses secreted and circulating antibodies to neutralize abnormal or intrusive substances. As fully mature B-lymphocytes, plasma cells have acquired the complex skill of producing immunoglobulin molecules, better known as antibodies. Plasma cell neoplasms are characterized by neoplastic proliferation of plasma cells involved in the production and secretion of monoclonal immunoglobulins (M proteins). Multiple myeloma is a systemic malignant disease and is associated with a poor prognosis. It is generally a disseminated disease involving many bones. Systemic symptoms include bone pain, pathologic fracture, renal failure, hypercalcemia, weight loss, anemia, thrombocytopenia, and neutropenia[4].

Solitary plasmacytoma is a localized lesion limited to a single bone and constitutes approximately three percent of all plasma cell containing tumours. The patients' age in studies ranged from 34 to 76 years, with a mean of 53 years. It is more prevalent in males than females[5,6], the ratio being 2:1. The common site is long bones; jaws being a rare site. Four percent of the solitary plasmacytomas occur in the mandible. It commonly presents as pain and swelling in the jaws, other symptoms being haemorrhage, paraesthesia, mobility and migration of teeth and pathological fractures. A study by Pisano *et al.,*[7] on 13 cases of solitary plasmacytoma showed that nine lesions were located posterior to the premolars, and only one case was anterior but distal to the canine. The case presented here confirmed to the common age and site trends. Radiological appearance of solitary plasmacytoma may have one of two patterns, as either an oval-shaped lytic image with destruction of the cortical bone, or as a unilocular or multilocular lesion showing expansion of cortical bone.

Extramedullary plasmacytoma are common in the upper aerodigestive tract and can present with swelling, headache, nasal discharge, epistaxis, hoarseness, dysphonia, dysphagia, and haemoptysis. In the oral cavity, it may be described as sessile or polypoid reddish masses in the mucous membrane.

Histopathologically, all plasma cell neoplasms have common features and are indistinguishable from one another. Sheets of bland, round or ovoid cells with eccentrically placed nucleus exhibiting a 'cartwheel' pattern of chromatin and a perinuclear halo are present. Because plasmacytic infiltrates are quite common in the jaws, particularly in response to odontogenic infections, differentiation of these lesions from plasma cell neoplasms pose a diagnostic difficulty. In inflammatory lesions, other leukocytes are also encountered and the stroma is collagenous. In plasma cell neoplasms the cell population is monoclonal and usually homogeneous[8].

The protocol of the treatment of plasma cell neoplasms depends on the stage of the disease. The standard treatment, given for multiple myeloma consists generally of intermittent administration of an alkylating agent and prednisone. The response rate is around 50% and mean survival after treatment is between 18 and 30 months[9].

The treatment of choice for solitary bone plasmacytoma is radiotherapy, surgical resection or a combination of the two. Cases of solitary plasmacytoma must be followed up with routine laboratory monitoring of the immunoglobulins and monoclonal proteins in serum, and Bence Jones proteins in urine because of its possibility of transformation into disseminated disease. Extramedullary plasmacytoma is a highly radio sensitive tumour. Therefore the treatment of choice, when the location of the lesion is well-defined, is radiotherapy[10].

Conclusion

Plasma cell neoplasms are a group of lymphoid neoplasms that are clinically and histopathologically similar. Distinguishing one from the other is critical to treatment and survival. Since solitary plasmacytoma is a well known precursor of multiple myeloma, a high index of suspicion is essential for the early diagnosis and appropriate intervention. Patients need a very systematic and regular, lifelong, follow up.

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CASE REPORT

Perioral piercing posing radiographic diagnostic challenge in periapical pathologies

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Abstract

Awareness of the existence of nose and other facial piercings is very important to avoid wrong diagnosis and mismanagement of patients while interpreting intraoral and extraoral radiographs. In the present case the patient was wearing a nose stud on the ala of the left nostril. The diagnostic intraoral periapical radiograph revealed a dumb-bell shaped periapical radio-opacity, measuring around three millimeters in diameter with well defined borders, in relation to the left maxillary central incisor. The accidental association warns us that a radiograph, however conclusive though the appearance may be, could become only an adjunct to confirm the clinical diagnosis.

Key words: Intraoral periapical radiograph, Periapical radio-opacity, Nose piercing

Introduction

Any radiographic examination with respect to oral examination should always be preceded by a thorough clinical examination, during which the clinician should make a note of all facial piercings/ ornaments and their location in the patient's case record to avoid the possibility of a radiographic mis-diagnosis. Patients should be instructed to remove all metallic ornaments and piercings in the area of interest prior to taking dental radiographs. Questions prompting the patient to disclose the existence of any perioral/ facial piercings should be incorporated in the history prior to making a radiographic diagnosis.

Clinical presentation

A female patient, aged 46, reported to Pushpagiri College of Dental Sciences for replacing two unsightly metal ceramic crowns with ceramic chipped off, displaying metal, in relation to maxillary right and left central incisors. The crowns were placed ten years back for cosmetic reasons.

Diagnostic intraoral periapical (IOPA) radiograph of the concerned teeth was taken to rule out any periapical pathology and a dumb-bell shaped periapical radio opacity, measuring around three millimetres in diameter with well defined borders was seen in relation to the left maxillary central incisor (Fig. 1).

The nose stud on the ala of the left nostril was responsible for the radiodense shadow in the periapical region of the left maxillary central incisor (Fig. 2). This tooth was asymptomatic and routine prosthodontic replacement with metal free ceramic crown was carried out (Fig. 3). The finding could have been misdiagnosed as a case of condensing osteitis, necessitating a root canal treatment in the left maxillary incisor. Three months of post-treatment follow up review was uneventful.

Fig. 1: Dumb-bell shaped radio-opacity in radiograph
Fig. 2: Nose stud producing the shadow
Fig. 3: Metal free crown on 21 intraorally

Fig. 4: Periapical radiolucency in IOPA radiograph
Fig. 5: Periapical granuloma in the extracted tooth

Fig. 6: Peri-apical opacity in IOPA radiograph

Discussion

Intraoral radiography is a vital tool in oral diagnosis besides being of diagnostic value in otolaryngology. Various types like IOPA radiographs, occlusal radiographs and bite wings are available, of which IOPA radiography that shows the tooth and the periapical or periradicular area[1] is the most frequently used. It is routinely used in diagnosing periapical pathologies and in root canal treatment.

Various periapical pathologies like periapical cyst, granuloma, abscess, etc., appear as periapical radiolucencies in IOPA radiographs (Fig. 4). A grossly decayed tooth with a periapical lesion immediately after extraction is shown in Fig. 5. Condensing osteitis, periapical cemental dysplasia etc appear as periapical radioopacities (Fig. 6). Many of these lesions can be varyingly symptomatic or asymptomatic at a given point of time.[2]

In CT scan, patients are instructed to remove their ornaments to avoid scattering of the radiation and subsequent ruining of the images[3]. But in dental radiography, piercings don't really affect the quality of images, but form radio opaque images which may lead to wrong interpretations when they are visible in the area of interest or at times can obscure certain pathologies[4]. Hence it is recommended to remove all the ornaments and piercings prior to taking dental radiographs.

It should also be kept in mind that a radiograph is only an adjunct to confirm the clinical diagnosis and should always be preceded by a thorough clinical examination, during which the clinician should make a note of all facial piercings/ ornaments and their location in the patient's case record to avoid the possibility of a radiographic misdiagnosis. Incidence of a misdiagnosis or not diagnosed for Periapical granuloma is 7% and radicular cyst it is 6%.[5] When further clarification is required a histological confirmation should not be hesitated upon.

Radiographic misdiagnosis of secondary caries due to the radiopacity of the restorative material has been recorded[6]. Furusawa M *et al.,*[7] reported a case of apical fenestration misdiagnosed as persistent apical periodontitis in radiographs and tried unsuccessfully to manage with repeated root canal treatment. Also various radiographic imaging techniques rather than a single modality may be used to confirm the diagnosis in case of unconventional findings. Patients who have treatment resistant sinusitis-like complaints and opacity of maxillary sinus in Water's view should be evaluated with respect to the presence of ectopic tooth. Panoramic radiographs followed by CT may be used to evaluate the ectopic tooth in the maxillary sinus[8]. The structure of tooth can be clearly detected on orthopantomograph.

Dislodgement of the nose stud or its parts and its entrapment inside the body may happen during dental imaging procedures which may lead to unforeseen complications.[9] Clinician should be careful to avoid dislodgement of parts of the nose stud if removal of the stud prior to imaging is not possible. Any unexpected radioopacity or a radiolucency should not be construed as a lesion and the clinician should approach any radiograph with an informed, evidence based and open mindset.

Conclusion

The case discussed here highlights the fact that knowledge of nose and other facial piercings and relevant socio-cultural norms is essential for a clinician to arrive at a proper diagnosis while interpreting intraoral and extraoral radiographs. Awareness of their existence is important to avoid wrong diagnosis and mismanagement of these patients. Patients may be instructed to remove all the removable ornaments and piercings in the area of interest prior to taking dental radiographs. The clinician should make a note of these piercings and their location in the patient's case record and radiographic examination should always be preceded by a thorough clinical examination.

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CLINICAL TIP

Incorrect restorations affecting the duration of orthodontic treatment

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Abstract

In malocclusion due to crowding of teeth, in patients whom the teeth had been previously restored with composite resin, it sometimes becomes difficult to differentiate between the tooth and the restoration. When such carious teeth are in the midline and the crowding is due to the overlapping of an incisor over the other, proper restoration becomes challenging. This could even have led to the fusion of the adjacent composite fillings with each other, if the proper technique had not been followed. In such cases orthodontic treatment to correct the crowding becomes difficult, and in effect it will strain the anchorage if the problem is not identified and rectified early. Correcting the faulty proximal contact can help such a situation during orthodontic treatment. Crowding will be spontaneously corrected due to the stretched gingival fibers as a result of the already applied orthodontic force. This clinical report emphasizes on the importance of clinical examination as well as proper restoration of carious overlapped teeth.

Key words: Composite resin, Anchorage, Orthodontic treatment, Crowding of teeth

Introduction

Irregular, crowded and protruding teeth have always been a problem faced by a substantial number of people in the general population. The indications for orthodontic treatment include psychosocial, developmental, physiological, trauma/ disease control and adjunctive treatment[1]. Apart from aesthetic and psychological reasons crowding of teeth can also lead to pathological conditions like carious teeth, periodontal diseases etc.

In cases where restorations are carried out on crowded anterior teeth due to dental caries, the material of choice is composite resin. This is mainly due to aesthetic aspect of the composite restorative material[5,6]. In the clinical scenarios, sometimes it becomes difficult to differentiate between the restoration and the tooth due to the excellent shade match of the composite resin. Cases where the crowding is due to the overlapping of incisors, there is a high chance of the incisors becoming carious; these lesions are most commonly found on the mesial aspect. Rarely incorrect restorations will lead to the composite from both the teeth sticking together. This is also difficult to distinguish radiographically since there is an overlap of the teeth. When specific Orthodontic treatment is initiated it becomes difficult to correct thecrowding due to the joined restorations. This will strain the posterior teeth, which are the anchorage units. The removal of this connection of two adjacent teeth by composite resin will spontaneously correct the overlapping due to stretched gingival fibers by the already applied orthodontic force.

Fig. 1: Proclined, teeth, overlapped central incisors
Fig. 2: Connected restoration of 11, 21
Fig. 3: Spontaneous correction on removing connection

Clinical presentation

An adult patient came for the correction of proclined as well as crowded upper anterior teeth. On examination the central incisors were found to be overlapping (Fig. 1).

It was decided to do orthodontic treatment by fixed appliance after the extraction of upper first premolars. Since there was severe crowding and increased overjet, it was decided to give transpalatal arch[2] (TPA) and also band the second molars for the conservation of anchorage[3,4].

After few months of application of orthodontic force for leveling and aligning, the 11 and 21 were not aligned in spite of the other teeth being aligned. This led to re-evaluation and it was found that the 11 and 21 were restored with composite resin for mesial interdental caries (Fig. 2) and were connected to each other. This may have been due to difficulty to restore the teeth as an independent unit at the time of restoration due to overlapping of the same. The connection of the composite restoration between 11 and 21 was removed and the crowding got spontaneously corrected (Fig. 3) due to the already stretched gingival fibers.

Conclusion

The clinician may overlook such a clinical situation due to the overlapping of such teeth and the difficulty in distinguishing it radiographically. In clinical conditions where maximum anchorage is required, loss of anchorage may result from such improper restorations. Due diligence in such cases will shorten the duration of treatment.

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CLINICAL TIP

A modified direct technique for fabrication of custom-made single provisional restoration

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Abstract

This article describes the fabrication of custom-made single crown provisional restoration by a modified direct technique. An intraoral wax pattern of the prepared tooth is made using the functionally generated path technique. Then the custom single provisional crown was fabricated from a matrix of silicone putty made of prepared tooth with intraoral wax pattern.

Key words: Provisional restoration, Direct technique, Functionally generated path technique

Introduction

In fixed prosthodontics the role of provisional restoration is very crucial for maintaining the patient's oral health till a definite restoration is cemented[1]. Provisional restoration protects the teeth from sensitivity and pulpal irritation and should be smooth, properly contoured and have a good marginal fit for maintaining proper oral tissue health[2,3]. It gives proper occlusal compatibility, tooth position, physiologic proximal and occlusal contact and protection against tooth fracture. It also resists occlusal loads and prevents displacement of restoration by a closely adapted internal surface[4]. So the provisional restoration is a replica of the final design of a definite restoration.

Provisional restorations can be classified by the method used for adapting the restoration to the teeth[5,6].

1. Direct technique is done on the prepared teeth in the mouth with the use of an overimpression or matrix
2. Indirect technique is done outside the mouth on a cast.
3. A combination indirect-direct technique is also used which involves fabrication of a preformed shell relined intraorally.

In cases where the patient presents with tooth preparation already being done and without a temporary, the prepared tooth is built up with the carding wax and acrylic tooth is placed in the area of missing tooth. Then an impression is made and is used to fabricate the temporary restoration[7]. There are several materials available for fabrication of single provisional crowns. These include prefabricated metal crowns, polycarbonate crowns, celluloid crowns, composite resin crowns, acrylic resin for custom provisionals, bis-acryl or bis-GMA automix composite resin materials, and composite resin for custom fabrication. *Bis-acryl resin composites* are very useful due to its ease of use, minimal shrinkage, and low exothermic reaction.

A more accurate mixing, due to the cartridge dispensing system, may contribute to improved marginal fit8. Technique for custom provisional restoration using direct technique requires an alginate or elastomeric over-impression to adapt the provisional restoration. The over-impression is made in the mouth or on a cast before the tooth preparation is begun. This article describes a modification in the direct technique for fabrication of a

Fig. 1: Excursive movements recorded in wax pattern
Fig. 2: Overcontoured buccal & lingual walls carved
Fig. 3: Finished intraoral wax pattern

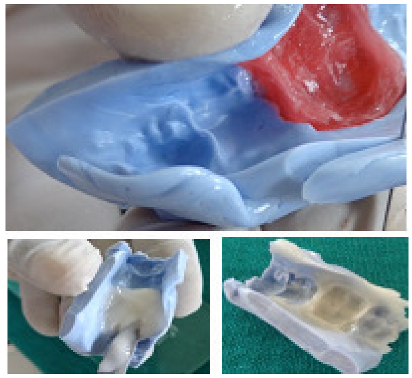

Fig. 4: Silicone putty index made
Fig. 5: Bis-acryl composite resin processing
Fig. 6: Cured Bis-acryl composite resin crown

Fig. 7: Provisional restoration checked for marginal fit
Fig. 8: Assessment for occlusal interferences
Fig. 9: Cemented provisional restoration

custom single provisional crown using Bis-acryl composite resin (Protemp 11 ESPE-Premier).

This technique is useful when a matrix or over-impression is forgotten to be made prior to tooth preparation. Also this technique can be used when there is insufficient time for fabrication of a using the indirect technique, which needs a cast and lengthy laboratory procedures. A functionally generated path technique is used here9,10. The pathway of the teeth opposed to the prepared tooth for complete cast crown is recorded throughout all functional movements of the mandible. The custom made single provisional crown may thus be positioned and formed so that it will remain in harmonious contact with its antagonist at all times.

Procedure

Tooth preparation was done for complete cast crown in the usual manner. After preparation, modelling wax was cut to a size of 2.5 x 2.5 cm and softened in a water bath at sixty degrees. The softened wax was moulded and placed on the prepared tooth and the patient was asked to close on the wax in centric occlusion relation. After that right and left lateral and protrusive movements were also recorded in the softened wax (Fig. 1).

The recording produced in the wax is a negative record of the movement of opposing teeth. So there will be harmonious contact with the antagonists at all times. The obtained intraoral wax pattern was removed from the mouth and placed in cold water for proper hardening. The overcontoured buccal and lingual walls were carved upto the margin using a heated lecrons carver (Fig. 2). The finished intraoral wax pattern with functionally generated pathway was placed back on prepared tooth (Fig. 3).

An elastomeric overimpression/ silicone putty index of the prepared tooth with intraoral wax pattern. The silicone putty index was removed and checked for completeness (Fig. 4). The abutments and the surrounding gingiva were lightly lubricated with petrolatum. The provisional restorative material Bis-acryl composite resin (Protemp 11 ESPE-Premier) was then mixed and placed in the tissue surface of the index, and reseated on the prepared tooth (Fig. 5). The composite resin record was removed and replaced a few times during the curing process to minimize the effect of the exothermic heat on the abutments. After polymerization the cured Bis-acryl composite resin crown was removed from the putty index (Fig. 6). The excess material was trimmed using acrylic burs.

The finished provisional restoration was placed on the prepared tooth and checked for marginal fit (Fig. 7). Then the patient was asked to close in centric occlusion and was assessed for occlusal interferences using articulating paper. The interferences were corrected using carbide burs. Then the same was repeated for lateral and protrusive interferences (Fig. 8). Carbide burs and diamond stones were used to roughly finish the contour and form of the provisional restoration. Polishing of the outer surface of the restoration was done with pumice and polishing compound. The crown was cemented with a non-eugenol provisional cement (RelyX Temporary NE 3M ESPE) (Fig. 9). Set temporary cement was removed using an explorer, and interproximally using dental floss.

The completed Protemp crown provides for positional stability of tooth preparation, contour and gingival adaptation consistent with gingival health, aesthetics and wear resistance.

Conclusion

When a matrix is forgotten to be made prior to preparation of tooth for custom made single crown provisional restoration which is required for the direct technique, or if there is insufficient time for using indirect technique, a modification of the direct technique can be made. This article describes a technique where an intraoral wax pattern of the prepared tooth is made using the functionally generated path technique. Then the custom single provisional crown was fabricated from a matrix of silicone putty made of prepared tooth with intraoral wax pattern which was then cemented with provisional cement. This technique is time saving and easy to fabricate, and is also cost effective.

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