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Editorial

Our journal Vol. 1 Issue III October – December 2014 is in your hand and ready to be circulated and read.

I am pretty sure that you are forced to turn the pages as many times as possible due to its style of presentation and freshness in its contents before it is being kept in abeyance.

I am happy to note that contents are highly influential not only for any aspirant in publication, but also for a budding professional to rekindle new ideas for publication and new vistas for research. It can also lead to new approaches for treatment planning, analyzing data and arriving at new treatment options which can be adopted and modified as the clinical situation demands through problem solving.

Thus our journal will be a permanent platform for presenting and sharing the new ideas achieved by evidences through experience in solving problems which is applicable to any specialty of the discipline. A multispecialty team approach for better management of the clinical situation demanded can be initiated and brought into practice by going through the articles. The ultimate aim is refining and updating of the professional himself and profession as whole and finally benefited for the public in general.

I appreciate and congratulate the contributors for continuously and constantly supplying the vital element of our journal for the timely publication and circulation maintaining the integrity in its standards and quality of contents.

With warm regards,

Dr. Kunjamma Thomas
Chief Editor

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SPECTROPHOTOMETRIC ANALYSIS OF CORONAL DISCOLOURATION INDUCED BY WHITE MTA AND BIODENTINE-AN IN VITRO STUDY

* Dr. Sheejith M, **Dr. Bhavya Sheejith, ***Dr. Kunjamma Thomas, ****Dr. Elsy Bijoy

Abstract

Aim: Tooth discoloration induced by endodontic materials may impair the aesthetic outcome of endodontically treated teeth. The aim of this study was to evaluate the specific chromatic alterations in tooth crowns induced by two endodontic restorative materials.

Materials and methods: 45 freshly extracted, fully developed, single rooted teeth were prepared and randomly assigned to two experimental groups (n = 15 each) and one negative control group (n = 15). Group 1 consists of White mineral trioxide aggregate and Biodentine formed Group 2, and controls formed Group 3. Double-beam UV spectrophotometer equipped with an integrating sphere was used to assess the coronal discolouration as determined by CIE L*, a* and b* and their corresponding total values.

Results: At baseline, no significant difference was detected for CIE values between the groups. Group 1 showed significant decrease in L*, a* and b* values over time. The colour change with White MTA led to clinically perceptible crown discolouration after 6 weeks which exceeded the perceptible threshold for the human eye i.e., $\Delta E > 3.5$.

Conclusions: White MTA induced clinically perceptible crown discolouration whereas Biodentine demonstrated colour stability. Materials used in endodontics may stain teeth; therefore, the choice of material should not rely solely on biological and functional criteria but also take aesthetic considerations into account.

Key words: tooth discolouration, endodontic restorative materials, spectrophotometry

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Introduction

Tooth discoloration induced by endodontic materials is a common finding and may impair the aesthetic outcome of endodontically treated teeth.¹⁻⁴ A major etiological factor for this occurrence is the presence of root canal filling materials in contact with the coronal dentin of the pulp

chamber. Any change in the optical and chromatic properties of the dentinal structure is likely to cause an alteration in the outward appearance of the crown caused by its light transmitting and reflecting properties.

Mineral trioxide aggregate (MTA) is a biomaterial that has been investigated for endodontic applications since the early 1990s.

In both animal and human studies, MTA materials have shown to have excellent potential as pulp-capping and pulpotomy medicaments. Although high success rates are reported, a number of cases of discoloration have also been noted.

Biodentine is a calcium silicate based product which became commercially available in 2009. The material is actually formulated using the MTA-based cement technology with improvement in some properties of these types of cements, such as physical qualities and handling. It is indicated for crown and root dentin repair treatment, indirect and direct pulp capping, pulpotomy, repair of perforations or resorptions, apexification, and root-end fillings.

Several case reports reveal discoloration produced by MTA. However, there is only one study documenting severe discoloration caused by biodentine. The aim of this study was to evaluate the specific chromatic alterations in tooth crowns induced by White MTA (Angelus, Londrina, Brazil) and Biodentine (Septodont, France) repair materials.

Materials and Methods

45 freshly extracted, fully developed, single rooted teeth that were free of cracks, fractures, caries, abrasions and discolouration because of systemic intrinsic causes were selected. Soft tissue was removed, and teeth were sectioned in the coronal third of the root complex, 1 mm below the cemento-enamel junction (CEJ). Pulpes were extirpated with an excavator, and the internal axial walls of the pulp chambers were chemo-mechanically

debrided with Hedstrom files (sizes 60–80) and 2.5%w/w sodium hypochlorite (10 mL) through the access. After final irrigation, the pulp chambers were washed with sterile saline (5 mL). The teeth were randomly assigned to two experimental groups ($n = 15$ each) and one negative control group ($n = 15$). (Fig 1)

Fig 1: Sectioning done at the CEJ



In the two experimental groups, Group 1 consists of White mineral trioxide aggregate (WMTA) (Angelus™, Londrina, Brazil) and Biodentine (Septodont, France) formed Group 2. (Fig 2 & 3 respectively). All the negative controls (Group 3) were instrumented and kept unfilled (Fig 4). Materials were prepared according to the manufacturer's instructions and placed into the pulp chambers with a Dovgan carrier (Quality Aspirators, Duncaville, TX, USA) through the access.

A slight vertical pressure was applied with finger pluggers to fill the pulp chamber with the material, up to the cervical sectioning level (Fig 5&6 respectively). All the crowns were transferred and stored in individual tubes containing distilled water and placed in an incubator at $37 \pm 1^\circ\text{C}$.

Fig 2 : Group 1 (N=15)



Fig 3 : Group 2 (N=15)



Fig 4 : Group 3(N=15)

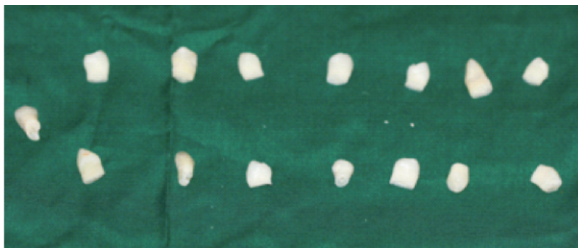


**Fig 5: White MTA
(AngelusTM, Londrina, Brazil)**



Fig 6: Biodentine(Septodont, France)



Measurement of crown chromatic alterations

Double-beam UV spectrophotometer equipped with an integrating sphere (Colorflex, Hunterlab, USA) was used in this study(Fig 7). The spectrophotometer was equipped with a black Bakelite sample assembly. The cylindrical inner frame (diameter-2 cm, inner height-0.2 cm) of the sample assembly was filled with black monochromatic thermo-plasticized silicone. The specimens were positioned in the circular opening of the integrating sphere's aperture mask according to a reference system to ensure the reproducibility of specimen's position. The spectrophotometer was connected to a computer, which recorded the spectral reflectance curves of the measured surfaces in the visual spectrum (380–780 nm).The double-beam integrating sphere was set to measure the intensity of spectral reflectance (R). The emitted light was directed towards the specimen. The reflected portion was collected in the integration sphere, normalized to the source light of the reflectance and calibrated with the measurement of a pure white standard (100%

reflection) over the entire wavelength spectrum of visible light. The colour appearance of the buccal surface of each crown was measured to simulate its appearance clinically.

Reflectance spectra were related to colour using the International Commission on Illumination [Commission Internationale de l'Eclairage] CIE values - L^* , a^* and b^* colour space. Using appropriate software (Color Analysis UV-2401PC), the spectral curves were transformed into L^* , a^* and b^* values of the colour space. L^* values represent lightness, on a continuous scale from black (0) to white (100), a^* values represent red (+80 a^*) to green (-80 a^*) and b^* values represent yellow (+80 b^*) to blue (-80 b^*) colour variations. Total colour differences (ΔE) were calculated according to the following equation: $\Delta E = [(L_i - L_0)^2 + (a_i - a_0)^2 + (b_i - b_0)^2]^{1/2}$.

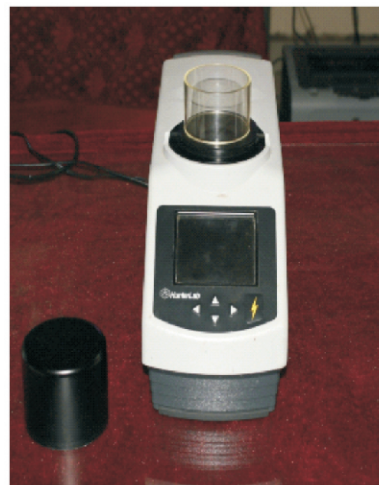
The proposed limit for colour matching adopted in this study was set at 3.5 ΔE units (perceptibility threshold). Differences beyond this were considered clinically perceptible. Measurements were carried out by the same operator prior to material placement i.e. at baseline and at 2 weeks, 4 weeks and 6 weeks after material placement.

Statistical analysis

Two-way ANOVA with repeated measurements was used for data analysis of CIE L^* , a^* and b^* chromatic parameters and total colour differences (ΔE). The effects and interactions of the experimental factors were investigated with pair wise between-group and within-group comparisons, which were

conducted with Bonferroni's method. The overall analysis was performed with SPSS Software. The level of statistical significance was set to $p < 0.05$.

Fig 7: Spectrophotometer



Results

The mean values of the CIE L^* , a^* and b^* parameters for Groups are presented in Table 1. At baseline, no significant difference was detected for L^* , a^* and b^* parameters between the groups.

Group 1 showed significant decrease in L^* , a^* and b^* values. With regard to the alterations in L^* parameter, a significant decrease was measured in WMTA experimental group. The alterations observed in the WMTA group were significantly greater compared with the Biodentine group [intergroup L^* (6 weeks) Biodentine-WMTA = 3.02 $P < 0.009$]. Regarding a^* and b^* chromatic parameters, a significant decrease was also measured in both experimental groups. The colour change with White MTA led to clinically perceptible crown discolouration after 6 weeks which exceeded the perceptible threshold for the human eye i.e., $\Delta E > 3.5$. (Table 2).

Table 1: CIE Lab values of the groups (Mean±SD)

Time line	Group 1 White MTA			Group 2 Biodentine			Group 3 Control		
	?L	?a	?b	?L	?a	?b	?L	?a	?b
Base line	84.55 (2.22)	0.42 (0.74)	20.62 (3.11)	85.93 (2.44)	0.45 (0.80)	21.59 (1.96)	84.55 (2.22)	0.42 (0.74)	20.62 (2.66)
2 weeks	84.12 (2.86)	0.12 (0.75)	21.68 (2.04)	84.77 (2.26)	0.39 (0.66)	20.33 (2.89)	84.64 (2.78)	0.40 (0.54)	20.54 (2.04)
4 weeks	82.80 (2.81)	0.20 (0.67)	20.92 (2.12)	84.48 (2.34)	0.38 (0.73)	20.49 (2.94)	85.09 (2.62)	0.42 (0.34)	20.92 (2.12)
6 weeks	81.53 (2.64)	0.37 (0.42)	19.63 (2.01)	84.55 (2.17)	0.41 (0.73)	20.57 (3.08)	84.53 (3.08)	0.37 (0.65)	20.55 (2.01)

Table 2: The mean values for color change (ΔE)

Time line	Group 1(ΔE)	Group 2(ΔE)	Group 3(ΔE)
2 weeks	1.45	0.51	0.56
4 weeks	3.07	0.61	0.54
6 weeks	3.64	0.58	0.55

Discussion

The results of this study indicate that MTA formulations induced significant colour changes in WMTA group, ΔE values ranged between 3 and 3.6 units, in the last 6 weeks, and slightly exceeded the perceptibility threshold i.e; $?E > 3.5$. In a previous study, the same MTA formulation exceeded the perceptibility threshold after 3 months.⁵

Direct comparisons cannot be performed because of the different experimental methodologies, including the colorimetric method of measurement, the material application method and the sample selection.

With regard to the alterations in L^* parameter, a significant decrease was measured in group 1 and this was significantly greater compared with the group 2 [intergroup $L^*(6 \text{ weeks})$ Biodentine-WMTA = 3.02 $P < 0.009$]. In terms of visual perception, the descriptive analysis of L^* values indicates a darkening effect in tooth crowns.

This clinical observation has been highlighted already in several clinical studies. When WMTA was applied in the aesthetic zone for conservative pulp therapy, apexification, treatment of horizontal root

fractures, internal root resorption and revascularization procedures, a dark tooth stain in the neck of the crowns was a common macroscopic finding.⁶⁻¹¹

Regarding a^* and b^* chromatic parameters, a significant decrease was also measured in both experimental groups. The alterations observed in the WMTA group were significantly greater compared with the other two groups. In terms of visual perception, the descriptive analysis of a^* and b^* values indicates a reduction in redness and yellowness, thus an increasing tendency towards green and blue, respectively.

The mechanism of MTA-induced discolouration has not been elucidated. MTA is a bioactive silicate that consists of hydrophilic particles, whose principal components are tricalcium silicate, dicalcium silicate–tricalcium aluminate, tricalcium oxide, bismuth and iron compounds. MTA application (white) for pulp capping or pulpotomy can lead to tooth discoloration due to the presence of bismuth oxide. It has been reported that Bi_2O_3 undergoes thermal dissociation at high temperature, which yields metallic bismuth and oxygen. The reduced dark crystals of bismuth atoms are responsible for the darkening of the sample, and the presence of these crystals has been identified by x-ray diffraction.⁹

After contamination of the specimens with blood, all Portland cement-based materials showed an increased discoloration. The microstructure of the materials shows pH dependent porosities. These porosities may uptake blood components and may be

responsible for the observed discoloration. This is of clinical relevance because Portland cement-based materials are usually placed in direct contact to vital, vascularized tissue. Thus, the development of biocompatible materials with a reduced porosity level may be beneficial.

Biodentine does not contain bismuth oxide. Thus, in aesthetic area, Biodentine may be more suitable than MTA.¹² One study¹³ evaluated Biodentine along with 4 different materials, in different oxygen and light conditions and spectrophotometric analysis was performed at different periods until 5 days. Favorable results were obtained for Portland Cement and Biodentine on color stability. Biodentine could serve as an alternative for use under light-cured restorative materials in areas that are esthetically sensitive.

The results of this study indicate that White MTA is associated with chromogenic effects. The application of WMTA in pulp chamber in the aesthetic zone should be avoided, whilst Biodentine should be used with caution. Further investigation is required for the determination of the etiology of MTA-induced discolouration in association with its chemical constitution.

Conclusion

Within the limitations of this ex vivo study, White MTA induced clinically perceptible crown discolouration from the first week of application, whereas Biodentine demonstrated colour stability. Materials used in endodontics may stain teeth; therefore, the choice of material should not rely solely on

biological and functional criteria but also take aesthetic considerations into account.

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THE ESTHETIC APPROACH TO THE MANAGEMENT OF NON SYNDROME ASSOCIATED MULTIPLE SUPERNUMERARY TEETH AND ODONTOME IN A MIDDLE AGED FEMALE

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Abstract

A clinically missing tooth imparts challenge for the clinician in diagnosis and treatment planning. Supernumerary teeth like mesiodens are mostly seen in the maxillary anterior, while Odontomes appear anywhere in maxilla and mandible and may not be associated especially with supernumerary teeth. This case report highlights two situations which have not been documented in literature previously. One being the combination of the rare occurrence of non syndrome multiple supernumerary teeth in middle aged individual, along with the simultaneous presence of mesiodens and odontomes in the same site. The article also focuses on the interdisciplinary management of the case.

Key words: Impaction, supernumerary tooth, mesioden, odontome, treatment

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Introduction

A clinically missing tooth often imparts challenge for the clinician in diagnosis and treatment planning. Delayed eruption of teeth caused by the presence of one or more supernumerary teeth blocking the eruption path of maxillary central incisor is relatively common. Also, odontoma, a common odontogenic tumor may lead to interference with the eruption of its associated tooth. Supernumerary teeth like mesiodens are mostly seen in the maxillary anterior, while odontomes have been reported to appear anywhere in maxilla and mandible. They do not appear to be associated especially with supernumerary teeth as might be suggested

where it occurs with great frequency between the maxillary central incisors or distal to the maxillary third molar.

This case report highlights two situations which have not been documented in literature previously.^{1,2} One being the combination of the rare occurrence of non syndrome multiple supernumerary teeth in middle aged individual, along with the simultaneous presence of mesiodens and odontomes in the same site. The article also focuses on the interdisciplinary management of the case.

Case report

A 35 year old female reported to clinic for replacement of missing upper tooth (Fig 1). She gave a history of unerupted upper permanent tooth. There was no associated familial history of partial anodontia or supernumerary teeth in the family.

Fig 1: Pre treatment photograph



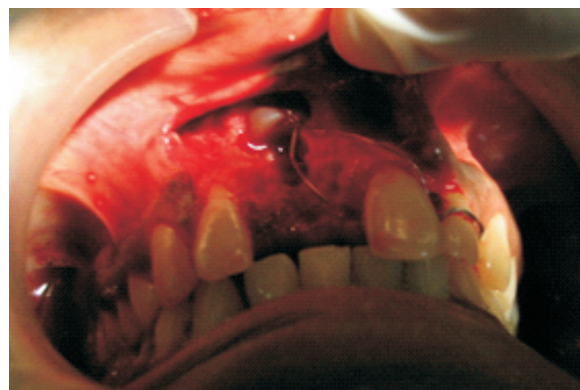
On examination, there was a missing maxillary right central incisor 11. IOPA X-ray of the site revealed the presence of multiple supernumerary teeth obliterating the path of eruption of 11. The incisor was impacted above the supernumeraries. The supernumeraries were diagnosed as mesiodens and odontomes (Fig 2). Since the patient was in her thirties, eruption of the incisor after the extraction of supernumeraries/odontomes could not be expected.³ Treatment was planned first to extract all supernumeraries/odontomes, engage the central incisor for orthodontic traction, occlusal rehabilitation and maintain the gingival health.

Fig 2: Pre operative IOPA X ray



Routine blood examination was carried out. A full thickness mucoperiosteal flap was elevated. The two mesiodens and six odontomes of various sizes were removed, and curettage was performed at the extraction site (Fig 3).

Fig 3: Intraoperative photograph



The incisal tip of the maxillary central incisor was engaged for bur hole. Ligature wire was looped through the hole for orthodontic

traction of 11(Fig 4). 1 week post operatively the site was found to heal uneventfully (Fig 5). Since the edentulous space between 21 and 12 was more than required for the erupting 11, it was decided to correct the diastema and maintain the occlusion of all teeth through orthodontic fixed appliance therapy.

Fig 4: Ligature wire looped on 11

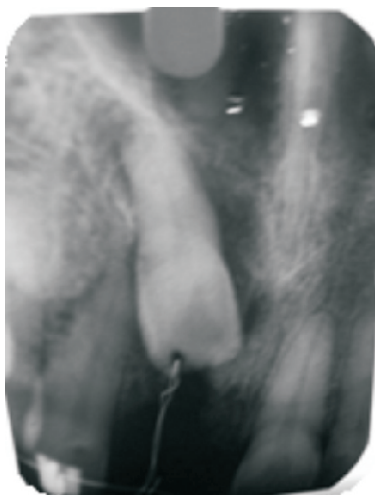


Fig 5: 1 week postoperative photograph



Beggs fixed appliance therapy was carried for the patient. 11 was brought to its original place, occlusal rehabilitation was done (Fig 6). After the completion of fixed appliance therapy, gingivoplasty was done palatally

from 13 to 23 to correct the pseudo pockets. Fixed retainer was placed palatally from 12 to 22 (Fig 7). Fixed retainer was positioned above the contact area taking into consideration the maintenance of good gingival health.

Endodontic treatment was carried out for 11, since it was found to be non vital. The bur hole was restored with composite. Strict oral hygiene instructions were given. The patient was instructed to report for review every 3 months for maintenance therapy. The patient was satisfied with the interdisciplinary esthetic oral rehabilitation (Fig 8).

Fig 6: Rehabilitation of 11



Fig 7: Fixed retainer placed



Fig 8: Post treatment photograph



Discussion

Supernumerary teeth may be defined as any teeth or tooth substance in excess of the usual configuration. They may occur singly, multiply, unilaterally, or bilaterally and in one or both jaws. They erupt normally or remain impacted; their presence leads to clinical problems like the interfere with normal occlusal development or with orthodontic mechanics, impaction, or delayed eruption of permanent teeth, malocclusion etc. In our case, supernumeraries caused delayed eruption and impaction of permanent tooth.

Supernumerary teeth are classified according to their morphology and location. Four different morphologic types seen in permanent dentition are: conical, tuberculate, supplementary, odontome.

The small peg-shaped conical tooth-mesiodens is most commonly seen in the permanent dentition. They usually occur singly and mostly located palatally between

the maxillary central incisors, tending to displace the erupting permanent central incisors. They often have a completely formed root. Tuberculate mesiodens are barrel-shaped, with several tubercles or cusps, and have incomplete or abnormal root formation. They can develop either unilaterally or bilaterally and are commonly associated with other supernumerary teeth.

Supplementary supernumerary refers to a duplication of teeth in normal series. The most common site is permanent maxillary lateral incisor. The majority of supernumerary teeth founds in primary dentition are supplementary type.

Odontome has been listed as the fourth type of supernumerary teeth by Howard.⁴ However, this category is not universally accepted. The term “odontome” refers to any tumour of odontogenic origin. Odontomes represent hamartomatous malformation rather than neoplasm. They are usually composed of more than one type of tissue – epithelial and mesenchymal, hence called composite odontomes. The cells exhibit differentiation to enamel and dentine, but they are laid down in abnormal patterns. If they resemble tooth structure, then such odontomes are called compound composite odontomes. If the calcified masses bear no morphologic similarity to teeth, then they are called complex composite odontomes.

The etiology of odontomes is unknown. There is no predilection for particular site in the oral cavity, although compound ones are mostly seen in anterior

sites and complex ones in the posterior sites. It does not appear to be associated especially with supernumerary teeth.

In the present case, we observed simultaneous occurrence of supernumerary mesiodens and odontomes. Also, the occurrence of multiple supernumerary teeth in this patient without any associated positive family history, systemic conditions or syndromes, however, is a rare phenomenon. Single supernumeraries occur in 76–86% of cases, double supernumeraries in 12–23% of cases, and multiple supernumeraries in less than 1% of cases.⁵

Early diagnosis of delayed eruption can minimize the treatment required and prevents development of associated problems. The clinician should obtain accurate radiographs. Extraction of the mesiodens in the early mixed dentition stage may facilitate spontaneous eruption and alignment of incisors, minimizing intervention, space loss and midline shift. Whereas for patients who report late for treatment like the middle aged female patient in this case, the incisors may not erupt spontaneously, so further surgical and orthodontic treatment may be required.

Dentists always need to play a crucial role identifying such cases and promptly planning and executing treatment for them in a most timely fashion.

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ARE YOU EQUIPPED FOR THE CHALLENGEΔ

*Dr.Manoj Kumar K. P, **Dr.Aswathi Vinod

Abstract

Personal protective equipments (PPE) aim at protection of all those who are vulnerable of acquiring infection both the operator as well as the patient. This article highlights both standard and expanded precautions with the correct order of donning and removing PPE, which is the key to protecting yourself and coworkers from contamination. Expanded precautions are used to supplement the standard precautions that should be practiced on all patients.

Key words: Personal protective equipments, standard precautions, expanded precautions

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Introduction

Personal protective equipments (PPEs) are specialized clothing or equipment worn by an employee for protection against infectious materials (OSHA). The main goal of aseptic technique is to protect the patient by preventing or minimizing postoperative infection by creating conditions and following procedures to prevent introduction of microbial contamination to sterile fields, sterile equipment and operating site.

Personal protective equipments aim at the protection of all those who are vulnerable of acquiring infection both the operator as well as the patient. Every patient you treat should be considered as immuno compromised patient and should follow all protocols that are followed when you treat a patient with aids or hepatitis.

PPE's that we commonly use include Gloves, Gowns, Goggles/Face Shield, and Particulate Respirator/Surgical Masks etc.

There are two types of precautions. They are the Standard (Formerly “Universal Precautions”) and the Expanded (Formerly “Transmission – Based Precautions”) precautions against contact, droplet and airborne infections. They are discussed in detail in this article.

STANDARD PRECAUTIONS

Wear gloves when touching blood, body fluids, secretions, excretions, contaminated items; make it a practice to wash hands (scrub) before examining patient (whether or not gloves will be worn) and after examining patient.

Scrubbing technique¹

The aim of surgical hand antisepsis is to remove debris and transient micro organisms, to reduce resident microorganisms to a minimum and to inhibit rapid rebound growth on the hands, nails and forearms of surgical personnel (AFPP 2011).

A daily shower, frequent hair washing and attention to hands and fingernails are most important. Finger nails should be kept short enough so that they are not visible over the tips of the fingers. Short nails are easy to keep clean, will not puncture gloves and should be free of any form of nail treatments or polish, wrist watches and jewellery of any kind (including dress rings and bangles) must not be worn.

The following section outlines the surgical hand antisepsis procedure.

1. Your initial scrub procedure should last 5 minutes.
2. Subsequent procedures last 3 minutes.
3. A clock should be provided for timing the scrub procedure.
4. If the scrub practitioners hands or arms accidentally touch the taps, sink or other unsterile object during any phase of the scrub cycle they are considered contaminated and the scrub cycle must begin again

Scrubbing areas other than the nails using the nail brush has shown to cause abrasions to the skin and should be avoided. Regulate the flow and temperature of the water. Open package containing nailbrush (Fig 1). Lie the brush on the back of the scrub sink still in the opened package. Wet hands and arms (Fig 2) for an initial prescrub wash. Use several drops of scrub solution, work up a heavy lather, then wash the hands and arms to the elbows. Rinse hands and arms thoroughly, allowing the water to run from the hands to the

elbows (Fig 3). Do not retrace or shake the hands and arms; let the water drip from the elbow.

Fig 1

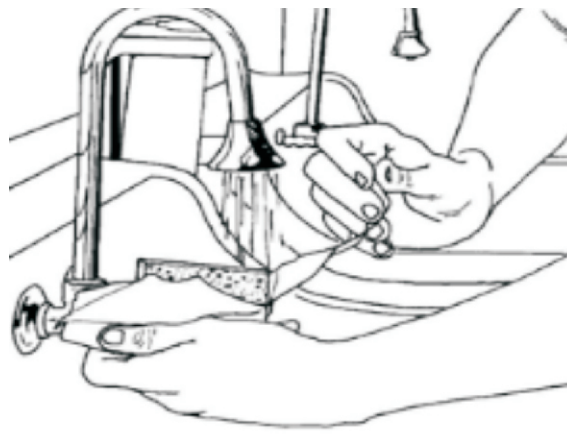
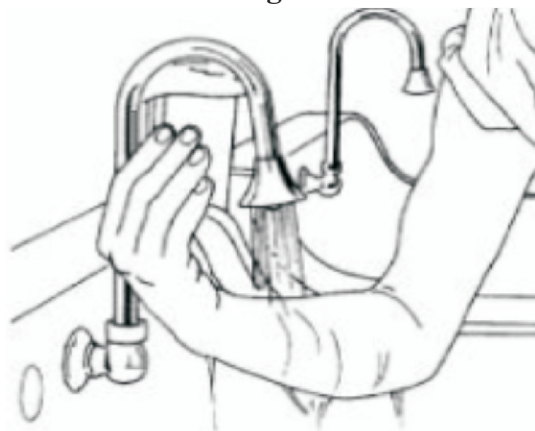


Fig 2



Fig 3



Remove the sterile brush and pick from opened package. Clean under nails with pick and discard (Fig4). Moisten brush and work up lather. Lather fingertips with the sponge-side of brush; then, using bristle side of brush, scrub the spaces under the fingernails of the right or left hand (Fig 5). Repeat for other hand.

Fig 4

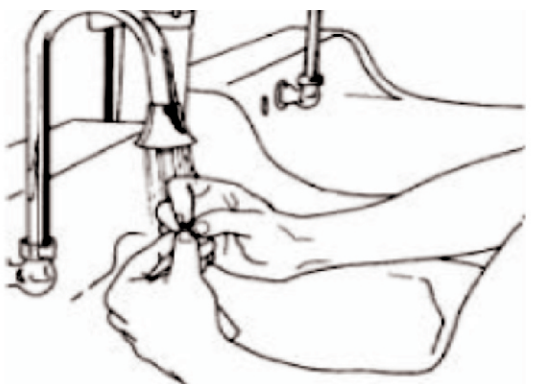


Fig 5



When scrubbing, the hands must remain above the level of the elbows and away from theatre attire to avoid contamination from splashing. Lather the fingers. Wash on all four sides of the fingers using the sponge side only (Fig 6).

Fig 6



The scrub procedure must follow the trust policy for hand decontamination ie;

1. Palm to palm
2. Right palm over left dorsum and left palm over right dorsum
3. Palm to palm fingers interlaced
4. Back of fingers to opposing palms with fingers interlocked
5. Rotational rubbing of right thumb clasped in left palm and vice versa

Rotational rubbing backwards and forwards with clasped fingers of right hand in left palm and vice versa.

Continue to wash the arms but encompassing only two thirds of the forearms to avoid compromising the cleanliness of the hands. Hands and arms must be rinsed thoroughly from fingertip to elbow without retracing, allowing the water to drip from the elbow before approaching the gown pack (Fig 7,8).

Pick up one hand towel from the top of the gown pack and step back from the table (Fig 9). Grasp the towel and open it fully. Do not allow the towel to touch any unsterile object or unsterile parts of your body. Hold your hands and arms above your elbow, and keep your arms away from your body (Fig 9).

Fig 7

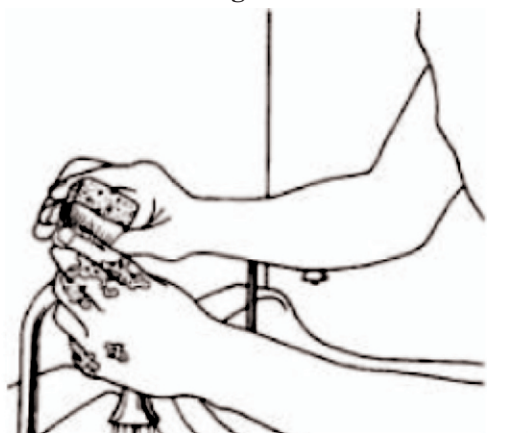


Fig 8



Holding one end of the towel with one hand dry the fingers of the opposite hand using a blotting rotational motion. Move to the dry area of the towel and continue in this manner down the forearm to the elbow. Do not retrace

any areas. Discard this towel in an appropriate receptacle. Repeat with the other towel from the pack for the other hand/arm (Fig10-12).

Fig 9



Fig 10-12



Donning of gloves:

Gloves act as a barrier to prevent transmission of infection between staff and patients. Surgical gloves must fit appropriately for comfort, dexterity and sensitivity. Sterile gloves are packaged so that the scrub person may don the gloves without contaminating the outer surfaces.

Don gloves last

Select correct type and size

Insert hands into gloves

Open the inner package containing the gloves and pick up one glove by the folded cuff edge with the sleeve-covered hand (Fig 13). Place the glove on the opposite gown sleeve palm down, with the glove fingers pointing toward the shoulder. The palm of the hand inside the gown sleeve must be facing upward toward the palm of the glove (Fig 14).

Fig 13-14



Place the glove's rolled cuff edge at the seam that connects the sleeve to the gown cuff. Grasp the bottom rolled cuff edge of the glove with the thumb and index finger (Fig 15). While holding the glove's cuff edge with one hand, grasp the uppermost edge of the glove's cuff with the opposite hand. Take care not to expose the bare fingers while doing this (Fig 16).

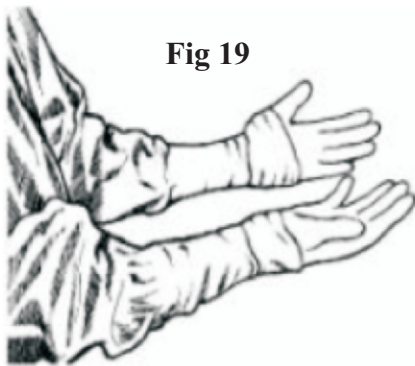
Fig 15-16



Continuing to grasp the glove, stretch the cuff of the glove over the hand (Fig 17). Using the opposite sleeve covered hand, grasp both the glove cuff and sleeve cuff seam and pull the glove onto the hand. Pull any excessive amount of glove sleeve from underneath the cuff of the glove (Fig 18).



Using the hand that is now gloved put on the second glove in the same manner. When gloving is completed no part of the skin has touched the outside surface of the gloves. Check to make sure that each gown cuff is secured and covered completely by the cuff of the glove. Adjust the fingers of the glove as necessary so that they fit snugly (Fig 19).

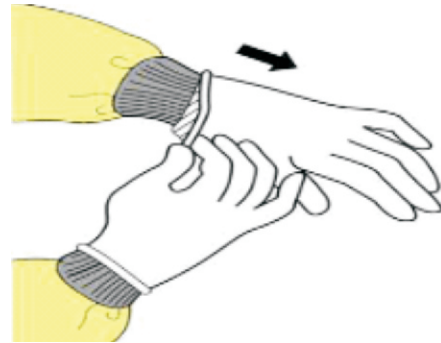


Removing used gloves:

1. grasp outside edge near wrist
2. peel away from hand, turning glove inside-out
3. hold in opposite gloved hand

4. slide ungloved finger under the wrist of the remaining glove peel off from inside, creating a bag for both gloves and discard(Fig 20-22)

Fig 20-22



Gowning technique^{1,2}

Once the sterile gloves are on the scrub practitioner is ready to secure their gown with assistance from the circulating person as follows;

The scrub person will take hold of the belt tab which is securing the belt ties. Keeping hold of the left side tie with the left hand pull the tab with the right hand ties still secured and hand the tab to the circulating person(Fig 23).

Fig 23



When the scrub person is properly positioned they will then take hold of the belt tie only being careful not to touch the tab and pull on the tie leaving the circulating person with only the tab in their hand the circulating person must hold on tightly to the tab so that when the scrub person pulls on the tie the tab doesn't come with it and contaminate them(Fig 25). Finally the scrub practitioner will secure the ties on left side(Fig 26).

Fig 25-26



The circulating person will take hold of the tab being very careful not to touch the tie and will move to the side or behind the scrub person. The scrub person will then turn if necessary to enable them to reach and retrieve the tie (Fig 24).

Fig 24



Removing the gown and gloves^{1,2}

On completion of a surgical case the outer part of the gown and gloves are considered to be contaminated by bacteria from the procedure and the scrub person must remove them very carefully to avoid contamination to their forearms and hands. The gloves should be removed after the gown. The procedure is as follows;

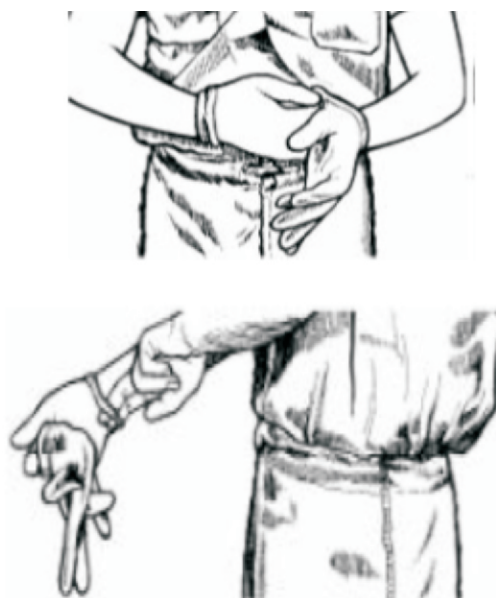
After the circulating person unties the neck and back ties, the scrub person performs the following procedure by themselves. Grasp the gown at the shoulders and pull the gown forward and down over the arms and gloved hands (Fig 27). Holding arms away from the body fold the gown so that the outside is folded in and discard it into the appropriate bag (Fig 28).

Fig 27-28



Grasp the outer surface of one glove with the other gloved hand "rubber to rubber" and peel off the glove. Discard the glove into the designated receptacle (Fig 29). Place the fingers inside the cuff of the glove of the other hand "skin to skin" peel off as before and discard (Fig 30).

Fig 29-30



Procedure for changing gloves during the case^{1,2}

When gloves require changing intra-operatively due to a puncture or inadvertent contamination, the glove must be removed in a way that avoids further contamination.

This can be achieved by pulling the gloves downwards by the fingers and palms (whilst also grasping the cuff of the gown), until the glove comes over the end of the hands / fingers. The glove may then be discarded into the appropriate receptacle.

Hands must remain inside the sleeves of the gown and the closed glove technique is used to don a new glove as described in the gloving procedure (Fig 27-30).

Alternatively a new glove may be donned with the assistance of another member of the surgical team as described below. Grasp the right glove firmly at waist level. Keeping your thumbs extended and covered by the glove cuff; stretch the cuff so that the practitioner can introduce their hand without touching your gloves.

The scrub person protects own gloved fingers by holding them beneath the cuff of the glove, and their thumbs by holding them away from the partly-gloved hand (Fig 31).

Fig 31



Mask and eye protection (goggles or a face shield)

Protect the mucous membranes of the eyes, nose, and mouth during procedures and activities that are likely to generate splashes or sprays of blood, body fluids, secretions, excretions.

Donning of goggles or a face mask

Position goggles over eyes and secure to the head using the ear pieces or headband.

Position face shield over face and secure on brow with headband and adjust to fit comfortably.

Removing goggles or face shield

Grasp ear or head pieces with ungloved hands and lift away from face. Place in designated receptacle for reprocessing or disposal.

Donning a mask

A surgical mask is worn primarily to protect the patient from bacteria exhaled by operating room personnel (Fig 32). The mask must fit snugly to the face to prevent passage of air around the sides and fogging of glasses if worn. A fresh mask should be donned immediately before beginning the scrub procedure and it is not considered sterile.

Fig 32



Where to remove PPE

- At doorway, before leaving patient room or in anteroom
- Remove respirator outside room, after door has been closed

- Ensure that hand hygiene facilities and trash receptacles are available at the point needed, e.g., sink or alcohol-based hand rub.

EXPANDED PRECAUTIONS

Expanded precautions are used to supplement the standard precautions that should be practiced on all patients.

➤ **Contact precautions**

- ✓ Gowns and gloves for contact with patient or environment of care.
- ✓ Importance for housekeeping staff in clinical settings (fomites).
- ✓ Examples: scabies, patients with resistant organisms, herpes simplex virus.

➤ **Droplet precautions**

- ✓ Surgical masks within three feet of patient
- ✓ Droplet transmission usually involves contact transmission;
- ✓ Examples: influenza, SARS

➤ **Airborne isolation precautions**

- ✓ Use of particulate respirator(e.g., N95)
- ✓ Use of negative pressure room, if available
- ✓ Examples: chickenpox, tuberculosis, measles.

Summary

It is always better to follow the saying “prevention is better than cure”. We have all the necessary facilities and armamentarium that is needed to protect the operator as well as the patient, the only thing we have to do is

strictly follow the proper usage of personal protective equipment without negligence. By doing the simple procedure of proper hand scrubbing large amount of infections can be minimized. The correct order of donning and removing PPE is the key in protecting yourself and coworkers from contamination.

Expanded precautions are used to supplement the standard precautions that should be practiced on all patients. Make it a habit to practice the correct sequence of ppe donning and removal as drills to make it second nature.

...you are being called to examine a patient with herpetic ulcers in the dental office who has a rash that might be measles.....the recommended PPE to wear are in front of you -gloves, gowns, mask, eye protection

Necessity is to make yourself and others aware of the need of using personal protective equipments, be aware about the known and unknown medical conditions protect yourself and others by using proper PPE.

Acknowledgement

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PRENATAL ANTICIPATORY GUIDANCE

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Abstract

Anticipatory guidance to pregnant women will have a positive effect on their oral health, pregnancy outcome and the oral health status of the infant. Many misconceptions prevailed among women, obstetricians, dentists and other health workers regarding the safety of oral health care during pregnancies. In recent years many organizations in the field of maternal and child health have issued consensus statements regarding the necessity of oral health care and guidance during pregnancy. This review brings forward all the recent developments and information regarding prenatal anticipatory guidance.

Key words: anticipatory guidance, pregnancy, infant oral health.

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Introduction

Just as a pregnant women's overall health can affect the health of her pregnancy and baby, her oral health can play a role in the occurrence of early childhood caries in her children. The condition of a women's mouth can also contribute to pregnancy related problems and influence birth outcomes. An association has been found between periodontal disease in pregnant women and adverse birth outcomes, including low birth weight, preterm birth, preeclampsia and gestational diabetes. In fact, 18 percent of low birth weight and preterm birth may be attributable to periodontal diseases.

The majority of children acquire dental caries (the most chronic childhood disease) through mother to child transmission of bacteria via saliva. Children of mother with high levels of oral bacteria and poor oral

health are more likely to develop dental caries at an early age than children of mother with lower level of oral bacteria and better oral health. Childhood dental caries and other dental diseases can lead to developmental disturbances, pain, problems of eating and speaking, low self esteem, school absenteeism, expensive dental treatment and poor oral health during adulthood. These connections illustrate the importance of oral health for women.

Many surveys show that women do not obtain dental care on a regular basis and most do not receive dental care at all during pregnancy. Oral health anticipatory guidance helps pregnant women to understand the importance of oral health for their own health, pregnancy outcome and oral health of their children. Ideally, infant oral health begins with prenatal oral health counseling for

mothers. Optimal maternal oral hygiene during prenatal period may decrease the amount of caries producing oral bacteria transmitted to the infant during common parenting behaviours such as sharing spoons. Providing pregnant women with counselling to promote oral health behaviours may reduce the transmission of such bacteria from mothers to infants and young children, thereby delaying or preventing the onset of caries. Providing pregnant women with oral health care, educating them about and treating dental caries is critical, both for the woman's oral health and for the future oral health of their children. For these reasons it is essential for health professionals to provide anticipatory guidance to pregnant women. The American Dental Association also affirms the importance of oral health care during pregnancy.¹

Approximately 40% of pregnant women have some form of periodontal disease.² A study conducted in 1996 showed an association between maternal periodontal disease and preterm birth.³ Other studies also supported their conclusion.^{4,5} Prenatal periodontal therapy is associated with the improvement of maternal oral health.^{6,7} Theoretically blood borne gram negative anaerobic bacteria or inflammatory mediators, such as lipopolysaccharides and cytokines, may be transported to the placental tissue as well as to the uterus and cervix. This results in increased inflammatory modulators that may precipitate preterm labour.

A survey in USA showed that 59% women did not receive any counseling about

oral health during pregnancy.⁸ Prenatal counseling about oral health care has been shown to be highly co-related with teeth cleaning during pregnancy.⁸ Physiologic changes during pregnancy may result in noticeable changes in oral cavity. These changes include pregnancy gingivitis, benign oral gingival lesions, tooth mobility, tooth erosions, dental caries and periodontitis. It is important to reassure women about these various changes to the gums and teeth during pregnancy and to reinforce good oral health habits to keep the gums and teeth healthy.

Anticipatory Guidance during pregnancy

Pregnancy is a 'teachable' moment when women are motivated to adopt healthy behaviours. A survey showed that 60% of pregnant women did not have their teeth cleaned during their more recent pregnancy.⁸ Prenatal counseling about oral health care has been shown to be highly co-related with teeth cleaning during pregnancy.⁹ Patients often need reassurance that prevention, diagnosis and treatment of oral conditions including dental x-rays (with shielding of abdomen and thyroid) and local anesthesia (lidocaine with or without epinephrine) are safe during pregnancy. Conditions that require immediate treatment, such as extraction, root canal treatment and restorations (amalgam or composite) of untreated caries, may be managed at any time during pregnancy. Delaying treatment may result in more complex problems. Counseling should include reinforcement of routine oral health maintenance, such as limiting sugary foods and drinks, brushing twice a day with

fluoridated tooth paste, flossing once daily and dental visits twice a year. Dentists often recommend the use of Chlorhexidine and fluoridated mouth rinses and xylitol containing chewing gums to decrease oral bacteria. For patients with vomiting secondary to morning sickness, hyperemesis gravidarum, or gastric reflex during late pregnancy, the use of antacids or rinsing with water containing baking soda (one teaspoon of baking soda in one cup of water) may help neutralize the associated acid.

Several organizations have undertaken efforts to promote oral health during pregnancy. The national centre for education in maternal and child health (USA) published “Bright futures in practice of oral health” (supported by the maternal and child health bureau) to promote and improve the health and well being of pregnant women, infants, children and adolescents. The American Academy of Pedodontics, The American Academy of Periodontology, The American College of Obstetricians and Gynecologists and The American Dental Association have issued statements and/or recommendations for improving the oral health of pregnant women, infants and children.

Common oral health conditions during pregnancy⁹⁻¹²

1. Pregnancy gingivitis

An increased response to dental plaque during pregnancy causes the gingiva to swell and bleed more easily in most women. Rinsing with salt water (i.e. One teaspoon full of salt in 1cup of warm water) may help with the irritation. Pregnancy gingivitis typically

peaks during the third trimester. Women who have gingivitis before pregnancy are more prone to exacerbation during pregnancy.

2. Benign oral gingival lesions (pyogenic granuloma, granuloma gravidarum or epulis of pregnancy)

In approximately 5% of pregnancies, a highly vascularised, hyperplastic, and often pedunculated lesion up to 2cm in diameter may appear, usually on the anterior gingiva. These lesions may result from a heightened inflammatory response to oral pathogens and usually regress after pregnancy. Excision is rarely necessary but may be needed if there is severe pain, bleeding or interference with mastication.

3. Tooth mobility

Ligaments and bone that support the teeth may temporarily loosen during pregnancy, which results in increased tooth mobility. There is normally no tooth loss unless other complications are present.

4. Tooth erosion

Erosion of tooth enamel may be more common because of increased exposure to gastric acid from vomiting secondary to morning sickness, hyperemesis gravidarum, or gastric reflex during late pregnancy. Rinsing with baking soda solution (i.e., a teaspoon of baking soda dissolved in a cup of water) may help neutralize the associated acid.

5. Dental caries

Pregnancy may result in dental caries due to increased acidity in the mouth, greater intake of sugary snacks and drinks secondary

to pregnancy cravings, and decreased attention to prenatal oral health maintenance.

6. Periodontitis

Untreated gingivitis can progress to periodontitis, an inflammatory response in which a film of bacteria, known as plaque adheres to teeth and release bacterial toxins that create pockets of destructive infection in the gums and bones. The teeth may loosen, bone may be lost and a bacteremia may result.

Why pregnant women do not get dental care^Δ

In 2007-2009 35% of the U.S women reported that they did not have a dental visit with in the past one year and 56% did not visit a dentist during pregnancy.¹³ Access to dental care was directly related to income level: the poorest women were least likely to have received dental care. Asides from financial constraints and lack of insurance coverage, barrier to dental care among those underserved include lack of education lack of access to transportation, and lack of dental providers. In one study more than 8% of women reported that the main reason they did not get dental services was that their providers advised against care.¹⁴ Additional factors that complicate oral health among underserved include poor nutrition and higher rates of tobacco, alcohol and drug use.

It is important for the obstetricians to be aware of their patient's health coverage for dental services during pregnancy so that referral to an appropriate dental provider can be made. Advocacy for broader oral health

coverage of women before, during and after pregnancy will optimize their general and oral health. Additional barriers to care include lack of awareness by health care and dental providers and women, about the safety of dental care during pregnancy. Obstetric providers should refer women for dental care in a timely manner with written note. Establishing relationships between prenatal care and oral health providers in the community facilitate a collaborative approach to women's oral health needs.

Oral health care during pregnancy: A national consensus statement (George town University, Washington D.C-2011)

A workshop organized by the George Town University Washington D.C on October 18, 2011, formulated a national consensus statement to help health professionals, program administrators and staff, policy makers, advocates and other stakeholders respond to the need for improvements in provision of oral health services to women during pregnancy.¹⁵⁻¹⁷ The expert workshop consisted of individuals with expertise in oral health and prenatal care with representation from national organizations including AAP, AAPD, ACOG, ACNM, ADA. The American Dental Hygienist's Association, The Association of State and Territorial Dental Directors, The National Maternal and Child Oral Health Policy Centre and The Medicaid – CHIP State Dental Association: federal agencies; as well as those involved in the development of existing perinatal oral health guidelines. The guidances included:

1. Assess pregnant women's oral health status

Take an oral health history. Following are examples of questions that oral health professionals may ask pregnant women. This information may be gathered through conversation or a questionnaire.

- a) When and where was your last dental visit?
- b) Do you have swollen or bleeding gums, a tooth ache (pain) problems eating or chewing food, or other problems in your mouth?
- c) How many weeks pregnant are you? (When is your due date?)
- d) Do you have any questions or concerns about getting oral health care while you are pregnant?
- e) Since becoming pregnant, have you been vomiting? If so, how often?
- f) Have you received prenatal care? If not, do you need help making an appointment for prenatal care?
- In addition to reviewing the dental history review medical and dietary histories, including use of tobacco, alcohol and recreational drugs.
- Perform a comprehensive oral reexamination, which includes a risk assessment for dental caries and periodontal diseases.
- Take radiograph to evaluate and

definitively diagnose oral diseases and conditions when clinically indicated.

2. Advice pregnant women about oral health care

- Reassure women that oral health care, including use of radiographs, pain medication, and local anesthesia is safe throughout pregnancy.
- Encourage women to continue to seek oral health care, practice good oral hygiene, eat healthy foods and attend prenatal classes during pregnancy.

3. Work in collaboration with prenatal care health professionals

- Establish relationships with prenatal care health professionals in the community. Develop a formal referral process whereby the prenatal care health professional agrees to see the referred individual in a timely manner. (E.g., that day, the following day) and provide subsequent care.
- Share pertinent information about pregnant women with prenatal care health professionals, and coordinate care with prenatal care health professionals as appropriate.
- Consult with prenatal care health professionals, as necessary – for e.g., when considering the following :
 - a) Co-morbid conditions that may affect management of oral problems. (e.g.: Diabetes, Hypertension, Pulmonary or cardiac diseases, Bleeding disorders.)

b) The case of intravenous sedation or general anesthesia.

c) The use of nitrous oxide as an adjunctive analgesic to local anesthetics.

4. Provide oral diseases management and treatment to pregnant women

- Provide emergency or acute care at any time during the pregnancy, as indicated by the oral condition.

- Develop, discuss with women and provide a comprehensive care plan that includes prevention, treatment, and maintenance, throughout pregnancy. Discuss benefits and risks of treatment and alternatives to treatment.

- Use standard practices when placing restorative materials such as amalgam and composites.

- Use a rubber dam during endodontic procedures and restorative procedures.

- Position pregnant women appropriately during care:

a) Keep women's head at a higher level than her feet.

b) Place women in a semi reclining position, as tolerated, and allow frequent position changes.

c) Place a small pillow under the right hip or have the women turn slightly to the left as needed to avoid dizziness or nausea resulting from hypotension.

- Follow up with pregnant women to determine whether preventive and restorative treatment has been effective.

5. Provide support services (case management) to pregnant women.

- Help pregnant women complete application for insurance or other sources of coverage, social services (e.g.: domestic violence services) or other needs (e.g.: Transportation, Translation)

- If the woman does not have a prenatal health care professional, explain the importance of care. Facilitate referrals to prenatal care health professionals in the community, especially those who accept Medicaid or other public insurance programs.

6. Improve health services in the community

- On the patient intake form, record the name and contact information of the prenatal care health professional.

- Accept women enrolled in Medicaid and other public insurance programs.

- Establish partnerships with community based programs. (e.g.: WIC, Early Head Start) that serve pregnant women with low incomes.

- Provide referral to nutrition professional if counseling (e.g.: guidance on food choices or nutrition related health problems) would be beneficial.

- Provide culturally and linguistically appropriate care. Take the time to ensure that women understand information shared with them.

7. Pharmacological considerations for the pregnant women

• Analgesics

Drugs like acetaminophen, acetaminophen with codeine, hydro codeine or oxy codeine, codeine, meperidine, morphine etc may be used during pregnancy.

Aspirin, ibuprofen and alaprofen may be used in short term duration during pregnancy, 40 to 72 hours. Avoid in 1st and 3rd trimesters.

• Antibiotics

Amoxicillin, cephalosporin, clindamycin, metronidazole and penicillin may be used during pregnancy.

Avoid during pregnancy ciprofloxacin, clarithromycin, levofloxacin, moxifloxacin. Never use tetracycline during pregnancy.

• Anesthetics

Consult with a prenatal care health professional prior to using intravenous sedation or general anesthesia. Local anesthetics with epinephrine (e.g.: bupivacaine, lidocaine, mepivacaine) may be used during pregnancy.

Nitrous oxide (30%) may be used during pregnancy when topical or local anesthetics are in adequate. Pregnant women require lower levels of nitrous oxide to achieve sedation; consult with prenatal care health professional.

• Over the counter use of antimicrobial mouth washes

Use alcohol free products during pregnancy. Cetyl pyridinium chloride mouth rinse, Chlorhexidine mouth rinse and xylitol may be used during pregnancy.

Guidances to the pregnant women (this can be given as handout to the pregnant women after the guidances)

Below are the tips for taking care of your oral health while you are pregnant. Getting oral health care, practicing good oral hygiene, eating healthy foods and practicing other health behavior will help you to keep you and your baby healthy. Delaying necessary treatment for dental problems could result in significant risk to you and your baby. (For e.g.; a bad tooth infection in your mouth could spread throughout your body).

1. Get oral health care

Taking care of your mouth while you are pregnant is important for you and your baby. Changes to your body when you are pregnant can make your gums sore or puffy and can make them bleed. The problem is called gingivitis (inflammation of the gums). If gingivitis is not treated, it may lead to more serious periodontal (gum) diseases. These diseases can lead to tooth loss.

- Oral health care including use of x-rays, pain medication, and local anesthesia, is safe throughout pregnancy.
- Get oral health treatment, as recommended by an oral health professional, before delivery.

- If your last dental visit took place more than 6 months ago or if you have any oral health problems or concerns schedule a dental appointment as soon as possible.
- Tell the dental office that you are pregnant and your due date. This information will help the dental teams provide the best care for you.

2. Practice good oral hygiene

- Brush your teeth with fluoridated toothpaste twice a day. Replace your toothbrush every three or four months; or more often if the bristles are frayed. Do not share your tooth brush. Clean between teeth daily with floss or an interdental cleaner.
- Rinse every night with an over-the-counter fluoridated, alcohol free mouth rinse.
- After eating, choose xylitol containing gums or use other xylitol-containing products, such as mints, which can reduce bacteria that can cause tooth decay.
- If you vomit, rinse your mouth with a teaspoon of baking soda in a cup of water to stop acid from attacking your teeth.

3. Eat healthy foods

- Eat a variety of healthy foods, such as fruits; vegetables; whole grain products like cereals, bread or crackers; and dairy products like milk, cheese, cottage cheese or unsweetened yogurt. Meats,

fish, chicken, eggs, beans and nuts are also good choices.

- Eat fewer foods high in sugar like candy, cookies, cake and dried fruits, and drink fewer beverages high in sugar like juice, fruit flavored drinks or pop (soda).
- For snacks, choose foods low in sugar, such as fruits, vegetables, cheese, and unsweetened yogurt.
- To help choose foods low in sugar, read food labels.
- If you have problems with nausea, try eating small amounts of healthy foods throughout the day.
- Drink water or milk, instead of juice, fruit flavored drinks, or pop (Soda).
- Drink water throughout the day, especially between the meals and snacks. Drink fluoridated water (via a community fluoridated water source) or if you prefer bottle water, drink water that contains fluoride.
- To reduce the risk of birth defects, get 600 micrograms of folic acid each day throughout your pregnancy. Take a dietary supplement of folic acid and eat foods high in folate and foods fortified with folic acid. Examples of these foods include:
 - a) Asparagus, broccoli and green leafy vegetables, such as lettuce and spinach
 - b) Legumes (beans, peas, lentils).
 - c) Papaya, orange, strawberries, cantaloupe and bananas.

Grain products fortified with folic acid (breads, cereals, corn meal, flour, pasta, white rice).

4. Practice other health behaviours

- Attend prenatal classes.
- Stop any use of tobacco products and recreational drugs. Avoid second hand smoke.
- Stop any consumption of alcoholic beverages.

The above given guidelines for the oral health professionals and the pregnant women are part of the National consensus statement made during a workshop by George Town university, Washington .D.C in 2011.

In addition to the early model of New York state practice guidelines (2006) for oral health care during pregnancy, a number of organizations have undertaken efforts to address oral health care during pregnancy and early childhood. Reinforcing these recommendations and to add to the growing repository of evidence, the California Dental Association Foundation (CDA Foundation) and the American College of Obstetricians and Gynecologists and District IX (ACOG District IX) collaborated in an effort to substantiate the relationship between health and oral health status, treatment of oral disease and pregnancy outcomes.¹⁸ The key consensus statement developed by the expert panel and advisory committee conference participants is as follows:

Perinatal oral health consensus statement

Prevention, diagnosis and treatment of oral diseases, including needed dental

radiographs and use of local anesthesia, are highly beneficial and can be undertaken during pregnancy with no additional fetal or maternal risk when compared to the risk of not providing care. Good oral health and control of oral disease protects women's health and quality of life and has the potential to reduce the transmission of pathogenic bacteria from mothers to children.

Health care professionals providing preconception care including primary and general women's health care, between pregnancies should be educated to recognize the relationship between oral health and pregnancy, and maternal oral health status and future caries risk during early childhood.¹⁸

Maintaining good oral health during pregnancy can be critical to the overall health of both pregnant women and their infants. As part of routine prenatal care, pregnant women should be referred to oral health professionals for examinations and any needed preventive care or dental treatment. Despite clear links between oral and overall general health, oral health is not accorded the same importance in health care policy as general health¹⁸. Reimbursement models and clinical practices typically view the oral cavity as separate from the rest of the body. While oral health should be an integral part of comprehensive care for pregnant women, variations in oral health practice patterns reflect the fact that oral health screening and referral are not routinely included in the prenatal care.¹ More over some oral health professionals are hesitant to treat pregnant women because of misconceptions, fear of law suits or lack of evidence based information.²⁰⁻²²

Preconception care

The most critical period of fetal development occurs in the earliest weeks following conception, before many women even know they are pregnant. Because at least one third of pregnancies are estimated to be unplanned²³ women frequently conceive while experiencing less than optimal health.^{2 4}

While oral health should be a goal in its own right, preconception prevention and treatment of oral health conditions as a mechanism to improve both women's oral and general health and their children's dental health must be considered.² Ensuring that evidence-based interventions are implemented to further improve infant and maternal pregnancy outcomes among women living with chronic conditions, which includes poor oral health, should be a priority preconception care activity.²⁶

During pregnancy and early childhood

Pregnancy and early childhood are particularly important times to access oral health care because the consequences of poor oral health can have a lifelong impact.²⁷ Improving oral health of pregnant women prevents complications of dental diseases during pregnancy (e.g. Abscessed tooth, tooth ache), and the potential to subsequently decrease early childhood caries (ECC) in their children.

Some oral health professionals have postponed treatment during pregnancy because of uncertainty about the risk of radiographs and bacteremia that can occur with dental prophylaxis and restoration.

However, differing appropriate treatment may cause harm to the women and possibly to the fetus for several reasons. First, women may self medicate with potentially unsafe over the counter medication such as aspirin to control pain. Second untreated dental caries in mother increases the risk of her children developing caries. Finally untreated oral infection may become a systemic problem during pregnancy.

Conclusion

A girl's education is the single best investment that any society can make -Carrol Bellamy

Of all preventive dentistry programs, dental health education is the most cost effective method and is the method of choice for a country like India where health budget allocation is substantially less as compared to that of developed countries. In the primary prevention programs dental health education to the pregnant women (prenatal anticipatory guidance) and women planning to become mothers (preconceptual counseling) are going to give the maximum results at bare minimum costs.

An infant aged 1½-2yrs of age coming to the dental clinic with several decayed primary decayed teeth, infected, painful and with exposed vital pulps, is posing a great problem to the clinicians. Such early childhood caries (ECC) are very common among infants. Non affordability and non availability of general anesthetic facilities in rural and urban areas makes dental treatments to such infants, an impossible task. Usually

treatment is reduced to a prescription of antibiotics and analgesics by the general dental practitioners and physicians. Then the infants continue to suffer from frequent tooth ache, abscessed teeth, facial infections, periapical cysts and malnutrition following poor intake of food due to painful teeth and the diseases due to malnutrition. Many children may not be suffering from Marasmus and Kwashiorkor but they suffer from many other ailments and poor development due to malnutrition, the cause of which can be traced to painful teeth and poor oral health.

Here comes the role of prenatal anticipatory counseling and guidance which are sure to prevent dental diseases in infants and guarantees oral health to children as they grow in to adolescents and adults. So while embarking on public health planning, dental health education during pregnancy and preconceptional period should get utmost attention and priority. Knowing fully these key facts, many organizations and institutions of maternal and child health care and dental health care have organized workshops and made consensus statements in recent years. Even in developed countries many people including parents, grandparents, health workers, obstetricians and dentists have misconceptions about dental health care during pregnancy. So these workshops and consensus statement emphasizes the need for wide publicity, reproduction and distribution of their consensus statements to all stake holders in health care of mother and child as well as the public.

Let the light of knowledge in health care give the children and adults freedom from

pain and sufferings. 'Health through knowledge' be our slogan. Huge investments on hi-tech –high cost machines, medicines, and hi-tech hospitals will not benefit in the battle for health. Primary prevention is the priority.

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THE DIABETIC RELATION OF PERIODONTAL DISEASES AND VICE VERSA

*Dr. Harish Kumar V. V.

Abstract

Periodontal diseases have a major influence on diseases and conditions that have a major impact on public health. Here the focus will be on one of the major systemic diseases- Diabetes Mellitus. Although the association between these diseases is now accepted as a reality, the clinical implications need to be adequately investigated. Given the interrelationship between diabetes and periodontal disease, it is important to establish a good communication between the specialist responsible for a diabetic patient and the patient's dentist.

Key words: periodontal disease, diabetes mellitus, two way relationship, periomedicine

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Introduction

There has always been and it is a known fact that periodontal diseases have their influence on systemic diseases or vice versa. Periodontitis is an independent risk factor for atherosclerosis including stroke, coronary heart disease, adverse pregnancy outcomes, and diabetes.

Periodontal diseases have a major influence on diseases and conditions that have a major impact on public health, including respiratory disease, chronic renal disease, rheumatoid arthritis, cognitive impairment, obesity, metabolic syndrome and cancer. Here the focus will be on one of the major systemic diseases-Diabetes Mellitus. Let us explore their known inter relationships, and discuss the scientific evidence.

The impact of periodontal treatment on the glycemic control in the diabetic has not been fully elucidated and vice versa, ie, the

effect of glycemic control on periodontal status. The impaired metabolism of glucose, lipids and proteins in diabetes produces alterations in macro and micro vascular circulation that are associated with the five classic complications of the disease, namely retinopathy, neuropathy, nephropathy, cardiovascular complications and delayed wound healing.¹ Periodontal disease has been proposed as the sixth complication of diabetes, based on the highly frequent presence of both in the same patient.²⁻⁵

The following mechanisms have been proposed to explain the classic complications of diabetes:

1. Polyol pathway

According to this theory, glucose is converted to sorbitol, by the action of aldose reductase, which is implicated as the toxin in almost all of these complications.

2. **Production of Advanced Glycation End products (AGEs)**

The second theory proposed the binding of glucose to proteins, lipids and nucleic acids giving rise to giving rise to AGEs, thereby altering their functions. Thus binding of glucose to hemoglobin, collagen or albumin produces complications in the respective organs where the AGEs are deposited (nervous system, kidney, retina or blood vessels)

Periodontal diseases are multifactorial, bacterial diseases, which affect the tooth supporting tissues. The 1999 American Association of Periodontology (AAP) classification, currently the most widely used, identifies six categories: gingival disease, chronic periodontitis, aggressive periodontitis, periodontitis as manifestation of systemic disease, necrotizing periodontal disease, and periodontal abscess.⁶

According to current concepts of the multifactorial etiology of periodontal disease, it is caused by the interaction among single or multiple microbial agents (necessary but not sufficient primary etiologic factors), a host with some degree of susceptibility, and environmental factors with influence on both.

Bacteria appear to act directly during the first moments of infection. However, most of their activity is indirect, via cell and humoral components of specific and non-specific host responses to protect the biofilm.⁴

Diabetes as a risk factor for periodontal disease

Many authors have described diabetes as a risk factor for periodontal disease. Mealey et al concluded that diabetic patients had a

three-fold higher risk of periodontal disease compared with non-diabetic patients after controlling for age, sex, and other confounding factors.⁵

For diabetes to be acknowledged as a risk factor it must meet the risk analysis criteria set out by Johnson & Hill, especially the two following conditions⁶:

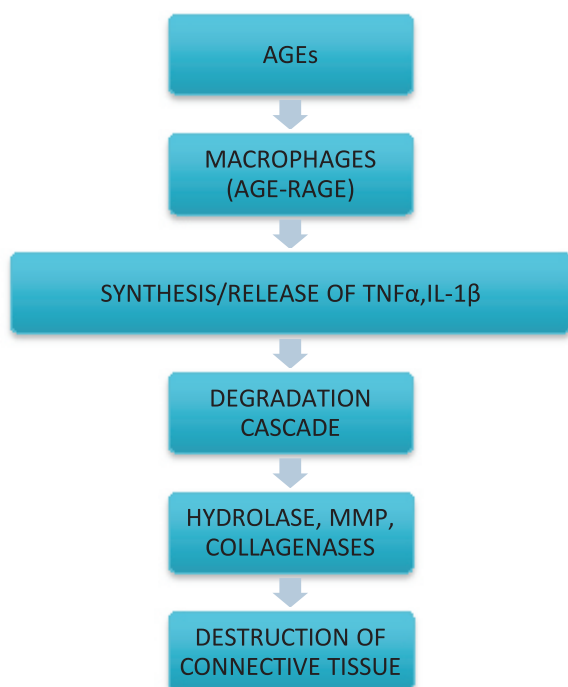
- 1) Biological plausibility that the factor can cause a given disease by a known action mechanism, and
- 2) Demonstration in prospective studies that the factor chronologically precedes the disease.

Genetic factors evidently play a major role in susceptibility to these diseases. However, the complex interactions in periodontal disease between host response mechanisms and the action of pathogenic microorganisms hamper clarification of the role of genetic factors.⁷ Nevertheless, an association has been observed between both diseases and an HLA genotype.

The HLA molecule (human major histocompatibility locus molecule) is genetically determined on chromosome 6, and disorders in this chromosome appear to predispose the host to both diabetes and periodontitis by altering antigen presentation to T cells and therefore the specific immune response of the patient.⁷

However, more studies are required in this area before conclusions can be drawn. The role of the immune system in the etiopathogeny of diabetes and periodontal disease is well documented.⁷

Table 1: The sequential steps to how diabetes leads to periodontal destruction



AGE-Advanced Glycation End Product, RAGE-Receptor for AGE, TNF α - tumor necrosis factor alpha, IL-1 β - interleukin-1 beta, MMP- matrix metalloproteinase.

The above model depicts how diabetes mellitus could contribute to the development of periodontal disease. The binding of AGEs to their receptors triggers a cascade of events that produce the destruction of connective tissue.

Patients with diabetes type-1 or -2 or periodontal disease show an imbalance or hyper-release of soluble cytokines against the attack of coadjuvant factors. In response to the presence of these modifying factors, cells of both diabetic and periodontal patients release an increased amount of certain cytoactive chemicals e.g., prosta-

glandin E2 (PGE2), interleukin 1 (IL-1), and tumor necrosis factor alpha (TNF- α). This up-regulation of immune response mediators has been demonstrated in vitro and in comparisons between diseased animals and healthy controls and may represent another possible explanation for the association between the two diseases.⁵

AGEs may be deposited on mono nuclear or polymorphonuclear cells, inhibiting their chemotactic and phagocytic capacities and permitting the advance of gram-negative anaerobic bacteria, which would explain the higher prevalence and severity of periodontal disease in diabetic patients.⁴ According to this theory, AGE-stimulated macrophages and PMN cells show a hyper-response to the progression of bacterial biofilm, releasing a larger amount of cytokines and soluble mediators.

To summarize, it has been shown, in a biologically plausible manner, how the host defense capacity can be altered in diabetes. The bacterial species in the periodontium are the same in diabetic and non-diabetic patients, suggesting that the increased periodontal disease risk in diabetic patients derives from an AGE-generating immunologic disorder.² In turn, periodontal pathogens cause the up-regulation of cytokines and tissue degrading enzymes, which may also have systemic consequences.⁸

Periodontal disease might increase the already elevated cytokine levels in diabetic patients and thereby contribute to systemic inflammation. Excessive formation and

accumulation of AGEs in tissues is the most common cause of diabetic complications. The binding of these molecules to neutrophils produces a hyperinflammatory state that amplifies the response to cytokines. These previously activated neutrophils also show a heightened response on making contact with LPS of gram-negative bacteria (e.g., P.g.) in the subgingival biofilm, and the consequent triggering of the inflammatory cascade increases the destruction of periodontal connective tissue and the severity of diabetes.

Conclusion

Given the interrelationship between diabetes and periodontal disease, it is important to establish a good communication between the specialist responsible for a diabetic patient and the patient's dentist.

Although the association between these diseases is now accepted as a reality, the clinical implications need to be adequately investigated. Importantly, the possibility of the simultaneous presence of the two diseases should be borne in mind to ensure their early diagnosis.

In view of the very high prevalence of both diseases and their potentially severe repercussions, the medical specialist should play a leading role in encouraging diabetic patients to visit their dentists regularly to control detrimental factors, such as the sustained presence of bacterial plaque in the periodontal pocket. Likewise, oral health personnel should bear in mind that impaired sugar metabolism and diabetes can affect the outcome and severity of periodontal disease.

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TISSUE ENGINEERING IN PERIODONTAL THERAPY

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Abstract

Tissue engineering is a contemporary area of science based on the principles of cell biology, developmental biology and biomaterials science to develop new procedures and biomaterials to replace lost or damaged tissues. For periodontal tissue engineering, this specifically relates to repair of alveolar bone, tooth associated cementum and periodontal ligament. Even though the current understanding about various molecular and genetic mechanisms controlling tissue regeneration had improved, the field of tissue engineering is still in its infancy. This article is on the concept of tissue engineering in Periodontics.

Key words: tissue engineering, periodontal therapy, regeneration

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Introduction

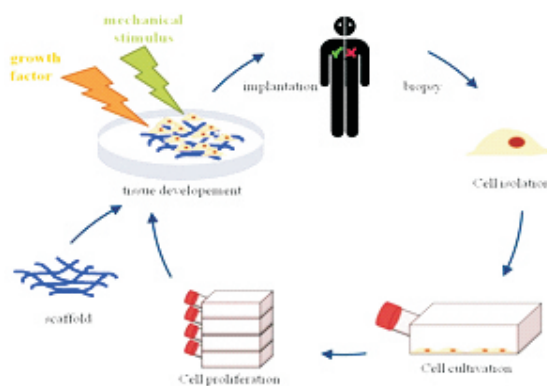
Since time immemorial the field of medicine has always been driven by the aim to alleviate pain and restore functional capabilities in all individuals. Tissue engineering is the latest introduction with this one point agenda in mind. It is a contemporary area of science based on the principles of cell biology, developmental biology and biomaterials science to develop new procedures and biomaterials to replace lost or damaged tissues.¹

Tissue engineering is defined as an interdisciplinary field that applies the principles of engineering and life sciences toward the development of biological substitutes that restore, maintain, or improve tissue function or a whole organ.²

For periodontal tissue engineering, this specifically relates to repair of alveolar bone,

tooth associated cementum and periodontal ligament.

Fig 1: Concept of tissue engineering



Principles

Tissue engineering follows essentially two main approaches for regeneration of tissue i.e. In-Vivo and Ex-Vivo concept. First, scaffolding can be used as a cell support device upon which cells are seeded in vitro; cells are then encouraged to lay down matrix

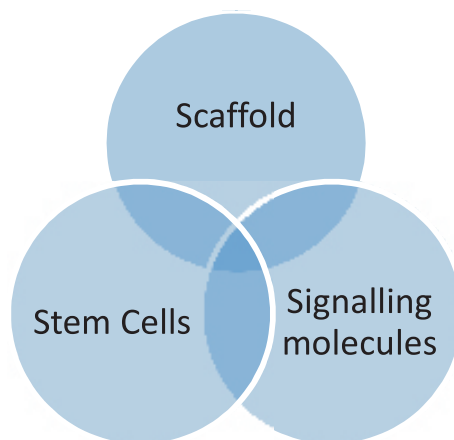
to produce the foundations of a tissue for transplantation.

The second approach involves using the scaffold as a growth factor/ drug delivery device. This strategy involves the scaffold being combined with growth factors, so upon implantation cells from the body are recruited to the scaffold site and form tissue upon and throughout the matrices. These two approaches are not mutually exclusive and can be easily combined.³

Tissue Engineering Triad

There are three main components that essentially form the triad of tissue engineering: Signalling molecules for morphogenesis, progenitor/stem cells, and scaffolds of extracellular matrix components. Interplay of these components play an integral part in regeneration of new tissue.

Fig 2: Tissue Engineering Triad



1. Stem Cells

Stem cells are Primal undifferentiated cells that retain the ability to produce an identical copy of themselves when they divide

(clone) and differentiate into other cell types. The various categories of stem cells include:^{4,5}

Totipotent stem cells- Produced from the fusion of an egg and sperm cell. Cells produced by the first few divisions of the fertilized egg cell are also totipotent. These cells can differentiate into embryonic and extraembryonic cell types.

Pluripotent(Embryonic) stem cells- Descendants of totipotent cells and can differentiate into cells derived from the three germ layers.

Multipotent(Adult) stem cells- Produce only cells of a closely related family of cells (e.g. hematopoietic stem cells differentiate into red blood cells, white blood cells, platelets, etc.).

Unipotent cells- Produce only one cell type, but have the property of self-renewal which distinguishes them from non-stem cells.

Large-scale tissue-engineering research, craniofacial or otherwise, began to take place in the early 1990s and has grown exponentially ever since.

2. Scaffolds

A scaffold plays the dual role of extended tissue exposure time and protein stability within body. The ideal requirements for a scaffold included:

1. Easy cell penetration, distribution & proliferation

2. Permeability of culture medium
3. In vivo vascularization (once implanted)
4. Maintenance of cell phenotype
5. Adequate mechanical stiffness
6. Proper biodegradation
7. Ease of fabrication

A scaffold may be classified as resorbable or non-resorbable. Resorbable scaffolds include alginate, amino acid polymers etc., while some non resorbable scaffolds are poly tetra fluoro ethylene, ceramics etc.

Various studies were conducted to prove the importance of using scaffolds in increasing the retentivity of growth factors into defects thereby resulting in regeneration. Nakahara et al⁶ combined collagen-scaffold material and gelatin microspheres, which prolonged the period of bFGF release in beagles with artificially prepared intrabony periodontal defects. Richardson et al⁷ reported the development of a new porous polymer scaffold that can deliver VEGF and PDGF.

3. Signalling Molecules

A key variable for successful tissue regeneration and engineering is the environment in which cells and tissues grow. Since the late 1990s, tissue engineering research has focused on two main approaches involving preparations containing biological mediators to selectively enhance the cells that populate the periodontal wound.

The first approach utilized semipurified preparations such as enamel

matrix derivative and autologous platelet-rich plasma preparations.

The second approach utilized recombinant growth factors such as recombinant human platelet-derived growth factor- BB and recombinant human basic fibroblast growth factor, and morphogens such as recombinant human bone morphogenetic protein.

Tissue engineering in the field of Periodontal Regeneration

As has already been highlighted, the most important requirements for periodontal tissue regeneration include progenitor cells, signaling molecules, an extracellular carrier/scaffolds along with favourable environmental conditions and adequate time.

There are mainly three approaches for tissue regeneration:

A. Protein Based approaches

Growth factors are a class of natural biological mediators which regulate key cellular events in tissue repair; i.e., Cell proliferation, chemotaxis (directed migration), differentiation and matrix synthesis via binding to specific cell-surface receptors.

Protein based approach incorporates the use of growth factors either in the form of Platelet rich plasma (PRP) or within a scaffold placed in the defect to allow for tissue regeneration.

PRP contains several growth factors including platelet derived growth factor, Transforming growth factor- β , thus

representing an autologous growth factor cocktail which has the advantage of being easily harvested from the patient with minimal invasiveness. In order to utilize the wound healing properties of the growth factors present in PRP it is necessary to provide a bone graft material or implantation of cell-scaffold construct.⁹

As stated earlier, locally applied growth factors have a higher chance of diffusion from the implantation site. Hence, the use of a biomaterial material as a vehicle for growth factors not only increases its retentivity but allows for greater tissue exposure time and protein stability.^{6,7}

B. Cell Based Approaches

Stem cells have long been under study for use in periodontal regeneration. Kawaguchi and colleagues used bone marrow derived Mesenchymal stem cells in combination with collagen to regenerate periodontal tissues in experimental class III furcation defects in dogs.¹⁰ Significant improvement was observed at implantation site. Azizuki et al used autologous periodontal ligament cells obtained from extracted teeth to fabricate cell sheets using a temperature responsive cell-culture approach. These sheets when implanted along with a hyaluronic acid carrier into experimental dehiscence in dog molars showed significant results at the end of 8 weeks.¹¹

C. Gene-Delivery Based Approach

This approach involves the introduction of a gene coding for a specific protein into the target cell, which subsequently produces the therapeutic protein. This approach was developed mainly

to counter problems associated with protein-delivery based approach by maintaining constant levels of the said therapeutic protein at the target site.

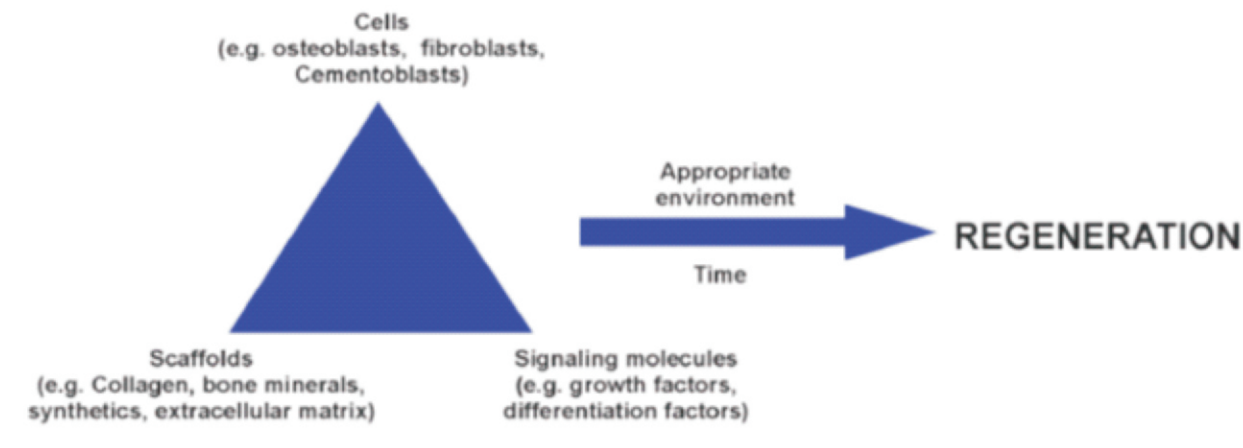
There are mainly two modalities followed within this approach:

- **In-vivo-** In this method, gene constructs such as expression plasmid DNA or viral particles, are physically entrapped within a scaffold or matrix. When the scaffold is placed into the defect site, host cells take up the gene construct and start producing the encoded protein.¹²
- **Ex-vivo-** In this approach, the cultured cells are transfected or transduced with gene constructs in vitro before transplantation into tissue defect.¹²

Jin and colleagues conducted studies using an adenovirus vector incorporated with BMP-7 and PDGF placed into rat periodontal alveolar defects. The study showed regenerative activities in periodontal ligament along with cementogenesis and osteogenesis.¹³ Similar results were observed by Bonadio et al using a plasmid DNA encoding the therapeutic protein was placed into skeletal defects in rats. However, It is important to note that these studies have proved to be successful only in the experimental phase and further research and human trials need to be conducted.

There are some disadvantages associated with the gene-delivery based approach including risk for mutagenesis, carcinogenesis and invoking an immune reaction in response to the viral proteins

Fig 3: Tissue engineering in periodontal regeneration



Conclusion

With the advent of latest techniques in the field of nanotechnology as well as molecular and cellular biology, knowledge regarding stem cells, gene therapy as well as signaling molecules has increased multifold. Even though the current understanding about various molecular and genetic mechanisms controlling tissue regeneration had improved, the field of tissue engineering is still in its infancy. Future studies will require the collaboration of researchers from different disciplines like cell biology, genetics etc along with clinicians to further augment the knowledge and study database that already exists.

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PERIODONTAL REGENERATION THROUGH CELL SHEET ENGINEERING- A NOVEL APPROACH

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Abstract

Regeneration of periodontium must include the formation of new cementum with collagen fibers inserted on a previously diseased root surface accompanied by alveolar bone regrowth. Today a variety of growth factors and signalling molecules are used to achieve periodontal regeneration through the concept of tissue engineering. Cell from numerous cell types which could maintain their differentiated functions has provided a new strategy to create transplantable cell sheets suitable for the regeneration of various tissues. This recent cell sheet engineering therapy has expanded in application from epithelial to mesenchymal regeneration, and thus offering exciting potential as practical alternatives in future regenerative medicine. This review is on cell sheet engineering in periodontal regeneration.

Keywords: periodontal therapy, periodontal regeneration, cell sheet engineering

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Introduction

Regeneration is defined as reproduction or reconstruction of a lost or injured part in such a way that the architecture and function of the lost or injured tissues are completely restored (Glossary of Periodontal Terms 1992). Regeneration of periodontium must include the formation of new cementum with collagen fibers inserted on a previously diseased root surface accompanied by alveolar bone regrowth.

Various surgical techniques are used for attaining periodontal regeneration, such as, bone grafts or bone substitute implants combined with flap procedures, root biomodification along with coronally advanced flap or the use of guided tissue regeneration. Although histology remains the

gold standard in assessing true periodontal regeneration, periodontal probing, radiographs, direct bone measurements etc have been used in the majority of regenerative studies¹ due to ethical restraints.

AAP workshop in 1996 put forward a set of criteria in order to consider a periodontal regenerative technique as a therapy procedure,

1. Human histologic specimens demonstrating formation of new cementum, periodontal ligament and alveolar bone.
2. Controlled human clinical trials with marked improvement in clinical probing attachment and bone.
3. Controlled animal histologic studies demonstrating formation of new

cementum, periodontal ligament and bone.

In the initial days scaling and root planing (SRP) with soft tissue curettage was used to achieve new attachment. Studies showed that this type of periodontal therapy resulted not only in the establishment of gingival health but also in the reduction of initially recorded pocket depth. This decrease in pocket depth was partly due to shrinkage of initially inflamed gingival and partly due to the formation of a new connective tissue attachment.

Prichard² through his studies established that new attachment formation is possible in three-wall intra bony lesions but not in two wall or one wall defects. Technique of Prichard included the elevation of tissue flaps for getting access into the defect and complete removal of granulation tissues followed by thorough root planing. In order to enhance bone regeneration, small perforations were made with a bur at several sites of the bone walls.

Later the outcome was assessed by comparing pre-operative and post operative radiographs, measurement of alveolar bone level adjacent to the root as well as by comparing study casts taken during operation and post-operatively after flap reflection. Results from a study by Ellegaard and Loe in 1971 revealed that complete regeneration had occurred in around 70% of 3 wall defects, 40% of 2 wall and 3 wall defects combined, and in 45% of 2 wall defects.³

Today a variety of growth factors and signalling molecules are used to achieve periodontal regeneration, such as

- Enamel matrix derivative
- Platelet rich plasma
- Platelet derived growth factor
- Gene delivery
- Cell based periodontal regeneration
- Growth regulatory factors

Cell sheets created from numerous cell types such as epidermal keratinocytes, vascular endothelial cells, renal epithelial cells, cardiomyocytes etc could maintain their differentiated functions as well. Thus temperature responsive culture system has provided a new strategy to create transplantable cell sheets suitable for the regeneration of various tissues and organs, making it applicable in variety of fields like,

- Corneal reconstruction
- Epithelial cell sheets to trachea
- Cardiac myocyte sheets for heart disease
- Functional liver systems using hepatocytes
- Epithelial cell sheets for oesophageal ulcerations

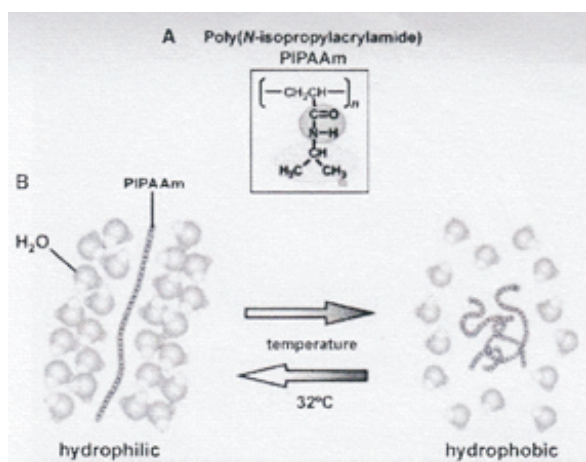
Procedure

Most tissue engineering methods create target tissue within the lab by proliferating and culturing cells together with scaffolds before transplanting them into the body. These cultured cells are detached from substratum by treatment with proteolytic enzymes like trypsin and/or dispase. During this process of detachment, enzymes induce degradation of cell-cell junction and extracellular matrix. Thus enzymatic treatment inflicts damage to cell membranes by hydrolyzing various cellular proteins, resulting in impairment of cell function.

Hence a novel method was developed to detach cultured cells without inducing any damage to them. Okano et al⁴ developed a new method to control cell surface adhesion using changes in cell culture temperature and a surface grafted temperature responsive polymer that is – PIPAAm [poly N isopropylacrylamide].

At temperature lower than 37 PIPAAm is fully hydrated with an extended chain conformation while at temperature above 37 it get dehydrated and compact. Cells generally adhere to hydrophobic surfaces but not to hydrophilic surfaces.

Fig 1: Temperature-responsive polymer, poly(N-isopropylacrylamide)



1. Chemical formula for PIPAAm
2. PIPAAm is hydrated with an extended chain conformation below 32°C (left) and is dehydrated and compacted over 32°C (right)

Okano used this particular property of PIPAAm to develop temperature responsive culture dishes by grafting PIPAAm onto tissue culture grade polystyrene dishes by irradiation with an electron beam. This allowed the cell harvesting possible with low temperature treatment. Endothelial cells and hepatocytes that were recovered from the temperature responsive surfaces simply by low temperature treatment maintained higher

function than those recovered by enzymatic action.

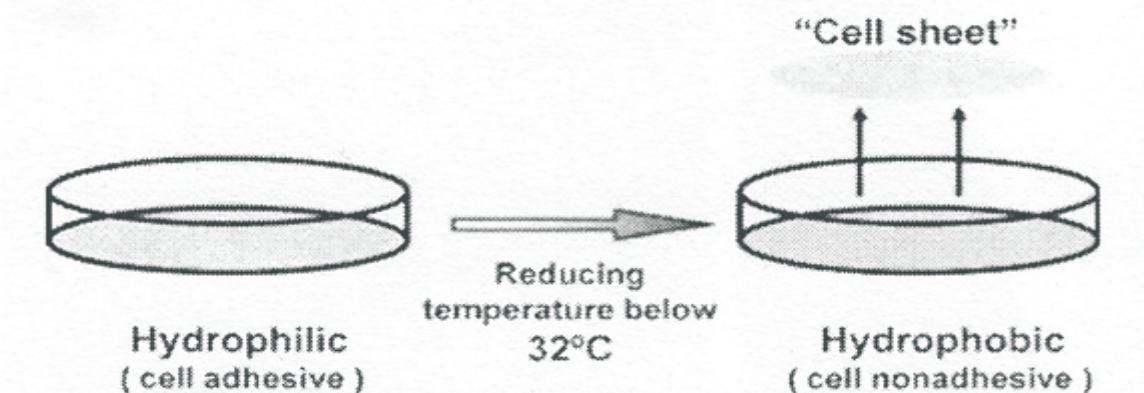
Kwon et al⁵ reported rapid cell sheet detachment of endothelial cells from PIPAAm grafted porous membranes in addition to single cell detachment. They also found that cultured cell sheets in a confluent state were rapidly detached from temperature responsive grafted surface by lowering the temperature. These sheets possessed intact surfaces and maintained a normal cell-cell junction. The temperature responsive dishes allowed cells to maintain adhesivity, growth and secretion activities, even when the culture temperature was changed.

Yamato et al⁶ reported a multilayered cell sheet using keratinocytes were detached from the grafted surface by lowering the temperature below 37 deg c. Thus cell sheet engineering by use of temperature responsive dishes provide a novel strategy to produce tissue without a specific scaffold. Resulting cell sheets could maintain the cell junction as well as extracellular matrix. These cell sheets can be multilayered, to strengthen the sheet and to increase the number of cells (UPCell - temperature responsive culture dishes).

Periodontal applications of cell sheet technology

Investigations were done to know the ability of periodontal cell sheets obtained from temperature responsive culture dishes in regenerating periodontal issues in experimental animals. Histological examination of transplanted cell sheets revealed a normal healing post surgically while after 1 week transplanted cells were found attached to the dentin and immature fibres were found obliquely anchored 4 weeks after surgery.

Fig 2: The mechanism of cell sheet harvest using temperature –responsive culture dishes.



Akizuki et al⁷ conducted studies to know the periodontal healing after application of cell sheets in beagle dogs. Periodontal ligament obtained from extracted tooth were used to prepare cell sheets in a temperature sensitive culture dishes and once the cells reached confluence, the culture medium was replaced with a medium that was supplemented with 50µg/ml ascorbic acid which in turn strengthened the cell sheet as a whole by increasing the collagen I production. Defects were created (5mm x 5mm) on the buccal root surfaces of mandibular first molar and periodontal ligament cell sheets were placed using hyaluronan sheets as carriers. Histological examination revealed collagen fibres that are inserted perpendicular into the newly formed bone and a toluidine blue-positive thin cementum. New periodontal ligament with rich capillary supply were present in the experimental group while no such changes could be appreciable in the control group.

Modifications were done to the cell sheet engineering process in order to improve the regeneration capacity of the periodontal ligament-cementum complex.

First, periodontal ligament cells were harvested onto the temperature-responsive culture dishes and an experimental group was cultured in a specialized medium called OSTEOGENIC DIFFERENTIATION MEDIUM. Studies done by Nagatamo et al⁸ showed that $27.8 \pm 4.8\%$ of periodontal ligament cells formed mineralized nodules in the osteogenic differentiation medium. A fibrin gel was used to arrange the cell sheets in a multilayered pattern. These constructs examined after 6 weeks exhibited marked increase in calcium deposition as well as alkaline phosphatase levels in vitro. On the contrary cells cultured without the supplement did not show any calcium nodules or abundance in extracellular matrix production. In order to verify the regenerative potential of human periodontal ligament cell sheets stimulated with osteogenic differentiation medium were transplanted onto the defects in the root surface of athymic rat mandibles prepared following King's method.⁹ The results indicated that most of the experimental group exhibited a new layer of cementum with new collagen fiber attachments.

Fig 3: Transplantable human periodontal ligament cell sheet



Conclusion

Numerous approaches are used currently to regenerate tissues using signalling molecules or cell based therapies. The recent cell sheet engineering enables us to transplant cell sheets with their conserved structure, so the functional in vitro constructs can be transplanted directly to the wound in vivo. These novel therapies have expanded in application from epithelial to mesenchymal regeneration, and thus offering exciting potential as practical alternatives in future regenerative medicine.

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LASERS IN PROSTHODONTICS - AN OVERVIEW

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Abstract

The introduction of lasers in the field of Prosthodontics is a technological advancement that has replaced many conventional surgical and technical procedures. Lasers are infact not new in the field of dentistry. They have been in use since 1960. A clinician needs to fully understand the Laser characteristics and the thermal implications & limitations of the optical energy. From operative dentistry to Periodontics, Paediatrics and prosthetics to cosmetics and implantology, Lasers have made a tremendous impact on the delivery of dental care in the 21st century and will continue to do so as the technology continues to improve and evolve. This review highlights the various applications of Lasers in the field of Prosthodontics like fixed and removable prosthesis, implantology, maxillofacial rehabilitation, dental laboratory etc.

Keywords: lasers, prosthetic rehabilitation, review

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Introduction

The field of Prosthodontics has come a long way from just replacing missing teeth by simple mechanics to the boundless era of modern technology. One such technological advancement is the introduction of lasers in the field of Prosthodontics that has replaced many conventional surgical and technical procedures and is beginning to replace the dental handpiece.

Lasers is the acronym for “Light Amplification by Stimulated Emission of Radiation” named by Gordon Gould in 1957.¹

Lasers are infact not new in the field of dentistry. They have been in use since 1960. They were first applied in dentistry for surgical treatment of tumors in the oral cavity. In 1997, the Erbium family of lasers, consisting of the Er: YAG and Er, Cr: YSGG wavelengths, was introduced in the United States of America. They have indications for use for both soft and hard tissue.^{2,3}

Science of lasers

Laser light: The light wave produced by a laser is a specific form of electromagnetic energy that behaves as a particle and a wave.

The basic unit of energy is called a photon. The wave of photons produced by a laser can be defined by 3 measurements, namely, velocity, amplitude and wavelength.

A material, either naturally occurring or man-made that when stimulated, emits laser light. This material may be a gas e.g. Argon, CO₂), a crystal (YSGG crystal doped with Er and Cr, YAG crystal doped with Er or Nd) or a solid-state semiconductor (AlGaAs, InGaAs diode). The active medium is positioned within the laser cavity, an internally-polished tube, with mirrors co-axially positioned at each end and surrounded

by the external energizing input, or pumping mechanism.

Pumping mechanism represents a man-made source of primary energy that excites the active medium. This is usually a light source, either a flashlight or arc-light or an electromagnetic coil. Energy from this primary source is absorbed by the active medium, resulting in the production of laser light by the process of stimulated emission.

Different types of Lasers used in Dental Treatment

Several types of lasers are available based on the wavelengths:

The Er: YAG (Erbium Yttrium Aluminium Garnet) laser possesses the potential of replacing the drill. Co2 laser can be used to perform gingivectomy and to remove small tumors. Argon laser is used in minor surgery. Nd: YAG (Neodymium Yttrium Aluminium Garnet) is used in tissue retraction, endodontics and oral surgery. The diode laser is effective for oral surgery and endodontic treatment. This laser helps to correct aesthetics flaws. It is used for soft tissue procedures.

Advantages of Laser over other techniques

1. It is painless, bloodless that results in clean surgical field, and fine incision with precision is possible.
2. There is no need for anesthesia if at all anesthesia has to be administered, then it needs to be used minimally only.
3. The risk of infection is reduced as a more sterilized environment is created as the laser kills bacteria.

4. No postoperative discomfort, minimal pain and swelling, generally doesn't require medication.
5. Superior and faster healing, offers better patient compliance.

Disadvantages of Lasers

1. Lasers cannot be used to remove defective crowns or silver fillings, or to prepare teeth for bridges.
2. Lasers can't be used on teeth with filling already in place.
3. Lasers don't completely eliminate the need for anesthesia.
4. Lasers treatment is more expensive as the cost of the laser equipment itself is much higher.

Applications of lasers in Prosthodontics

Lasers are now being used in a variety of procedures in prosthetic dentistry.

✓ Fixed prosthetics/esthetics

CLINICAL PROCEDURES

1. Crown lengthening
2. Soft tissue management around abutments
3. Osseous crown lengthening
4. Troughing
5. Formation of ovate pontic sites
6. Bleaching
7. Veneer removal
8. Tooth preparation for veneers and full coverage crowns and bridges⁴
9. Removal of carious lesion and faulty composite restorations before

placement of final restorations⁴

10. Crown fractures at the gingival margins
Enamel and dentin Etching⁶

LABORATORY PROCEDURES

1. Welding of components of FPD
2. Laser holographic imaging
3. Laser scanning of casts for CAD/ CAM
4. Ceramic cutting procedures

✓ ***Implantology***

CLINICAL PROCEDURES

1. Initial incision
2. Implant site preparation.
3. Second stage surgery of submerged implants
4. Promote osseointegration
5. Treatment of infrabony defects
6. Removal of peri-implant hyperplastic overgrowths
7. Treatment of peri implantitis

LABORATORY PROCEDURES

1. Laser titanium sintering
2. Laser ablation of titanium surfaces
3. Laser assisted hydroxyapatite coating
4. Laser welding of titanium components of the prostheses

✓ ***Removable prosthetics***

1. Tuberosity reduction
2. Torus reduction
3. Soft tissue modification
4. Epulis fissurata
5. Denture stomatitis

6. Residual ridge modification
7. Treatment of flabby ridges
8. Vestibuloplasty
9. Sulcus deepening
10. Frenectomies
11. Osseectomy during tooth/root extraction or ridge recontouring
12. Treatment of soft tissue and hard tissue undercuts

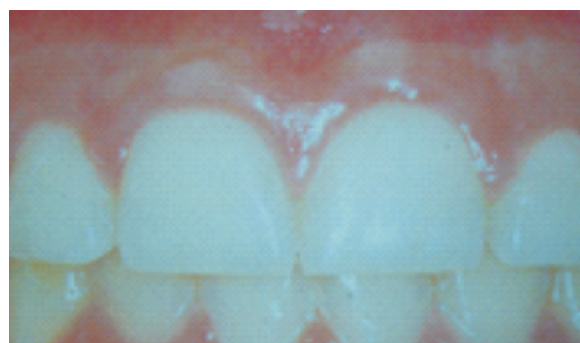
✓ ***Lasers in maxillofacial rehabilitation***

1. Planning the shape and position of the prostheses.
2. Three dimensional acquisition of optical data of the extraoral defects.

Fixed Prosthesis/Esthetics

- Crown lengthening procedures : with the help of lasers are indicated in following conditions:
 - a. Caries at gingival margin
 - b. Cuspal fracture extending apical to the gingival margin
 - c. Endodontic perforations near alveolar crest.
 - d. Insufficient clinical crown length.
 - e. Difficulty in placement of finish line coronal to the biological width.
 - f. Need to develop a ferrule.
 - g. Unaesthetic gingival architecture.
 - h. Cosmetic enhancements

Fig 1: Lasers for crown lengthening





Lasers offer unparalleled precision and operator control and may be beneficial for finely tracing incision lines and sculpting the desired gingival margin outline (Fig 1).

Also, less complicated and achieves maximum patient comfort. However, it is argued that lasers do not work well for crown lengthening procedures. Adequate correction is achieved only with conventional flap surgery.⁷

- Soft tissue management around abutments

Argon laser energy has peak absorption in hemoglobin, thus lending itself to providing excellent haemostasis and efficient coagulation and vaporization of oral tissues. These characteristics are beneficial for retraction and haemostasis of the gingival tissue in preparation for an impression during a crown and bridge procedure.

Argon laser with 300 um fiber, and a power setting of 1.0W, continuous wave delivery and the fiber is inserted into the sulcus in contact with the tissue. In a sweeping motion, the fiber is moved around the tooth.

It is important to contact the fiber tip with the bleeding vessels. Provide suction and water spray in the field. Gingivoplasty may also be done using argon laser.

- Modification of soft tissue around laminates

The removal and re-contouring of gingival tissues around laminates can be easily accomplished with the argon laser.

- Osseous crown lengthening

Like teeth mineralized matrix of bone consists mainly of hydroxyapatite. The water content and hydroxyapatite are responsible for the high absorption of the Er: YAG laser light in the bone. Er: YAG laser has very promising potential for bone ablation.

- Laser troughing

Lasers can be used to create a trough around a tooth before impression taking. This can entirely replace the need for retraction cord, electrocautery, and the use of haemostatic agents. The results are predictable, efficient, minimize impingement of epithelial attachment, cause less bleeding during the subsequent impression, reduce postoperative problems, and reduce chair time. It alters the biological width of gingiva. Nd:YAG laser is used.

- Bleaching

Aesthetics and smile has become important issues in modern society. Bleaching has become the common method for tooth whitening. Bleaching using diode lasers results in immediate shade change and less tooth sensitivity and is preferred among in office bleaching systems.⁸

- Veneer removal

Lasers like Er:YAG and Er Cr:YSGG can be used remove unwanted or failed veneers.⁴

- Crown fractures at the gingival margins

Er:YAG or Er, Cr:YSGG lasers can be carried out to allow correct exposure of the fracture margin.⁹

- Formation of ovate pontic sites

The use of an ovate pontic receptor site is of great value when trying to create a natural maxillary anterior fixed bridge. This is easily accomplished with the use of an laser.¹⁰

Implantology

- Implant recovery

One advantage of use of lasers in implantology is that impressions can be taken immediately after second stage surgery because there is little blood contamination in the field due to the haemostatic effects of the lasers. There also is minimal tissue shrinkage after laser surgery, which assures that the tissue margins will remain at the same level after healing as they are immediately after surgery.^{11,12}

- Implant site preparation

Lasers can be used for the placement of mini implants especially in patients with potential bleeding problems, to provide essentially bloodless surgery in the bone.¹²

- Removal of diseased tissue around the implant

Lasers can be used to repair ailing implants by decontaminating their surfaces with laser energy. Diode, CO2 & Er:YAG lasers can be used for this purpose. Lasers can also be used to remove granulation tissue in case there is inflammation around an already osseointegrated implant.^{12,13}

Removable prosthetics

The successful construction of removable full and partial dentures mainly depends on the preoperative evaluation of the supporting hard and

soft tissue structures and their proper preparation. Lasers may now be used to perform most preprosthetic surgeries. These procedures include hard and soft tissue tuberosity reduction, torus removal, and treatment of unsuitable residual ridges including undercut and irregularly resorbed ridges, treatment of unsupported soft tissues. Lasers also may be used to treat the problems of hyper plastic tissue and nicotinic stomatitis and ease the discomfort of epulis, denture stomatitis, and other problems associated with long term wear of ill fitting dentures.

- Treatment of unsuitable alveolar ridges

Alveolar resorption usually is uniform in vertical and lateral dimensions. On occasion, irregular resorption occurs in one of the dimensions, producing an unsuitable ridge. To remove sharp bony projections and to smooth the residual ridge soft tissue lasers surgery to expose the bone may be performed with any number of soft tissue wavelengths (CO2, diode, Nd:YAG,) Hard tissue surgery may be performed with the erbium family of wavelengths.

- Treatment of undercut alveolar ridges

There are many causes of undercut alveolar ridges. Two of the most common causes are dilated tooth sockets and non replacement of a fractured alveolar plate. Naturally occurring undercuts such as those found in the lower anterior alveolus or where a prominent pre-maxilla is present may be the cause of soft tissue trauma, ulceration, and pain when prosthesis is placed on such a ridge. Soft tissue surgery maybe performed with any of the soft tissue lasers. Osseous surgery may be performed with the erbium family of lasers.

- Treatment of enlarged tuberosity

The most common reason for enlarged tuberosities usually is soft tissue hyperplasia and alveolar hyperplasia accompanying the over-eruption of unopposed maxillary molar teeth.

Surplus soft tissue should be excised, allowing room for the denture bases. The soft tissue reduction may be performed with any of the soft tissue lasers. Erbium laser is the laser of choice for the osseous reduction.

- Surgical treatment of tori and exostoses

Prosthetic problems may arise if maxillary tori or exostoses are large or irregular in shape. Soft tissue lasers may be used to expose the exostoses and erbium lasers may be used for the osseous reduction. A smooth, rounded, midline torus normally does not create a prosthetic problem because the palatal acrylic may be relieved or cut away to avoid the torus.

- Soft tissue lesions

Persistent trauma from a sharp denture flange or over compression of the posterior dam area may produce a fibrous tissue response.

Hyperplastic fibrous tissue may be formed at the junction of the hard and soft palate as a reaction to constant trauma and irritation from the posterior dam area of the denture. The lesion may be excised with any of the soft tissue lasers and the tissue allowed to re-epithelialize. Normal excision of Epulis fissuratum is done by excision

of the fold, if small, or sub mucosal dissection followed by sharp sub mucosal excision, with suturing of the flap of the periosteum, however this method frequently fails because of extensive contracture of the vestibule, with loss of height.

Normally used laser for removal of Epulis fissuratum is CO₂ laser. The main advantage is the less patient discomfort.

Laser application in dental laboratory

Lasers have been used for deposition of hydroxyapatite (HA) thin films on titanium implants. Pulsed laser deposition (PLD) has proven to be a promising method to produce pure, crystalline and adherent HA coatings which show no dissolution in a simulated body fluid. Use of lasers for surface treatment of titanium castings for ceramic bonding have shown improved bond strength when compared to acid etching techniques which are commonly used. Lasers can also be used for welding.^{15,16}

Lasers in maxillofacial rehabilitation

The use of lasers in the maxillofacial prosthetics is mainly for the initial work up of three dimensional acquisition of optical data of the extraoral defects. Laser technology has proved to be particularly useful for planning the shape and position of the prostheses. Lasers can totally eliminate the need for conventional impression techniques and associated disadvantages like deformation of the soft tissue and discomfort to patients. Lasers also overcome the drawbacks of 3D CT and MRI reconstruction as the patient is not exposed to considerable radiation and any stress.

Conclusion

Lasers have become a ray of hope in dentistry. When used effectively and ethically, lasers are an exceptional modality of treatment for many clinical conditions that dentists treat on a

Fig 2: Laser for Epulis fissuratum



daily basis. But lasers has never been the “magic wand” that many people have hoped for. It has got its own limitations. If a clinician decides to use a laser for a dental procedure, he or she needs to fully understand the character of the wavelength being used, and the thermal implications & limitations of the optical energy.

However, the future of the dental laser is bright with some of the newest ongoing research. From operative dentistry to Periodontics, Paediatrics and prosthetics to cosmetics and implantology, Lasers have made a tremendous impact on the delivery of dental care in the 21st century and will continue to do so as the technology continues to improve and evolve.

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AWARDS AND ACHIEVEMENTS



Dr. Binu Purushothaman, Professor & Head, Department of Orthodontics was honoured with the “Young Dentist Award” by the Indian Dentist Research and Review(IDRR).



Dr. Bijoy
Second year PG student (Orthodontics)
Silver medal at “PACE 2014”-
Post Graduate Academic Confluence at
Kannur



Dr. Rahul C S
Second year PG student (Orthodontics)
Best Scientific e-Poster
X-TRACT '14 - IDA Kerala State Students
Conference, hosted by IDA Alappuzha
Branch in Nov 2014



Dr. Shijo Danny Kurien
 Second year PG Student (OMFS)
 Best Paper Award at the 11th Annual Kerala
 State Conference of AOMSI
 held in October 2014



Dr. Sarfras Raseel T
 Second year PG student(OMFS)
 Best poster award at the 39th AOMSI National
 Conference, Goa held in November 2014



Interns bagged several prestigious awards at the National Under Graduate Conference of Oral Medicine and Radiology, Bangalore held in September 2014.
 Sruthy Kirshnan (Best paper award), Sreerag AS, Sruthi Saji, Babin C B (Third prize, Dental Quiz), Stiya Ann Varghese, Viyana C, Reshmi Haridas (Top 10 Best Posters)

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