JPID
jpid.ipskerala.com

The journal of

PROSTHETIC AND IMPLANT DENTISTRY

Official Publication of Indian Prosthodontic Society
Kerala State Branch

Volume 1
Issue 3
May–August 2018

The journal of
PROSTHETIC AND IMPLANT DENTISTRY

Official Publication of Indian Prosthodontic Society
Kerala State Branch

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

EDITORIAL BOARD

INDIAN PROSTHODONTIC SOCIETY KERALA STATE BRANCH EXECUTIVE COUNCIL

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

The Journal

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

Information for Authors

The manuscript will be reviewed for possible publication with the understanding that it is being submitted to JPID alone at that point in time and has not been published anywhere,simultaneously submitted or already accepted for publication elsewhere. The journal expects that the 'corresponding author' authorised by all the contributors will communicate with the journal for all matters related to the manuscript. The order of naming contributors should be based on the relative contribution of the contributor towards the study and writing the manuscript. Once submitted the order cannot be changed without written consent of all the contributors. Conflicts of interest / competing interests, if any, must be disclosed. All manuscripts received will be duly acknowledged. Submitted manuscripts will initially be reviewed by the Editors. Manuscripts with insufficient originality, serious scientific/ technical flaws or lack of a significant message are rejected before proceeding for formal review. Manuscripts that are found suitable for publication in JIPD are sent to two or more expert reviewers. The selection of these reviewers is at the sole discretion of the Editor. The journal follows a double blind review process,wherein the reviewers and the authors are unaware of each other's identity. Every manuscript will be assigned to a member of the editorial team, who based on the comments from the reviewers takes a final decision on the manuscript. The authors will be asked to modify the manuscript if needed. The comments and suggestions received from the reviewers are conveyed to the corresponding author. The whole process of submission of the manuscript to the final decision and sending and receiving proofs is completed online. Manuscripts (single word document file with doc or docx extension without exceeding 4MB file size) typed in British English should be uploaded in our website www.ipskerala.com. Text should be made in MS Word. Size 12 of 'Times New Roman' font with double spacing is recommended for the main text. Title page should contain NAME OF THE ARTICLE, NAME AND DETAILS OF CONTRIBUTORS and NAME EMAIL & MOBILE NUMBER OF CORRESPONDING AUTHOR. Name and details of the authors should not be mentioned anywhere else. For Headings, Size 16and 20 can be used. Images, graphs and tables should be included in the main text. References from articles in journals, books and other monographs should be in the formats used by the NLM in Index Medicus. References should be numbered consecutively in the order in which they are first mentioned in the text (not in alphabetic order).Scanned image of signed Copyright transfer statement by corresponding author should be attached as a separate file (jpg,jpeg,gif,png or bmp format. Maximum size permitted is 1 MB).

Scanned image of signed Copyright transfer statement by all the contributors should be attached as a separate file (Specification same as image).

Subscription

Electronic copies can be downloaded from www.ipskerala.com free of cost.

Advertisement Policy

The journal accepts advertising. Frequency

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

discounts and special positions are available. Enquiries about advertisements should be sent to ipskeralaeditor@gmail.com. The journal reserves the right to reject any advertisement considered unsuitable according to the set policies of the journal. Appearance of advertising or product information in the various sections in the journal do not constitute an endorsement or approval by the journal and/or its publisher of the quality or value of the said product or of claims made for it by its manufacturer.

Disclaimer

Scientific content presented in this journal are the views of the authors and not of the Journal or its Editorial Board or its publisher. Neither the Editorial Board nor the publisher assumes any liability or responsibility for the accuracy, completeness or usefulness of any information provided in this journal, nor shall they be liable for any direct, indirect, incidental, special, consequential or punitive damages arising out of the use of the Journal of Prosthetic and Implant Dentistry. Readers are encouraged to confirm the information contained herein with other sources to avoid any error or omission or for the results obtained from the use of data contained in this publication.

Addresses

Editorial Office

Dr Prasanth Viswambharan
'Kailasam', KRA 15A
Opp LPS Pettah, Palpu Road,
Nalumukku-Pettah, Trivandrum, Kerala,
PIN 695 024.

Phone +919446353602, +919846909058

Email: ipskeralaeditor@gmail.com

Published by
Indian Prosthodontic Society, Kerala State Branch.

Designed and Published by
Suman Graphics, Trivandrum.

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

CONTENTS

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

Editorial

Kerala is wobbling under the worst flood in the history. Heavy torrential rains and flood left over more than 400 dead, thousands displaced in the state, swamping homes, demolishing roads and disrupting road, rail and air traffic in many places. Inundation of land and property left people shattered to an extent that no one can ever imagine. People witnessed their whole life savings getting washed out by the violent stream of water along with land sliding, claiming the lives of their beloved ones; a truly devastating situation.

Amidst all these, there is a silver line of hope. We could see people unite regardless of the caste, creed, religion and politics to tackle the havoc. This very gesture vouch that humanity still exists. Armed forces, fishermen, local residents and volunteers worked as a unit. Central and state governments reacted to the situation very well. International agencies offered help in rebuilding Kerala.

But when these flood victims return to their wrecked shelters, they need to start from scratch to rebuild their lives back to normal. This poignant situation bellows the dire need of support from all of us. 'Little by Little A Little become a Lot'. Let's us join our hands together, to revive the lives of flood victims to restore every damage caused by inundation, to restore our MIGHTY KERALA!!!! Like a Phoenix rising from the ashes!!!

'We all can work, but together we win'; I strongly appeal to the members of Indian Prosthodontic Society, Kerala State Branch to help the government in the humanitarian task of relieving the distress of the poor sufferers by contributing generously to the Chief Minister's Distress Relief Fund and thus earn the gratitude of their distressed fellow ones.

Dr Prasanth Viswambharan

Chief Minister's Distress Relief Fund
Account Number 67319948232
IFS Code SBIN0070028
State Bank of India
City Branch, Trivandrum

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

LIQUID SUPPORTED DENTURE FOR RESORBED AND FLABBY RIDGES- A CASE REPORT

*Sijin Sivankutty, **R Ravichandran, ***Prasanth V, **** Lylajam S, *****Smitha

*Final yr post graduate, **HOD, ***Assistant Professor , ****Professor, *****Lecturer Department of Prosthodontics, Government Dental College, Trivandrum | Corresponding Author: sijnsijm170@gmail.com

Introduction

Flabby ridges refers to the hyper plastic tissue which replaces bone after bone resorption and is usually seen in long term denture wearers. The common complaint when dentures given to such patients with flabby ridges are ill fitting dentures so certain modifications in denture should be made to avoid minimum displacement of denture during function and providing maximum retention and stability.

This article illustrates the concept of liquid supported denture and a case report done in this manner to prevent displacement of dentures due to flabby tissues as the liquid filled denture adapts well to the mucosa and act as a shock absorber from uneven stresses.

An ideal denture base would continuously adapt to the mucosa and thus should be flexible. However, it also has to support the teeth during function and thus should be rigid. Obviously, these properties cannot be combined in one material. Yet, with combinations of materials, the base. This requirement can be satisfied by liquid supported dentures[1]

In 1961 chase[2] used elastic impression materials on mucosal side of dentures in severely traumatized tissues, then came use of tissue conditioners for traumatized tissues.

Soft liners are those materials used in cases of denture sore mouth, liquid supported dentures serve both functions

Case report

A completely edentulous patient came to the Department of Prosthodontics, Government Dental College Trivandrum with ill fitting old denture. On examination there was flabby tissue and atrophied ridges Fig. 1 so we planned for a liquid supported denture rather than conventional denture because liquid supported denture acted as a shock absorbing denture due to its liquid cushion like effect the forces could be uniformily distributed and also minimum displacement from flabby tissues and also reducing further bone resorption.

Fabrication of liquid supported dentures

Procedures till try in are similar to conventional dentures Fig 2. After try in procedure the upper cast was sent to the lab for fabrication of vacuum heat pressed poly ethylene sheet of 1.5 mm thickness.

The poly ethylene sheets were constructed in such

a manner that it was shorter from the sulcular depth by 2 mm and short of posterior palatal seal area Fig. 3.

After dewaxing procedure the vacuum sheet was placed and heat cure resin was packed with the vacuum sheet in its position. The upper denture with vacuum sheet was tried in patients mouth for retention stability and support Fig. 4 .patient was asked to use this denture for 2 weeks so that she feels comfortable with new denture.

On the next visit after 2 weeks the poly ethylene sheets were removed and putty impression of the tissue surface of denture was made and poured with dental stone on this cast another vacuum polyethylene sheet of 0.5mm was fabricated, hence creating a space of 1mm on to which high viscosity glycerine Fig. 5 could be placed.

0.5 mm vacuum sheet was then placed to tissue surface of denture by adhesive and cold cure resin Fig. 6

Holes were then placed on the buccal flanges of the denture Fig. 7 and glycerine was injected through the holes and then one hole was closed with cold cure resin

After checking the vertical dimension in patients mouth other hole was closed. Fig. 8 shows the post operative view

A liquid-supported denture can add a series of attributes to the conventional acrylic resin denture: 3

1. Preservation of residual ridge by optimal distribution of masticatory forces.

2. Better retention, stability, support, and comfort

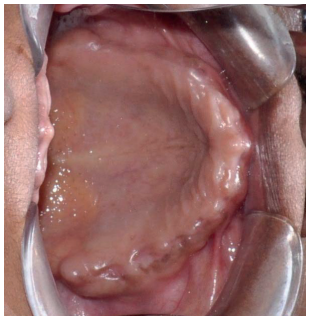


Fig.1. Flabby and resorbed maxillary ridge

Fig.2 .Try in on complete denture

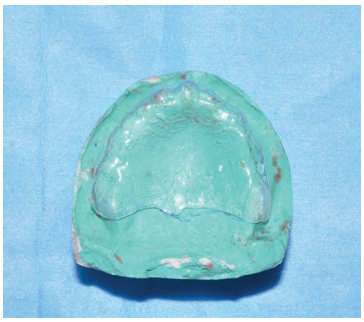


Fig. 3 vacuum heat pressed polyethylene sheet

Fig.4. Maxillary denture with vacuum poly ethylene sheet embedded

Fig.5. Highly viscous glycerine

Fig.6. 0.5 mm vacuum sheet was then placed to tissue surface of denture by adhesive and cold cure resin

Fig. .7 Holes placed on buccal flanges using round burs

Fig.8 Post operative view

due to close adaptation.

3. Optimized atmospheric pressure, adhesion, cohesion and mechanical interlocking in undercuts.

4. Improved patient tolerance because of great comfort due to smooth flexible surfaces

5. Prevention of chronic soreness from rigid denture surface.

Discussion

Liquid supported denture is based on the theory that when the force applied on the denture is absent the base assumes its pre shaped form that is the one during processing[1]. But under masticatory load, the base adapts to the modified form of mucosa due to hydrodynamics of the liquid improving support, retention and stability. There will also be optimal stress distribution of masticatory forces over a larger area which reduces tissue overloading. Prevention of soreness and increased comfort level are other advantages of the liquid supported denture.[4]

Bibliography

1. C. L. Davidson and G. Boere, "Liquid-supported dentures, part I: theoretical and technical considerations," The Journal of Prosthetic Dentistry, vol. 63, no. 3, pp. 303–306, 1990.
2. Chase WW. Tissue conditioning using dynamic adaptive stress. J Prosthet Dent 1961;11:804-15.
3. Kakade Dilip;Athavale Smita;Shingote Santosh,Dammani Brajesh.Liquid-supported denture: a gentle option. J Indian Prosthodont Soc 2007;7:35–39
4. Boere G, de Koomen H, Davidson CL. Liquid-supported dentures. Part II: Clinical study, a preliminary report. J Prosthet Dent 1990;63:434–436.

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

RIDGE SPLIT AND BONE EXPANSION IN POSTERIOR ATROPHIC MANDIBULAR REGION

*Byju Paul Kurian, **Angel Mary Joseph,***Merlyn George, ****Prisly Thomas

*Professor and Head, **Senior lecturer, ***Postgraduate Student, **** Clinician, Department of Prosthodontics, Annoor Dental College, Muvattupuzha, Kerala Corresponding Author: dr.byjupaulkurian@gmail.cm

Abstract:

Ridge augmentation technique have proved to be successful in achieving adequate horizontal and vertical dimension for implant placement in moderate ridge defects. However, this technique has several disadvantages. This led to the advent of ridge splitting technique for improving the dimension of bone for implant placement in moderate ridge defects.

Ridge splitting is a technique of bone manipulation to form a receptor site without the removal of bone from implant site. This technique is a quick method wherein an atrophic ridge can be predictably expanded, eliminating the need for a second donor site and a second stage surgery. This case report describes the placement of implant prosthesis using ridge split technique and bone expansion in the region of atrophic mandible.

Keywords: Bone expansion, Horizontal ridge defect, Ridge split technique.

Introduction

Edentulism causes resorption of the alveolar ridge and bone loss compromising dental implant placement in a prosthetically ideal position. Therefore, augmentation of an insufficient bone volume is indicated prior to the placement of implants to attain predictable long-term treatment outcome[1]. Ridge augmentation technique using autograft, block graft and guided bone regeneration have proven to be successful in achieving horizontal and vertical dimension of bone. However, some drawback of technique include invasiveness, additional donor site requirement, resorption of grafting materials, membrane collapse, exposure to infection and donor site morbidity[2]. Hence ridge splitting technique have gained popularity in moderate ridge defects for prosthetic implant placement[3].

Ridge splitting is a technique of bone manipulation to form a receptor site without the removal of bone from implant site. This is a quick method wherein an atrophic ridge can be predictably be expanded, eliminating the need for a second donor site and a second stage surgery. This case report describes a prosthetically driven implant placement in left mandibular first molar tooth using ridge split and bone expansion technique.

Case report

A sixty two year old female patient reported to the Department of Prosthodontics with a chief complaint of tooth loss in lower left posterior region for the past 2-3 yrs. Patients medical/social and family history was non-contributory. On intraoral

examination she had a previously treated 4 unit metal ceramic fixed dental prosthesis in 17 to 14 region, metal ceramic crowns in #11, #12, #21, #26, #42, #43, #46, root canal treated teeth in #34, #35, #37 and missing #36 (Fig. 1). OPG examination showed adequate bone height and width in 36 region (Fig. 2). A CBCT scan revealed 2.75mm of bucco-lingul width of ridge. However, there was adequate bone to allow ridge split and expansion procedure (Fig. 3). Various treatment options were discussed with the patient and with the consent of the patient, implant placement with ridge split and bone expansion using bone spreader and expander in 36 region was planned.

1) Stage I procedure- surgical phase

Prophylactic antibiotic and analgesics was prescribed 1hr before the procedure and Chlorhexidine mouthwash was given 3 days before implant surgery. The patient was prepared in a sterile environment and local anaesthesia (2% lignocaine with 1:80,000 adrenaline) was

Fig. 1:Pre-operative intraoral view showing narrow ridge in 36 region

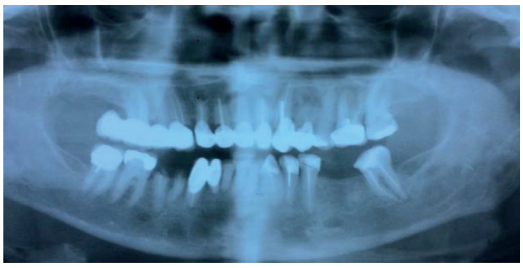


Fig. 2: Pre-operative panoramic radiograph

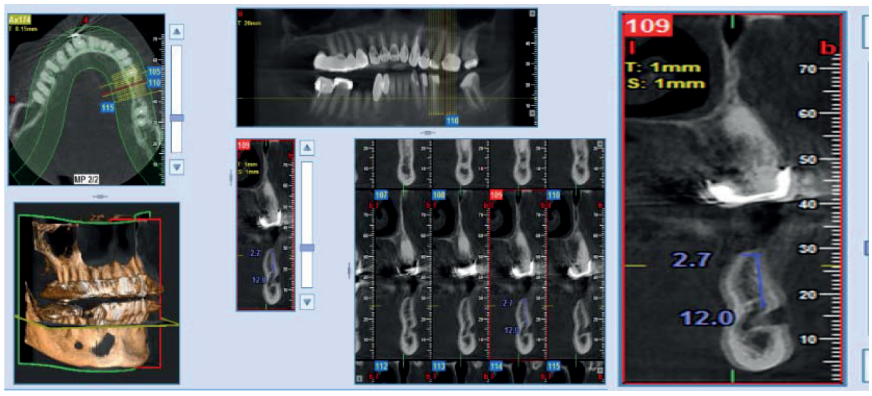


Fig.3: CBCT showing 2.75mm width of bone in 36 regio

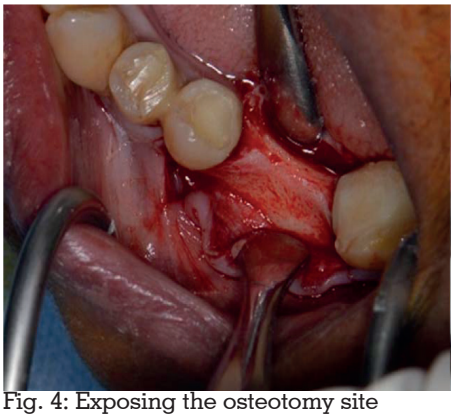


Fig. 4: Exposing the osteotomy site

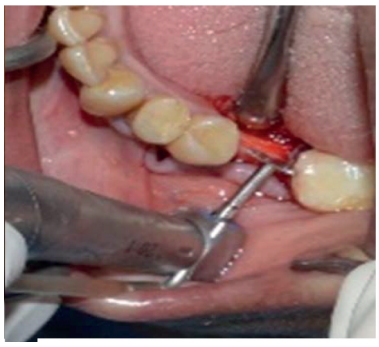


Fig. 5: Beveled chisel was malletedto a depth of 7mm

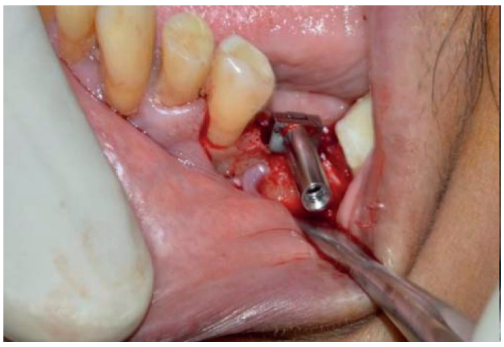


Fig. 6: Bone spreader placed for bone expansion.

Fig. 7: Completion of bone expansion using bone expanders.

administered. The ridge was palpated for assessment of the ridge thickness and presence of bony undercuts. A full thickness crestal incision was given and a muco-periosteal flap was reflected to expose the surgical site (Fig. 4). A crestal bone cut was initiated and carried to depth of 7mm by bone saw. A narrow 2mm beveled chisel was malleted to a depth of 7mm to create space for the bone spreaders (Fig. 5). The ridge splitting bone spreader was tapped to a depth of 7mm and the bone spreader screw was tightened with a lever (Fig. 6). As the screw of the bone spreader tightened, the wings of the bone spreader opened up (Fig. 7). After creating the buccal plate, a pilot drill was placed to create the osteotomy site and bone expansion screws were tapped into the site with sequential drilling upto 3.5mm diameter of bone expander. Self tapping, threaded implant of 3.75 mm × 10 mm implant was carefully placed in the site at the same surgical appointment (Fig. 8, 9). Multiple interrupted 4-0 silk sutures were placed. Patient was periodically recalled and a healing abutment was placed after 4-6 months. (Fig. 10)

2) Stage II procedure – implant prosthesis phase

Following the placement of healing abutment, patient was recalled after 2 weeks for making impressions of 36 region (Fig. 11). Crown preparation was done for the root canal treated 34, 35, and 37. A transfer coping was placed and an open tray Impression was made for the fabrication of cement-screw retained Implant prosthesis in 36. Impression was also made for the metal ceramic crowns on 34, 35 and metal crown in 37. Patient was recalled after 1 week for the final cementation of the crowns and implants (Fig. 12).

Discussion

Ridge augmentation procedure is deemed important if the alveolar bone width is less than 5mm, in order to receive an endosseous implant. If implants are placed in areas of inadequate ridge

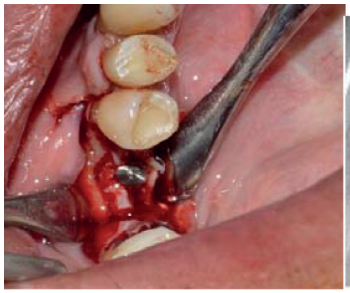
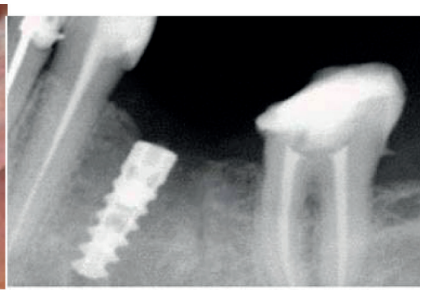



Fig.: 8, 9: Placement of implant of size 3.75* 10mm and post-operative radiograph following implant placement

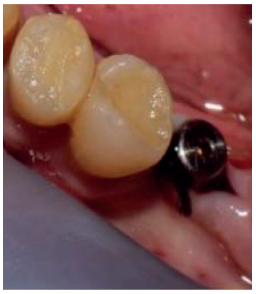


Fig.: 10: Placement of healing abutment

Fig. 11: Placement of transfer coping



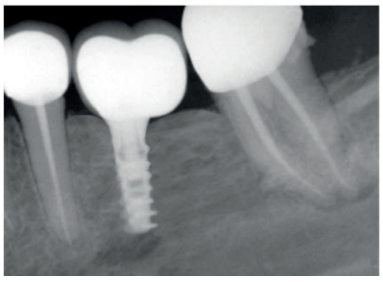


Fig. 12: Post-operative intraoral view and radiograph

width then following problem can be encountered.

1. Dehiscence of labial bone predisposing to peri-implantitis,

2. Resorption of thinner labial plate in near future

3. Undercuts on alveolar bone which may give rise to off-axis loading[4].

Ridge augmentation procedure may be done by using autogenous block graft, corticocancellous particulate bone graft, allograft using GBR (guided bone regeneration) membrane, distraction osteogenesis and ridge splitting with bone expansion techniques etc. The ideal indications of ridge splitting and bone expansion procedure are those sites that do not require vertical ridge augmentation and those that have cancellous bone present between labial and palatal cortical plate. Although this procedure is technique sensitive, there are many advantages over other techniques. The advantages being it takes help of inherent quality of flexibility of cancellous bone and maintaining the integrity of labial bone with an intact periosteum[5,6]. Though this technique provides atraumatic approach for bucco-lingually deficient ridge, a study by Padmanabhan and Gupta demonstrated greater crestal bone loss associated with osteotome technique compared to conventional technique in the mandibular region[7].

Conclusion

Careful patient selection and bone evaluation is important to guarantee the success of ridge split and bone expansion for a prosthetically driven implant placement. This procedure serves as a minimally invasive technique to achieve ideal goals of implant dentistry augmentation for moderate mandibular ridge defect as in this case report.

References

1. Buser D, Martin W, Belser UC. Optimizing esthetics for implant restorations in the anterior maxilla: Anatomic and surgical considerations. Int J Oral Maxillofac Implants 2004;19(suppl): 43–61
2. Hjorting-Hansen E. Bone grafting to the jaws with special reference to reconstructive preprosthetic surgery. A historical review [in German]. Mund Kiefer Gesichtschir 2002;6:6–14
3. Simion, M.; Baldoni, M. & Zaffe, D. Jawbone enlargement using immediate implant placement associated with a split-crest technique and guided tissue regeneration. Int. J. Periodontics Restorative Dent., 12(6):462-73, 1992.
4. Goyal S, Iyer S. Bone manipulation techniques. Int J Clin Implant Dent. 2009;1:22–31
5. Summers RB. The osteotome technique: Part 2 – The ridge expansion osteotomy (REO) procedure. Compendium. 1994; 15:422. 424, 426, passim; quiz 436
6. Summers RB. A new concept in maxillary implant surgery: The osteotome technique. Compendium. 1994; 152:154–6. 158 passim; quiz 162.
7. Padmanabhan TV, Gupta RK. Comparison of crestal bone loss and implant stability among the implants placed with conventional procedure and using osteotome technique: A clinical study. J Oral Implantol. 2010;36:475–8

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

PROSTHETIC REHABILITAION OF A MANDIBULECTOMY PATIENT FOLLOWING OSTEORADIONECROSIS –A CASE REPORT

*Joshy P Abraham, **Kurian Varghese, *Jaysi JJ, ***Roshini Abdul Vaheed, *Sreelekshmi

*Postgraduate Student **Professor and Head, *** MDS Practitioner, Department of Prosthodontics, Azeezia Dental College, Meyyanoor, Kollam, Kerala Corresponding Author: joshykylm@gmail.com

Abstract:

Osteoradionecrosis (ORN) of the jaws, particularly of the mandible, is a long-term and serious complication of therapeutic radiotherapy for head and neck cancer. The mandible is affected more commonly than any other bones of the head and neck region. Surgical management for osteoradionecrosis with radical resection of mandible results in gross loss of anatomical structure and multiple impairment. Prosthetic rehabilitation in these patients are aimed at improving the quality of life of the patient. This article is a case report on the prosthetic management of mandibulectomy patient following osteoradionecrosis reconstructed with a modified reconstruction plate technique.

Key words:
Osteoradionecrosis, mandibulectomy.

Introduction

One of the most common cancer by incidence and death from cancer worldwide is Head and neck cancer. Head and neck cancer treatment comprises surgery, radiotherapy, chemotherapy, or a combination. But, for oral cancer, the treatment of choice is surgery and later followed by radiotherapy in patients with advanced disease.

The psychological, cosmetic and functional results of oral cancer treatment may combine to have serious effects on the patient's quality of life (QOL)[1].

The main aim in cancer treatment is not only on survival but also on rehabilitation, which improves multiple impairments and QOL. The possible outcomes of radical surgery include alteration in oral anatomy, loss of teeth and surrounding anatomical structures, significant amount scarring and heavy flaps, loss or change of sensation, and reduced mouth opening due to trismus.

General tissue effects of radiation include oral mucositis, loss of taste, dysgeusia/hypogeusia, erythema, muscle fibrosis, xerostomia, radiation caries, trismus, TMJ dysfunction, osteoradionecrosis and Changes in oral flora causing candidal infections, gingivitis

Delayed effects on Salivary glands include increase in viscosity of saliva with decreased amount and decreased pH, and difficulty in swallowing.

Osteoradionecrosis is a chronic, non-healing wound caused by hypoxia, hypo cellularity and hypo vascularity of irradiated tissue, frequently affecting mandible[2]. Osteoradionecrosis is commonly treated with hyperbaric oxygen therapy followed by segmental mandibulectomy & reconstruction with plate is common[3].

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

Case report

A 59 year-old, female patient was referred to the Oral and Maxillofacial Surgery department of our college with complaint of pus discharge in relation to right lower jaw. The patient had a history of squamous cell carcinoma of the tongue which was treated with radiation and chemotherapy. Extra oral examination revealed asymmetrical face with an Orocutaneous fistula on the right mandibular angle region (Fig. 1). Right-side facial paralysis was noted. Necrotic bone was seen exposed intra orally (Fig. 2). Swelling and trismus was evident. Patient was advised for an OPG which revealed osteoradionecrosis of the right and left side mandible (Fig. 3). Segmental mandibulectomy with modified radical neck dissection was done for right side and marginal dissection for the left side mandible after Hyperbaric Oxygen therapy (Fig. 4). The reconstruction had been done with a modified technique using reconstruction plates without bone or soft tissue (Fig. 5).

Alginate impression was made three days post-surgery for fabrication of an interim denture. Interim denture with self-cure acrylic (DPI RR Cold cure). Silicone soft liner (Tokuyama dental America) was used in relining the interim denture.

Following six months post-surgical review, Patient reported to department of Prosthodontics for reconstruction in relation to the resected mandible (Fig. 6). On intra oral examination healing was found satisfactory. Various treatment options were assessed for this particular case. Modified surgical technique with arch bar presented with many challenges. Concerns on the ability of the arch bar to resist occlusal force and the increase in the leverage force that would act on the arch bar with no soft tissue covering to provide the cushioning effect were assessed. Other major issue was difficulty

Fig. 1 - Orocutaneous fistula on right angle of mandible

Fig. 2 - Exposed necrotic bone

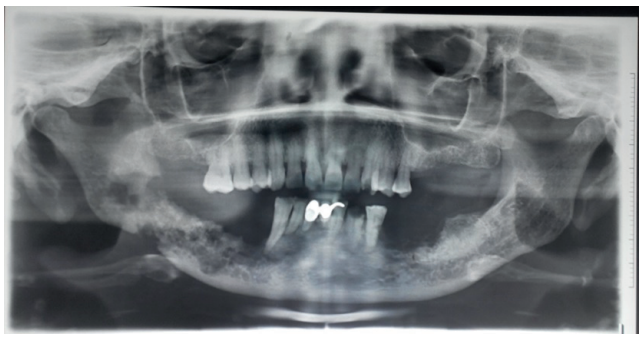


Fig. 3 - Preoperative opg

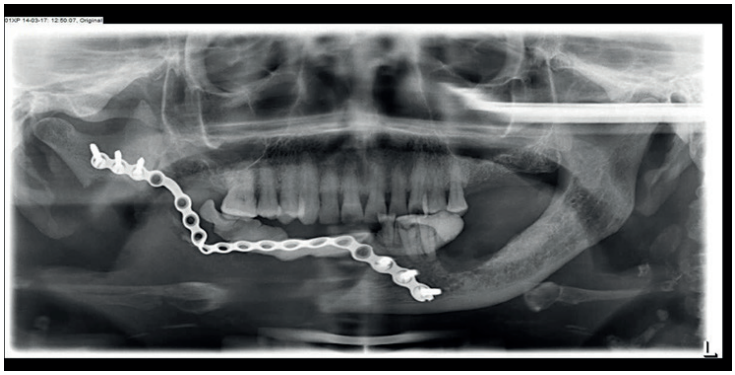


Fig. 4 post surgery opg

Fig. 5 – postoperative intraoral view

in maintain oral hygiene, and the amount of soft tissue support that could be utilized. Considering all these factors an appropriate treatment plan was formulated. Remaining natural teeth were advised for endodontic therapy followed by fabrication of post and core coping. Mandibular left canine was planned to be retained. For utilization of the retentive holes in the arch bar customized cast inserts were planned. Treatment modality was discussed with the oral surgery department and explained to the patient and prior consent was obtained.

Primary impression with alginate was made and a custom tray was fabricated using cold cure acrylic resin. Wax spacer was added to record the reconstruction plate and the extension of the tray was assessed in patient's mouth to utilize the soft tissue support on the left side. Border molding was done using putty addition silicone (GC Flexceed putty) (Fig. 7). Acrylic tags were placed to record the retentive holes of the reconstructive plate (Fig. 8). Undercuts were blocked using wax and final impression was made using light body addition material (GC Flexceed Light body) (Fig. 9). Jaw relation was recorded and maxillary and mandibular models were mounted in an articulator. Teeth arrangement was done with flat cusped posteriors to minimize the lateral forces acting on the denture and try in was done (Fig. 10). Acrylization of the prosthesis was done using heat cure acrylic resin (DPI Heat cure) (Fig.11).

Wax up was done on the master cast for fabrication of the retentive inserts using inlay wax (Fig. 12). Retentive elements were provided for engaging into the denture (Fig. 13) and these inserts were casted using cobalt chromium alloy (Fig. 14). Retentive inserts were attached to the denture by pick up technique while adequate care was

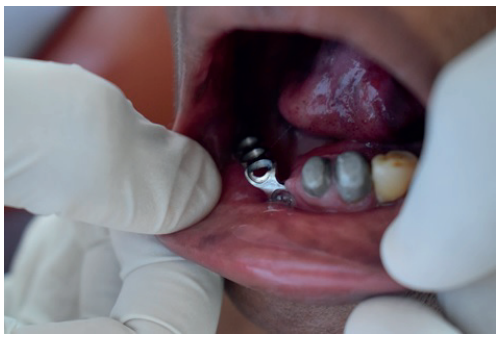


Fig. 6 - Post surgical healing

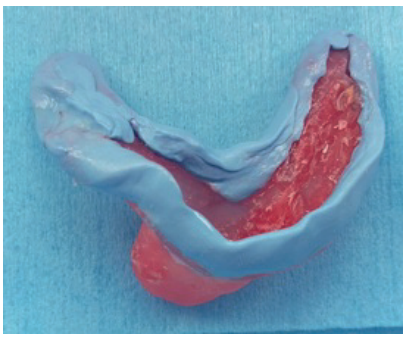


Fig. 7 border molding

Fig. 8 Acrylic tags were placed to record the retentive holes.

Fig. 9 - final impression

Fig. 10 - trial denture

Fig. 11 acrylic denture

taken to avoid acrylic from engaging the acrylic plate (Fig. 15). Final denture insertion was done following which patients was reviewed at frequent intervals (Fig. 16 A,B).

Discussion

Osteoradionecrosis is late complication of radiation therapy that results in irreversible tissue death that is clinically observed as bone exposure for more than 3 months duration[4]. The mandible is affected more often than any other bone in head and neck region. Osteoradionecrosis of the mandible often affects the body of the mandible[5] which is treated with segmental or marginal resection. The defect is usually bridged using conventional reconstruction plate or using free osteocutaneous flap from fibula, iliac etc[6]. However, these flaps can have limitations in supplying the necessary combination of bone and soft tissue, and both have a significant donor site morbidity. In the irradiated patient, healing conditions for a bone graft are less than optimal due to poor vascularity[7]. These issues prompted for a modified technique in the fixation of reconstruction plate. A customised prosthetic approach was necessary for rehabilitation of the patient. It is of utmost importance to correlate all aspects of dental care in order to achieve best outcomes for the patients. Modified surgical technique with arch bar presented with many challenges. Bridging the defect with a reconstruction plate alone is bound to fail sooner or later because of metal fatigue leading to plate fracture[8]. Reconstruction plate is more prone to fail as no soft tissue support is present to provide the cushioning effect. Other major issue was difficulty in maintain oral hygiene with chance of food entrapment beneath the

Fig. 12 Wax up -retentive insert

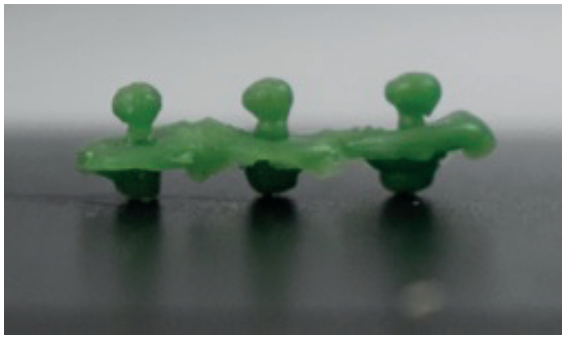


Fig. 13 Retentive element to engage denture

Fig. 14 Casted insert

Fig. 15 final prosthesis

Fig. 16 A- Post insertion

Fig. 16 B - Post insertion

prosthesis and reconstruction plate. The intraoral soft tissue opening for the reconstruction plate along with the compromised health condition of the patient calls for frequent checkup and high standard of hygiene.

References

1. SZ Krista, RN Simon and JB Chris. The Prosthodontic Pathway of the Oral Cancer Patient. Dent Update 2012; 39: 98–106.
2. Mounsey RA, Boyd JB. Mandibular reconstruction with osseointegrated implants into the free vascularized radius. Plast Reconstr Surg 1994;94:457–464.
3. King M, Casarett G, Weber D. A study of irradiated bone: I. Histopathologic and physiologic changes. J Nucl Med 1979;20:1142–1149.
4. Kahenasa N, Sung EC, Nabili V, Kelly J, Garrett N, Nishimura I. Resolution of pain and complete healing of mandibular osteoradionecrosis using pentoxifylline and tocopherol: A case report. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012;113:e18–23.
5. Lyons A, Ghazali N. Osteoradionecrosis of the jaws: Current understanding of its pathophysiology and treatment. Br J Oral Maxillofac Surg. 2008;46:653–60.
6. Li Z, Zhao Y, Yao S, Zhao J, Yu S, Zhang W. Immediate reconstruction of mandibular defects: a retrospective report of 242 cases. J Oral Maxillofac Surg. 2007;65(5):883–890.
7. Jacobson A S, Buchbinder D, Urken M L. Reconstruction of bilateral osteoradionecrosis of the mandible using a single fibular free flap. Laryngoscope. 2010;120(2):273–275.
8. Katakura A, Shibahara T, Noma H, Yoshinari M. Material analysis of AO plate fracture cases. J Oral Maxillofac Surg. 2004;62(3):348–352.

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

IMPLANT OVERDENTURE ATTACHMENT SYSTEMS – A REVIEW

*Rohit Raghavan, **Shajahan P A,***Ratheesh N,

*Professor & Head, ** Professor, ***Post Graduate Student, Dept of Prosthodontics, Royal Dental College | Corresponding Author: : Dr Ratheesh N, E-mail: drratheeshnp@gmail.com

Introduction

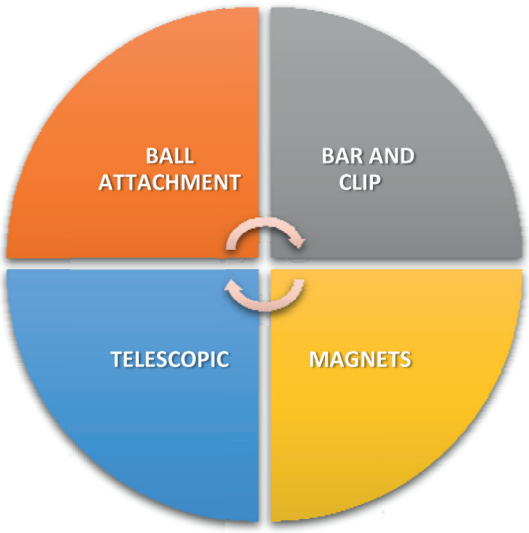
Edentulism is considered a poor health outcome and may compromise the quality of life especially for the geriatric community. The prosthetic management of the edentulous patient has long been a major challenge for dentists. The problem of stability and retention of a complete denture is solved with the use of an implant retained denture, commonly known as an implant overdenture. According to recent ITI consensus, a two-implant retained, tissue-supported overdenture restoration is considered the minimum standard of care for edentulous patients. The purpose of the review was to collect data regarding the different attachment systems available for the clinician to provide an informed decision when planning implant overdenture.[1 2]

An attachment is defined as "a mechanical device for the fixation, retention, and stabilization of a prosthesis, it has a retainer consisting of a receptacle and a closely fitting part. The female matrix component is usually contained within the normal or expanded contours of the crown of the abutment tooth and the male patrix component is attached to the implant or denture framework."

Types of attachments

Criteria for selecting attachments

- Available bone and bone quality
- Patient's prosthetic expectation
- Patient's economic status
- Clinical expertise of specialist
- Availability of skilled technician.
- Interforaminal distance
- Available vertical restorative space



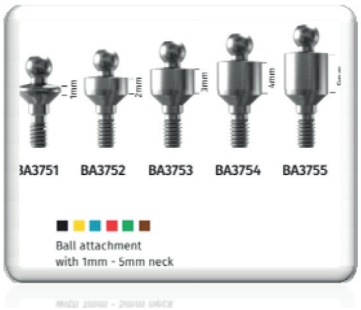
Ball attachments

Stud type ball attachments are considered as the simplest type of overdenture attachments. It is cheaper than all other systems. It consists of a titanium male unit and an easily replaceable rubber ring female unit that is retained in a metal retainer ring. It transfers the stresses to the abutments and provides an excellent shock absorbing effect during the function. If implants are nonparallel and they have angulations >15°, ball attachments cannot be used. The O-rings gradually loose retention and must be replaced periodically.[9]

The ERA® Implant-Supported Overdenture System can be used either individually as implant abutments or can be incorporated into a bar. It is a time-tested system first introduced 20 years ago. The male portion of the attachment is a nylon piece of varying retentive quality. The attachment is resilient, stable, and can be easily serviced.

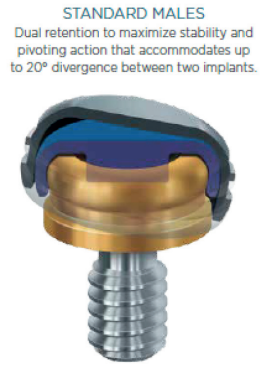
The ERA males are available in collar heights of 3 mm or 5 mm for externally hexed implants and 2 mm or 4 mm for implants with internal hexes. The female part comes in 0-, 5-, 11- and 17-degree configurations to correct for angulated implants. The retentive portion is coated with titanium nitrite to reduce wear.

The ERA® males are made of nylon and are available in five color-coded styles. The black male is used for lab processing. The remaining males are of varying degrees of retention: white (least retentive), orange, blue, and grey, (most retentive). The males act as a hybrid ball-and-socket attachment, allowing for movement in all

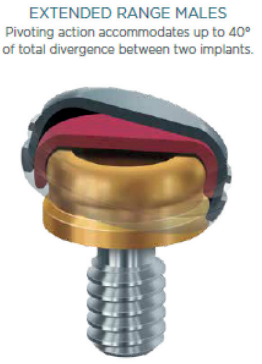


Nylon Metal

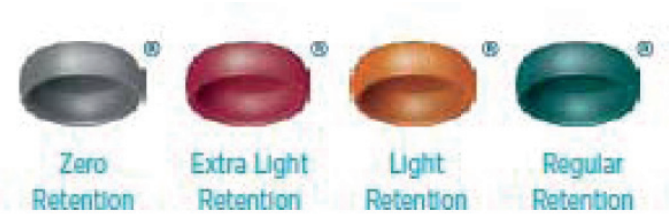
Rubber



Allow for insertion of the overdenture with up to 20 degrees of divergence between implants and are available with 1.5, 3 or 5 lbs of retention forces.



Allow for insertion of the overdenture with up to an extensive 40 degrees of divergence between implants and are available with 0, 1, 2 or 4 lbs. of retention forces.



directions, including resilient, vertical movement.

Locator® Attachment System is designed with customizable levels of retention and a low vertical profile. It has the ability to pivot, which increases the attachment's resiliency and tolerance for the high mastication forces. This pivoting action, along with the attachment's self-aligning design, provides ease of seating the denture by the patient.[5]

It can be used in cases of limited inter-arch space (up to 4.85mm). It can accommodate inter implant angulations up to 40°. They provide dual retention, mechanical and frictional.

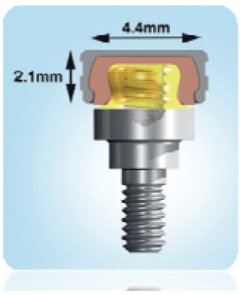
OT Equator® System is one of the newest line of low profile overdenture attachments. It has a low vertical profile of 2.1 mm and diameter of 4.4 mm. It is available in two versions, castable and prefabricated titanium abutments. They are compatible with most implant brands and manufactured with cuff heights from 0.5 mm to 7 mm.

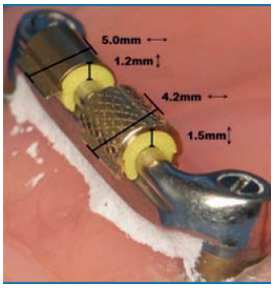
Female caps are retained by means of a stainless-steel housing ranging in four levels of retention, making it easy to process at the dental laboratory or chairside in the dental office.[5]

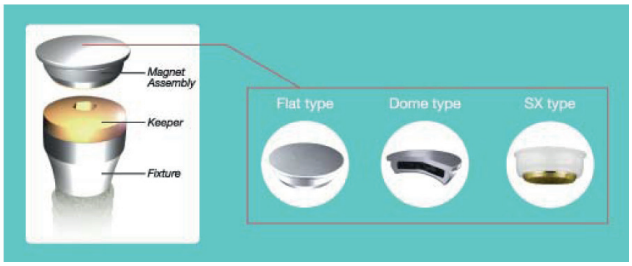
Bar and clip attachment

The bar attachment consists of a metallic bar that splints two or more implants or natural teeth spanning the edentulous ridge between them and a sleeve incorporated in the overdenture which clips over the original bar to retain the denture. The bar attachments could be Prefabricated or Custom made, Rigid or Resilient The assumed advantage of bar attachment is the better transmission of forces between the implants due to the primary splinting effect, load sharing, better retention, and the least post insertion maintenance.[9]

Hader® Bars and Clips are classified as hinge type resilient attachment, and it provides mechanical snap retention. This system consists of a castable plastic bar available in variable height and length, Hader clips and the metallic housing. 4 grips of Hader clips–the reduced retention white, standard retention yellow, increased retention red, and the salvage Blue clips for worn bars are available. When utilized with the metal housings, adjusting retention for the patient is simple–remove the







present clip and insert the proper retention clip. It is not indicated in cases with insufficient space for placement of the attachment and denture teeth since a minimum of 4.5mm space required. In cases where the patient is unable to meet the oral hygiene requirements of a bar restoration.[3]

Preci-Bar (Dolder®) Bar is classified as a combination resilient attachment as they allow vertical and hinge movements. Due to its adjustability, it is easy to control the retention provided by the bar. The pear, or ovoid, shape is used for a resilient prosthesis. The U-shape is for a rigid or non-resilient prosthesis. It is best-indicated when patient has adequate inter-arch space, and minimum resiliency and maximum retention is required.[6]

Although bar type attachments provide optimal stress distribution through its splinting effect, Finite element analysis shows maximum stress generation around implants with bar attachment. Fabrication is expensive and technique sensitive. Maintenance of hygiene is often difficult in elderly patients which can lead to problems like mucosal irritation and periimplantitis. Frequent loosening of retentive clips is also a minor inconvenience for patients.[8]

Magnetic attachments

Magnetic Attachments are classified as universally resilient attachment. They are made up of mainly aluminum-nickel-cobalt metals however, newer generation magnets are made up of rare earth elements such as samarium and neodymium.

Not very successful since the magnetic forces of attraction generated to provide retention were weaker as compared to retention provided by mechanical attachments like ball and bar attachments. Magnetic attachments also tend to get corroded in saliva on long-term use.[4]

MagDen TM magnetic implant overdenture system incorporates a MAGFIT TM technology which seals the metal capsule around a magnet and thus protects it from corrosion in the mouth. According to the manufacturer, fewer than 1 in 10 capsules associated with overdentures on natural teeth separated from the denture base during an 8-year clinical trial; more interestingly, none experienced loss of magnetic attraction. The manufacturer also reported that a 3-μm veneer of ceramic titanium nitride was applied to the container to resist abrasion and reduce the patient's exposure to nickel. Magnetic attachments are available for all leading Implant systems.[4]

Telescopic implant supported overdenture

Telescopic crowns are also known as a double crown or a crown and sleeve coping. These crowns consist of an inner or primary telescopic coping, permanently cemented to an abutment, and a corresponding detachable outer or secondary telescopic crown, rigidly connected to a detachable prosthesis. They provide excellent retention from frictional fit between the crown and the sleeve.

They also provide better force distribution due to the circumferential relation of the outer crown to the abutment increasing axial forces and reducing rotational forces According to wall design, telescopic retainers can be classified into Parallel sided crowns, Tapered (conical-shaped) crowns, and Crowns with additional attachments.

Ankylos® The SynCone® concept is a telescopic overdenture system with unified head geometry for both mandible and maxilla and 5° taper angle. This system is independent of the number of implants since it has uniform geometry. It is easy to maintain oral hygiene. This system is available in a broad range of angulations, 7.5° in the mandible and 22.5° and 30° for the maxilla. All angulations are available in different gingival heights for greater flexibility.[7]

Conclusion

The attachment retained implant supported overdenture solves the problems inherited with conventional denture. The selection of attachment system depend on, amount of retention needed, available inter arch space, manual dexterities of the patient, skills of the dentist and finally the cost. Considering meta analysis of countless studies to compare different attachment systems, we can conclude that locator attachments have superior properties as compared to any other attachment system available.

References

1. Feine JS, Carlsson GE, Awad MA, Chehade A, Duncan WJ, Gizani S, et al. The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients. Montreal, Quebec, May 24-25, 2002. Int J Oral Maxillofac Implants 2002;17: 601-2.
2. Thomason JM, Kelly SA, Bendkowski A, Ellis JS. Two implant retained overdenturesea review of the literature supporting the McGill and York consensus statements. J Dent 2012;40:22-34.
3. Alsiyabi AS, Felton DA, Cooper LF. The role of abutment attachment selection in resolving inadequate interarch distance: A clinical report. J Prosthodont2005;14:184-9.
4. Hiroshi I. Clinical analysis on the reliability of the magnetic attachment over an 8 year period. In: Ai M, Shiau YY, editors. New magnetic applications in clinical dentistry. Tokyo: Quintessence International; 2004. p. 93-6
5. Büttel AE, Bühler NM, Marinello CP. Locator or ball attachment: A guide for clinical decision making. SchweizMonatsschrZahnmed2009;119:901-18.
6. Trakas T, Michalakis K, Kang K, Hirayama H. Attachment systems for implant retained overdentures: A literature review. Implant Dent 2006;15:24-34.
7. Zhang RG, Hannak WB, Roggensack M, Freesmeyer WB. Retentive characteristics of AnkylosSynCone conical crown system over long-term use in vitro. Eur J ProsthodontRestor Dent 2008;16:61-6.
8. Tokuhisa M, Matsushita Y, Koyano K. In vitro study of a mandibular implant overdenture retained with ball, magnet, or bar attachments: Comparison of load transfer and denture stability. Int J Prosthodont2003;16:128-34.
9. Cakarer S, Can T, Yaltirik M, Keskin C. Complications associated with the ball, bar and Locator attachments for implant-supported overdentures. Med Oral Patol Oral Cir Bu cal 2011;16:e953-9.

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

CONCEPTS OF TERMINAL HINGE AXIS : AN UPDATE

*Pallawi Minhas, **Pankaj Dhawan, ***Pankaj Madhukar, ***Piyush Tandon, ****Shivam Singh Tomar, ****Divyesh Mehta, ****Mansi Nautiyal

**Post-Graduate Student, **Prof & Head, ***Professor, ****Senior Lecturer, Department of Prosthodontics,MRDC.*
Corresponding Author: pminhas@gmail.com

Abstract:

The hinge axis is a part of every masticatory movement of the mandible and, therefore, cannot be disregarded. An accurate determination, recording and transfer of hinge axis from patients to the articulator is essential for the dental restoration function, facial appearance and maintenance of patient's oral health.

Key words:
Hinge axis, Transverse hinge axis, Terminal hinge axis(THA) , Mandibular hinge axis, Kinematic point (KP)

Introduction

The mandibular movement path is the combined effect of rotation and gliding path of the axis. The hinge axis is an imaginary line connecting the centre of rotation of one condyle to the centre of rotation of the other condyle around which the mandible may rotate through the sagittal plane. When the condyles are in their most superior position in the articular fossa and the mouth is purely rotated open, the axis around which movement occurs is called as Terminal Hinge Axis[1]. GPT-9 defines Terminal Hinge

Axis is an imaginary line around which the mandible may rotate within the sagittal plane. In centric relation the mandible can be rotated around the horizontal axis to a distance of 20 to 25mm, as measured between the incisal edges of the maxillary and mandibular incisors. The trained hinge movement is used only to locate the starting point of mandibular opening and not the condylar path itself[2]. The hinge axis of patient should coincide the hinge axis of articulator for successful treatment outcome.

Review of literature

Campion[3] produced the first graphic record of mandibular movements on a patient. He used a basic form of pantograph which produced a succession of dots on the skin of the side of the face as the condyles moved during function. Bennett[4] (1908), in his paper on movements of the mandible, stated that no single fixed centre of rotation for the mandible existed since the centre of rotation constantly shifted (for movements in the sagittal plane). He pointed out that the mandible was capable of two independent movements; one, an angular rotation about the condyle, the other a translation movement produced by the gliding of the condyle along its path.

In 1939 McCollum[5] one of the leading advocates of the 'hinge-axis theory' demonstrated the existence of a definite opening and closing axis by using a face-bow rigidly attached to the lower teeth with orthodontic appliances. The development of accurate and rigid clutches, and adjustable face-bows, led to the determination of the hinge-

axis easily.

Weinberg[2] pointed out that it was essential to use the terminal or 'trained' mandibular hinge movement. He described geometrical and clinical methods for finding hinge axis and determined whether there were one or two transverse hinge-axes. He gave clinical evidence of the transverse hinge-axis and pointed if pin point accuracy in the location of the transverse hinge-axis was necessary, and related these factors to clinical practice. Weinberg recorded a 0.2 mm error in cusp height resulting from incorrect location of the terminal hinge axis. Page[6] stated that there were at least twelve hinge axes in every head; three in each temporomandibular joint and three in each mandibular angle. These were responsible for movements in all three planes.

Schallhorn[7] compared Beyron's arbitrary points with the KP in 70 dentulous patients and found more than 95% to be within 5 mm of the Kinematic Point. Beck[8] compared the KP with arbitrary points of Gysi, Beyron, and Bergstrom in 12 subjects and found Bergstrom's point to be the closest with an average of 4.1 mm from the KP, Beyron's an average of 5.7 mm, and Gysi's an average of 10.7 mm from the KP. Trapazanno and Lazari[9] (1961) concluded the presence of multiple hinge axis. They stated that the technique or recording terminal hinge axis requires two operators. Relaxation of the patient during location of terminal hinge axes is essential. Because of the presence of multiple hinge axes points, increasing or decreasing the vertical dimension on the articulator is contraindicated unless a new interocclusal record is made on the patient at the desired vertical dimension.

In 1970, Long[10] described an intra-oral technique for locating the terminal hinge-axis by using two accurate centric relation records at two different degrees of jaw separation. In 2004, Preston[11] discussed the history and development of the hinge-axis concept, particularly in relation to colinear and non-colinear theories.

In 2010 Tokiwa H et al.[12] conducted a study to determine anatomical locations of the hinge axis point, kinematic axis point and reference point for the palpated lateral condylar pole on lateral cephalograms. Lateral cephalograms were used to determine anatomical locations of the three points in the condyle. Mean location of hinge axis point was 12.9 mm anterior of the porion and 5.3 mm inferior to the Frankfort horizontal plane, the kinematic axis point was situated in 12.8 mm anterior and 0.1 mm inferior, and the reference point for the palpated lateral condylar pole was situated 10.7 mm anterior and 0.8 mm inferior, respectively. The kinematic axis point was located outside the condyle in the majority of subjects.

Schools of thought regarding Hinge Axis Theory[1]

1. Absolute location of the hinge axis:

This group of people believed that there is a definite transverse axis and it should be located as accurately as possible.

2. Arbitrary location of the hinge axis

This group believed that the hinge axis is of considerable value, but it is not worth the effort to locate. It is not of significance if the hinge axis of the articulator does not coincide with the hinge axis of the patient.

3. Nonbelievers in the transverse axis location

This group believed that the hinge axis is only theoretical and not practical. It is impossible to locate hinge axis with accuracy and it can't be reproduced by one axis of an articulator. Hence an arbitrary axis is acceptable.

4. Split axis theory

This group include those who follow transograph theory. They believe in 'split-axis' with which each condyle rotate independently of other. There are two separate hinge axes of rotation, one in each condyle and they exist parallel to each other.

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

Location of the transverse hinge axis

I. Arbitrary method

Many clinicians use arbitrary reference points based on average, anatomic landmarks considered reasonably accurate for most clinical situations. Arbitrary axis points determined from anatomical landmarks are popular due to their ease of the use compared to kinematic method of locating terminal hinge axis. It has been demonstrated mathematically that location of an arbitrary axis point ± 5 mm anterior-posterior to the kinematic axis will result in negligible error (0.2 mm) on the nonworking side when a 3.0 mm thick centric relation record is used.[13]

Arbitrary posterior reference points

1. 1 cm in front of the line from the apex of the tragus of the ear to the outer canthus of the eye, given by Fenn et al[14].

2. 11 to 13 mm anterior to the upper one-third of the tragus of the ear on a line extending to the outer canthus of the eye, given by Henderson et al[15].

3. 13 mm anterior to the posterior margin of the center of the tragus of the ear on a line extending to the corner of the eye, given by Osborne et al[16].

4. 10 mm anterior to the center of a spherical insert for the external auditory meatus and 7 mm below the Frankfort horizontal plane[17].

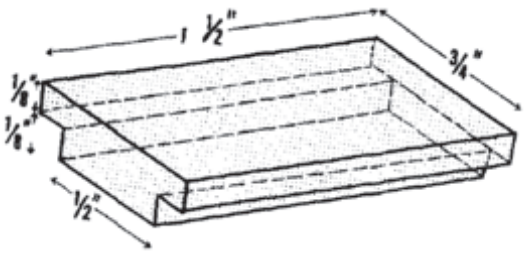


Fig. 1. Modified Lucite blank

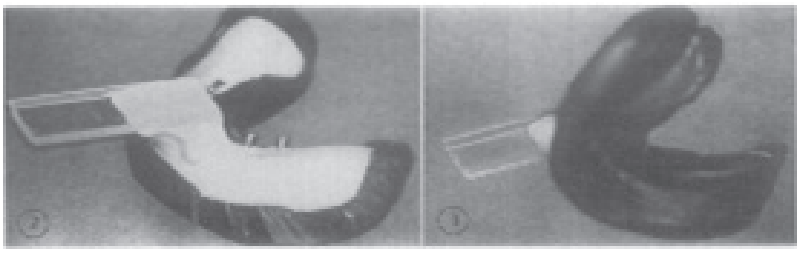


Fig. 2& 3 Modified tray with modeling compound impression

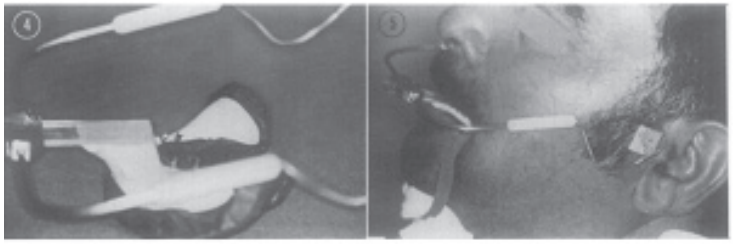


Fig. 4 & 5 Lucite blank fixed to tray

Fig. 6. The Buhnergraph attachment for a Whip Mix articulator.

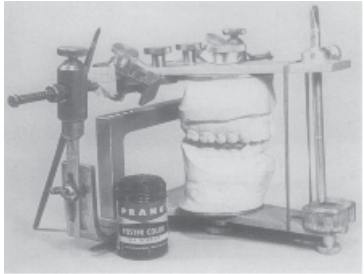


Fig. 7. The Buhnergraph in use.

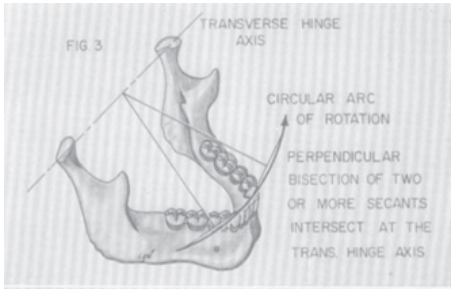


Fig. 8. Geometrical location of transverse hinge axis.

5. Palpation. This method was first described by Dawson[18]. From a position behind the patient, the index finger was placed over the joint area, and the patient was asked to open widely. As the condyle translated forward, the fingertip was dropped into the depression left by the protruded condyle.

6. Lundeen's point which is about 13 mm anterior to tragus on line from the base of tragus to outer canthus of eye.[26]

6. The Gysi point located 13 mm in front of the most upper part of the external auditory meatus on a line passing to the ectocanthion[19].

7. The Lejoyeux point situated 10 to 11 mm in front of the ear on a line to the canthus and 5 mm below it[20].

8. Weinburg point which is 11-13mm anterior to reference line drawn from middle and posterior border of tragus of ear to the corner of eye.[25]

In a study done by Mohmoud K.A.Razek[21], in which five methods were used to locate the arbitrary hinge axis of the mandible on 120 dentulous patients. The obtained axes were compared with the kinematic axis which had been located on each patient. While none of the arbitrary methods used proved to be ideal for locating the hinge axis, the axis located by Dawson's palpation method fell consistently closer to the kinematic axis. A combination of the arbitrary methods should therefore be used if it is not feasible to record the axis kinematically[27].

II. Kinematic method of hinge axis

The consensus is that a hinge axis locator and kinematic face-bow provide the most accurate method of mounting. As explained in a study by Palik et al[22], the kinematic face-bow uses the terminal hinge axis and inferior orbital rim as reference points. The area of the true hinge axis was located by palpating the subject's condyles during opening and closing of the mandible. A hinge axis flagging device, worn like a pair of glasses and secured posteriorly by a head strap, was adjusted to the subject. The subject was then positioned at approximately a 45 to 60-degree angle from horizontal. Without determination of kinematic hinge points, even a post insertion remount perpetuates the errors noted in this study. The only alternative is selective grinding of the restorations and/or the remaining natural teeth.[28]

III. Modified techniques

1. Loma-linda hinge axis recording device and method.[23]

The disadvantage of a kinematic hinge-axis location for edentulous patients is its unreliability because of the resiliency of the oral mucosa, the added weight of the recording clutch which tends to shift the denture base, and the time-consuming nature of the procedure. Hence to eliminate these disadvantages, modification technique was developed.

Modification of hinge axis locator: (1) Cut two parallel channels down the length of a clear Lucite plastic blank to accommodate the hinge-axis recorder and flags. (2) Modify a set of lower edentulous impression trays with cold-cure acrylic resin to accommodate the modified Lucite blank. (3) Cut a pair of hollow tubes, four in all, ½ inch in length. (4) Perforate each of the aluminum trays, and shorten the handle. (5) Fix the Lucite blank and hollow tubes to the trays with a mix of cold cure acrylic resin. (6) The resin is allowed to harden, chemically locking the Lucite to the tray as a new handle and mechanically locking the tubes as stabilizers for a circummandibular elastic effect. (7) The acrylic resin covers all external portions of the edentulous trays and is smoothed and contoured to eliminate all sharp and rough edges. (8) A series of lower impression trays can thus be modified to make clutches for use with the Loma Linda hinge-axis locator.

Technique of hinge axis location[23] (1) Select a

modified tray of the proper size for the patient. (2) With modeling compound, make a lower, functional, border-molded impression to serve as a stable, customized clutch for the hinge-axis locator. (Fig. 2&3) (3)Place the hinge-axis locator and flags on the Lucite blank of the clutch, and lock them into place (Fig. 4). (4) Place squares of graph paper bilaterally over the approximate location of the patient's condyles. (5) Position the flags on the recorder over the graph paper, and locate a kinematic hinge axis on the patient. (6) Record the hinge axis with a pencil dot at the appropriate location on the graph paper with the patient's mandible protruded. This is done one side at a time. The hinge-axis location is verified with the pencil dots on the graph paper .The hinge-axis is thus located.(Fig. 5)

2. Buhnergraph intraoral method[10]

Buhnergraph instrument (named after Dr. W. A. Buhner of Daytona Beach, Florida) consists of a U-shaped piece of aluminum which is attached to the lower member of a Whip Mix articulator (Fig 6). On each side an adjustable arm is attached containing a pointed shaft which moves in and out. The adjustable shafts are made from a Hanau Richey face-bow, Model D. (Hanau Engineering Co. Inc., Buffalo, N. Y.) The ends are cut off, flattened, and a slot is made for the bolt and the wing nut which attaches them to the aluminum bar. The pointed shafts are adjusted to fit into the recess on each lateral face of the condylar guide housing. These recesses mark the center of rotation of the articulator. A piece of graph paper is now fastened to the lateral face of each condylar guide housing and the horizontal graph lines are made parallel to the upper member of the articulator. Tempera paint has been touched to the tips of the adjustable shafts of the buhnergraph, and they are moved medially until a mark is made on the graph paper. The relationship of the upper and lower parts of the instrument is maintained by the wax interocclusal registration, the anterior guide pin, and the rubber band. (Fig. 7)

3. Geometric location of the transverse hinge axis[2]

The transverse hinge axis is located geometrically by erecting perpendiculars that bisect two or more secants of the circular path. The transverse hinge axis is always perpendicular to the arm of rotation and vice versa. The transverse hinge axis usually passes through or near the condyles.(Fig. 8)

4. Abdal-hadi's technique[19]

The arbitrary method is based on the high correlation between the width profile of the face and the X coordinate of the kinematic point. The equation is Y = 9.5 c 0.95 (X) where Y represents the width profile of the face measured from the ectocanthion to the center of the external auditory meatus and X is equal to the anterioposterior position of the kinematic point. A constant distance equal to 0.5 mm was used above the line passing from the center of the external auditory meatus to the canthus to locate the superioinferior position of the proposed method.

Importance of terminal hinge axis

Terminal Hinge axis act as definite point of reference for all procedures for reconstruction. It permits accurate recording and checking of the centric relation of the patient. Vertical dimension on the articulator can be altered without change in the path of closure.[1] It permits remounting of the prosthesis in the same relationship on the articulator as is present in the patients mouth. It permits duplication of all the arcs of closure of the mandible on an articulator and thus the cusps can be tailored to harmonize with these arcs. Location of terminal hinge axis serves to orientate maxilla and act as static starting point for functional mandibular movements[2].

Conclusion and summary

The presence or absence of a hinge axis of the mandible is of prime importance in clinical phases

of dentistry. The location of THA is mainly related to the accurate transfer of CR record rather than eccentric condylar inclinations. The T.H.A plus one other anterior point serves to locate the maxillae in space and to record the static starting point for functional mandibular movements. There cording and reproduction of the opening axis of the mandible enable a given occlusal relation to be reproduced on the anticulator at any height or vertical relation. An infinite number of points exist which may serve as hinge points. Most arbitrary axis point locations recommended in the literature will create 6 mm or more of error. A minimal error of 5 mm can be expected no matter what arbitrary position might be chosen. Placement of the tragus-canthus line at the superior border of the tragus of the ear will contribute to greater inaccuracy in most patients[24]. Largest percentage of true axis location are inferior to tragus-cathus line at superior border of tragus of ear.

References

1. Rathee M.Philosophy and Physics of Mandibular Hinge Axis: A Review. Int J Sci Res 2014;3.
2. Weinberg A. The transverse hinge axis: real or imaginary.J Prosthet Dent.1959; 9:775- 87.
3. Winstanley RB. The hinge-axis: a review of the literature. J Oral Rehabil. 1985;12: 135- 59.
4. Bennett NG. A contribution to the study of the movements of the mandible. Proceeding of the Royal Society of Medicine 1908; 1: 79.
5. Mc Collum BB : The mandibular hinge axis and the method of locating it. J Prosthet Dent 1960; 10: 428- 35.
6. Page HL. Some confusing concepts in articulation. Part I. Dent Digest 1958; 64; 71.
7. Schallhorn RG.: A study of the arbitrary center and the kinematic center of rotation for face-bow mountings. J Prosthet Dent 1957; 7: 162- 69.
8. Beck, H0.: A clinical evaluation of the arcon concept of articulators. J Prosthet Dent 1959; 9: 409-21.
9 Trappazano VR, Lazzari JB: A study of hinge axis determination. J Prosthet Dent 1961; 11: 858- 63.
10. Long JH. Location of the terminal hinge axis by intra-oral means. J Prosthet Dent. 1970; 23: 11.
11. Preston JD. A reassessment of the mandibular transverse horizontal axis theory. 1979.J Prosthet Dent. 2004; 91.
12. Tokiwa H, Nakazawa F, Ozaki M, Nakamura Y. Anatomical location of various condylar points for jaw movement analysis in Japanese women. J Oral Rehabil. 2010 Apr;37(4):235-41.
13. Nagy WW, Smithy TJ, Wirth CG. Accuracy of a predetermined transverse horizontal mandibular axis point. J Prosthet Dent 2002; 87:387-94.
14. Fenn HRB, Liddelow KP, Gimson AP. Clinical Dental Prosthetics. London Staples Press, 1961: 274.
15. Henderson D, Steffel V L. McCracken's Removable Partial Prosthodontics, 4th ed. St. Louis:The C. V. Mosby Co. 1973: 173-74.
16. Osborne J, Lammie G A. Partial Dentures, 3rd ed. Oxford and Edinburgh: Scientific Publications, 1968: 367- 68.
17. Bergstrom G. On the reproduction of dental articulation by means of articulators, a kinematic Investigation. Acta Odontol Stand. 1950; 9.
18. Dawson PE. Evaluation, Diagnosis, and Treatment of Occlusal Problems. St. Louis: The C. V. Mosby Co. 1974: 132-34.
19. Abdal-Hadi L. The hinge axis: evaluation of current arbitrary determination methods and a proposal for a new recording method. J Prosthet Dent. 1989; 62: 463-7.
20. Lejoyeux J, Prothese complete.Tome 23rd eed. Paris: Maloine. S.A editeur. 1976; 295:223- 45.
21. Razek A. Clinical evaluation of methods used in locating the mandibular hinge axis. J Prosthet Dent. 1981; 46:369-73.
22. Palik JF, Nelson DR, White JT. Accuracy of an earpiece face-bow. J Prosthet Dent. 1985; 53:800-4.
23. Renner RP, Lau VM. Hinge-axis location and face-bow transfer for edentulous patients. J Prosthet Dent. 1976; 35:352-6.
24. Walker PM. Discrepancies between arbitrary and true hinge axes. J Prosthet Dent. 1980; 43:279-85.
25. Ercoli C, Graser GN, Tallents RH, Galindo D. Face-bow record without a third point of reference: Theoretical considerations and an alternative technique. J Prosthet Dent 1999;82:237-41.
26. Wilkie ND. The anterior point of reference. J Prosthet Dent 1979;41:488-96.
27. Razek A. Clinical evaluation of methods used in locating the mandibular hinge axis. J Prosthet Dent. 1981; 46:369-73.
28. Gordon SR, Stoffer WM ,Connor SA: Location of the terminal hinge axis and its effect on the second molar cusp position. J Prosthet Dent 1984; 52: 99-105.

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

"ANALYSIS OF STRESS DISTRIBUTION AT THE CEMENT –CROWN INTERFACE IN ALL-CERAMIC CROWNS CEMENTED USING TWO DIFFERENT RESIN CEMENTS" - AN IN VITRO 3DIMENSIONAL FINITE ELEMENT STUDY

* Kalpana D., ** Sanjana J. Rao, ***Priyanka Bhat, ****Venkatesh Pathi

*Prof. & HOD, **Reader, *** , ****PG student, Department of Prosthodontics, Dayananda Sagar College of Dental Sciences and Hospital, Kumaraswamy Layout, Bangalore. Corresponding Author: bhatpriyanka18@gmail.com

Introduction

With the increasing demand for natural looking restorations, all-ceramic materials have emerged as a virtual boon for the Prosthodontist. Initially ceramics were used for anterior crowns and low stress areas. The ongoing research has led to improvement in the ceramic restorations to the extent that all ceramic restorations can now be planned for almost any clinical situation.

Dental ceramics have the advantages of biocompatibility, long term color stability, chemical durability, wear resistance and maneuverability to be formed into precise shapes. The newer ceramics are further complemented by strength comparable to conventional metal and metal ceramics.

Ceramics fused to metal were the first ceramic systems to be introduced which combined the esthetic quality of ceramics and the mechanical strength of metals. The drawbacks, as well as the desire for more esthetic materials by patients and dentists, have stimulated research and development of metal free ceramic systems.[1]

According to method of fabrication ceramics are classified as powder condensed, slip casted, hot pressed and computer aided (CAD/CAM) ceramics.[2]

IPS Empress 2 is a lithium-disilicate glass ceramic (SiO_2-Li_2O). IPS Empress 2 has a flexural strength of 400±40 MPa which is much higher than that of IPS Empress. The increased flexural strength makes it suitable for the usage for fabrication of 3-unit FPDs in the anterior region, and can extend to the second premolar.[2]

Lithium disilicate has an unusual microstructure, in that it consists of multiple small interlocking plate-like crystals that are randomly oriented. This is ideal from the point of view of strength because the needlelike crystals cause cracks to deflect, branch or blunt. Thus, the propagation of cracks through this material is arrested by the lithium disilicate crystals, providing a substantial increase in the flexural strength.[3]

Resin cements increase the fracture resistance of ceramic materials that can be etched and silanated[24]. The ability to adhere to multiple substrates, high strength, insolubility in the oral

environment, and shade-matching potential have made resin cements the adhesive of choice for esthetic type restorations, including composite inlays and onlays, all ceramic inlays and onlays, veneers, crowns, FPDs, and the newly developed fiber-reinforced composite restorations.[4]

Resin cements are low viscosity composite resins. These cements are virtually insoluble in oral fluids. They have far better modulus of elasticity compared to conventional luting agents. Resin cements have the highest tensile strength and compressive strength among all luting agents.[12]

The presents study evaluates the stress distribution in all ceramic restorations cemented using two different resin cements. The effect of two different thicknesses of the respective cements on the stress distribution will also be studied.

Aims and Objectives of the Study:

The aim of the study was to evaluate by means of a three-dimensional finite element analysis (3D FEA) the effect of luting agent type and thickness on stress distribution at the cement-crown interface and in all ceramic crowns for mandibular first premolar cemented using two different resin cements.

Materials & methods

Finite Element Analysis (FEA) has been widely used through numerical analysis that has been successfully applied in many engineering and bioengineering areas since the 1960s.[5] It represents one of the most significant developments in the history of computational methods. Initially, this technique was used widely only in aerospace engineering, but slowly due to the flexibility of the method to model any complex geometries and provide instant results, it made its presence felt in dentistry.[6]

The basic steps involved in this method are pre-processing, solving and post-processing.[8]

The pre-processing stage consists of geometric modelling of a structure, discrimination of a model into smaller elements connected by nodes using the proper selection of an element type and assigning the material properties. The final step in pre-processing is the application of external forces, pressure, thermal changes, or other factors; and displacement constraints at specified nodes.[9] The computer software solves a set of simultaneous equations with thousands of variables to achieve the desired results. The post-processing stage consists on the graphical presentation of results, including qualitative and numerical results.[10]

I. Finite element modelling

1. Construction of geometric model

a) Modeling of the bone

b) Modeling of the mandibular first premolar with crown

A three-dimensional finite element model of mandibular first premolar was generated using Catia, a popular modelling software. The average values of dimensions for a mandibular first premolar were taken from literature to create the models.[10]

Lithium disilicate reinforces glass ceramic was chosen as the crown material.[2,11]

Modeling of the cement layer

The cement layer was designed between the prepared tooth and the crown. Two resin cements from different manufactures were chosen namely Rely X Unicem (3M ESPE MN) and Panavia F (densply) [16,17]. Two models were generated with 40 μm and 80 μm thickness respectively[11].

2. Mesh generation

The three-dimensional finite element model corresponding to the geometric model was meshed using Ansys Pre-processor (ANSYS version 12.0

software). The type of meshing is free meshing because the model is not geometrically symmetric.

3. Specifying material properties

For the execution and accurate analysis of the program and interpretation of the results, two material properties were utilized i.e. Young's modulus and Poisson's ratio.[12,10,17]

4. Applying boundary conditions

Following the creation of the 3D meshes, a boundary condition was applied to simulate the natural relationship of the tooth supported by the PDL and the bone structure.

5. Application of loads

The magnitude of applied loads was within physiologic limits. An axial load of 400 N was directly applied onto the crown on all models.

A total of 4 models were created and grouped into two for the ease of analysis;

1. GROUP I (A) Mandibular first premolar with crown cemented using RelyX Unicem having 8 GPa modulus and cement layer thickness of 40 μ.

2. GROUP I (B) Mandibular first premolar with crown cemented using RelyX Unicem having 8 GPa modulus and cement layer thickness of 80 μ.

3. GROUP II (A) Mandibular first premolar with crown cemented using Panavia F cement having having 18 GPa modulus and cement layer thickness 40 μ.

4. GROUP II (B) Mandibular first premolar with Panavia F cement having cement layer thickness 80 μ.

Results

Stress and strain distribution in the FE models

Table A

Mechanical properties of different models used in the model

Material	Young's modulus (MPa)	Poisson's ratio
Bone	13700	0.30
Periodontal ligament	68000	0.45
Dentin	18000	0.33
Empress crown	96000	0.25
Rly x unicem resin cement	8000 (8 GPa)	0.25
Panavia F cement	18000 (18 GPA)	0.35

Table B

Model	No of elements	No of nodes
Rely X Unicem cement with 40 μ cement thickness	425018	293416
Rely X Unicem cement with 80 μ cement thickness	425018	293416
Panavia F cement with 40μcement thickness	432539	300126
Panavia F cement with 80 μ cement thickness	432539	300126

comes in numerical values and in color coding. Maximum values of Von Mises stress is denoted by red colour and minimum value by blue color. In between the values are represented by bluish green, green, greenish yellow and yellowish red in the ascending order of stress distribution.

Table I shows the peak values of von-Mises stress generated in cement, dentin and crown for all four models

Table I : Peak von-Mises stresses in the cement, dentin and crown in all the four models

Models	Stress in cement layer (MPa)	Stress in Dentin (MPa)	Stress in Crown (MPa)
Group I A	27.57	32.178	35.75
Group I B	35.22	32.245	36.21
Group II A	28.6	32.59	39.64
Group II B	33.15	32.71	40.25

TABLE II: Comparison of Rely X and Panavia F with cement layer 40 microns thick

Models	Stress in cement layer (MPa)	Stress in Dentin (MPa)	Stress in Crown (MPa)
Group I A	27.57	32.178	35.75
Group II A	28.6	32.59	39.64

TABLE III : Comparison of Rely X and Panavia F with cement layer 80 microns thickn

Models	Stress in cement layer (MPa)	Stress in Dentin (MPa)	Stress in Crown (MPa)
Group I B	35.22	32.245	36.21
Group II B	33.15	32.71	40.25

Table II shows the Comparison of peak values of von-Misses stresses generated when cement layer is 40 micron thick with Rely X cement (8 GPa) and Panavia F (18 GPa)

Table III shows the Comparison of peak values of von-Misses stresses generated when cement layer is 80 micron thick with Rely X cement (8 GPa) and Panavia F (18 GPa)

Table IV shows the comparison of peak values of von-Misses stresses generated in Rely x cement having modulus of elasticity 8 GPa with 40 micron and 80 microns cement layer thickness.

Table V shows the comparison of peak values of von-Misses stresses generated with Panavia F cement having modulus of elasticity 8 GPa with 40 micron and 80 microns cement layer thickness.

Discussion

Finite element analysis methods enable the study of the biomechanical behavior of the restored system under different loading conditions and the manipulation of individual/specific components of the system by specifying each element's physical

TABLE IV: Comparison of 40 and 80 micron thickness cement layer with Rely X (8 GPa)

Models	Stress in cement layer (MPa)	Stress in Dentin (MPa)	Stress in Crown (MPa)
Group I A	27.57	32.178	35.75
Group I B	35.22	32.245	36.21

TABLE V : Comparison of 40 and 80 micron thickness cement layer with Panavia F (18 GPa)

Models	Stress in cement layer (MPa)	Stress in Dentin (MPa)	Stress in Crown (MPa)
Group II A	28.6	32.59	39.64
Group II B	33.15	32.71	40.25

properties, such as the elastic modulus.

Model consideration:

Each component was modeled separately and then assembled. A segment of bone was modeled to simulate the posterior region of the mandible because simulation of the whole mandibular body is very elaborate.

Four different finite element models were created and meshed with nodes and tetrahedra solid elements.

The models represented:

1. Mandibular first premolar crown cemented with RelyX Unicem cement having cement layer thickness of 40 μ.

2. Mandibular first premolar crown cemented with RelyX Unicem cement having cement layer thickness of 80 μ.

3. Mandibular first premolar crown cemented with Panavia F cement having cement layer thickness of 40 μ.

4. Mandibular first premolar crown cemented with Panavia F cement having cement layer thickness of 80 μ.

Material properties:

The cortical bone, cancellous bone and tooth were presumed to be linearly elastic, homogenous and isotropic. The mechanical properties of the interface material were mathematically calculated under the assumption that it was a composite material.

Loads and constraints :

The constraints at the end of the bone segment and force application on top of the crown approximated only roughly the complex balance between masticatory forces and their reactions.

Simulated occlusal loads on the crowns were accomplished by applying 400 N axial loads. Though the oblique loading may be considered to be more clinically relevant, it is advantageous to understand the performance of such systems under static axial loading.

Finite Element Analysis

Analysis was performed using ANSYS software. The following variables were analyzed.

1. Stress distribution in the cement, crown and dentin using resin cement of Young's modulus 8 MPa with a cement layer thickness 40microns.

2. Stress distribution in the cement, crown and dentin using resin cement of Young's modulus 8 MPa with a cement layer thickness 80microns.

3. Stress distribution in the cement, crown and dentin using resin cement of Young's modulus 18 MPa with a cement layer thickness 40microns.

4. Stress distribution in the cement, crown and dentin using resin cement of Young's modulus 18 MPa with a cement layer thickness 80microns.

Von Mises stresses in the above mentioned regions were measured and analyzed under different loading conditions. The results are tabulated as four tables from table I to V

Observations in Comparison of von misses stresses generated when cement layer is 40 micron thick with Rely X cement (8 GPa) and Panavia F (18 GPa)

The maximum stresses recorded in cement layer ,dentine and crown were 27.57, 32.178, 35.75 respectively for 8 MPa modulus of elasticity and the values were 35.22, 32.245, 36.21 respectively for 18 MPa modulus of elasticity.

Observations in Comparison of von misses stresses generated when cement layer is 80 micron thick with Rely X cement (8 GPa) and Panavia F (18 GPa)

The maximum stresses recorded in cement layer ,dentine and crown were 28.6, 32.59, 39.64 respectively for 8 GPa modulus of elasticity and the values were 33.15, 32.71, 40.25 respectively for 18 GPa modulus of elasticity.

Observations in the comparison of von misses stresses generated in Rely x cement having modulus of elasticity 8 GPa with 40 micron and 80 microns cement layer thickness.

The maximum stresses recorded in cement layer ,dentine and crown were 27.57, 32.178, 35.75 respectively for 40 microns thickness and the values were 28.6, 32.59, 39.64 respectively for 80 microns thickness .

Observations in the comparison of von misses stresses generated in Panavia F cement having modulus of elasticity 18 GPa with 40 micron and 80 microns cement layer thickness.

The maximum stresses recorded in cement, dentine and crown were 35.22, 32,245, 36.21 respectively for 40 microns thickness and the values were 33.15,32.71,40.25 respectively for 80 microns thickness .

Within the limitations of the FEA study few clinical inferences can be drawn.

After studying the von-Mises stress patterns in our FEA models, we found that modulus of elasticity of the cement has its influence in stress distribution in a crown dentine as well as the cement layer itself.

When a cement of higher elastic modulus was used a definite increase in stresses within the cement layer, tooth dentin and crown was seen.

Increasing the thickness of cement layer from 40 to 80 microns resulted an increase in stresses in the crown, dentin and cement layer.

Conclusion

Even though FEM is an accurate and precise method for analyzing structures, the present study has certain limitations.

Within the limitations of the present study and on the basis of results obtained, it can be concluded that:

1. Increase in the modulus of elasticity of the resin cement can cause increased stresses on the tooth dentine, cement layer and the crown. The highest stress concentration is seen at the distobuccal line angle.

2. The increase in thickness of the cement layer also increases the stresses in cement tooth dentine and crown. When the thickness of the cement is increased fron 40 to 80 μ stress increased in all layers.

3. It may be concluded that using a cement with least acceptable modulus of elasticity and optimum cement layer thickness can result in even stress distribution in the restoration thereby enhancing the longevity .Unnecessary increase in cement layer thickness has not additional benefits.

References

1. Arvind Shenoy and Nina Shenoy. Dental ceramics: An update J Conserv Dent 2010 13(4): 195–203.
2. Laila Al Dehailan. Review of the Current Status of All-Ceramic Restorations. IU School of Dentistry 2009.
3. Ariel J. Raigrodsk ,Contemporary materials and technologies for all-ceramic fixed partial dentures: A review of the literature.J Prosthet Dent 2004;92:557-62.
4. H. W. A. Wiskott, C. Krebs, S. S. Scherrer, J. Botsis, U. C. Belser Compressive and Tensile Zones in the Cement Interface of Full Crowns: A Technical Note on the Concept of Resistance. Med Dent 1999; 8(2):80–91.
1. 35 (Susan Hattar , Muhanad M. Hatamleh, Faleh Sawair ,Mohammad Al-Rababah. Bond strength of self-adhesive resin cements to tooth structure The Saudi Dental Journal 2015; 27: 70–74.
2. Brigitte Ohlmann , Justo Lorenzo Bermejo , Peter Rammelsberg ,Marc Schmitter , Andreas Zenthofer , Thomas Stober. Comparison of incidence of complications and aesthetic performance for posterior metal-free polymer crowns and metal–ceramic crowns: Results from a randomized clinical trial J Dent 2014;42:671 – 676.
3. Magne P. Efficient 3D finite element analysis of dental restorative procedures using micro-CT data. Dental

Materials 2007;23(5):539–48.

4. Boschian Pest L, Guidotti S, Pietrabissa R, Gagliani M. Stress distribution in a post-restored tooth using the three-dimensional finite element method. Journal of Oral Rehabilitation 2006;33(9):690–7.
5. Piccioni et al. Application of the finite element method in Dentistry. RSBO. 2013 Oct-Dec;10(4):369-77.
6. Thresher RW, Saito GE. The stress analysis of human teeth. J Biomech 1973;6:443-9.
7. Mohammed Zahran, Omar El-Mowafy, Laura Tam, Philip A. Watson and Yoav Finer .Fracture Strength and Fatigue Resistance of All-Ceramic Molar Crowns Manufactured with CAD/CAM J Prosthodont 2008;17:370–377.
8. Adams V, Askenazi A. Building Better Products with FiniteElement Analysis. 1st ed. Santa Fe, NM: Onword Press; 1999.
9. Wakabayashi N, Ona M, Suzuki T, Igarashi Y. Nonlinear finite element analyses: advances and challenges in dentalapplications. Journal of Dentistry 2008;36:463–71.
10. lvaro Della Bona, Marcia Borba, Paula Benetti, Yuanyuan Duan, Jason A. Griggs Three-dimensional finite element modelling of all-ceramic restorations based on micro-CT. jdent 2013;412 – 419.
11. Stanley J. Nelson,Major M. Ash.wheeler's dental anatomy physiology and occlusion. 9th ed; Elsevier 2010
12. Bin Liu, Chenglin Lu, Yanling Wu, Xiuyin Zhang, Dwayne Arola and Dongsheng Zhang. The effect of adhesive type and thickness on stress distribution in molar restored with all Ceramiccrowns. J Prosthodont 2011; 20:35-44.
13. Niek De Jager, PremPallav, Albert J. Feilzer. The influence of design parameters on the FEA-determined stress distribution in CAD-CAM produced all-ceramic dental crowns. Dent Mater 2005; 21:242-251.
14. Larry L. Pace,1 Susan K. Hummel,Victoria A. Marker, and Ali Bolouri .Comparison of the Flexural Strength of Five Adhesive Resin Cements. J Prosthodont 2007;16:18-24
15. ShirinShahrbaf, Richard vanNoort, BehnamMirzakouchaki, ElahehGhassemieh, and Nicolas Martin: Effect of the crown design and interface lute parameters on the stress-state of a machined crown–tooth system: A finite element analysis. Dent Mater2012; 29; e123-131.
16. PerihanOyar, MutahharUlusoyandGürcanEskitaşçıoglu. Finite element analysis of stress distribution in ceramic crowns fabricated with different tooth preparation design. J Prosthet Dent 2014;112:871-87
17. Shirin Shahrbaf, Richard van Noort, BehnamMirzakouchaki, ElahehGhassemieh,

    Nicolas Martin. Fracture strength of machined ceramic crowns as a function of tooth preparation design and elastic modulus of the cement. Dent Mater 2014; 30:234-241.

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

SOCKET SHIELD TECHNIQUE: ESTHETIC REPLACEMENT OF FRACTURED MAXILLARY CENTRAL INCISOR WITH IMPLANT: A CLINICAL REPORT

*Sreejith M., **Simna S., *Swapna C.

*Professor, **P.G. Student, KMCT Dental College, Corresponding Author: simnasnadh@gmail.com

Abstract:

The "socket-shield technique" is a recent development in implantology by retaining root fragment attached to the buccal bone plate to avoid tissue alteration after tooth extraction. To get the desired emergence profile for esthetic replacement, immediate implant placement with socket shield technique was selected as the best choice of treatment plan for this case. Four months after implant placement, clinical examination showed healthy peri implant soft tissue and the ridge was well preserved. A definitive metal ceramic crown was fabricated and cemented on a titanium abutment. The prosthesis successfully restored the function of the patient.

Keywords: Socket Shield, ridge preservation

Introduction

Esthetic implant placement is one of the challenges in current day implant practice. Vertical bone deficiencies after extraction often lead to compromised esthetic outcomes,[1] when restoring anterior maxillary teeth in esthetically demanding situations.[2] Many ridge preservation techniques were developed like atraumatic extraction and guided bone regeneration.[3] There is no conclusive evidence that ridge preservation procedures improve the ability to place implants. Bone grafting materials and a collagen barrier can only partly compensate for resorption in bone volume, therefore a better solution is desirable.[4,5,6,7] Keeping the tooth in the socket and maintaining the system of periodontium seems to be the gold standard. In 2010, Hürzeler et al[8] introduced an innovative and less invasive socket shield technique without the use of bone substitute material to avoid the resorption process in horizontal and vertical dimensions, in which a partial root fragment was retained around an immediately placed implant with the aim of avoiding tissue alterations after tooth extraction.

Alternatives for socket shield technique include socket sealing technique first described by Landsberg[9] involve atraumatic flapless tooth extraction using periotomes followed by debridement and decortication of the socket walls to enhance osteogenic activity by providing a pool of cells into the site through blood stream. The socket is then packed with bone graft of choice. A fairly thick free gingival graft is then harvested from palate to cover the bone grafting material and protect it from hostile oral environment. Misch[10] suggested modified socket seal surgery using

composite graft, PDGF from patients own blood to act as chemo attractant for mesenchyme cells to speed up the bone formation. Markus Hurtzler[11] developed the Root-T-Belt method where sectioning is vestibular-lingual, thus preserving the proximal remainder of the root to protect the papilla

The purpose of this clinical report was to present the esthetic replacement of fractured maxillary central incisor with implants by socket shield technique, to achieve an optimal esthetic outcome.

Clinical report

A 25 year old man having trauma of the maxillary right central incisor was reported to the department of Prosthodontics KMCT dental college, Kerala, India. The chief complaint was elongated tooth. He is a theater artist by profession. Unaesthetic smile affected his profession and he was under psychological trauma. The trauma occurred one week before and not undergone any treatment.

Clinical examination revealed that maxillary right central incisor was extruded by 3mm with increased mobility (Fig.1A). Periodontal conditions were sound. Thickness of gingiva was classified as thick biotype (thickness was >1.5mm).[12] CBCT examination (Fig.1B) revealed fracture of middle one third of the root and classified under Ellis class VI root fracture.[13] The prognosis of the tooth

Fig. 1. A.Pretreatment photograph view B. CBCT view

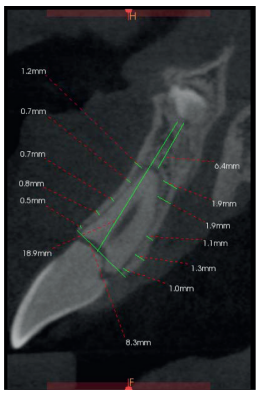


Fig..2. CBCT view showing thin buccal cortical plate

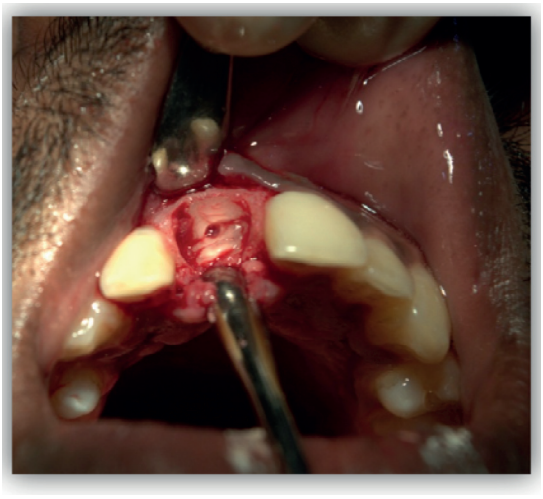


Fig..3. After decoronation

Fig.4. After removing lingual portion of root

was evaluated as poor and it was decided for extraction.

Various treatment options were discussed for post extraction replacement of maxillary right central incisor. Patient opted for implant supported fixed restoration. Cone Beam Computerized Tomography (Fig. 2) reveals thin buccal cortical plate (0.5mm). Immediate implant placement with 'socket shield technique' was planned for this case to avoid labial plate fracture during extraction of teeth.

Under strict aseptic conditions, tooth was decoronated 2mm below the alveolar crest at the fractured site (Fig.3). The tooth was sectioned mesiodistally in vertical direction using a long shaft tapered fissure diamond bur. Then, all root fragments were removed on the lingual, mesial and distal aspect using periotome, retaining only the buccal portion of the root (Fig. 4)

Osteotomy drills were performed through the lingual aspect of the root. Socket was prepared for implant placement. Implant of adequate length and width (Myriad plus, D 4.5×L 13 Lot no; PL 0301120182) was inserted and torqued using torque wrench. It has got a primary stability of >30 N cm(Fig. 6 A,B). The titanium abutment was milled and provisional crown was cemented using temporary cement (Provicol C. batch no; REF 1076). All centric and eccentric functional contacts from the provisional crown were eliminated. Periodic examination was done.

After 6 month of waiting period clinical and radiographic examination was carried out (Fig.7). The gingival architecture around the implant was found to be well preserved. The abutment level impression was made using polyvinyl siloxane (3M ESPE. Batch no;20021202). The definitive restoration consisted of a metal ceramic crown was cemented using glass ionomer luting cement (Fig.8) (3M ESPE Ketac TM Cem radiopaque Glass ionomer cement. LOT no:665265). The prostheses have been in function for one year.

Discussion

According to Salama et al.[14] leaving the root of a tooth in the socket will preserve bone and soft tissue dimensions, provided that the root is not infected or mobile. The buccal side of the tooth fragment revealed intact periodontal ligament. No signs of bone resorption were observed at the alveolar bone crest. Johnson DL[15] demonstrated the integration of newly formed cementum between dentin and the implant on histologic evaluation. Retaining the buccal aspect of the root during implant placement does not appear to interfere with osseointegration.[8] A drawback of socket shield technique is that its association with certain risks, such as the formation of a peri-implant periodontal membrane[16] or the development of peri-implant infections, as well as resorption associated with the usual biological long-term complications. These occur especially in the presence of pre-exiting or developing periodontal or endodontic infections or inflammations of the retained tooth fragments.

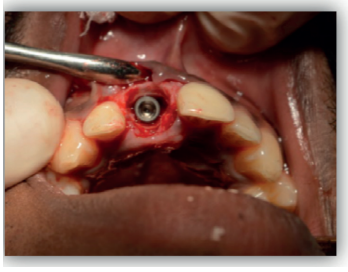


Fig. 6. A. Impant inserted. B. Primary stability more than 30N

Fig.7 Radiograph after 6 month

Fig.8 .Definitive crown cemented

Summary

Socket shield technique in implantology could be used very much in the future, because it is conservative alternative allowing less dependence on bone grafts. However, long-term follow-ups and a larger number of subjects need to be studied. It is not used on a daily basis due to its difficulty to work over the root and infrequency of root fractures without any infectious areas. The outcome is anatomically, post-operatively, aesthetically, prosthodontically and periodontally more predictable in cases of vertical fracture. Further histological evidence and long-term follow up has to be conducted to recommend the socket-shield technique on a general basis.

References

1. McAllister BS, Haghighat K. Bone augmentation techniques. J Periodontol 2007;78:377-96
2. Petropoulou A, Pappa E, Pelekanos S. Esthetic considerations when replacing missing maxillary incisors with implants: J Prosthet Dent 2013;109:140-144
3. Chen C L. Socket shield technique for ridge preservation: A case report.2013;2(2);16-19
4. Bäumer D, Zuhr O, Rebele S, Schneider D, Schupbach P, Hürzeler M. The socket-shield technique: histological, clinical, and volumetrical observations after separation of the buccal tooth segment – a pilot study. Clin Implant Dent Relat Res 2015; 17: 71-82
5. Darby I, Chen ST, Buser D. Ridge preservation techniques for implant therapy. Int J Oral Maxillofac Implants 2009;24:260-71
6. Spear F. Implants or pontics: decision making for anterior tooth replacement. J Am Dent Assoc 2009;140:1160-6
7. Esposito M, Grusovin MG, Felice P, Karatzopoulos G, Worthington HV, Coulthard P. The efficacy of horizontal and vertical bone augmentation procedures for dental implants - a Cochrane systematic review.
9. Hurzeler MB, Zuhr O, Schupbach P, Rebele SF, Emmanouilidis N, Fickl S. The socket-shield technique: a proof of principle report. J Clin Periodontol 2010; 37: 855-62.
10. Landberg, C,.Socket seal surgery combined with mediate implant placement: A novel approach for single tooth replacement. Int J Periodontics Restorative Dent.1997.;17: 141-49.
11. Misch C E. A modified socket seal surgery with composite graft approach. J Oral Implantol.1999;2: 44-50.
12. Hrtzeler M,Zurhr, O. Socket shield Technique. Approach of principle Report dog model.J Periodontol. 2010;37:855-62
13. Fu JH,Yeh CY,Chan HL,Tatarakis N,Leong DJ,Wang HL. Tissue biotype and its relation to underlying bone morphology. J Periodontol.2010;81(4):569-74.
14. Feliciano, Caldas. A systematic review of the diagnostic classifications of traumatic dental injuries. Dental Traumatology 2006;22:71-76
15 Salama, T. Ishikawa, H. Salama, A. Funato, D. Garber. Advantages of the Root Submergence Technique for Pontic Site Development in Esthetic Implant Therapy. The International Journal of Periodontics & Restorative Dentistry. 2007; 27(6):521-7
16. Johnson DL, Kelly JF, Flinton RJ, et al. Histologic evaluation of vital root retention. J Oral Surg. 1974;32:829.
17. Parlar H, Bosshardt D.D, Unsai B, Cetiner D, Haytaç C, Lang N.P. New formation of periodontal tissues around titanium implants in novel dentin chamber model. Clin. Oral Implant. Res. 2005;16:259–67.

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

ANCIENT AYURVEDA IN MODERN DENTISTRY: A REVIEW ARTICLE

* Shivam Singh Tomar, **Kapila Chakarvarty, ***Divyesh Mehta, ***Mansi Nautiyal,

*Senior Lecturer, ** Lecturer, ***Senior Lecturer, Prosthodontics, Manav Rachna Dental College | Corresponding Author: drshivamprosthodontist@gmail.com

Abstract:

Ayurveda-harmony of body mind and soul is a Sanskrit word where "ayur" means life and "veda" the science of life. It is traditional hindu system of medicine developed in India thousands of year ago. Oral health is integral part to general well being. Ayurveda acknowledges the link between oral health and overall health. It recommends a combination of life style management and treatment with specific herbs and minerals to cure dental diseases. Now a day, herbs are used as alternative medicine and are helpful in treatment of oral diseases. Ayurveda explains simple and wonderful remedies which help us to maintain strong and healthy teeth. Dravyaguna- pharmacology of ayurvedic medicine is successfully used in dentistry as tooth cleaning, anti-inflammatory, anti-analgesic and antimicrobial agents. Current researches and various studies show that herbs are useful in treatment of diseases of oral cavity.

Key words:
Dravyaguna, ayurveda, dental diseases, oral health.

Introduction

Ayurveda is as primitive as life is, it evolved in India around 5000 years ago, now practiced in other countries as a form of alternative medicine. The earliest literature Charaka Samhita and Sushruta Samhita have not any description of dentition however Sushruta has described Dantamula (gum) disorders and 8 dentational diseases[1]. But Vagbhata gives information about dental disorders, it has mentioned "Danta Roga" (teeth diseases) and Dantamamsa Roga (gum diseases)[2]. The pioneer in this field is Kashapya which deals with different aspects of dentation in Kashapya Samhita in separate chapter " Dantajanamika".

Our body is constituted of three physical humors i.e. dosha. These are vatta (wind), pitta (bile), kapha (phelgum) each of which has five subtypes. Bodhaka kapha[3]- a subtype is primary player in oral cavity. Imbalance in any of these doshas affects overall health and when bodhaka kapha is disordered it affects not only oral health as well as all kapha system throughout the body[4]. Ayurveda believes balance in these doshas determine healthcare in ayurveda including dental health.

Ayurveda and Dental Tissues

Teeth are integral part of our body which help in chewing of food which is very important for digestion. There is a famous saying "eat your liquids and drink your solids". This is not possible without teeth. Dental science has witnessed use of herbal products in treatment of oral diseases. There are numerous medicinal plants that are used in articulating beneficial measures and ayurvedic material has been proved to be safe and effective through ages[5]. Even in ancient time Indians used wooden twigs called "datun" to brush their teeth, though the wood of twig varies according to time and place. Various herbs like amla, launga oil, nimbu, triphala, neem, aloevera, piper, betel, osmium sanctum (basil, tulsi), haritaki (tea tree

oil) poses antibacterial and antiplaque properties[6].

Teeth eruption and Ayurveda

Vaghbhata[7], *Yog Ratnakar*[8] and *Vangsena*[9] mentioned herbs for easy and painless eruption of teeth. Powder of *pippli, dhataki pushpa,* and *amalaki* fruits with honey when rubbed on gums helps in easy eruption of teeth. Use of *ghrita* medicated with *vacha, brihati, patha, kutaki,ativisa* and drugs of *jivaniyagana* facilitates easy eruption of teeth. Shankh bhasm, a good source of calcium should be administered daily.

Ayurveda, herbs and oral diseases

In ayurveda use of plants and herbs for dental care has been demonstrated to possess antiplaque properties. For past thousand years medicinal plants have been used in medicine for maintaining oral hygiene and these herbs are alkaline in nature with high antibacterial activity, which further help to maintain acid alkaline balance of saliva, decreases plaque and calculus formation and further reduces risk of periodontal diseases[10].

Action of various herbal extracts on dental disease

Chewing Sticks- Plaque, gingivitis and periodontal diseases.

Chewing sticks are named as *datun* in India and Pakistan, *miswak, siwak* or *arak* in Middle East, miswaki in Tanzania. Ayurveda says use herbal sticks twice daily to prevent diseases. The procedure is to crush one end, chew on it and eat it slowly until they become frayed into a brush. The brush end is now used to clean teeth in a manner in which we use tooth brush.

Azadirachata Indica *(neem)* is commonly used dental stick. In West Africa lime tree (Citrus Aurantifolia), the orange tree (Citrus Sinensis) are used as chewing sticks. The roots of seena (Cassia Vinnea) were used by American Negros. Salvadora Persica *(meswak)* was used by Babylonias in 3500 BC[11], later they were used by Greek and Roman Emperors.

Neem (Azadirachta indica) is famous herbal chewing stick. The twigs and oil of neem contain substances that have broad spectrum antimicrobial activity and when it is incorporated in toothpaste reduces gingivitis. Various other plants are also used in oral health care as chewing sticks, some plants along with their properties are listed in Fig.1. These chewing sticks have anti-plaque, anti-cariogenic, antiseptic, antibacterial, antifungal, astringent, styptic, anti-inflammatory and antiviral properties which help in prevention of dental caries and periodontal diseases. Incorporation of these herbal sticks in toothpaste has been found to be more effective as compared to conventional tooth pastes.

Various studies have also demonstrated the usefulness of chewing sticks. Danielsen et al assessed the efficacy of brushing with chewing sticks on plaque removal and concludes that brushing with a chewing stick for five minutes resulted in a net reduction of the proportions of plaque deposit sites per child and the tooth paste resulted in no additional effect[12]. Kadam et al in their study proved that the chewing sticks have medicinal and anticariogenic properties[13]. In 2014 Ranjit et al studied the antimicrobial activity of leaf and bark extract of Azadirachta indica (Neem), showed more zones of inhibition against Vibrio cholerae and Bacillus subtilis, while E. Coli and S. typhi were less susceptible to Neem extract[14].

Almas and Al-Zeid tested the antimicrobial activity of Salvadora persica in vivo on Streptococcus mutans and Lactobacilli[15]. Eid and Selim examined the relationship between miswak and gingival health in terms of pocket depths, periodontal disease severity and gingival recession in 264 patients who were on routine periodontal treatment. They suggested that the use of miswak may influence periodontal health and may be considered as a contributing factor to gingival

recession16. Present day researches show that all chewing sticks described in ancient ayurveda texts (circa 200 BC) have medicinal and anti-cariogenic properties[17].

Neem

Neem (Azadirachta Indica)-a divine tree is used as ayurvedic medicine since 4000 years for medicinal purposes. *Neem* is called "Arista" in Sanskrit a word which means "perfect, complete and imperishable"[18]. The benefits of neem are listed in ancient documents charak-samhita and susruta-samhita. The neem tree has been declared the "Tree of the 21st century by United Nations[19]. The US National Academy of Science published a report in 1992 entitled "Neem: A tree for solving global problems[20].

The most active biological components of neem is azadirachtin, others are meliacin, gedunin, salanin, nimbin, valassin, nimbolinin, nimbidol. Various parts of neem plant have shown medicinal properties (Fig. 2)

Azadirachtina and nimbin are the principal constituents of neem which are responsible for antibacterial activity. Neem leaf extract has shown significant reduction in plaque index and bacterial count especially of S.mutans and lactobacilli species[21]. Elavarasu et al also demonstrated in their study definite anti plaque activity of neem oil[22]. Neem leaf and oil have found to have both antifungal properties and anticariogenic activity. Neem extract has demonstrated inhibition of Streptococcus mutans, Streptococcus salivarius, Streptococcus mitis, and Streptococcus sanguis at various concentrations, antibacterial properties were seen at even 5% of concentration[23].

Neem mouthwashes are effective in reducing acute and chronic gingival and periodontal inflammation. Polysaccharides extracted from the neem have anti-cancer and anti-inflammatory effects. Polysaccgride G1 A and G1 B has strong antitumor effects with complete regression of tumor[24], polysaccharides GIIa and GIIIa has shown anti-inflammatory effect on carrageenin-induced oedema[25].

The antibacterial anti-inflammatory, anti cariogenic and antiviral properties of neem make it useful ingredients for dental products.

Aloe Vera Gel

Aloe vera (Aloe barbadensis) the miracle herb, name Aloe derives from the Arabic word "Alloeh" meaning shining bitter substance while "vera" in Latin means true.[26] It is mainly found in Africa, Asia, America, Egypt.[27]

Content of Aloe Vera Gel

It contains various mineral and vitamins. Vogler and Earnest in 1999 suggested that aloe vera gel contain 75 nutrients.[29]

Vitamins- A B1, B2, B3, B6, C, E, choline, folic acid, alpha-tocopherol, beta-carotene.[28]

Amino acids- Aloe Vera provides 19 out of 20 amino acids except tryptophan.[29]

Minerals-calcium, potassium, sodium, iron, magnesium, copper and zinc.[30]

In addition to vitamins, minerals and amino acids, aloe vera also contains enzymes that helps in digestion (amylase, lipase, acid phosphatase, alkaline phosphatase, lactic dehydrogenase) and other one are anti-inflammatory. A.vera enzymes like bradykinase, sterols like lupeol which act as antiseptic, analgesic and anti-inflammatory agents, and sugars- monosacchrides (glucose and fructose) and polysaccharides (Acemannan).

Aloe Vera and Dentistry

Aloe Vera is used in treatment of gingivitis and periodontitis. Studies by Geetha Bhatt et al., have proved the use of aloe vera gel as a subgingival administrator in the treatment of periodontal pockets.[31] Studies have also shown

that incorporation of Aloe Vera in mouthwash and toothpaste show remarkable improvement in plaque induced gingivitis.

It has antiviral properties, also helps in treatment of herpes simplex and herpes zoster infections, acute lesions of mouth, apthous ulcers and cracks in the corner of lips. Studies have also shown that it reduces the growth of organisms such as S. viscosus, S.mutans, S.sanguis, Candida albicans in the oral caity[32]. Extraction sites respond good and empty purses are not developed by application of aloe vera gel. Even gum problems and burning mouth syndrome respond positively to aloe vera gel.

Choonhakarn et al.[33] check the efficacy of Aloe vera gel in the treatment of oral lichen planus (OLP). He concluded that Aloe vera gel is statistically significantly more effective than placebo in inducing clinical and symptomatological improvement of OLP. Sudarshan et al.[34] carried out a preliminary study to compare the efficacy of Aloe vera gel in the treatment of oral submucous fibrosis (OSMF).

Aloe Vera is also used around implants to control inflammation caused by bacteria contamination. Latex free aloe vera coated gloves are also available mainly for cracked hands for they provide soothing, cooling, moisturizing effect of[35]. Aloe Vera, a miracle herb, has a lot to offer in field of dentistry.

Clove

Clove (Syzygium aromaticum syn. Eugenia aromaticum or Eugenia caryophyllata) are dried buds of family Myratacea. Cloves are used in ayurveda and Chinese medicines, even archeologist discovered cloves in Syria and predicted that they date back to 1721 B.C.

Clove oil is chemically composed of phenylpropanoids eugenol, eugenyl acetate, carvacrol, thymol, cinnamaldehyde, □-caryophyllene, and 2-heptanone, when analyzed by gas chromatography[36]. It is rich in minerals such as calcium, iron, phosphorous, sodium, potassium and vitamin A and C[37]. Eugenol is widely used in dentistry. Eugenol has analgesic, anti bacterial, anti oxidant, local anesthetic and anti fungal effect and widely used in dentistry. The concentration of eugenol ranges from 60-90% that depends from where oil is extracted- either bud, leaf or stem.

Clove oil is old remedy for tooth pain (i.e. as anesthetic) by holding whole clove at the site of tooth ache, or nibbling on it until it's chewed up. It is used in form of paste or mixture as dental cements- as liner or base or temporary restoration purpose. It is applied directly to the gums (used topically) for toothache, for pain control for complication of teeth extraction called dry socket[38].

Treatment of dental implant surfaces with clove oil has shown to inhibit biofilm production[39]. It was found to possess inhibitory effect on multi-resistant Staphylococcus spp[40].

Oil pulling *(Gandusha)*

Oil pulling or oil swishing is mentioned in ayurvedic text Charaka Samhita where it is called kavala graham or Gandusha. Kavala and Gandusa are old methods of oral cleansing. Oil pulling involves pulling or swishing oil in mouth for oral and systemic health benefits. In gandusa the mouth is filled completely with liquid, held for about 3-5 min, and then released while in kavala graham the mouth is three-fourth filled, held for three minutes then gargled and released. This technique benefits bad breath, dry face, exhaustion, anorexia, loss of taste, and sore throat.

Oil pulling therapy is done using oils like sesame oil or sun flower oil. Oil pulling is clinically very effective against gingivitis41. The mechanism of action is not clear. It is thought that stimulation of enzymes take place during swishing which draws the toxins out of the blood. The oil used in oral cavity protects it against the infection and inflammation by its antioxidant property.

A study was conducted by Asokan S et al (2009) to evaluate the effect of oil pulling with sesame oil on plaque-induced gingivitis, and to compare its efficacy with chlorhexidine mouthwash[42]. Ayurveda advises oil gargling to purify the entire system; as it holds the thought that each section of the tongue is connected to different organ such as to the kidneys, lungs, liver, heart, small intestines, stomach, colon, and spine, similarly to reflexology and TCM[43].

Amla/Amalaka/Amalaki

Amla(Phyllanthus emblica)- the divinity thing in Ayurveda , believed that amrit/ambrosia packed with all rasas thereby, it becomes an unavoidable part in ayurveda. In that sense, amalaki and hareetaki stand next to amrit since they exhibit five rasas[44]. The fruit amla is deliberated as a rasayana for pitta. Charaka samhita mentioned amalaki is viewed one of the most potent and nutritious herb and also it says "Amalaki is the best rejuvenative herb"[45].

Amla has low molecular hydrolysable tannins (Emblicanin A and Emblicanin B, punigluconin) thereby it is considered as one of the most strong antioxidant herb in ayurveda[45]. Amla is also considered general rebuilder of oral health. It works as a mouth freshner. Zeatin, a cytokine like substance present in amla leaves helps in refreshing the mouth and strengthening the teeth and bones. According to ayurveda, amla is supposed to strengthen the internal organ system of our body and increase the afford strength and wellness.

Ginger

Ginger (Zingiber officinale), a medicinal plant is widely used in ayurveda for treating various ailments. Its active components are volatile oils, Shogaols, Gingirols, Diarylhepatanoids[15]. Ginger has excellent anti-inflammatory and anti analgesic property and is used in treatment of toothache and gingivitis. It has antimicrobial activity on the growth of Streptococci mutans and Lactobacilli. Studies have shown that ehatnol extract of ginger was effective against Candida albicans, hence used in treatment of oral candidiasis[46].

Roopal V Patel demonstrated that combined extracts of ginger and honey showed maximum inhibitory concentration against S.mutans and S.aureus and were least effective against L.acidophillus in comparison with gentamycin, showing,there is a significant synergistic effect of antimicrobial activity from the combination of ginger and honey, against isolates from carious teeth[47].

Ginger constituents have pharmacological properties similar to that of dual acting NSAIDS. Compounds in this class inhibit arachidonic acid metabolism via the cyclooxygenase (COX) and lipooxygenase (LOX) pathways. These compounds have notably fewer side effects than conventional NSAIDs and now are being investigated as a novel class of anti-inflammatory compounds. Although ginger has potentially strong anti-inflammatory components, its efficacy on acute inflammation was not assessed before the ability of Ginger powder (Zintoma, Goldaru) to reduce postoperative swelling, pain and trismus in an acute pain model[48].

Turmeric

Turmeric (haldi), a rhizome of Curcuma longa used for thousand years as dye, a flavoring and medicinal herb. Since turmeric has antioxidant, antimicrobial, astringent, antiseptic and other useful properties, it is used in dentistry also. As a natural product turmeric is non toxic and has diversified effects on oral diseases. Ancient Indian medicine touted turmeric as an herb with an ability to provide glow and lusture to the skin as well as vigor and vitality to the body[49].

The active component of turmeric is known as curcumin. It has wide range of systemic and oral applications. It eliminates pain and swelling

when massage over the aching tooth with roasted, ground turmeric. Rinsing the mouth with turmeric water (boil 5 g of turmeric powder, two cloves and dried leaves of guava in 200 ml water) gives instant relief. Applying a paste made from 1 tsp of turmeric with ½ tsp of salt and ½ tsp of mustard oil provides relief from gingivitis and periodontitis when rubbed daily over the gums. It is also used as a staining agent in plaque detection system in detecting plaque in oral cavity.

Studies by Kwang-Hee et al show that Curcuma longa essential oil inhibits S.mutans acid production and growth at concentrations from 0.5 to 0.4 mg/ml, this oil also inhibited the adhesion to saliva coated hydroxyl apatite beads at concentration higher than 0.5 mg/ml[50].

Jeon et al showed that fractions of turmeric separated using methanol extract shown inhibitory effects on virulence properties of S.mutans biofilms, such as bacterial adherence, acidogenicity and aciduricity[51].

Curcumin also exhibits phototoxic effects against gram positive and gram negative bacteria, they can be used for photodynamic therapy in root canal treatment[52]. Studies also show that Curcumin inhibits E.fecalis biofilm formation, showing that it has potential to be used as an irrigant for root canal treatment[53]. Pit and fissure sealent can be produced from a composition comprising a polymerizable resin system containing acrylic monomer and at least one colorant selected from the group constisting of Annatto extract, turmeric extract and ß-Apo-8'-Carotenal[54].

Miscellanous

Walnut: powdered fruit skin is used for cleansing the teeth. Also it strengthen the gums and checks bleeding.

Rough Chaff: its root powder is beneficial for teeth cleansing. Its juice eases dental pains.

Indian Gumarabic Tree: Bark gargle is beneficial in stomatitis and throat inflammations. Chewing of barks strengthen loose teeth and arrest bleeding from gums. It cleans dirty teeth too.

Bakula: Ripen fruit is used to clean the teeth. Brushing with stem cleans the teeth. Gargling with the mix of Acacia eases swelling and bleeding of gums. It helps to fix the loose tooth.

Indian Nightshade: Its gargle alleviate foul odor of the mouth.

Cardamom: Smell of Oral cavity and teeth disappear after gargling with it. Its seed acts like as mouth freshener. Its oil is used for toothache.

Cassia Flower: Good for dental diseases. Gum's oil massage helps to stop bleeding and strengthens the gums. Acts like as a deodorants. Its gargling is important for dental afflictions.

Variegated Bauhinia: Decoction of bark skin heals wounds. Skin paste reduces the swelling.

Tailpepper: It is a good mouth deodorant. Its powder is extremely beneficial for teeth cleansing. It is also used in tooth powders.

Indian Beech: Root powder is good for teeth and gums. Seed oil is antiseptic, analgesic and anti pruritic. Leaves paste is extremely useful for wounds and swellings.

Nut Gall: Its gargle is effective for gums problems. Useful for mouth odorant.

Camphor: Place a swab, dipped in camphor oil to relieve the dental pain. Used to make tooth powders. Camphor+ Neem juices prevent falling of eyelashes.

Cutch Tree: Its powder stop gums bleeding. Highly useful for skin affliction. Also good for dental caries and cavities.

Musk-mallow: Its seed powder is used as mouth deodorant, good for mouth and sore throat problems.

Red Wood tree: Gargle is good for stomatitis and sore throat. Its fruit is useful for getting fair complexion of skin.

Oak Galls: Mix of Oak, alum and catechu cleanses the teeth. It fixes the loose teeth. Its gargle is good for tonsils. Used in hair dye preparation.

Long Zedoary: Rhizome powder is used for cleansing of teeth. Used as deodorants too. It is also given for hiccup.

Toothache tree: The fruit chewed reduces dental pains and refreshes the mouth. It is also known for sore throat, toothache and stomatitis.

Cinnamon: Soak the cotton swab in cinnamon oil and place it in dental cavities. It reduces pains. It eases dispigmentation. Used as mouth freshener and mouth deodorants.

Conclusion

In Ayurveda, teeth are considered part of Astidhatu - bone tissue, so that their sockets are like joints.

Fig. 1

S.No	Plants	Useful properties
1	Salvodora persica (Miswak)	Astringent, antibacterial
2	Azadirachta indica (neem)	Bitter, astringent, antiseptic, antibacterial, analgesic, anti-inflammatory, antiviral, antifungal
3	Acacia catechu (khair)	Astringent, cooling, antiseptic anti-inflammatory, bitter
4	Acacia nilotica (kikar)	Astringent, styptic antibacterial, antifungal, acrid
5	Acacia leucophloca (safed babul)	Astringent, styptic, antibacterial, antifungal
6	Ficus fenghalensis (bargad)	Astringent, antiseptic, anti-inflammatory, analgesic, antioxidant
7	Glycyrrhiza (mulhatti)	Demulcent, haemostatic, antimicrobial, anti-inflammatory, antiviral, analgesic
8	Ficus racemosa (gular)	Astringent, antiseptic, antifungal, anti-inflammatory
9	Aegle marmelos (Bael)	Astringent, antibacterial
10	Zanthoxylum aromatum (tejovati)	Astringent, antiseptic, antibacterial

Fig. 2

Parts of tree	Compound name	Activity
Seed	Nimbidin, nimbin, azadirachtin, nimbolide, gedunin, mahamoodin	Antifungal, antibacterial, antiviral, anti carcinogenic, anti pyretic, hypoglycemic, anti malarial
Bark	Gallic acid, epicatechin, catechin, margolene, margolononene, isomargolonone, polysaccharides G1 A, G1 B, G2 A, G3 A, N-B2 peptidoglucan	Anti bacterial, antitumor, anti-inflammatory, immunomodulatory
Leaf	Cyclic trisulphide, cyclic tetrasulphide	Antifungal, anti ulcer

Herbs taken internally to strengthen Astidhatu, i.e. the skeleton and the joints, are good for long-term health of the teeth. Ayurvedic aspect of dental care is very useful in present day life, both in preventive and curative aspect.

Science of ayurveda should be integrated with modern dentistry, and further researches should be made. Herbal drugs are locally available and it doesn't require technology or expertise or extra resources to manufacture it. These are cost effective and are easily available remedies which were used in ancient time. Further researches should be made to incorporate these in oral health care products.

References

1. Sushruta Samhita, Sushruta, Kaviraj Ambikadattashastri (2011)Ayurvedatatvasandipika Hindi Commentery ,Reprint, Chaukhambha Sanskit Santhana, Varanasi, Nidana Sthana, 16: 382.
2. Murtthy KRS (2013) Vagbhata Astanga Hyridayam Edition 9th 2013 Choukhambha Krishnadas Academy Varanasi UttaraSthana chapter 21, Mukharoga p.184.
3. Vasant Lad, Textbook of Ayurveda Volume 1: Fundamental Principles of Ayurveda (Albuquerque: The Ayurvedic Press, 2002), 72–3.
4. Lad, Textbook 1: Fundamental Principles, 73.
5. Patil AA, Deosarkarb B, Nirasc S, Chaudhari V: Oral Health & Ayurveda. Journal of Interdisciplinary Dental Sciences 2013; 2(2):
6. Gupta D, Nayan S, Tippanawar HK, Patil GI, Jain A, Momin RK, Gupta RK: Are herbal mouthwash efficacious over chlorhexidine on the dental plaque?. Phcog Res 2015; 277-81.
7. Murtthy KRS (2013) Vagbhata Astanga Hyridayam Choukhambha Krishnadas Academy Varanasi UttaraSthana chapter 2, Balamaya Pratishedha, Ver 35,36,37 p.19.
8. YogRatnakar (2010) 'Vidyotini' Hindi commentary, Vaidya Laksmiprati Sastri, Edition Reprint, Chaukhambha Prakashana, Varanasi, Uttarardha, Balarogadhikara, Dantbhedajrogeshu. Ver. 1, pp. 447
9. Vngasena, 'Hari' Hindi Commetery, P Hariprasa Tripathi (2009) Chaukhambha Sanskrit Series Office, Varanasi, (1stedn), Chapter 19- Shishurogadhikara, Ver. 137-138, pp. 238.
10. Jose M, Bhagya B, Shantaram M. Ethnomedicinal herbs used in oral health and hygiene in coastal dakshina kannada. JOHCD 2011 Sept;5(3): 119-23.
11. Yu, Hai-Yang; Qian, Lin-Mao; Zheng, Jing (2013). Dental Biotribology. Springer. pp. 18–19. ISBN 978-1-4614-4550-0.
12. Danielson B, Baelum V, Manji F, Fejerskov O. Chewing sticks, toothpaste, and plaque removal. Acta Odontol Scand 1989; 47: 12-5.
13. Avinash Kadam, B S Prasad, Dilesh Bagadia, V R Hiremath: Effect of Ayurvedic herbs on control of plaque and gingivitis: a randomized controlled trial. Ayu. 2011: 532-35.
14. Ranjit R. Raut, Ajit R. Sawant and Bhagyashree B. Jamge: Antimicrobial activity of Azadirachta indica (Neem) against Pathogenic Microorganisms.Journal of Academia and Industrial Research (JAIR) Volume 3, Issue 7 December 2014.
15. Almas K, Al-Zeid Z. The immediate antimicrobial effect of a toothbrush and miswak on cariogenic bacteria: a clinical study. J Contemp Dent Pract 2004;15:105-14.
16. Eid MA, Selim HA. A retrospective study on the relationship between miswak chewing stick and periodontal health. Egyptian Dent J 1994; 40: 589-92.
17. Naik GH, Priyadarsini KI, Satav JG, Banavalikar MM, Sohoni DP, et al. (2003) Comparative antioxidant activity of individual herbal components used in Ayurvedic medicine. Phytochemistry 63: 97-104.
18. K. Girish, Bhat. S. Shankara, Neem- A Green Treasure, Electronic Journal of Biology, 2008, Vol 4(3):102-11.
19. United Nations Environment Programme Neem: The UN's tree of the 21st Century. Nairobi: United Nations Environment Programme; 2012. [Online] Available from: http://www.unep.org/wed/tree-a-day/neem.asp. [Accessed on 10 September, 2012]
20. National Academy of Science . Washington, DC: NAS; 1992. Neem, a tree for solving global problems[R]
21. Pai MR, Acharya LD, Udupa N. Evaluation of antiplaque activity of Azadirachta indica leaf extract gel--a 6-week clinical study. J Ethnopharmacol. 2004 Jan;90(1):99-103.
22. Sugumari Elavarasu, P. Abinaya, S. Elanchezhiyan, Thangakumaran, K. Vennila, K. B. Naziya. Evaluation of anti-plaque microbial activity of Azadirachta indica (neem oil) in vitro: A pilot study. J Pharm Bioallied Sci. 2012 August; 4(Suppl 2): S394–S396.
23. Prashant G M, Chandu G N, Murulikrishna K S, Shafiulla M D. The effect of mango and neem extract on four organisms causing dental caries: Streptococcus mutans, Streptococcus salivavius, Streptococcus mitis, and Streptococcus sanguis: An in vitro study. Indian J Dent Res 2007;18:148-51.
24. Fujiwara T, Takeda, T., Ogihara, Y., Shimiju, M., Nomura, T. and Tomita, Y., Studies on the structure of polysaccharides from bark of Melia azaradichata,

Chem. Pharm.Bull. ibid, 1982, 30, 4025-30.

25. Fujiwara, T. Sugishita, E., Takeda, T., Ogihara, Y., Shimizu, M., Nomura, T. and Tomita, Y. Further studies on the structure of polysaccharides from bark of Melia azadirachata. Chem. Pharm. Bull. Ibid, 1984, 32, 1385-1391.
26. PDR for herbal medicines. ed.1. Montvale, NJ: Medical Economics Company; 1998. p. 631.
27. Surjushe A, Vasani R, Saple DG. Aloe vera: A short review. Indian J Dermatol. 2008;53:163–6.
28. Hayes SM. Lichen planus- Report of successful treatment with aleo vera. Gen Dent. 1999;47:268–72
29. Vogler BK, Ernst E. Aloe vera: A systemic review of its clinical effectiveness. Br J Gen Pract.1999;49:823–28.
30. Yamaguchi I, Mega N, Sanada H. Components of the gel Aloevera (L) burm. F. Biosci Biotechnol Biochem. 1993;57:1350–52.
31. Bhatt Geetha, Praveen K, Dodwad Vidya. Aloe vera: Nature's soothing healer to periodontal disease. J of Indian Soc Periodontology. 2011;15(3):205–09.
32. Lee SS, Zhang W, Li Y. The antimicrobial potential of 14 natural herbal dentifrices: Results of an in vitro diffusion method study. J Am Dent Assoc. 2004;135(5):1133–41.
33. Choonhakarn C, Busaracome P, Sripanidkulchai B, Sarakarn P. The efficacy of Aloe vera gel in the treatment of oral lichen planus: A randomized controlled trial. Br J Dermatol. 2008;158:573-77
34. Sudarshan R, Annigeri RG, Sree Vijayabala G. Aloe vera in the treatment for oral submucous fibrosis – A preliminary study. J Oral Pathol Med. 2012;41:755–61.
35. New products and focus on infection control and surgery design. British Dent J. 2012;212(1):47.
36. Chaieb K, Hajlaoui H, Zmantar T, Kahla-Nakbi AB, Rouabhia M, Mahdouani K, et al. The chemical composition and biological activity of clove essential oil, Eugenia caryophyllata (Syzigium aromaticum L. Myrtaceae): A short review. Phytother Res. 2007;21:501–6.
37. Health benefits of clove oil. Organic facts. http://www.organicfacts.net/health-benefits/essential-oils/health-benefits-of-clove-oil.html
38. Agarwal R, Lakshmi T. Essential oils in dentistry-An update. Int J Pharm Tech Research. 2013;5:1804-07.
39. Dagil N, Dagil R. Possible use of essential oils in dentistry. J Int Oral Health. 2014;6:i-ii.
40. Chaieb K, Hajlaoui H, Zmantar T, Kahla-Nakbi AB, Rouabhia M, Mahdouani K, et al. The chemical composition and biological activity of clove essential oil, Eugenia caryophyllata (Syzigium aromaticum L. Myrtaceae): A short review. Phytother Res. 2007;21:501–6.
41. Patil AA, Deosarkarb B, Nirasc S, Chaudhari V: Oral Health & Ayurveda. Journal of Interdisciplinary Dental Sciences 2013; 2(2):
42. Asokan S, Emmadi P, Chamundeswari R. Effect of oil pulling on plaque induced gingivitis: A randomized, controlled, triple-blind study. Indian J Dent Res. 2009;20:47–51.
43. Asokan S. Oil pulling therapy. Indian J Dent Res. 2008;19:169. [PubMed]
44. Mirunalini et al. Amla :A novel ayurvedic herb as a functional food for health benefits-A mini Review. Int J Pharm Pharm Sci, 2013, Vol 5, Suppl 1, 1-4
45. Scartezzini P, Antognoni F, Raggi MA, Poli F, Sabbioni C. Vitamin C content and antioxidant activity of the fruit and the Ayurvedic preparation of Emblica officinalis Gaertn. Journal of Ethnopharmacology 2006;104 :113–118.
46. Atai Z. Inhibitory Effect of Ginger Extract on Candida albicans. American Journal of Applied Sciences 2009; 6:1067-9.
47. Patel, Roopal V., Vidhi T. Thaker, and V. K. Patel. "Antimicrobial activity of ginger and honey on isolates of extracted carious teeth during orthodontic treatment."Asian Pacific Journal ofTropical Biomedicine 1.1 (2011): S58-S61.
48. Anti-inflammatory and Anti-analgesic effects of ginger powder in Dental pain Model. Qazvin University Of Medical Sciences. Sept 2011. https://clinicaltrials.gov/ct2/show/study/NCT01429935.
49. Chaturvedi T P. Uses of turmeric in dentistry: An update. Indian J Dent Res 2009;20:107-9
50. Lee, K.-H., Kim, B.-S., Keum, K.-S., Yu, H.-H., Kim, Y.-H., Chang, B.-S., Ra, J.-Y., Moon, H.-D., Seo, B.-R., Choi, N.-Y. and You, Y.-O. (2011), Essential Oil of Curcuma longa Inhibits StreptococcusmutansBiofilm Formation. JournalScience, 76: H226–H230. doi: 10.1111/j.1750-3841.2011.02427
51. https://iadr.confex.com/iadr/2012rio/webprogram/Paper161330.html
52. Ethnopharmacological approach in Endodontic Treatment: A Focused Review", Int. J. Drug Dev. & Res., Oct-Dec 2011, 3(4): 68-77
53. Neelakantan, Prasanna, et al. "Effectiveness of curcumin against Enterococcus faecalisbiofilm." Acta OdontologicaScandinavica(2013): 1-5.
54. http://www.freepatentsonline.com/4261879.html

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

NANO REINFORCEMENT OF DENTURE BASE RESINS

* Smitha L Rajeev

Lecturer, Government Dental College, Trivandrum | Corresponding Author: drsmitharajeev@gmail.com

Abstract:

The era of nanotechnology has opened a new pathway in many fields including dentistry. Nanoparticles carry special properties such as chemical, optical, magnetic and electro-optical properties, unlike in the molecular form. The mechanical properties like toughness, stiffness, transparency, abrasion resistance, solvent and heat resistance and decreased gas permeability are some of the features exhibited by nanoparticles.These properties make it attractive to dentistry where materials with superior mechanical and viscoelastic properties are often required.Polymethyl methacrylate resins are one of the most widely used resins in dentistry. Addition of nanoparticles such assilver, titaniumdioxide zirconium oxide and ferric oxide, topolymethyl methacrylate has shown to increase its mechanical properties. Along with that these materials have antimicrobial action that makes it suitable for preventing denture stomatitis. This review aims to throw light on the various properties of nanoparticle reinforced denture base resins.

The era of nanotechnology has opened a new pathway in many fields including dentistry. Tremendous applications in medicine and dentistry has made this, one of the most researched fields in the millennium. The word nano is derived from the Greek word "νανος" which means dwarf .By definition one nanometer (10−9) or "one-billionth of a meter."[1] Nanotechnology is engineering at the molecular scale and it looks into molecular structure and properties of materials in a way science has never looked before. Nanotechnology is the science of manipulating materials on an atomic or molecular scale especially to build microscopic devices (such as robots).[2] Nanoparticles carry special properties such as chemical, optical, magnetic and electro-optical properties, unlike in the molecular form. The mechanical properties like toughness, stiffness, transparency, abrasion resistance, solvent and heat resistance and decreased gas permeability are some of the features exhibited by nanoparticles. These properties makes it attractive to dentistry where materials with superior mechanical and viscoelastic properties are often required. The various nanoparticles are nanopores, nanotubes, quantum dots, nanoshells, dendrimers, liposomes, nanorods, fullerenes, nanospheres, nanowires, nanobelts, nanorings, and nanocapsules.[3] The upsurge in research regarding the property of matter at this dimension, has led to the development of several modified and improved materials in medical and dental field thus making nanotechnology one of the most promising and influential areas of scientific research.

Polymethyl methacrylate resins are one of the most widely used resins in dentistry. It is primarily

used for making denture bases and functional appliances. One of the major post insertion complaints among complete denture patients is the occurance of denture stomatitis. More than 70% of complete denture wearers has seen to be affected with denture stomatitis. Candida albicans adhesion is the major causative factor in denture stomatitis. Incorporation of nanoparticles into the denture base materials in the form of silver and platinum nanoparticles is found to be an effective measure against this. Addition of metal nanoparticles such as silver, titanium dioxide and ferric oxide, to polymethyl methacrylate materials could increase the surface hydrophobicity and thereby reduce bimolecular adherence.[4]

Silver nanoparticles

Silver (Ag) has been used in medical field for a long period of time. It is a highly active compound possessing a broad spectrum antibacterial and antifungal properties. Nanosized (nm) inorganic particle form of silver, with its rapid and broad spectrum efficacy and its sustained silver cation (Ag+) release makes it a more effective means of prophylaxis than micro sized silver powder which shows lower antimicrobial activity owing to the limited surface.[3] The release of silverions plays the major role in the antibacterial mechanism of silver nanoparticles by rupturing the cell wall causing protein denaturation,blocking cell respiration, and finally causing microbial death.[5] Denture base resin containing silver colloidal nanoparticles was evaluated by Monteiro et al through morphological analysis to check the distribution and dispersion of the particles in the polymer and by testing the silver release in deionized water at different time periods. They found that incorporation of silver nanoparticles in the acrylic resin was evidenced but silver was not detected by the detection limit of the atomic absorption spectrophotometer used in this study even after 120 days of storage in deionized water and hence silver nanoparticles may be incorporated in the PMMA denture resin to attain an effective antimicrobial material to help control common infections involving oral mucosal tissues in complete dentures.[7] Some studies have shown that nano-silver incorporated poly methyl methacrylate resin exhibited anti-adhesion activity at a high concentration (5%) only.[8]

Improved viscoelastic and mechanical properties including surface hardness, flexural strength and impact strength of acrylic resin denture base material was found in several studies.[9,10] Flexural strength was shown to be adversely affected in the study conducted by Pinar cevik et al. The study evaluated flexural strength, surface hardness, surface roughness, and resilience of hydrophobic nanoparticle silica and prepolymer denture base acrylic resin. Both the silica and prepolymer incorporation into acrylic resin adversely affected the flexural strength of the acrylic resin compared to control group but the greater concentrations of the fillers resulted in increased mechanical properties of the acrylic resin.[10] Mahross et al investigated the effect of silver nanoparticles incorporation on viscoelastic properties of acrylic resin denture base material. They found that the silver nanoparticles incorporation within the acrylic denture base material can improve its viscoelastic properties.[11]

Research into thermal properties of nanoparticle modified polymethyl methacrylate has shown that mean thermal conductivity polymethyl methacrylate reinforced with nanosilver were significantly higher than the unmodified polymethyl methacrylate ($P<0.05$).[12] Al Noori et al evaluated thermal diffusivity of nano – sized additives (Al_2O_3, ZnO and Ag) with different concentrations (0.25% , 0.5 % , 1% and 2%) by Weight on flexible denture base material. Thermal diffusivity of flexible with nano-sized additives (Al_2O_3, ZnO and Ag) with different concentrations (0.5%, 1% and 2%) by weight showed a significant increase than the 0.25% additives and control groups. Minimum thermal diffusivity (0.0866 mm2/s) represented control, while maximum (0.1256 mm2/s) represented 2% Al_2O_3. They concluded that the nano-sized

additives to flexible denture base material were effective for enhancement of thermal diffusivity of flexible denture base material.[13]

Kurt A. et al evaluated the antifungal activity and cytotoxicity of denture base material containing silver microparticles. The polymethyl methacrylate (PMMA) denture base material with silver microparticles added to the polymer powder in different concentrations by volume (0%, 0.25%, 0.5%, and 1%). The antifungal effect against C. albicans increased with the percentage of silver microparticles ($P < 0.05$). It was seen that polymethyl methacrylate denture base material containing silver microparticles have antifungal activity and no cytotoxic effect.[14]

Various researches so far conducted in this field has shown us that incorporating nano silver particles into denture base resins may lead to prevention of biofilm formation and thereby decreasing occurance of denture stomatitis. It is shown to have enhanced thermal diffusivity and mechanical properties. They have shown superior mechanical and visco elastic properties than unmodified poly methyl methacrylate .

Titanium di oxide(TiO_2)and Ferric Oxide (Fe_2O_3) nanoparticles

The potential for plaque accumulation in removable prosthesis can lead to increased cariogenic bacterial activity as well as increased colonisation of candida albicans. Antimicrobial action of titanium dioxide especially against candida albicans and staphylococcus aureus have been proved by recent studies. The Titanium di oxide has impressive features like low toxicity, high refractive index, antibacterial effect, corrosion resistant and high microhardness. It is also economical. Nanoscale Titanium di oxide reinforcement agents bring new optical, electrical, physiochemical properties attained at very low Titanium di oxide content. Titanium di oxide nanoparticles has antimicrobial properties as well. Song et al in their study on the effects of nano□titanium dioxide and nano□silicon dioxide particles on the mechanical and antimicrobial properties of denture base resin. They found that addition of nano□titanium dioxide particles could improve the antimicrobial property of denture base resin, and that it could improve the tensile strength and frictional resistance of denture base resin. Mixture of the two nano□particles, at a certain ratio, could improve the tensile strength, frictional resistance and antimicrobial property of denture base resin to a certain extent.[15]

Chatterjee et al in his study explained that nanofiller infusion improves the thermal, mechanical, and UV absorption properties of poly methyl methacrylate acrylic resins.[14] Sodagar et al studied the effects of titanium dioxide and Silicon di oxide nanoparticles on flexural strength (Fs) of poly methyl methacrylate acrylic resins and found that incorporation of titanium dioxide and silicon di oxide nanoparticles into acrylic resins can adversely affect the flexural strength of the final products, and this effect is directly correlated with the concentration of nanoparticle.[16] Shirkavand et al evaluated the tensile strength of heat-curing acrylic resin reinforced by TiO_2 nanoparticles added into the resin matrix and found that a considerable increase in tensile strength occurred with titanium NPs reinforcement agents in 1wt% by weight. Hua et al examined mechanical behaviour of TiO_2 nanoparticle-reinforced resin-based dental composites and found that nanocomposites needed much lower volume fraction of reinforcing media.[17]

The addition of metal nanoparticles to organic materials is known to increase the surface hydrophobicity and to reduce adherence to biomolecules. Most commonly used metal nanoparticles are titanium dioxide and ferric dioxide. Potential of metal oxide nanoparticles for the improvement of resin-based dental materials

has been pointed out by many researchers. An improvement in mechanical properties is also seen in some studies.[18-20]

Zirconium oxidenano particles

Zirconium oxide nano-particles are highly biocompatible, with high fracture resistance and hence was selected to improve the properties of poly methyl methacrylate. Research is going on regarding the physical mechanical and optical properties of this material. Gad et al suggested that incorporation of Zirconium oxidenano particles increased tensile strength but negatively affected the optical properties[21]. Zhang et al studied hybrid effects of Zirconium oxide nanoparticles (nano-ZrO_2) and aluminum borate whiskers (ABWs) and found that the flexural strength and surface hardness was improved.[22] Ashour and Ebrahim showed that the best mechanical properties like increased the flexural strength, fracture toughness and hardness were achieved by adding 7%wt Zirconium oxide concentration[23,24]. Another study by Sahirand Ergun pointed out that adding Zirconium oxide adversely affected the transverse strength of polymethyl methacrylate resins.[25]

Nano-gold, Platinum, Palladium

Researchers have explored the use of noble metals like Nano-gold and platinum nanoparticles to improve the properties of polymethyl methacrylate denture base. The studies on the effect of incorporating nano-gold to polymethyl methacrylate are ongoingat present time. Several studies by Morsyhas shown that incorporating Nano-gold improved the flexural strength and thermal conductivity to almost double than that of pure polymethyl methacrylate.[26] Platinum nanoparticles increases the mechanical properties of polymethyl methacrylate and provide antimicrobial effect.[27] Palladium nanoparticle added to polymethyl methacrylate showed a better bending strength than silver and gold. Addition of gold and palladium nanoparticles improved Vickers hardness of polymethyl methacrylate.[28]

Nano-carbon

Addition of 1% of carbon nanotubes to polymethyl methacrylate resulted in high impact strength and flexural strength of polymethyl methacrylate.[29] 1.5% of single-walled carbon nanotubes added to polymethyl methacrylate increased the impact and transverse strength. [30] Addition of 0.5% and 1% of multiple-wall carbon nanotubes has also shown to improve the flexural strength and resilience of polymethyl methacrylate[31]. On the other hand carbonnanotubes are shown to decrease the surface hardness and one walled carbon tubes has insignificant effect on mechanical properties.[32]

Nano diamond is yet another material considered for enhancement of properties of polymethyl methacrylate denture base resins. Addition of 1% nanodiamond to room temperature curing polymethyl methacrylate resins has shown to increase its compressive and tensile strength.[33]

Cytotoxicity

Toxic effects of nanoparticles have been always been a negative factor that has led people to question its usefulness in dentistry. Research have shown that nanoparticles have cytotoxic effects. Apoptotic and micronuclei inductive impact of titanium dioxide nanoparticle has been studied by Park et al.[34] Several studies have pointed out DNA damage caused by zirconium dioxide.[35,36] Certain others like Kurt has shown that silver nanoparticles have less or no significant cytotoxicity[14]. It is an area of interest in which serious research is being done by scientists around the world.

Summary

Acrylic dental prosthesis has been an economical treatment option for edentulous patients. The major disadvantages of denture base resin is its susceptibility to fracture or deformation due to

its inferior mechanical and physical properties. Addition of reinforcing materials such as fibres, fillers and hybrid reinforcement has been used to enhance the mechanical properties. Nanoparticles is the latest invention in this arena. Use of silver nanoparticles, titanium dioxide nanoparticles and ferric oxide nanoparticles has shown considerable antimicrobial activity. This can be a boon to complete denture wearers who are prone to denture stomatitis. Studies show a definitive increase in fracture toughness, impact strength and flexural strength in silver, titanium dioxide, ferricoxide, zirconium dioxide, and noble metal nanoparticle reinforced polymethyl methacrylate denture base resins. Increase in viscoelastic properties is shown by nanocarbon reinforced denture base resins. Even though a marked improvement in physical mechanical and viscoelastic properties are exhibited by nanocarbon reinforced denture base resins, cytotoxicity still remains as a major factor of concern. Further comprehensive research regarding safe administration of nanoparticles is mandatory before introducing these materials clinically.

Reference

1. Shilpa S. Sasalawad, Sathyajith N. Naik, K. K. Shashibhushan, P. Poornima, Shivayogi M. Hugar, N. M. Roshan, "Nanodentistry: The next big thing is small," Int J Contemp Dent Med Rev, vol. 2014, Article ID 101114, 2014. doi: 10.15713/ins.ijcdmr.12
2. www.merriam-webster.com/dictionary/nanotechnology.
3. Freitas RA. Nanomedicine. Basic Capabilities. Vol. 1. Georgetown, TX: LandesBiosci; 1999. p. 345-7
4. Acosta-Torres LS, Mendieta I, Nuñez-Anita RE, Cajero-Juárez M, and Castaño VM. Cytocompatible antifungal acrylic resin containing silver nanoparticles for dentures," Int Nanomedicine 2012; 7:4777-86; http://dx.doi.org/10.2147/IJN.S32391
6. Damm C, M¨unstedt H. Kinetic aspects of the silver ion release from antimicrobial polyamide/silver nanocomposites. Appl Phys A 2008;91:479-86.
7. Monteiro DR, Gorup LF, Takamiya AS, de Camargo ER, Filho AC, and Barbosa DB. Silver distribution and release from an antimicrobial denture base resin containing silver colloidal nanoparticles. J Prosthodont 2012; 21 (1): 7–15; http://dx.doi.or/10.1111/j.1532-849X.2011.00772.x
8. Li Z, Sun J, Lan J, Qi Q. Effect of a denture base acrylic resin containing silver nanoparticles on Candida albicans adhesion and biofilm formation. Gerodontology 2014;
9. Hua Y, Gu L, Watanabe H. Micromechanical analysis of nanoparticle-reinforced dental composites. International Journal of Engineering Science 2013; 69: 69–76;http://dx.doi.org/10.1016/j.ijengsci.2013.04.001
10. Cevik P1, Yildirim-Bicer AZ . The Effect of Silica and Prepolymer Nanoparticles on the Mechanical Properties of Denture Base Acrylic Resin .J Prosthodont. 2016 Nov 29. doi: 10.1111/jopr.12573.
11. Mahross, Hamada &Baroudi, Kusai. (2015). Effect of silver nanoparticles incorporation on viscoelastic properties of acrylic resin denture base material. European journal of dentistry. Vol 9. Page : 207-212. 10.4103/1305-7456.156821.
12. Hamedi-Rad F, Ghaffari T, Rezaii F, Ramazani A. Effect of Nanosilver on Thermal and Mechanical Properties of Acrylic Base Complete Dentures. Journal of Dentistry (Tehran, Iran). 2014;11(5):495-505.
13. Ammar Khalid Al- Noori ,Nadira A. Hatim , Dr. Amer A. Taqa. Thermal Diffusivity of Nano-Sized Additives on Flexible Denture Base Material. International Journal of Enhanced Research in Science Technology & Engineering. Vol. 4 Issue 4, April-2015, pp: (210-217). ISSN: 2319-7463
14. Kurt A, Erkose-Genc G, Uzun M, Emrence Z, Ustek D, Isik-Ozkol G. The antifungal activity and cytotoxicity of silver containing denture base material. Niger J Clin Pract2017;20:290-5
15. Rong Song, Xiaohui Jiao, Long Lin, (2011) "Improvement of mechanical and antimicrobial properties of denture base resin by nano□titanium dioxide and nano□silicon dioxide particles", Pigment & Resin Technology, Vol. 40 Issue: 6, pp.393-398, https://doi.org/10.1108/03699421111180545Rong Song, Xiaohui Jiao, Long Lin, (2011) "Improvement of mechanical and antimicrobial properties of denture base resin by nano□titanium dioxide and nano□silicon dioxide particles", Pigment & Resin Technology, Vol. 40 Issue: 6, pp.393-398, https://doi.org/10.1108/03699421111180545
16. Chatterjee, A. (2010) Properties Improvement of PMMA Using Nano TiO2. Journal of Applied Polymer Science, 18, 2890-2897. http://dx.doi.org/10.1002/app.32567
17. Y. Hua, L. Gu, and H. Watanabe, "Micromechanical analysis of nanoparticle-reinforced dental composites," International Journal of Engineering Science, vol. 69, pp. 69–76, 2013.

    Sodagar, A., Bahador, A., Khalil, S., Shahroudi, A.S. and Kassaee, M.Z. (2013) The Effect of TiO2 and SiO2 Nanoparticles on Flexural Strength of Poly(methyl methacrylate) Acrylic Resins. Journal of Prosthodontic Research, 57, 15-19. http://dx.doi.org/10.1016/j.

jpor.2012.05.001

18. L. S. Acosta-Torres, M. C. Arenas, R. E. Nuñez-Anita, et al., "Nanopigmented Acrylic Resin Cured Indistinctively by Water Bath or Microwave Energy for Dentures," Journal of Nanomaterials, vol. 2014, Article ID 198572, 8 pages, 2014. https://doi.org/10.1155/2014/198572.
19. Laura S. Acosta-Torres,1 Luz M. Lopez-Mar ´ ın, ´ 1 R. Elvira Nu´nez-Anita, ˜ 2 Genoveva Hernandez-Padr ´ on, ´ 1 and Victor M. Castano˜ 1.Biocompatible Metal-Oxide Nanoparticles: NanotechnologyImprovement of Conventional Prosthetic Acrylic Resins.Journal of NanomaterialsVolume 2011, Article ID 941561, 8 pagesdoi:10.1155/2011/941561
20. Nadagouda, Mallikarjuna&Abbaraju, Venkataraman &Aminabhavi, Tejraj. (2004). A study on ?Fe2O3 loaded poly(methyl methacrylate) nanocomposites. Journal of Applied Polymer Science - J APPL POLYM SCI. 94. 2551-2554. 10.1002/app.21144.
21. Gad MM, Abualsaud R, Rahoma A, Al-Thobity AM, Al-Abidi KS, Akhtar S. Effect of zirconium oxide nanoparticles addition on the optical and tensile properties of polymethyl methacrylate denture base material. International Journal of Nanomedicine. 2018;13:283-292. doi:10.2147/IJN.S152571.
22. Zhang, Xiu-Yin & Zhang, Xin-Jing & Huang, Zhuo-Li & Zhu, Bangshang& Chen, Rong-Rong. (2014). Hybrid effects of zirconia nanoparticles with aluminum borate whiskers on mechanical properties of denture base resin PMMA. Dental materials journal. 33. 141-6. 10.4012/dmj.2013-054.
23. Ahmed MA, Ebrahim MI. Effect of zirconium oxide nano-fillers addition on the flexural strength fracture toughness, and hardness of heat-polymerized acrylic resin. World J Nano Sci Eng. 2014;4:50–57.
24. Ashour, Mohamed & I. Ebrahim, Mohamed. (2014). Effect of Zirconium Oxide Nano-Fillers Addition on the Flexural Strength, Fracture Toughness, and Hardness of Heat-Polymerized Acrylic Resin. World Journal of Nano Science and Engineering. 04. 50-57. 10.4236/wjnse.2014.42008.
25. Zeynep SAHIN and Gulfem ERGUN (2017). The Assessment of Some Physical and Mechanical Properties of PMMA Added Different Forms of Nano-ZrO2. Journal of Dental and Oral Health. ISSN: 2369-4475
26. Morsy MA, Al-Daous MA. Mechanical properties evaluation of new AuNP-PMMA Composite. Int Rev Chem Eng. 2013;5:65–70.
27. Nam KY. Characterization and bacterial anti-adherent effect on modified PMMA denture acrylic resin containing platinum nanoparticles. J Adv Prosthodont. 2014;6(3):207–214.
28. Aoyagi Y, Miyasaka T, Ando N. Application of noble metal cluster to PMMA resin and influence on mechanical properties and color. Dent Mater J. 2015;34(6):781–788.
29. Mahmood WS. The effect of incorporating carbon nanotubes on impact, transverse strength, hardness, and roughness to high impact denture base material. J Bagh Coll Dent. 2015;27:96–99.
30. Ibrahim RA. The effect of adding single walled carbon nanotube with different concentrations on mechanical properties of heat-cure acrylic denture base material. J Bagh Coll Dent. 2015;27:28–32.
31. Wang R, Tao J, Yu B, Dai L. Characterization of multiwalled carbon nanotube-polymethyl-methacrylate composite resins as denture base materials. J Prosthet Dent. 2014;111:318–326.
32. Qasim SB, Al Kheraif A, Ramakrishaniah R. An investigation into the impact and flexural strength of light cure denture resin reinforced with carbon nanotubes. World Appl Sci J. 2012;18:808–812.
33. Perchyonok VT, Souza J, Zhang S, Moodley D, Grobler S (2015) Bio-Active Nano-Diamond Designer Materials and Dentures: From Design to Application. Dentistry 5:344. doi:10.4172/2161-1122.1000344
34. Park.E-J, Chung K-H.Oxidative stress and apoptosis ninduced by titanium dioxidenanoparticle in cultured BEAS-2B cell.Toxicol Lett.2008;180(3):222-9.
35. Chen M ,vonMikeczA.Formation of nucleioplasmic protein aggregate impairs nulear function in response to SiO2 nanoparticles. Chem Soc Rev.2005 ;305 (1) 51-62.
36. Kim I-S,BaekM,Choi-S-J.Comparative cytotoxicity of Al2O3,TiO2 and ZnO nanoparticles on human lung cells.JNanosci Nanotechnol.2010;10(5);3453-8.

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

SYSTEMATIC REVIEW OF GINGIVAL RETRACTION IN FIXED PARTIAL DENTURE

*Jeevitha Mani, **Venkatesan N., ***Karthik V.C., *Vidhu Antony

*P.G. Student, **Professor & HOD, ***Senior Lecturer, Department of Prosthodontics, Adhiparasakthi Dental College & Hospital, Tamilnadu-603319. Corresponding Author: jeevithamanib4u@gmail.com

Abstract:

Aim : *To evaluate the effective gingival retraction technique in fixed partial denture*

Materials and methods: *The MEDLINE-PubMed database was searched from 1980 to 2010 year previously. Several journals were hand searched and from cross reference and were systematically analysed.*

Result: *The search ultimately yielded 13 articles meeting the eligibility criteria were selected. They were systematically analysed and it was found that braided and knitted gingival retraction cords with medicament was found clinically effective than others.*

Conclusion: *Based on the available data in the current existing studies,Braided and knitted gingival retraction cords with medicament were found to be clinically effective when compared with others*

Key words:
gingival retraction, gingival displacement

Introduction:

The relationship of fixed partial denture and the surrounding hard and soft tissue should be considered crucial for its long term success. Marginal adaptation and periodontal integrity of the tooth depends on the close adaptation of the restoration to the finish line of the preparation. This requires a proper impression in which the finish lines are exposed. Various methods of tissue management such as mechanical, mechanico-chemical, electro surgery, rotary gingival curettage (gingitage), lasers etc., have been described in literature[1,2] .

Various tissue reactions can occur due to either physical trauma or chemical trauma which might lead to injury to the underlying structure such as Circum-gingival fibres and such. This might lead to gingival recession in some cases. They usually heal around 1 to 2 weeks clinically and histologically. However the injury produced may be reversible and self-limited or irreversible. Therefore effectively managing the gingiva prior to making an impression is an important step in process of fixed partial denture.

Need for the study:

The primary object of this study was to evaluate the ability of different types of retraction techniques and materials by their ease of use, fraying of cords, hemostasis, widening of sulcus, bleeding on removal, dry sulcus, etc.,

The secondary object was to evaluate their influence on gingival and periodontal health, which was assessed using plaque index, gingival index, periodontal index, bleeding on probing

and pocket depth.

Materials and methods:

The following analysis was performed according to the guidelines and the principles of the PRISMA statement for a systematic review.

Focused question:

The review is focused on: "What is the efficiency of various retraction methods and their effect on gingival health during impression in fixed partial denture?"

Search strategy:

The MEDLINE–PubMed database was searched from September 1980 to 2010 years previously.

The following search terms were used as shown in Fig. 1.

Study inclusion criteria:

The studies were analyzed according to the following inclusion criteria:

1. All studies on gingival retraction were included.

2. The following retraction techniques were considered:

   a. Mechanical

   b. Mechanicochemical

   c. Electrosurgery

   d. Laser

3. Articles related to gingival retraction and their effect on gingivawere considered for inclusion

4.Only studies in the English language were included

5. Only human studies were included.

Study exclusion criteria:

The studies with following criteria were not included in the review:

1. Case reports regarding patients with any syndrome or major systemic disease

2. Studies not related to gingival health

3. Studies not related to dentistry

4. Studies with insufficient information

5. Animal studies.

6. Other than English

Data extraction:

All studies which met the inclusion and exclusion criteria for review were obtained and screened independently.

The following data were extracted from the studies included for review:

Publication, study design, number of abutment teeth, type of gingival retraction, observation and inference. The observation includes the ease of use, fraying of cords, hemostasis, widening of sulcus, bleeding on removal, dry sulcus, periodontal index, gingival index, plaque index, bleeding on probing and probing depth.

Discussion:

There are various methods by which a gingiva can be retracted effectively during impression making in fixed partial denture. There are mainly three methods by which gingiva can be retracted namely, Mechanical Methods (Retraction cord either twisted, braided, knitted etc.), Chemicomechanical method (Retraction cord with medicaments, Magic foam, Expasyl retaction system, Aquasil ultracordless tissue retraction system), Surgical method (Rotarty curettage - gingettage) and Others (Electro surgery, LASER gingival retraction methods)

Reference	Study design	sample size	Observation																					
				Ease of use	Fraying of cord	Hemostasis	Widening of sulcus	Bleeding at removal	Dry sulcus	Periodontal index		Gingival index		Plaque index			Probing depth							
										before	after 1 day	before	after 1 day	before	after 1 day	difference	before	after 1 day					
Al Hamad KQ et al																								
	com-parision study	60 abdutments	poly vinyl siloxane (magic foam)									84.83	102.54	90.63	86.93		90.98	92.02						
			paste like material (expasyl)									71	112.15	90.5	89.05		85.81	95.84						
			conventional cord(Ultrapak)									82.67	101.27	89.9	88.77		97.29	91.08						
Asbjorn Jokstad et al	RCT	50 abutments	knitted aluminum sulphate	14	14	9	9	9	9															
			knitted epinephrine	13	15	12	12	12	12															
			twined epinephrine	5	3	3	3	3	3															
Beier US et al	case series	269 abutments	magic foam cord				93.70%																	
Cui Huang et al	systematic review																							
Dennis J Weir et al	comparison study	120 abutments	non medicated cord dry					0																
			non medicated water					0																
			non medicated hemodent					10																
			R-epinephrine cord dry					1																
			R-epinephrine cord water					0																

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

			R-epinephrine cord hemodent					18										
			aluminum sulrfate cord dry					1										
			aluminum sulrfate water					0										
			aluminum sulrfate cord hemodent					16										
GS Renuka Prasanna et al	RCT	16 abutments	retraction cord(knitted impregnated)				0.21											
			displacement paste(expasyl paste)				0.26											
Jen Chang Yang et al	comparison study	24 abutments	epinephrine impression cord(Ultrapak)				0.28											
			15% AlCl3-injection type(expasyl)				0.29											
			0 % AlCl3-injection type(Korlex-GR)				0.25											
Ovul Kumbuloglu et al	comparison study	402 abutments	Ultrax epinephrine HCL thin braided	22	0		23	2										
			sulpak epinephrine HCL thin wound	19	3		20	4										
			ultrax epinephrine HCL large braided potassium aluminum	6	2		7	6										
			ultrax epinephrine large braided	6	3		6	6										

			ultrax epinephrine medium braided	22	0		25	2										
			sulpak epinephrine medium wound	19	3		23	4										
			sulpak potassium aluminum large wound	2	5		6	6										
			racestyptine aluminum chloride faden G	2	4		2	6										
			racestyptine aluminum chloride faden F	13	6		20	6										
			surgident epinephrine HCLsaturated faden 3	23	2		24	4										
			surgident epinephrine HCL saturated faden 4	6	4		6	6										
			gingibraid 2n	23	0		25	0										
			stay put 2	25	0		26	0										
			epipak aluminum chloride rings	4	23		2	22										
			traco aluminum chloride	22	3		5	20										
			ultrapak ferric sulfate 1	26	0		24	2										
Ozlem Acar et al	comparison study	252 abutments	non impregnated cord	82.5			71.4	85.7										

		AlCl3 impregnated displacement cord	74.6			85.7	28.6											1	1
		15% AlCl3 topical gingival displacement paste with displacement cap	95.2			84.1	4.8											1	1
		AlCl3 impregnated displacement cord + 15% AlCl3 topical gingival diaplacement paste + displacement cap	41.3			100	12.7			0.15	0.09	0.9	0.53			0	0	0	0
Jain Feng et al		braided cords		60 abutments															
Ankit Gupta et al	comparitive study	copper wire reinforced retraction cord(stay put)		60 abutments		0.233 mm	48.75												
		aluminum chloride retration paste(expasyl)				0.151 mm	14.63												
		expanding type of polyvinyl siloxane(magic foam cord)				0.199 mm	28.13												
H.R Sarmento et al	RCT	cordless (expasyl)		24 abutments												0	0	0	0
		conventional (ultra pak cord + viscostat clear)																	

For a retraction to be effective they should meet the fundamental requirements during gingival retraction, which mainly includes the effective gingival retraction to facilitate the flow of impression material, to control bleeding and to do no harm to gingival tissues.

This review has systematically analyzed the studies under following sub-headings viz. 1. Ease of use of retraction cords[3,4,5,] 2. Fraying of retraction cords[3,4], 3. Hemostasis[3], 4. Widening of sulcus[3,4,5,6,7,8,9], 5.Bleeding at removal[3,4,5,9,10,] 6. Dry sulcus[3] and Gingival health is assessed with, 7.Periodontal index[11], 8. Gingival index[11,12,13], 9. Plaque index[12,13,] 10.Probing depth[12,13].

Results:

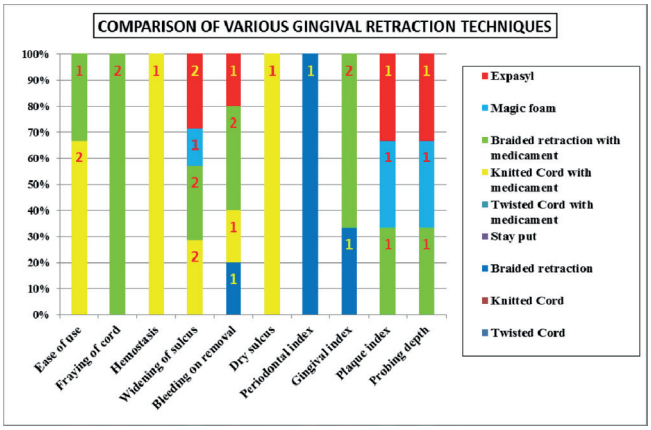
After analyzing the article related to gingival retraction, it was found that,

1. Ease of use: Of the 3 study on ease of use, 2 study with Knitted retraction cord with medicaments was found to be easy to use.

2. Fraying of cords: of the 2 study on fraying of cord, it was found that braided cords with medicament was better to resist fraying of cords

3. Hemostasis: a study conducted on hemostasis, it was found that knitted retraction cord with medicament controlled hemostasis.

4. Widening of Sulcus: of the 7 study on widening of sulcus,it was found that braided and knitted retraction cords produced better widening of sulcus.



5. Bleeding on Removal: of the 5 study on bleeding on removal braided retraction cord with medicament was found to produce less bleeding on removal

6. Dry Sulcus : a study on dry sulcus found that knitted retraction cords with medicament was better

7. Periodontal effects: a study on periodontal index and retraction cord found that braided retraction cords produced less periodontal effects

8. Ginigival health: of the 3 study done with gingival index and retraction cord,it was found that braided cords and expasyl produced less gingival effects

9. Plaque control: of the 2 study done for plaque assessment ,it was found that braided retraction cords and expasyl produced better plaque control.

10. Probing depth: of the 2 study on probing depth it was found that braided and expasyl retraction cord produced the less postoperative probing depth

Conclusion:

To conclude, the kintted retraction cord with medicament is found to be better in ease of use, widening of gingival sulcus, producing hemostasis, dry sulcus, and found to produce less periodontal affects. On the other hand braided withdrawal cord with medicaments is found to be better resistance to fray, less bleeding on removal, and less adverse effect on gingival, better plaque control and reduced post operative probing depth. Both the materials (knitted and braided retraction cord with medicament)was found to produce satisfactory level of widening of sulcus.

The newer material like expasyl, magic foam, etc., seems to be versatile, but there is no enough research using these newer products. Hence a lot more research has to be undertaken comparing

the newer materials and the newer materials with the older marteials .

References:

1. Safari S, Ma VS, Mi VS, Hoseini Ghavam F, Hamedi M. Gingival Retraction Methods for Fabrication of Fixed Partial Denture: Literature Review. Journal of dental biomaterials. 2016 Jun;3(2):205.

2. Benson BW, Bomberg TJ, Hatch RA, Hoffman W. Tissue displacement methods in fixed prosthodontics. Journal of Prosthetic Dentistry. 1986 Feb 1;55(2):175-81.

3.Jokstad A. Clinical trial of gingival retraction cords. Journal of Prosthetic Dentistry. 1999 Mar 1;81(3):258-61.

4.Kumbuloglu O, USER A, Toksavul S, Boyacioglu H. Clinical evaluation of different gingival retraction cords. Quintessence International. 2007 Feb 1;38(2).

5.Acar Ö, Erkut S, Özçelik TB, Ozdemır E, Akçil M. A clinical comparison of cordless and conventional displacement systems regarding clinical performance and impression quality. Journal of Prosthetic Dentistry. 2014 May 1;111(5):388-94.

6.Beier US, Kranewitter R, Dumfahrt H. Quality of impressions after use of the Magic FoamCord gingival retraction system--a clinical study of 269 abutment teeth. International journal of prosthodontics. 2009 Mar 1;22(2).

7. Prasanna GR, Reddy K, Kumar RN, Shivaprakash S. Evaluation of efficacy of different gingival displacement materials on gingival sulcus width. The journal of contemporary dental practice. 2013 Mar 1;14(2):217.

8.Yang JC, Tsai CM, Chen MS, Wei JY, Lee SY, Lin CT. Clinical study of a newly developed injection-type gingival retraction material. Chinese Dental Journal. 2005 Sep 1;24(3):147.

9.Gupta A, Prithviraj DR, Gupta D, Shruti DP. Clinical evaluation of three new gingival retraction systems: A research report. The Journal of Indian Prosthodontic Society. 2013 Mar 1;13(1):36-42.

10. Weir DJ, Williams BH. Clinical effectiveness of mechanical-chemical tissue displacement methods. Journal of Prosthetic Dentistry. 1984 Mar 1;51(3):326-9.

11. Feng J, Aboyoussef H, Weiner S, Singh S, Jandinski J. The effect of gingival retraction procedures on periodontal indices and crevicular fluid cytokine levels: a pilot study. Journal of Prosthodontics. 2006 Mar 1;15(2):108-12.

12. Sarmento HR, Leite FR, Dantas RV, Ogliari FA, Demarco FF, Faot F. A double□blind randomised clinical trial of two techniques for gingival displacement. Journal of oral rehabilitation. 2014 Apr 1;41(4):306-13.

13.Al Hamad KQ, Azar WZ, Alwaeli HA, Said KN. A clinical study on the effects of cordless and conventional retraction techniques on the gingival and periodontal health. Journal of clinical periodontology. 2008 Dec 1;35(12):1053-8.