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CASE REPORT

A CASE REPORT ON NON-SURGICAL MANAGEMENT OF VERTICAL MAXILLARY EXCESS

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ABSTRACT

An aesthetic smile is produced by the interplay of three components namely lips, gingiva and teeth. The various etiological factors that can be attributed to gummy smile include vertical maxillary excess, altered passive eruption of antero superior teeth, upper dentoalveolar protrusion, extrusion and hyperactivity of upper lip levator muscles. This case report depicts the successful non-surgical orthodontic management of a 19 year old female patient diagnosed as Angle's Class I malocclusion with vertical maxillary excess, mild upper and lower anterior crowding with congenitally missing 33 and a mildly convex soft tissue profile.

Keywords: Gummy smile, non-surgical, orthodontic, TADs, vertical maxillary excess.

J Odontol Res 2021;9(2)5-10.

INTRODUCTION

An attractive aesthetic smile is produced by the optimal interaction and interplay of three components, namely lips, gingiva and teeth.[1] As per Kokich Jr et al during smile when the gingival exposure reaches 4mm, it is considered as unaesthetic smile by clinicians and common man.[2,3] But according to some other reports it is stated that 2 mm gingival exposure on smiling is considered as compromised by orthodontists.[3]

According to Garber and Salama, a smile can be classified into high, medium or low. When considerable amount of soft tissue is exhibited above upper teeth during smile, it is considered as gummy smile.[4]

The excessive display of gingiva could be attributed to the imbalance of three components: (1) bone, (2) lips, and (3) teeth.[5] The various etiological factors that can be attributed to gummy smile include vertical maxillary excess, altered passive eruption of anterosuperior teeth, upper dentoalveolar protrusion, extrusion and hyperactivity of upper lip levator muscles.[3]

The overgrowth of maxilla in a vertical direction constitutes a skeletal problem called vertical maxillary excess (VME).[5,6]

VME can be defined as a disproportional growth of the maxilla in the vertical direction, which could lead to a long face syndrome. Garber and Salama classified VME into 3 degrees:

(i) Degree 1: excessive gingival display of 2-4mm and it can be treated by orthodontic intrusion, crown lengthening, or botulinum toxin injection

(ii) Degree 2: excessive gingival display of 4-8mm and it can be treated by lip stabilization technique or orthognathic surgery

(iii) Degree 3: excessive gingival display of more than 8mm and can only be treated by orthognathic surgery[6].

The hyperplastic growth of maxillary skeletal base and gingival display below the lower border of upper lip.[3] Generally a short upper lip or hypermobile lip is caused by the action of elevator muscles that lift the lip to a higher position. Associated dental problems of gummy smile include incisal overeruption (anterior dentoalveolar extrusion), compensatory incisal eruption (incisal wear), and Altered Passive Eruption (APE).[1,5] In majority of the gummy smile cases it is a consequence of both APE and VME.[4]

Age and gender are associated with gummy smile. Literature reports increased smile height among women as compared to males. Also it is cited that the dentogingival exposure decreases with age.[3]

The patients with 'gummy' smile exibit poor oral health and general health related quality of life presenting with poor psychological status, reflected by low self-confidence.[5]

Treatment options include various surgical and non-surgical modalities. Orthognathic surgery, orthodontic corrections, lip repositioning or botulinum injection, aesthetic crown lengthening or a combination of these options are recommended depending upon the clinical scenario.[5]

The following case report depicts the successful non-surgical orthodontic management of gummy smile with vertical maxillary excess presented by a 19 year old female patient.

CASE REPORT

A19 year old female patient reported to the Department of Orthodontics with chief complaint of "gummy smile" noticed 6 years back.

The case was diagnosed as Angle's Class I malocclusion with vertical maxillary excess, mild upper and lower anterior crowding with congenitally missing 33 and a mild convex soft tissue profile. During a natural smile, the maxillary teeth visible were right second premolar to left second premolar. She had an anterior tooth display in excess of 10mm during smile and more than 6mm during speech. The pretreatment facial profiles, dental arches and occlusal relationships are depicted in figure 1 and 2.

Two treatment options were suggested to the patient :

1) Surgical management with Lefort I osteotomy to reduce vertical maxillary excess along with alignment of upper and lower anteriors.

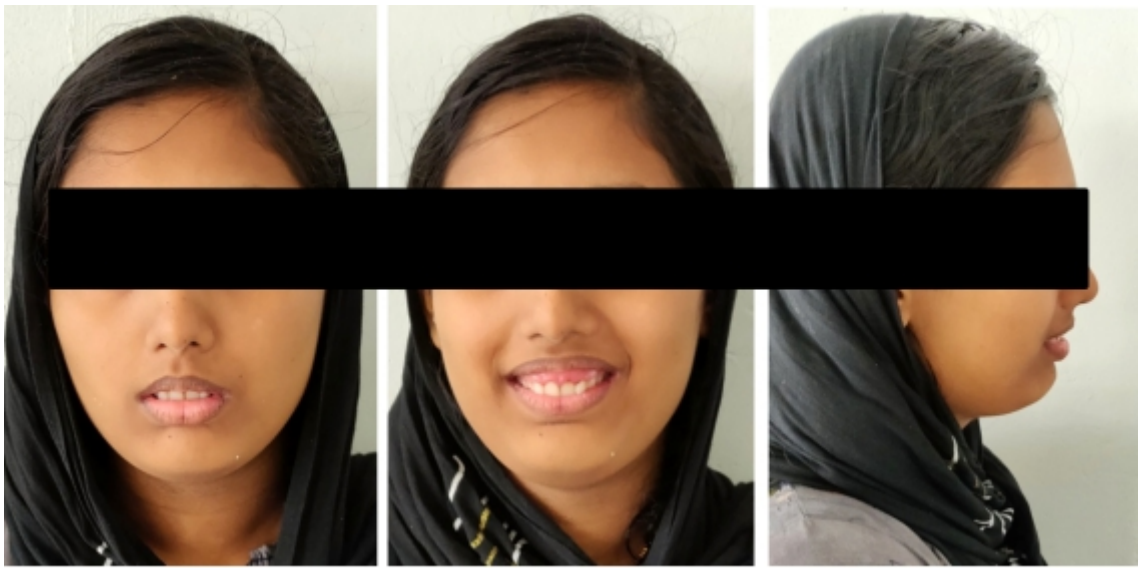

Fig 1: Pre- treatment facial profile

Fig 2: Pre- treatment photographs of dental arches and occlusal relation

2) Non surgical management with temporary anchorage devices (TADS-interradicular micro implants) for reducing the vertical maxillary excess by intrusion of maxillary anteriors.

The patient was more comfortable with the non-surgical option and chose the second modality of treatment. The treatment plan was well explained to the patient and a written consent was obtained.

After initial alignment and leveling, two micro implants (1.4* 8mm) were inserted between the roots of 12 & 13 and 22 & 23. Elastomeric chains were attached to archwire for maxillary anterior segment intrusion from the TADS.

The oral hygiene status of patient was poor even after repeated instructions leading to gingival enlargement and inflammation which hindered further intrusion. In this case, periodontal therapy was considered as a potential adjuvant in improvising the aesthetic appearance and adjustment of smile height. Here gingivectomy was suggested to increase the crown height and was performed by one of the faculties of Periodontics of the same institution.

Some amount of interproximal reduction was carried out in the upper arch as a part of treatment. The clinical and radiographic images during the treatment phases are depicted in figure 3.

A 24 month active orthodontic treatment yielded acceptable aesthetic appearance with reduction of excessive gingival exposure. Figure 4 and 5 gives the post treatment facial profiles and occlusal relation. Pre-operative and post- operative smile height comparisons are given in figure 6.

DISCUSSION

Here the female patient presented with gummy smile was diagnosed with Angle's Class I malocclusion with vertical maxillary excess.

In this case, as the patient was 19 years old and visibility was well in excess of 9mm during smile, the

Fig 3: Clinical and radiographic images of treatment phases

option of growth modification was out of question. Also the patient was not willing for surgical correction, the chosen option was non-surgical correction using TADs.

The treatment plan was to intrude the maxillary incisors, followed by upward movement of the gingival line to correct the gummy smile. The entire maxillary anteriors were planned to intrude as a treatment modality for deep bite presented by the patient. The literature reports that effective maxillary incisors intrusion was achievable with minimum side effects and patient co-operation using TADs as a means of stationary anchorage.[7] Clinical crown lengthening is defined as a surgical procedure that aims to expose sound tooth structure for restorative purposes via apical repositioning of the gingival tissue with or without removal of alveolar bone.[8] This periodontal surgery was planned as an adjunct to orthodontic treatment in order to solve the issue of short clinical crowns. But on radio-

Fig 4: Post treatment facial profile

Fig 5: Post- treatment photographs of dental arches and occlusal relation

Fig 6: Comparison of smile height: pre treatment and post treatment phases

graphic examination insufficient height of alveolar bone was noted, hence the treatment plan of crown lengthening was dropped, only gingivectomy was performed. The interproximal reduction was done to compensate for the increased overjet created due to discrepancy in tooth material in upper and lower arches. The results of this non-surgical correction was found to be appreciable and satisfactory.

CONCLUSION

In this case, the patient with Angles Class I malocclusion with vertical maxillary excess, treatment was successfully delivered by non-surgical orthodontic treatment method by intrusion of maxillary anteriors maximizing skeletal treatment effects. Elastomeric chains were attached to arch wire for

maxillary anterior segment intrusion from the TADS. Some amount of interproximal reduction was done to compensate for the increased overjet created due to discrepancy in tooth material in upper and lower arches. Gingivectomy was performed as a potential adjuvant in rendering improved aesthetic appearance, increased crown height and adjusted smile height.

REFERENCES

1. Garber DA, Salama MA. The aesthetic smile: diagnosis and treatment. Periodontology 2000. 1996 Jun;11(1):18-28.
2. Kokich VO Jr, Kiyak HA, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. J Esthet Dent. 1999;11(6):311-24.
3. Seixas MR, Costa-Pinto RA, Araújo TM. Checklist of aesthetic features to consider in diagnosing and treating excessive gingival display (gummy smile). Dental Press Journal of Orthodontics. 2011 Apr;16(2):131-57.
4. Hegde MN, Hegde N, Bhat R (2014) Gummy Smile Correction: Case Report. J Laser Opt Photonics 1: 103.
5. Hung YJ, Lin IP, Wang SH, Lai EH. A stepwise approach to the correction of excessive gingival display: an integrative review of the literature. Australasian Orthodontic Journal. 2020 Nov;36(2):184-94.
6. Saad D, Moukarzel C, Haddad NE, Rizk A. A Suggested Approach of Managing Excessive Maxillary Gingival Display in Terminal Dentition. Case Reports in Dentistry. 2020 Nov 19;2020.1-11
7. Alaty MM. Temporary anchorage devices and gummy smile. The Libyan Dental Journal. 2015 Aug 1;1-5.
8. Liaw JJ. Application of TADs in an Adult Gummy Smile Case with Vertical Maxillary Excess. Temporary Anchorage Devices in Clinical Orthodontics. 2020 Apr 6:647-60.

CASE REPORT

MANAGEMENT OF DENTIGEROUS CYST BY CONSERVATIVE SURGICAL APPROACH: A CASE REPORT

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ABSTRACT

Dentigerous cysts are commonly occurring cysts associated with an impacted tooth. It is usually formed by the fluid accumulation between the reduced enamel epithelium and the enamel surface of a developed tooth. This case report depicts the successful dental management of a 37 year old male patient who presented with dentigerous cyst associated with an impacted maxillary lateral incisor.

Keywords: dentigerous cyst, endodontics, enucleation, impacted

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INTRODUCTION

The most prevalent odontogenic cyst that accounts for almost 24% of all true cysts in the jaws is dentigerouscyst.[1] It is also called follicular cyst. This is caused by the accumulation of fluid between the reduced enamel epithelium and the enamel surface of a developed tooth and it originates by separation of the follicle from around the crown of an unerupted tooth.[2]

The rapid transudation of serum across the capillary walls results in increased hydrostatic pressure of the pooling fluid, resulting in the separation of follicle from the crown with or without reduced enamel epithelium. In case of a deciduous tooth, an intrafollicular spread of periapical inflammation can also end up in the development of dentigerous cyst.[3] It is more common among second to fourth decade of life.[2]

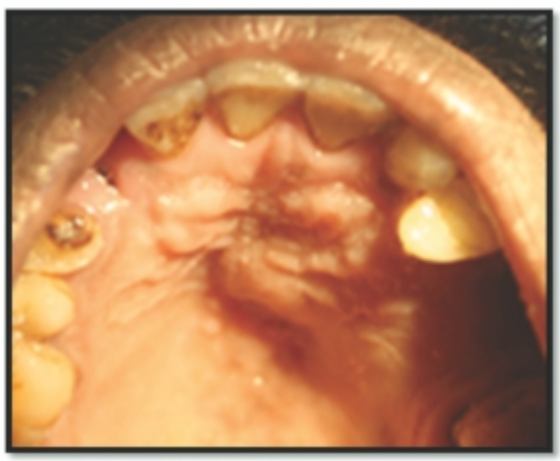

Fig 1: Intra oral image of palatal swelling

Fig 2: Clinically missing 22

In this case report, the management of dentigerous cyst associated with an impacted maxillary lateral incisor and endodontic management of associated teeth is described.

CASE REPORT

A 37year-old male patient reported to the Department of Conservative Dentistry, PMS Dental College Trivandrum, with chief complaint of a mild swelling in the upper left palatal region and altered taste sensation since one year. The patient also noticed the discolouration of teeth close to the swelling. He did not give any history of trauma or pain. There was no relevant medical history. Patient noticed the changes when he was working abroad and was unable to utilise the dental care due to work related issues.

The intraoral examination revealed a diffuse tender swelling extending from 11 to 24, crossing the midline with no mobility of involved teeth. Also it was noted that 22 was clinically missing. Figures 1 and 2 give the clinical picture of the case. Surface pus discharge was seen from gingival sulcus of 23 and 24. Electrical pulp testing revealed that 23 and 24 were non vital, whereas rest of the adjacent teeth were asymptomatic and normally responded to electric pulp testing. The images of bite wing radiograph and OPG are given in figures 3 and 4. Based on the history, clinical and radiographic evaluation, it was provisionally diagnosed as dentigerous cyst. Treatment plan was formulated to be carried out in three stages.

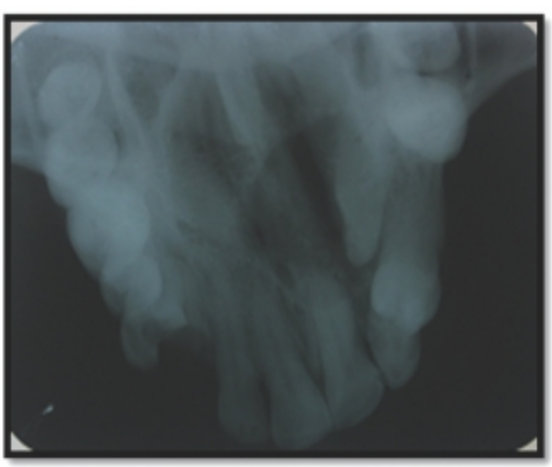

Fig 3: Bitewing radiograph showing lesion and impacted tooth

Fig 4: OPG showing lesion and impacted tooth

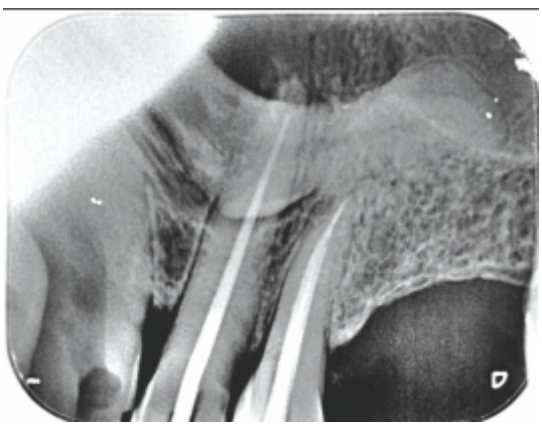

Fig 5:
Post endodontic treatment image of 23,24

1. Root canal treatment of the non- vital teeth - 23 and 24 .
2. Surgical removal of impacted 22 and enucleation of the associated cyst.
3. Apicectomy and retrograde filling of 23 and 24.

After explaining the treatment plan to the patient, informed consent was obtained prior to the start of the procedures. Access opening was done in 23 and 24 in the initial appointment. Calcium hydroxide intra canal medicament was given after estimating working length and biomechanical preparation. Then, in the subsequent visits, root canal treatment was completed.

Surgical removal of impacted tooth and enucleation as well as apicectomy and retrograde filling was planned after one week of obturation. Surgical extraction of tooth was assisted by the faculty from the Department of Oral and Maxillofacial Surgery. Local anesthesia was administered followed by the elevation of full thickness crevicular flap extending from 11 to 24 to obtain good access to the impacted lateral incisor. The bone overlying the impacted tooth was removed using a bone drill and after warranting adequate visibility of the tooth, it was extracted using forceps ensuring maximum preservation of alveolar crest. Cyst enucleation was carried out using curette and the samples of the removed tissue was sent for biopsy evaluation.

Root end of 23 and 24 were resected and retrograde filling was done. The flap was sutured using 3-0 silk suture. The patient was put on antibiotics and analgesics and post-operative instructions were given to him. The suture was removed after one week. Follow ups showed uneventful healing with appreciable results.

DISCUSSION

Differential diagnosis included odontogenic kerato cyst, radicular cyst and ameloblastoma. As the involved teeth were non-carious, radicular cyst was excluded from the list. The radiographic and

Fig 6: Elevation of mucoperiosteal flap and extraction of 22

histopathological findings were in favour of dentigerous cyst.

There are multiple theories that suggest the development of dentigerous cyst like intrafollicular theory, enamel hypoplasia theory and main's theory.[2]

The common methods of management include marsupialisation and cyst enucleation depending on cyst size, location, status of unerupted tooth involved and proximity to adjacent vital structures[2,4].

Enucleation is the complete separation and removal of lesion with its lining from the adjacent bone. Curettage involves taking out the lesion together with part of the adjacent bone (generally, 1-2 mm) using mechanical, physical, and chemical materials.[5] In some cases enucleation can pose risks of jaw fracture or nerve injuries. Decompression or marsupialisation is recommended in this aspect. In marsupialization, a window is created in cystic wall and sutured to the oral mucosa. Decompression is based on a creation of a window between the cyst and oral cavity by fixing a kind of device. Both these techniques, release intraluminal pressure in cyst cavity and gradually result in decreased volume of lesion.[6]

Generally the standard treatment choice for a dentigerous cyst is enucleation along with extraction of the associated impacted tooth. In cases where a single draining is ineffective and complete removal of the surrounding structure is not desirable, marsupialisation is chosen.[7]

In this case complete curettage and enucleation was opted as the treatment of choice along with the surgical removal of the impacted tooth by creating a bony window from the buccal side. Then apicectomy of the involved teeth was done, followed by retrograde

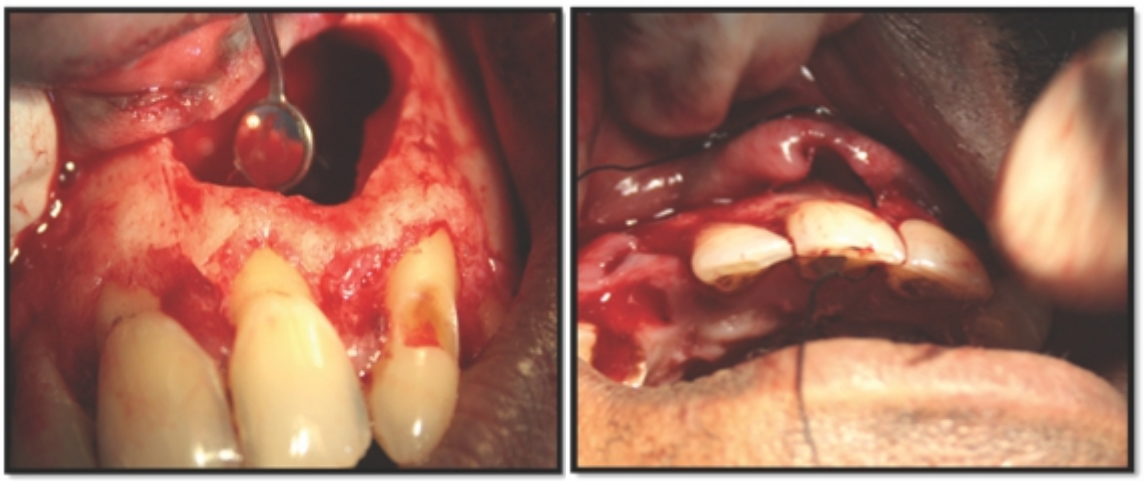

Fig 7: Cleaning and suturing the opening

filling. The root end filling was given to seal or improve the existing root canal filling material of the apical portion.

Hence early diagnosis of these lesions and prompt treatment of signs and symptoms need to be considered to prevent further complications.

CONCLUSION

Complete curettage and enucleation can be successfully implemented in patients with small sized dentigerous cyst. The surgical removal of the impacted tooth and endodontic management of the involved teeth were the treatment of choice opted in this case.

REFERENCES

1. Gonzalez SM, Spalding PM, Payne JB, Giannini PJ. A dentigerous cyst associated with bilaterally impacted mandibular canines in a girl: a case report. Journal of Medical Case Reports. 2011 Dec;5(1):1-4.
2. El GaouziRajae EH. Dentigerous cyst: enucleation or marsupialization (a case report). The Pan African Medical Journal. 2021;40.
3. Devi P, Thimmarasa VB, Mehrotra V, Agarwal M. Multiple dentigerous cysts: a case report and review. J Maxillofac Oral Surg. 2015;14(Suppl 1):47-51.
4. Gondim JO, Neto JJ, Nogueira RL, Giro EM. Conservative management of a dentigerous cyst secondary to primary tooth trauma. Dental Traumatology. 2008 Dec;24(6):676-9.
5. Oh S, Park JH, Paeng JY, Kim CS, Hong J. Comparison of surgical approach and outcome for the treatment of cystic lesion on lower jaw. Journal of the Korean Association of Oral and Maxillofacial Surgeons. 2012 Oct 1;38(5):276-83.
6. Demir E, Günhan Ö. Treatment Results of Dentigerous Cysts Managed by Marsupialisation, Enucleation or Enucleation with Platelet Rich Plasma-a Retrospective Study. Meandros Medical and Dental Journal. 2021 Aug 1;22(2):116.
7. Shah KM, Karagir A, Adaki S, Pattanshetti C. Dentigerous cyst associated with an impacted anterior maxillary supernumerary tooth. Case Reports. 2013 Jan 31;2013:bcr2012008329.

CASE REPORT

NEUTRAL ZONE CONCEPT - AN AID IN MANAGEMENT OF A PATIENT WITH ATROPHIC EDENTULOUS MANDIBULAR RIDGE - A CASE REPORT

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ABSTRACT

Complete denture prosthodontics consistently aims at providing comfort, function, esthetics, and the maintenance of patient's health to ultimately improve the quality of patient's life. Elderly patients, especially those who are long-time complete denture wearers have advanced atrophy of ridge and musculature of the cheeks and lips. Neutral zone technique is a functional approach to overcome the problem of instability of lower dentures caused in patients by a more potential musculature or in patient who have dimensional or altered neuromuscular control. This article presents a case report of fabrication of complete denture in atrophic mandibular ridge using the neutral zone concept.

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INTRODUCTION

Conventional complete denture fabrication in patients with severe residual ridge resorption is often challenging. Elderly patients, especially those who are long-time complete denture wearers have advanced atrophy of ridge and musculature of the cheeks and lips[1,2]. Adaptation to newly fabricated complete dentures was less of a problem in the past probably because new denture wearers were younger patients. Since people experience tooth loss later in life now a days, it makes them difficult to develop the neuromuscular skills needed for the successful wearing of dentures. The lack of these neuromuscular skills makes denture wearing on atrophic ridges difficult[3,4]. It is the duty of a prosthodontist to rehabilitate those patients to near normal function, irrespective of the clinical picture. Neutral zone technique is a functional approach to overcome the problem of instability of lower dentures caused in patients by a more potential musculature or in patient who have dimensional or altered neuromuscular control[5]. This article discusses about fabrication of conventional complete denture in a severely atrophied mandibular ridge using neutral zone concept.

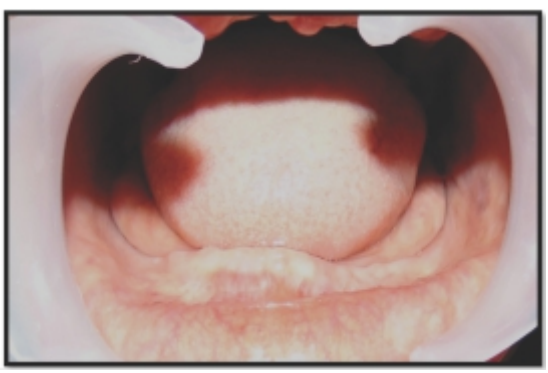

Fig 1 - Atrophied Mandibular Arch

Fig 2 - Mandibular Primary Impression

Fig 3 - Maxillary Primary Impression

CLINICAL REPORT

A 68-year-old completely edentulous female patient reported to the Department of Prosthodontics complaining of fractured lower complete denture which was fabricated 8 years back. The denture was unstable since 1 year and patient was having difficulty in function.

On examination the patient was having reduced ridge height and width with respect to mandibular arch in posterior regions (Fig 1). Since the mandibular ridge was severely resorbed, it was decided to fabricate the complete denture using closed mouth neutral zone technique. The steps and number of visits were well explained to the patient.

PROCEDURE

Primary impression using type I Impression compound was made using functional methods (fig 2). Primary cast was poured using Type II gypsum product. Stable bases (fig 3) were fabricated using self-cure resin with spurs made of 19mm gauge orthodontic wire projecting downward in maxillary and upward in mandibular bases. These spurs help with the retention of the low fusing impression compound. These bases were inserted into patient's mouth and checked for retention and stability during

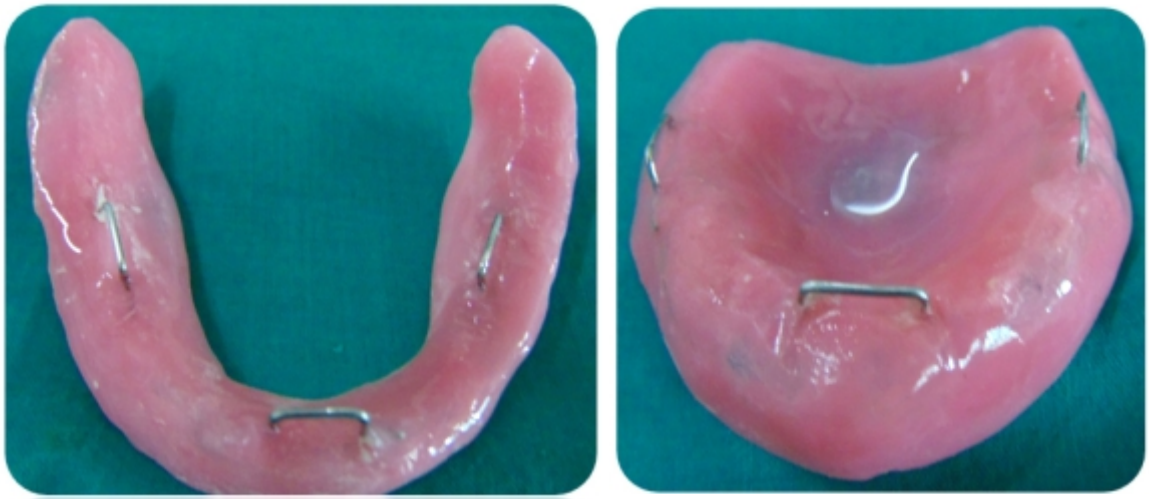

Fig 4 - Stabilized bases

Fig 5 - Recording neutral zone by sucking motion in upper arch

Fig 6
Recording neutral zone in mandibular arch

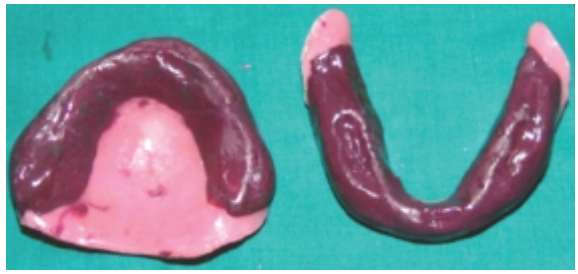

Fig 7- Recorded Neutral zone in maxillary and mandibular arch

opening, swallowing, and speaking. McCord and Tyson's admix impression technique was used to record neutral zone[6,7]. Type I low fusing Impression cake and Type I low fusing green stick compound in the ratio of 3: 7 parts by weight were placed in a bowl of water at 60^{0}C and kneaded to a homogenous mass and was properly adapted to the stabilized base with spurs. Patient was advised to perform a series of actions like swallowing, speaking, sucking (fig 5), pursing lips, pronouncing vowels, sipping water and slightly protruding the tongue several times which simulated physiological functioning for molding the modelling plastic into the area of the neutral zone. Maxillary rim was oriented in the patient's mouth, the height of the lower compound rim was adjusted with a sharp knife [fig 6] and Jaw registration was carried out [fig7]. Once tentative jaw relation was completed, Secondary impression was made with zinc oxide Eugenol impression material using closed mouth technique [fig 8].

Master cast was fabricated using dental stone. Locating grooves were cut on the master cast (fig 9).

Fig 8 - Secondary impression by closed mouth technique

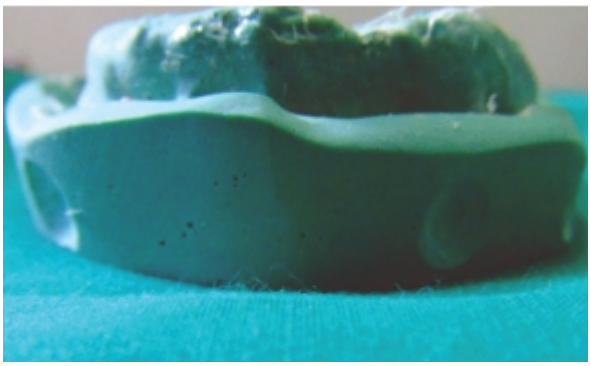

Fig 9 - Locating Grooves

Fig 10 - Articulated compound occlusal rim

Fig 11 - Index made with dental stone

The compound occlusal rim was articulated (fig 10). Index around the impression on both the labial and lingual sides were made using dental stone (fig 11) which fitted accurately on groves over the master cast. The admix material was then removed from the stabilized base and was replaced with modelling wax (fig 12). The index preserved the space of the neutral zone. Teeth arrangement was done according to the index (fig 13). The position of the teeth was checked by placing the index together. Patient was recalled for Try in appointment. Trial dentures were checked in the patients mouth for aesthetics, phonetics and occlusion. Wax was removed from the labial and the lingual surfaces of the trial dentures leaving only minimal wax which could support the teeth. Patient was trained for making physiological movements such as tongue, cheek and lip movements. Once the patient was trained regarding the functional movements, Zinc oxide Eugenol paste was applied on the external surfaces of maxillary and mandibular stabilized bases. The impression paste was also placed over the palatal surface of maxillary bases. The stabilized bases were placed in the mouth and patient was asked to perform functional movements. This recorded the polished surfaces of the denture according to the neutral zone (fig 14). The dentures were processed and finished. Care was taken during finishing and polishing of the dentures so that the contours recorded previously were unaltered.

The dentures provided the patient with improved facial appearance, retention and stability during function as they have been fabricated in harmony with their surroundings (fig 15).

Fig 12- Compound rim replaced with wax

Fig 13 -
Teeth arrangement with the help of index

Fig 14 - External impressions of maxillary and mandibular trial dentures

Fig 15 - Denture insertion

DISCUSSION

Neutral zone is defined as the potential space between the lips and cheeks on one side and the tongue on the other; that area or position where the forces between the tongue and cheeks or lips are equal.8The functions of the lips, cheeks, and tongue and their controlling action on the dentures during function is a fundamental principle behind the neutral zone concept[9]. With the neutral-zone approach to complete dentures, the procedure is reversed when compared to routine steps[10]. Individual trays are constructed first. These trays are very carefully adjusted in the mouth to be sure that they are not overextended and remain stable during opening, swallowing, and speaking. Next, modeling compound is used to fabricate occlusion rims. These rims, which are molded by muscle function, locate the patient's neutral zone. After a tentative vertical dimension and centric relation

have been established, the final impressions are made with a closed-mouth procedure. Only when the final impressions are completed are the occlusal vertical dimension and centric relation finally determined. With the neutral-zone procedure, the external contours are molded by muscle function[9]. The external or polished surface of the denture is in contact with the cheeks, lips, and tongue. Complete dentures fabricated using neutral zone technique has advantages like improved stability and retention, correct positioning of posterior teeth which allows sufficient tongue space, reduced food entrapment of adjacent to the molar teeth and good esthetics due to facial support[11]. Due to these advantages neutral zone technique was selected for this case and improved stability was achieved.

CONCLUSION

Neutral zone technique is one of the best alternative techniques in case of highly atrophied mandibular residual ridge, but it is rarely used because of the extra clinical step involved and complexity.

REFERENCES

1. Yeh YL, Pan YH, Chen YY. Neutral zone approach to denture fabrication for a severe mandibular ridge resorption patient: Systematic review and modern technique. Journal of dental sciences. 2013 Dec 1;8(4):432-8.
2. Porwal A, Sasaki K. Current status of the neutral zone: a literature review. The Journal of prosthetic dentistry. 2013 Feb 1;109(2):129-34.
3. Miller WP, Monteith B, Heath MR. The effect of variation of the lingual shape of mandibular complete dentures on lingual resistance to lifting forces. Gerodontology. 1998 Dec;15(2):113-9.
4. Ikebe K, Okuno I, Nokubi T. Effect of adding impression material to mandibular denture space in Piezography. Journal of oral rehabilitation. 2006 Jun;33(6):409-15.
5. Gahan MJ, Walmsley AD. The neutral zone impression revisited.Br Dent J 2005;198:269-72
6. Cagna DR, Masad JJ, Schiesser FJ. The neutral zone revisited: From historical concepts to modern application. J Prosthet Dent 2009;101:405-12.
7. Srivastava V, Gupta NK, Tandan A, Kaira LS, Chopra D. The Neutral Zone: Concept and Technique. J Orofac Res 2012;2(1):42-47.
8. Glossary of Prosthodontic Terms (8th ed). J Prosthet Dent 2005; 94:10-92.
9. Fahmy FM, Kharat DU. A study of the importance of the neutral zone in complete dentures. Journal of Prosthetic Dentistry. 1990 Oct 1;64(4):459-62.
10. Beresin VE, Schiesser FJ. The neutral zone in complete dentures. The Journal of prosthetic dentistry. 1976 Oct 1;36(4):356-67.
11. Raja HZ, Saleem MN. Neutral zone dentures versus conventional dentures in diverse edentulous periods. Biomedica 2009;25:136-45.

REVIEW ARTICLE

HUMAN TONGUE PRINT ANALYSIS FOR BIOMETRIC AUTHENTICATION - A REVIEW

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ABSTRACT

Tongue is a vital organ which is well protected from the external environment and enclosed in the oral cavity. Biometrics refers to a real-time identification system that is used in the identification of a person. In recent years the necessity for security has propelled the research in the field of biometrics. In biometric authentication, the input image is compared against a sample template to identify the person. This review discuss about the uniqueness of tongue prints, its advantages and various tongue print biometric systems.

Keywords: Tongue-print, biometric, tongue recognition, biometrics authentication system.

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INTRODUCTION

Personal identification is becoming increasingly important not only in legal medicine but also in criminal investigation and genetic research. In this computer driven era, biometric authentication is a method of personal identification, and has gained popularity. This method had replaced the age old tradition of recognizing a person using personal identification marks. Biometrics refers to the automatic identification of a person based on his or her physiological or behavioural characteristics.[1]

Biometric authentication is a method of personal identification that has become increasingly important in today's networked society. A biometric system should support the facet of identification, authentication and non-repudiation in information security.

Most of the present day biometric systems have some features that render them less sensitive. Finger prints can be eroded due to work, altered by surgery and subjected to injuries or burns, so they are not stable. Optical scanners reliability and sensitivity are reduced as the finger touches the scanning device. Fingerprints can be recreated in latex using an object touched by the person. Retinal scanning is highly sensitive and can get affected by the bright light and diseases such as cataract and astigmatism. Voice recognition can be affected by the cold and cough, in case of extreme emotional states, there are chances of misspoken words.[2]

In recent years, tongue print is gaining momentum as an important tool in biometric authentication. The dorsum of the tongue carries a great deal of information along with its visual difference in shape, texture and pattern which can be called the tongue print. The anterior portion of dorsum of tongue shows three types of papillae- circumvallate, filiform papillae and fungiform papillae. Fungiform papillae are rounded reddish elevations present near the tip and margins of tongue and when prominent may appear rough and pebbly. Filiform papillae are most numerous and cover most of the anterior 2/3rd of tongue and impart a velvety appearance to the tongue. The arrangement of these papillae along with circumvallate papillae and sulcus terminalis gives rise to different geometrical shapes and surface textures making the tongue print unique for each individual, even between identical twins.

Figure 1: Tongue image

Table 1: Biometrics can be divided into two classes:

Physiological	Behavioural
Face, fingerprint, hand geometry, iris recognition, retina recognition, palm vein, DNA, ear biometric, finger vein, eye vein recognition, foot print and foot dynamics, thermography recognition.	Signature, voice/ speech recognition, handwritten biometric recognition, gait, typing/ keystroke recognition, skin reflection, lip motion.

The tongue is an organ housed inside the body but it can be easily stuck out for inspection. The tongue is connected to the oral cavity and cannot be inspected without having the permission of the subject. Sticking out ones tongue is undeniable proof of life; whereas the other biometric techniques can be applied without the person's consent.[3] The tongue print can be used as secure and safer way for authentication. Its use in forensic as well as natural and human made disasters is yet to be documented.

Classifications:

1. Stefanescu et al. analyzed lingual morphological aspects and demonstrated their importance. Based on the results gathered from their analysis, they also put forth a classification of tongue features.[4]

   Tongue Texture: Physiological, scrotal, geographic.

   Shapes of tongue: ovoid, ellipsoid, rectangular, pentagonal, trapezoid to asymmetrical.

   Longitudinal grooves: perceptible/ imperceptible, rectilinear/twisty, superficial/ deep.

   Lingual apex: sharp, septate.

2. Tongue prints based on multiple parameters PMSFT[5].

   Pattern: Reticular, wavy, linear, horizontal

   Margin: Smooth, scalloped

   Shape: U- shape, V- shape, square

   Fissure:

   Type- 1 (Continuous central fissure)

   Type- 2 (Noncontinuous central fissure)

   Type- 3 (Continuous central fissure with lateral fissures)

   Type- 4 (Noncontinuous central fissure with lateral fissures)

   Type- 5 (Lateral fissures only)

   Type- 6 (Absence of fissures)

   Texture: Velvety, pebbly, matted

Review of Literature

J.H.Jang et al. in 2002 paper shows digital tongue inspection system that has been developed that consists of the implemented hardware part for tongue image acquisition, the image processing part that includes colour interpolation, edge detection algorithm for tongue area separation and tongue colour detection algorithm, and the database and user interface system for archiving and managing acquired tongue images.[6]

Zuo et al. have presented a technique for automated tongue segmentation by merging polar edge detector and active contour model. Experimental results revealed that the tongue segmentation can segment the tongue precisely. Recently, developing approaches for segmenting the tongue images have received a great deal of attention among researchers.[7]

M. Diwakar and M. Maharshi have demonstrated an extraction and recognition of tongue-print images for biometric system from the tongue database in 2013. Their paper demonstrated two phases. First, find out spots on the tongue with the help of histogram and second phase to extract image of tongue and recognize from the tongue- image database.[8]

In 2014 B. Zhang and H. Zhang thoroughly examined tongue shapes using geometry features through computerized methods. The features helped to define 5 tongue shapes rooted upon traditional Chinese medicine and using a decision tree.[9]

In 2017 Jeddy et al. in their paper have explained the search for a new personal identification method which has led to the use of the lingual impression or the tongue print as a method of biometric authentication.[10]

Zhu et al. suggested a quite high accuracy method for tongue image extraction using fusion of colour and space information in order to extract tongue body region from background. This method could achieve relatively good segmentation effects, for those tongue images with coating. And the efficiency of this method was acceptable and practical for the applications of tongue diagnoses.[11]

Zhong et al. recommended a new method in which the RGB colour space of tooth-marked tongue images were converted into HSI color space and used a threshold value to complete segmentation of tooth-marked tongue images.[12]

Chen et al. combined the graph theory and multi resolution image segmentation methods, to segment the image on two different resolutions. The proposed method was novel, but the accuracy was not high,

was only 87.3% and the efficiency test was not provided by the authors.[13]

Li and Wei put forward an adaptive segmentation algorithm to section tongue images professionally, which divided tongue image into several parts, used an iterative approach to calculate each threshold, and used each local threshold to segment tongue images. The results showed that they could section well the tongue images whose background and boundaries were not strong.[14]

Zhi Liu et al. developed a 3D tongue image database that uses both texture and shape of the tongue images. Based on their research they concluded that the tongue can be used as a biometric trait.[15]

Li Qet al. and Manoj Diwakar et al. used different methods of capturing tongue images, creating image database and evaluated the possibility of using tongue in human identification. Diwakar also identified spots on the tongue for person identification using histogram as feature.[16,8]

Omer et al. conducted a cross sectional descriptive study and concluded that tongues are different between identical twins and hence can be a new personal identification method which needs further elaboration.[17]

Bob Zhang and Han Zhang, extracted geometric features from tongue images and tried to establish the relationship between a patient's state, healthy or diseased, and human tongue.[18]

Stefanescu et al. demonstrated the importance of lingual morphological aspects. Based on the results gathered from their analysis, they also put forth a classification of tongue features.[19]

Salim Lahmiriused wavelet transform for texture analysis and extracted six statistical features for tongue print verification.[20]

Ryszard S. Choras utilizes steerable filters and Weber Law Descriptor feature for identification.[21]

Zhang et al. proposed a novel feature that makes use of both shape and texture of the tongue for identification. They have taken geometrical features to represent the shape and texture codes for the textural features.[22]

To establish a measurable and machine readable relationship between expert human judgments and the machine classifications of tongue shapes, Huang et al. used a decision support tool, Analytic Hierarchy Process (AHP). Experimental results show that the proposed shape correction method reduces the deflection of tongue shapes and that their shape classification approach, tested on a total of 362 tongue samples, achieved an accuracy of 90.3%.[23]

Sivakumar et. al. in their study have used Local Binary Pattern (LBP) algorithm for extracting features. Extracted features were then trained by a linear Support Vector Machine (SVM) for personal identification. From the database consisting of 136 tongue print images of 34 individuals, they have achieved an accuracy of 97.05% for identification.[24]

Santhu et. al. in their study have used convolutional neural networks with Matlab version 2019 as the computing platform. From the database of 900 tongue print images they have scored 98.61% as accuracy in identification.[25]

CONCLUSION:

Tongue is a unique vital organ well protected within the oral cavity; hence tongue prints are immune to forgery and cannot be reverse engineered. Tongue image data base will enable the possibility of using tongue prints as a novel biometric tool in forensic as well as in biometric applications Since different tongue parameters are recorded, the accuracy of biometric authentication will be more. To our knowledge, little work has been done in digitalized tongue prints and research in tongue prints is at a preliminary stage.

REFERENCES

1. Sareen P. Biometrics - Introduction, Characteristics, Basic technique, its Types and Various Performance Measures. International Journal of Emerging Research in Management &Technology. 2014; 3 (4): 109-119.
2. Jain A.K, Ross A and Prabhakar S. An Introduction to Biometric Recognition. Institute of Electrical and Electronics Engineers. 2004; 14(1): 1-29.
3. Radhika T, Jeddy N, Nithya S. Tongue prints: A novel biometric and potential forensic tool. Journal of forensic dental sciences. 2016; 8(3): 117- 119.

4. Stefanescu C.L, Popa M.F and Candea L.S. Preliminary study on the tongue based forensic identification. Romanian Journal of Legal Medicine.2014;22: 263-266.
5. Angelin D, Nair BJ, Sivakumar TT et.al Tongue print as a tool for human identification? : A pilot study. Trivan Dent J. 2013; 4:58-62.
6. Jang J.H.et al. Development of the Digital Tongue Inspection System with image analysis. Institute of Electrical and Electronics Engineers. 2002; 2: 1033-1035.
7. Zuo W, Zhang D, Wang K, Zhang H. Combination of Polar Edge Detection and Active Contour Model for Automated Tongue Segmentation. Institute of Electrical and Electronics Engineers. 2004: 270-273.
8. Diwakar M, Maharshi M. An extraction and recognition of tongue-print images for biometrics authentication system. Int J Comput Appl. 2013; 61: 36-42.
9. Zhang B, Zhang H. Significant geometry features in tongue image analysis. J Evid Based Complementary Altern Med.2015: 1-8.
10. Jeddy N, Radhika T, Nithya S. Tongue prints in biometric authentication: A pilot study. Oral Maxillofac Pathol.2017; 21(1):176-179.
11. Zhu M, Du J, Ding C. A Comparative Study of Contemporary Color Tongue Image Extraction Methods Based on HIS. Int J Biomed Imaging. 2014: 1-10.
12. Kumar A, Sangwan S. Biometric Security Systems. International Journal of Engineering Trends and Technology. 2014; VII(4): 169-170.
13. Chen S.C., Fu H.G and Wang Y. Application of improved graph theory image segmentation algorithm in tongue image segmentation. Computer Engineering and Applications. 2012; 48(5): 201-203.
14. Li J.P, Pan B.C and Wei Y.K. Tongue image segmentation based on fuzzy rough sets. Environmental Science and Information Application Technology. 2009:367-369.
15. Zhi L, Yan J, Zhang D and Tang Q. A tongue-print image database for recognition. Institute of Electrical and Electronics Engineers. Proceedings of the Sixth International Conference on Machine Learning and Cybernetics, Hong Kong.2007: 19-22.
16. Li Q and Zhi L. Tongue color analysis and discrimination based on hyper spectral images. Computerized Medical Imaging and Graphics. 2009; 33(3): 217-221.
17. Omer A.M, Tagwa E.E and Muhammed E.H. Tongues: Could they also be another fingerprint. Indian Journal of Forensic Medicine and Toxicology. 2014; 8(1): 171-175.
18. Bob Z and Han Z. Evidence-based complementary and alternative medicine, 2015.
19. Stefanescu C.L, Popa M.F and Candea L.S. Preliminary study on the tongue based forensic identification. Romanian Journal of Legal Medicine.2014;22: 263-266.
20. Salim L. Recognition of tongue print textures for personal authentication: A wavelet approach. Journal of Advances in Information Technology. 2012; 3(3): 168-175.
21. Ryszard S.C. Biometric identification through tongue texture measurements. International Journal of Computers.2016;1: 73-77.
22. Zhang D, Liu Z, Yan J and Shi P. Tongue-Print: A Novel Bio-metrics Pattern, Springer, Korea. 2007: 1174-183.
23. Huang B, Jinsong W, Zhang D, Naimin L. Tongue shape classification by geometric features. Information Sciences. 2010; 180: 312-324.
24. Sivakumar T.T, Shali S.N, Geevar C.Z, Madhu S.N, Anna P.J. Identification of tongue print images for forensic science and biometric authentication. Journal of Intelligent & Fuzzy Systems. 2018; 34: 1421-1426.
25. Sadasivan S, Sivakumar T.T, Joseph A P, Geevar C.Z and Madhu S.N. Tongue Print Identification Using Deep CNN for Forensic Analysis. Journal of Intelligent & Fuzzy Systems. 2020; 38: 6415-6422.

REVIEW ARTICLE

TRAUMEEL - AN EMERGING OPTION TO NONSTEROIDAL ANTI- INFLAMMATORY DRUGS IN THE MANAGEMENT OF PAIN AFTER PERIODONTAL FLAP SURGERY - A REVIEW

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ABSTRACT

Pain management after performing periodontal flap surgery is of paramount importance. There is a new topic to examine while considering the negative effects of nonsteroidal anti-inflammatory medicines (NSAIDs) and the benefits of homoeopathic therapy. Traumeel is a homoeopathic complex medicine with natural ingredients that is used to treat inflammation, trauma, and degenerative diseases. Traumeel has also been shown to have anti-inflammatory and analgesic properties in clinical studies as well as in vivo tests with models such maxillofacial inflammations, periodontitis, and pain syndrome following dental canal filling. The level of patient acceptability is likewise extremely high. To achieve the intended effect, the rule of thumb for analgesic therapy is to utilise the lowest dose with the fewest side effects. This isa comprehensive review about traumeel & its emerging role in Dentistry.

Keywords: Traumeel, Flap surgery, NSAIDs, Ibuprofen, Postoperative pain.

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INTRODUCTION

Postoperative pain after periodontal flap surgery is a common occurrence. Pain after periodontal flap surgery is of mild to moderate severity.[1] It is the consequence of a cascade of events during the inflammatory response triggered by surgical trauma.[2] Pain management after performing periodontal flap surgery is one important step. Usually, a prescription of oral analgesics is the most common method to manage post- operative pain. Given the vast array of analgesics available, the surgeon is often challenged when choosing an effective and safe analgesic for use after periodontal flap surgery.

Non-steroidal anti-inflammatory drugs (NSAIDs) have a remarkable benefit in the control of pain after periodontal surgical procedures.[1] They are the most dominant analgesic and anti-inflammatory drugs in dental practice.[3] Use of NSAIDs, to control pain, is more efficacious than narcotics, due to blocking the source of pain which in fact, is inflammation.[4]

There is no evidence that any one non-selective NSAID is more successful than the other for non-specific pain management, but Ibuprofen is nowadays considered the safest, inexpensive choice.[5] However gastric ulceration and intolerance, inhibition of platelet function, hypersensitivity reactions, and alteration of renal function are notable side effects associated with it.[1]

The recent focus and publicity on the adverse effects of analgesics, makes selection of analgesics for pain management important both clinically and legally. Alternative to ibuprofen suggested is traumeel, which is a homeopathic compound preparation that consists of a number of different herbal active substances. It is said to curb inflammatory response by stimulating the production of protective cytokines by immune cells.[3] A number of studies have demonstrated the efficacy of this medical product.[6-18]

A recent clinical study has compared the analgesic, anti-inflammatory, and tissue response of ibuprofen and traumeel after periodontal flap surgery. Traumeel presented no adverse GI effects, better tissue response, high patient compliance, and was highly effective in controlling post surgical pain. This clearly demonstrates the effectiveness of traumeel in controlling both pain and tissue response post periodontal flap surgery along with the added benefits in improving periodontal health.[19]

What is Traumeel???

Traumeel is a blend of diluted plant and mineral extracts that has been pre-mixed. Traumeel is a popular treatment for musculoskeletal injuries and inflammation. After an accident, injury, or surgery, it decreases inflammation, relieves pain and bruises, and promotes recovery. Traumeel has been used to aid recovery from sprained joints, strained/pulled muscles, bruises, nerve pain, swelling, post-surgical pain and to boost wound healing.[8,13]

The beneficial effects of traumeel have been demonstrated in clinical trials, as well as in vitro experimental models, including the carrageenan-induced edema test and the adjuvant arthritis test.[8,13]

Traumeel is not a non-steroidal anti-inflammatory drug (NSAID); however, it has been shown to have both local and systemic efficacy in reducing pain and inflammation and is as effective at reducing symptoms of inflammation as NSAIDs.[8,13]

The different formulations of Traumeel

It can be obtained in:

- Ointment/gel for topical application.
- Oral tablets.
- Ampoules of solution for injection Oral drops.

The components of Traumeel

All of the formulations of Traumeel contain14 components. These are listed in Table1, including the characteristics of each ingredient as well as the dosage forms. The components of Traumeel work together to guarantee that the action is complete.

Table 1
Properties of different components of Traumeel

Components	Properties
Aconitum napellus Hamamelis virginiana Achillea millefolium Bellis perennis Atropa belladonna	Increase of tone and stabilization of vasal permeability Hemostasis Elimination of venous stasis
Arnica montana Aconitum napellus Arnica montana Chamomilla recutita Hypericum perforatum	Analgesia
Echinacea angustifolia Echinacea purpurea Mercurius solubilis Hahnemanni Hepar sulfuris Calendula officinalis Arnica montana Echinacea purpurea Symphytum officinale	Anti-infective action Stimulation of wound healing Formation of osseous callus

Indications of Traumeel

Pain management after periodontal flap surgery

Trauma: Contusions, distortions, sprains, dislocations, hematoma and fractures

Inflammation of the musculoskeletal system: Arthritis, polyarthritis, reactivated arthrosis, bursitis, synovitis, scapulohumeral periarthritis, tendonitis and tendovaginitis.

Mechanism of action of Traumeel

Traumeel has an inhibitory effect on proinflammatory mediators, such as Interleukin-1 beta (IL-1β), Tumour necrosis factor alpha (TNF-α) and Interleukin-8 (IL-8), in resting as well as activated immune cells.

Components of Traumeel are non-cytotoxic to granulocytes, lymphocytes, platelets and endothelial cells presenting that the defensive functions of these cells are preserved during treatment with Traumeel.

Components in Traumeel elevate the levels of anti-inflammatory cytokine, transforming growth factor beta (TGF-β), indicating that the immunological 'bystander reaction' may play a role in the action of Traumeel.

The various in vitro and in vivo studies offer a mechanism for the effectiveness of Traumeel in reducing symptoms of inflammation observed in clinical practice.

Table 2 - Traumeel activity on experimental models in vitro and in vivo

Experimental model	Action of Traumeel
Neutrophil adhesion and superoxide anion production	No significant effect
Platelet adhesion	No significant effect
Carrageenan-induced edema	Inhibition
Adjuvant arthritis	Inhibition - First acute phase No significant effect - Second chronic phase

Overview of benefits of Traumeel

- Adverse effects are extremely rare
- There are no known drug interactions
- No evidence of carcinogenicity has been found
- If required, traumeel can be used for long-term use. No age limitation for the use
- Not known to have direct or indirect teratogenicity to fetus

- Not known whether any of the ingredients in traumeel are excreted in human milk

Table 3 - Comparison of traumeel vs. NSAIDs

Properties	Traumeel	NSAIDs
Anti-inflammatory	Yes	Yes
Analgesic	Yes	Yes
Evidence base	Yes	Yes
Gastrointestinal toxicity	No	Yes
Interactions with other medications	No	Yes
Deterioration of wound healing	No	Yes
Sodium/Water retention	No	Yes

CONCLUSION

There are a variety of analgesics and techniques to treat pain after periodontal flap surgery. Patients want to be given the best analgesic and technique for managing their pain and periodontists need to know them. Knowing how well an analgesic and mechanism works and its associated adverse effects is fundamental to clinical decision-making. Selecting the most appropriate analgesic is an issue of efficacy, safety, and cost. No analgesic, dose, or combination will work for all patients. Rather, the dentist must monitor the patient's pain on a regular basis and intervene as needed to change drugs to balance analgesic efficacy with side effects. Rational prescribing will result in good pain management with minimal or no side effects. However, based on findings, use of traumeel is a valuable and effective protocol for postoperative pain prevention and control in patients undergoing periodontal flap surgery. Long-term studies with a larger sample size, as well as studies using other types of periodontal surgery that are expected to cause more pain and swelling (perioplastic surgery, boneresective surgery, and regenerative surgeries), are needed to determine the effectiveness of traumeel's analgesic and anti-inflammatory effects.

REFERENCES

1. Rashwan WA. The efficacy of acetaminophen-caffeine compared to Ibuprofen in the control of postoperative pain after periodontal surgery: a crossover pilot study. J Periodontol. 2009 Jun;80(6):945-52.
2. ZardoLN, SantosFA, PilattiGL. Use of etoricoxib and dexamethasone for postoperative pain prevention and control in mucogingival surgery: a randomized parallel double-blind clinical trial. Braz J Oral Sci. 2013 Dec;12(4):345-51.
3. Zuhr O, Hurzeler M. Plastic-esthetic periodontal and implant surgery, A microsurgical approach. Quintessence Publishing Co,Ltd;2012.p.181-84.
4. Yaghini J, Abed AM, Mostafavi SA, Roshanzamir N. The effect of diclofenac mouthwash on periodontal postoperative pain. Dent Res J. 2011;8(3):146-9.
5. Ettlin DA, Ettlin A, Bless K, Puhan M, Bernasconi C, Tillmann HC, et al. Ibuprofen arginine for pain control during scaling and root planing: a randomized, triple-blind trial. J Clin Periodontol. 2006 May;33(5):345-50.
6. Lussignoli S, Bertani S, Metelmann H, Bellavite P, Conforti A. Effect of Traumeel S, a homeopathic formulation, on blood-induced inflammation in rats. Complement Ther Med. 1999Dec;7(4):225-30.
7. OberbaumM, YanivI, Ben-GalY, SteinJ, Ben-ZviN, FreedmanLS, Branski D. A randomized, controlled clinical trial of the homeopathic medication TRAUMEEL S in the treatment of chemotherapy-induced stomatitis in children undergoing stem cell transplantation. Cancer. 2001 Aug 1;92(3):684-90.
8. Porozov S, Cahalon L, Weiser M, Branski D, Lider O, Oberbaum M. Inhibition of IL-1ß and TNF-a secretion from resting and activated human immunocytes by the homeopathic medication Traumeel®S. Jimmunol Res. 2004;11(2):143-9.

9. Birnesser H, Oberbaum M, Klein P, Weiser M. The homeopathic preparation Traumeel® S compared with NSAIDs for symptomatic treatment of epicondylitis. Journal of musculoskeletal research.2004;8:119-28.

10. Gavriliuc L, Sevcenco N, Godoroja P, Dandes N, Lisii L. Treatment of patients with parodontitis by antihomotoxic pharmaco therapy with Traumeel. S. The journal Oral Health and Dental Management in the Black Sea Countries.2004;3(4):38-42.

11. Muller-Lobnitz C, Göthel D. Review of the clinical efficacy of the multicomponent combination medication Traumeel and its components. Altern Ther Health Med. 2011 Mar 2;17(2 Supp1):S18-3.

12. Oberbaum M, Spira RM, Lukasiewicz E, Armon Y, Samuels N, Singer SR, et al. Effect of Traumeel S on cytokine profile in a cecal ligation and puncture (CLP) sepsis model in rats. J Altern Complement Med. 2011 Oct;17(10):909-13.

13. Schneider C. Traumeel- an emerging option to nonsteroidalanti-inflammatory drugs in the management of acute musculoskeletal injuries. Int J Gen Med. 2011 Mar 25;4:225-34.

14. Zilinskas J, Zekonis J, Zekonis G, Sadzeviciene R, Sapragoniene M, Navickaite J, et al. Inhibition of peripheral blood neutrophil oxidative burst in periodontitis patients with a homeopathic medication Traumeel S. Med Sci Monit. 2011May;17(5):CR284-91.

15. Natsis K, Lyrtzis C, Papathanasiou E, Anastasopoulos N. Rectusabdominis over use injury in a tennis athlete treated with traumeel. Am J Case Rep. 2012;13:3-6.

16. Farrer S, Baitson ES, Gedah L, Norman C, Darby P, Mathie RT. Homeopathic prescribing for chronic and acute periodontal conditions in 3 dental practices in the UK. Homeopathy. 2013 Oct;102(4):242-7.

17. Gonzalez de Vega C, Speed C, Wolfarth B, González J. Traumeel vs. diclofenacforreducingpainandimprovinganklemobilityafteracuteankle sprain: A multicentre, randomised, blinded, controlled and non-inferiority trial. Int J Clin Pract. 2013Oct;67(10):979-89.

18. Muders K, Pilat C, Deuster V, FrechT, Kruger K, Pons-KuhnemannJ et al. Effects of Traumeel (Tr14) on exercise-induced muscle damage response in healthy subjects: a double-blind RCT. Mediators Inflamm. 2016;2016.

19. Das R, Deshmukh J, Asif K, Sindhura H, Devarathanamma MV, Jyothi L. Comparative evaluation of analgesic and anti-inflammatory efficacy of ibuprofen and traumeel after periodontal flap surgery: A randomized triple-blind clinical trial. J Indian Soc Periodontol. 2019;23(6):549-53.

REVIEW ARTICLE

ROOT BIOMODIFICATION IN PERIODONTAL THERAPY - A REVIEW

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ABSTRACT

Periodontitis is a multifactorial chronic immune-inflammatory disease characterized by destruction of tooth supporting structures. Repair of the periodontium and the regeneration of periodontal tissues remains a major goal in the treatment of periodontal disease. The periodontal therapy helps in the restoration of the lost periodontium. Root biomodification forms an essential step in periodontal therapy to get rid of the smear layer on the root surface which would facilitate new attachment. In this review article we would like to give emphasis on the different means and agents which are routinely used for root biomodification, smear layer.

Key words: Root biomodification, Periodontitis, smear layer.

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INTRODUCTION

The periodontal therapy aims to facilitate formation of new connective tissue attachment on the denuded root surface. This type of regeneration can be described by the term 'New attachment' and it can be described as embedment of new periodontal ligament fibers on to new cementum previously denuded by the periodontal disease.[1]

Periodontitis-affected root surfaces remain hypermineralized contaminated with cytotoxic and other biologically active substances. Root biomodifiers help to remove the smear layer formed on the root surface as a result of mechanical debridement and also to expose collagen fibers making the root surfaces biologically acceptable.[2]

The periodontal therapy helps in the restoration of the lost periodontium and conversion of the periodontally affected root surfaces into a substrate, which is biologically hospitable for epithelial and connective tissue cell adherence and attachment. Methods to achieve this objective include scaling and root planing, as well as treatment of denuded root surfaces with various chemicals and antimicrobial agents.[3] Mechanical therapy alone cannot decontaminate a periodontitis-affected root surface completely. It is because the bacterial toxins are not completely eliminated from the root surface and the instrumented surface will inevitably be covered by a smear layer that contains remnants of dental calculus, contaminated cementum and subgingival plaque. This acts as a physical barrier between periodontal tissues and root surfaces inhibiting the formation of new attachment.[4]

Methods of Root Conditioning

Various methods for root conditioning have been attempted. These include mechanical and chemical methods, growth factors and lasers.

A) Mechanical methods

Mechanical modification of root surface involves scaling and root planning procedure. This helps in removal of cementum, removal of softened dentin, or the smoothening of surface irregularities. Even though there has been enough documentation about the effectiveness of scaling and root planing, its efficacy in making the root surface disease free has been questioned. Such root modification may not completely remove contaminated cementum especially in the apical areas. A smear layer will inevitably cover the mechanically instrumented root surface. Thus alternate approaches were suggested to overcome these limitations inherent in the mechanical therapy.[5]

B) Chemical methods

Root surfaces affected by periodontal diseases can undergo structural and chemical changes due to the effects of cytotoxic and other biologically active substances from periodontal microorganisms. This bacterial contamination inhibits the reattachment of gingival and periodontal cells and cannot be reversed by the use of conventional scaling and root planing procedures alone. They are not able to completely eliminate the infection due to the production of a compact smear layer.[6] Because the presence of a smear layer is unfavorable for the reattachment of periodontal connective tissue, the purpose of surface demineralization is to recreate a biologically active substrate for periodontal cellular reattachment.[7] Therefore, chemical conditioning agents are often used to remove root surface impurities including minerals and cytotoxic materials formed from the bacterial products.[8]

Various chemicals have been used on root surface to remove the smear layer. This would promote healing and may provide better clinical outcomes. The application of growth factors on root surface to enhance periodontal regeneration has also studied recently. Lasers have been extensively used to remove smear layer from the root surface.[9]

The root surface biomodification agents are broadly classified into the following categories

1. Root conditioners
   - Citric acid
   - Tetracycline HCI

- EDTA
- Fibronectin
- Laminin
- Doxycycline
- Minocycline
- Polyacrylic acid
- Phosphoric acid
- Formaline
- Chlorhexidine
- Hydrogen peroxide
- Cetylpyridium chloride and sodium-n-lauroyl sarcosine
- Cohnns factor
- Bile salts and plasma fractions

2. Enamel matrix proteins

3. Platelet rich plasma

4. Recombinant human growth factors

5. Hyaluronic Acid

6. Lasers

1. Citric acid: It contains two or more groups in its molecule. This can combine with calcium and act as chelating agent. It can participate in surface exchange mechanism; with citric ions replacing phosphate ions in the hydroxyapatite crystals. Citric acid acts on dentinal hydroxyapatite by the release of hydrogen ions which may demineralize the crystalline structure.[11] Citric acid demineralization increases the new attachment/reattachment and thereby helps in regeneration by antibacterial effect, root detoxification, exposure of root collagen and opening of dentinal tubules, removal of smear layer and by initial clot stabilization. Studies reported the reattachment of collagen fibers to previously denuded root surfaces following treatment of root surface with citric acid (pH 1.0) and application time of 2-3 minutes.[11]

It has been stated that citric acid (pH= 1) application for 3 minutes using a rubbing pressure on the surface resulted in complete removal of smear layer and exposure of smoother root dentin surface with relatively wide dentinal tubular openings.[12] Demerits associated with citric acid application include formation of extremely acidic environment in the surrounding tissues, which may result in unfavourable wound healing responses. Its low pH has been shown to induce cytotoxic effects when in direct contact with periodontal cells. The factors influencing the effects of citric acid on root surface include concentration and pH of the acid, duration and mode of application.[12]

2. Tetracycline hydrochloride: The tetracyclines are a group of bacteriostatic antimicrobials effective against a wide range of microorganisms. The unique property of the drugs of this group is their ability to modulate the host response. This group of drugs have matrix metalloproteinase inhibitory and anti-inflammatory properties.[13] Tetracycline hydrochloride also inhibits microbial attachment and has root surface conditioning properties. It has been demonstrated that tetracycline conditioning of the root surfaces removes the surface smear layer, inhibits collagenase activity and bone resorption by its local antimicrobial effects.[12]

The properties of tetracycline hydrochloride which make it a suitable root surface biomodification agent include:[14]

- It facilitates attachment and growth of gingival fibroblasts, thus improving regeneration.
- It has anti-collagenase activity.
- It has anti-inflammatory properties.
- It has excellent substantivity.
- It inhibits parathyroid hormone induced bone resorption

It also has an indirect relationship to regeneration. Application of low pH tetracycline increases fibronectin and other extracellular matrix glycoprotein binding to the root surface, improving fibroblast attachment and growth on the root surface. It also suppresses the proliferation and growth of epithelial cells.[15]

Tetracycline hydrochloride has sustained release from root surface for at least 48 hours and up to 14 days, which provides its antibacterial properties during the period of healing. It was demonstrated that 10 or 100 mg/ml solutions of tetracycline hydrochloride were sufficiently concentrated to facilitate the removal of smear layer and expose a regular pattern of open dentinal tubules. The application time is 2-3 minutes.[16]

It has been demonstrated that they can also influence fibroblast behaviour thereby improving their attachment and migration on root surface. The proposed mechanisms by which these influence fibroblast behaviour include.

- Induced cementogenesis
- Collagen splicing
- Fibronectin fibrin-collagen binding thereby inhibiting epithelial apical migration
- Increased fibroblast chemotaxis, migration and attachment.[17,18]

3. Ethylene-diamine-tetra-aceticacid (EDTA):. EDTA is a chelating agent used widely during endodontic treatment. EDTA exerts its demineralizing action through chelating divalent cations at neutral pH. Studies show that application of 18% EDTA on root surface improves fibroblast attachment and migration on the root surface and also facilitates development of an oriented fiber attachment system between the demineralized surfaces.[19]

4. Fibronectin: It is actively involved in many cellular processes, including tissue repair, embryogenesis, blood clotting, and cell migration/adhesion. It exhibits a chemoattractant effect on fibroblasts and mesenchymal cells. It also promotes cell adhesion to both collagen and scaled root surfaces. One important function of fibronectin is its action as a non-specificopsonin. It binds to act in and DNA promoting cellular and tissue debris removal by macrophages. It has been demonstrated that the application of fibronectin to partial demineralized root surfaces increases new attachment and cell proliferation from periodontal ligament and supra crestal area. Optimum concentration for fibronectin application has been shown to be 0.38 mg/ml saline.[14]

5. Laminin: The most abundant components of basement membranes are the laminins and type IV collagens. While collagen has some adhesion promoting activity, laminin has been shown to have potent actions on cells: stimulating cell adhesion, growth, differentiation, and migration. Laminin promotes gingival epithelial chemotaxis and movement of gingival fibroblasts. A mineralized surface attract laminin favouring epithelial proliferation whereas a demineralized surface attract fibronectin favouring fibroblast proliferation.[15]

6. Doxycycline: Doxycycline belongs to the tetracycline group of drugs. It is an effective antimicrobial agent against periodontal microbes. It also has anti enzymatic properties. Topical application of doxycycline has demonstrated a long lasting substantivity on periodontally diseased root surfaces. It has been reported that the antibacterial effect of doxycycline persists on the conditioned root surface upto 14 days.[16]

7. Polyacrylic acid: Polyacrylicacid, weak in nature, has been used as root surface conditioning agent. Its acid etching effect removes smear layer from the root surface thereby making it more suitable for healing. A study compared periodontal healing after application of polyacrylic acid for 20 seconds and citric acid application for 3 minutes on root surface. Results showed a greater connective tissue adhesion to root surface in case of polyacrylic acid treated teeth as compared to citric acid treated teeth.[17]

Many other agents such as phosphoric acid, formalin, chlorhexidine, hydrogen peroxide, cetylpyridium chloride and sodium lauroyl sarcosine, Cohnns factor and bile salts and plasma fractions have also been proved useful as root surface biomodification agents. But there is scanty evidence available for their use in comparison to the commonly used agents such as citric acid, tetracycline hydrochloride or EDTA.[18]

8. Platelet rich plasma (PRP)

Platelets are important component of blood coagulation cascade. Major components of platelet structure include secretory granules (primary, secondary and tertiary granules), which contain growth factors, coagulation proteins, adhesion molecules, cell activating molecules, cytokines, integrins, inflammatory molecules, and some other molecules, which get synthesized in megakaryocytes and gets packaged into the granules through vesicle trafficking processes. The concept behind PRP application for periodontal regenerative procedure is to obtain high density platelet concentrate from patient's own blood. Then the concentrate is applied in the area of periodontal wound healing where regeneration is desired. Platelet derived growth factor (PDGF) is a major mitogen for fibroblasts, smooth muscle cells, and other cells.[19]

9. Recombinant human growth factors

Presently, the application of growth factors for periodontal regeneration is a major focus of research. Various growth factors which are considered to contribute to periodontal regeneration include the platelet derived growth factor (PDGF), insulin like growth factor (IGF), transforming growth factor (TGF), epidermal growth factor (EGF), fibroblast growth factor (FGF), and bone morphogenetic protein (BMP). Usually, these growth factors promote proliferation of fibroblasts from the periodontal ligament and favour bone formation. Evidences provide improved cellular response following growth factor application. Enamel Matrix Derivatives (EMD) induced PDL fibroblast proliferation and migration, total protein synthesis, Alkaline Phosphatase (ALP) activity, and mineralization, whereas TGF-β1 increased cellular adhesion. However, the combination of both these factors did not positively change the PDL fibroblast behavior. PDGF-BB in concentrations equal to or greater than 50ng/ml demonstrates a significant stimulation of PDL cells that are adherent to periodontal disease root surface. Hence it plays an important role in promotion of the PDL healing and can also be useful in clinical application for the promotion of regeneration of the periodontal tissue.[26]

10. Enamel matrix proteins

It is well established that organic matrix plays an important role in mineralization. Application of enamel matrix proteins on root surface creates a biological environment which is similar to that during tooth development favouring periodontal regeneration. This is based on the biologic concept that the application of Enamel Matrix Protein (amelogenins) would promote periodontal regeneration mimicking the events that take place during the development of periodontal tissues. It was found that EMD's increased the proliferation of PDL cells, but not epithelial cells. Total protein production by PDL cells was increased and mineralized nodule formation of PDL cells also showed an increase. Other mechanisms which potentiate periodontal regeneration upon EMD application include enhanced attachment of periodontal ligament fibroblasts to diseased root surfaces, increased production of growth factor, limiting epithelial down growth and improved matrix formation by affecting fibroblast mRNA levels for synthesis of matrix proteoglycans and hyaluronic acid.[27]

Emdogain: is the commercially available formulation of EMD. It is extracted from developing embryonal enamel of porcine origin. It contains several matrix proteins from the amelogenin family. Studies have shown that EMD influences the migration, attachment, proliferative capacity and biosynthetic activity of periodontal ligament cells.[28]

11. Hyaluronic Acid (HA)

HA is an integral component of the periodontal ligament matrix. It plays various important roles in cell adhesion, migration and differentiation mediated by the various HA binding proteins and cell-surface receptors. HA has been considered as a metabolite or diagnostic marker of inflammation in the gingival crevicular fluid (GCF). It is also a significant factor in growth, development and repair of tissues. HA accelerates the bone regeneration mechanism by means of chemotaxis, proliferation and successive differentiation of mesenchymal cells. HA shares bone induction characteristics with osteogenic substances namely bone morphogenetic protein-2 and

osteopontin.[29] Gengigel contains high molecular weight fractions of HA in a gel formulation with 0.2% concentration for its effect in the treatment of plaque-induced gingivitis as an adjunct to SRP[21]. Hyaluronan also increases the production of proinflammatory cytokines by fibroblasts, keratinocytes, cemento blasts and osteo blasts which elevates the inflammatory response and consequently stimulate hyaluronan synthesis by endothelial cells.[30]

12. Lasers

Lasers have been extensively studied for their effect on root surface and on periodontal ligament cells. A study concluded that the usage of the CO2 and Er:YAG laser at the determined power settings can treat dentin hypersensitivity thereby reducing its symptoms significantly. However, the Er:YAG laser has a better effect on tubular occlusion with less thermal change which makes it a useful conditioning tool under such conditions. An in vivo study examined morphologic alterations in the periodontal pocket epithelium with presence or absence of clinical inflammation following the use of the Neodymium: Yttrium-Aluminum-Garnet (Nd:YAG) laser irradiation. The SEM and histologic findings showed the feasibility of ablating pocket epithelium with an Nd:YAG laser irradiation using parameters of 2 W of power (200 mJ, 10 pps). Furthermore, the presence or absence of clinical inflammation appeared to have an influence on the degree of laser-mediated epithelial ablation.[31]

Laser application on root surface showed a significant effect on fibroblast attachment. In an in vitro study, the effect of Nd:YAG laser (at energy 75 mJ at 20 pulse/sec using a 320µm contact fiber for 1 minute) on fibroblast attachment to non-diseased root surfaces was evaluated. The study concluded that laser exposure denatures the surface protein which inhibits fibroblast attachment.[32]

13. Chlorhexidine

Chlorhexidine showed an increase in the bone height when applied to the root surface during surgical treatment of bifurcation defects in dogs. It did not show an influence in the level of connective tissue attachment.[33]

14. Sodium Hypochlorite

Sodium hypochlorite acts as a bactericidal and cleaning agent. It acts by degrading the endotoxins by hydrolysis.[34]

15. Sodium Deoxy Cholate and Human Plasma Fraction Cohn IV

These agents help to dissociate endotoxin into subunits thereby helping to detoxify the diseased root surface. The human plasma fraction possibly contains fibronectin.[3]

16. Formalin

Root surface conditioning by topical application of acidic solutions helps to remove not only root instrumentation smear layer, but also any remaining root surface contaminants. Demineralization of the root surface with root conditioning agents helps in the uncovering and widening of the dentinal tubules with exposure of dentin collagen. It provides a matrix which supports migration and proliferation of cells involved in periodontal wound healing resulting in an improved connective tissue cell attachment to the root surfaces.[35]

Acid conditioning have been used to decontaminate and to demineralize the root surface. Its helps to remove the smear layer, exposing some components of the extracellular matrix of dentin and cementum, such as type I collagen, thereby facilitating attachment between the root surface and the healing connective tissue.[35]

CONCLUSION

It is a known fact that the periodontally diseased root surface does not favour periodontal regeneration due to its surface characteristics. It has been understood that demineralization alters the diseased root surface, creating a more acceptable surface that can influence events in wound healing process. There are many studies that clearly indicate a greater

potential for cell and fiber attachment to demineralized root surfaces. Other factors such as spatial relationships and wound stabilization may also play a vital role in the extent and predictability of periodontal wound healing following root surface demineralization. Appropriate root surface conditioning may regulate the adsorption of plasma proteins, enhance adhesion of the blood clot and stimulate deposition of collagen against the root surface. An understanding of the early events in wound healing is important to the selection of appropriate agents and their potential to promote regeneration. The recent use of Lasers on root surface has also shown promising results and more studies are required for proving its potential. The present status indicates that root biomodification does not have any added advantage in periodontal regeneration and large size randomized clinical trials are required to give a definite conclusion.

REFERENCES

1. Shewale AH, Gattani D, Mahajan R, Saravanan SP, Bhatia N. Root surface biomodification: Current status and a literature review on available agents for periodontal regeneration. Br J of Med Med Res. 2016;13:1-4.
2. Blomlöf JP, Blomlöf LB, Lindskog SF. Smear removal and collagen exposure after non-surgical root planing followed by etching with an EDTA gel preparation. J Periodontol. 1996;67:841–5.
3. Nanda T, Jain S, Kaur H, Kapoor D, Nanda S, Jain R. Root conditioning in periodontology—Revisited. Journal of Natural Science, Biology, and Medicine. 2014 Jul;5(2):356.
4. Blomlöf JP, Blomlöf LB, Lindskog SF. Smear removal and collagen exposure after non-surgical root planing followed by etching with an EDTA gel preparation. J Periodontol 1996;67:841-5.
5. Suchetha A, Darshan BM, Prasad R, BharwaniAshit G (2011) Root Biomodification- A Boon or Bane? Indian J Stomatol 2: 251-5
6. Blomlof J, Lindskog S (1995) Root surface texture and early cell and tissue colonization after different etching modalities. Eur J Oral Sci 103: 17-24.
7. Wikesjo UM, Selvig KA (1999) Periodontal wound healing and regeneration. Periodontol 2000 19: 21-39.
8. Chandra RV, Jagetia GC, Bhat KM (2006) The attachment of V79 and human periodontal ligament fibroblasts on periodontally involved root surfaces following treatment with EDTA, citric acid, or tetracycline HCL: an SEM in vitro study. J Contemp Dent Pract 7: 44-59.
9. Bhushan K, Chauhan G, Prakash S. Root biomodification in periodontics-the changing concepts. J Dent Oral Care Med. 2016;2(1):105.
10. Oles RD, Ibbot CG, Laverthy WH (1985) Effects of citric acid treatment on pedicle flap coverage of localized recession. J Periodontol 56: 259-61.
11. Register AA (1978) Induced reattachment in periodontal endodontic lesion by root demineralization in situ. Oral Surg Oral Med Oral Pathol 45: 774-83.
12. Hanes PJ, o'brien NJ, Garnik JJ (1991) A morphological comparison of radicular dentin following root planing and treatment with citric acid or tetracycline hcl. J Clin Periodontal 18: 660-8.
13. Ciancio SG (1990) Antibiotics in periodontal therapy. In Newman MG, Kornman K, editors: Antibiotics/antibacterial use in dental practice, Chicago, Quintessence.
14. Madison JG, Hokett SD (1997) The effects of different tetracyclines on the root surface of instrumented, periodontally involved human teeth: A comparative scanning electron microscope study. J Periodontol 68: 739-45.

15. Wikesjo UM, Baker PJ, Christersson LA, Genco RJ, Lyall RM, et al. (1986) A biochemical approach to periodontal regeneration: Tetracycline treatment conditions dentin surfaces. J Periodont Res 21: 322-9.

16. Penmatsa T, Varma S, Mythili, Rao KP, Kishore T, Bindu H (2013) Effect of various concentrations of tetracycline hydrochloride demineralization on root dentin surface: A scanning electron microscopic study. J Pharm BioalliedSci 5: S48-53.

17. Register AA, Burdick FA (1975) Accelerated reattachment with cementogenesis to dentin, demineralized in situ. I. Optimum range. J Periodontol 46: 646-55.

18. Garrett JS, Crigger M, Egelberg J (1978) Effects of citric acid on diseased root surfaces. J Periodontal Res 13: 155-63.

19. Pitaru S, Melcher AH (1983) Orientation of gingival fibroblasts and newly synthesized Collagen fibers in vitro. Resemblance to transseptal and dentogingival fibers. J Periodontal Res 18: 483-500.

20. Smith B, Caffesse R, Nasjleti C, Kon S, Castelli W (1987) Effects of citric acid and fibronectin and laminin application in treating periodontitis. J ClinPeriodontol 14: 396-402

21. Sangeetha Subramanian et al., Fibrin Clot Adhesion to Dentin Journal of Clinical and Diagnostic Research. 2017 Aug, Vol-11(8): ZC82-ZC85

22. Terranova V, Martin S (1982) Molecular factors determining gingival tissue interactions with tooth structure. J Periodontal Res 17: 530-3.

23. Wiland BB, Hancock EB, Kafrawy AH (1990) The effect of polyacrylic acid on root surface. Research forum abstracts, Annual meeting of AAP at Dallas, Texas, USA.

24. Demirel K, Baer PN, mcnamara TF (1991) Topical application of doxycycline on periodontally involved root surfaces in vitro: Comparative analysis of subtantivity on cementum and dentin. J Periodontol 62: 312-6.

25. Wang HL, Pappert TD, Castelli WA, Chiego DJ, Shyr Y, et al. (1994) The effect of platelet derived growth factor on the cellular response of the periodontium: an autoradiographic study on dogs. J Periodontol 65: 429-36.

26. Rodrigues TL, Marchesan JT, Coletta RD, Novaes Jr AB, Grisi MF, Souza SL et al. Effects of enamel matrix derivative and transforming growth factor-ß1 on human periodontal ligament fibroblasts. Journal of clinical periodontology. 2007 Jun;34(6):514-22.

27. Gestrelius S, Andersson C, Lidström D (1997) In vitro studies on periodontal ligament cells and enamel matrix derivative. J ClinPeriodontol 24: 685-92.

28. Hammarstro ML (1997) Enamel matrix, cementum development and regeneration. J ClinPeriodontol 24: 658-68. 62. Gestrelius S, Andersson C, Lidström D (1997) In vitro studies on periodontal ligament cells and enamel matrix derivative. J ClinPeriodontol 24: 685-92.

29. Fujioka-Kobayashi M, Müller HD, Mueller A, Lussi A, Sculean A, Schmidlin PR et al. In vitro effects of hyaluronic acid on human periodontal ligament cells. BMC Oral Health. 2017 Dec;17(1):1-2.

30. Jentsch H, Pomowski R, Kundt G, Göcke R (2003) Treatment of gingivitis with hyaluronan. J ClinPeriodontol 30: 159-64.

31. Ting CC, Fukuda M, Watanabe T, Sanaoka A, Mitani A, Noguchi T. Morphological alterations of periodontal pocket epithelium following Nd: YAG laser irradiation. Photomedicine and Laser Surgery. 2014 Dec 1;32(12):649-57.

32. Thomas D, Rapley J, Cobb CM, Spencer P, Killoy W (1994) Effects of the Nd:YAG laser and combined treatments on in vitro fibroblast

attachment to root surface. J ClinPeriodontol 21: 38-44.

33. Alleyn CD, O'Neal RB, Strong SL, Scheidt MJ, Van Dyke TE, mcpherson JC. The effect of chlorhexidine treatment of root surfaces on the attachment of human gingival fibroblasts in vitro. Journal of periodontology. 1991 Jul;62(7):434-8.

34. Estrela C, Estrela CR, Barbin EL, Spanó JC, Marchesan MA, Pécora JD. Mechanism of action of sodium hypochlorite. Brazilian dental journal. 2002;13:113-7.

35. Lee JY, Seol YJ, Park JR, Park YJ, Chung CP. Biological effects of a root conditioning agent for dentin surface modification in vitro. Journal of periodontal & implant science. 2010 Dec 1;40(6):257-64.