Effect of Periodontally Accelerated Osteogenic Orthodontics (PAOO) on Periodontium: A case report

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Abstract:

Background: Periodontally accelerated osteogenic orthodontics found to be effective in accelerating orthodontic treatment. Proper case selection and careful surgical and orthodontic treatment is very important. This technique accelerates the tooth movement while maintaining the integrity of the periodontium. The aim of this paper is to present rapid and effective Periodontally accelerated osteogenic orthodontics treatment while maintaining the integrity of periodontium.

Methods: Subject diagnosed with angle class II, div.I malocclusion with healthy periodontium was included. After initial orthodontic alignment and leveling Periodontally accelerated osteogenic orthodontics advocated for comprehensive fixed orthodontic appliances in conjunction with full thickness flaps with labial and lingual corticotomies around teeth to be moved in was performed. Bone graft (DFDBA) was applied directly over the bone cuts and flaps sutured. Periodontal variables including Pocket Probing Depth, Plaque Index, Gingival Index and Clinical Attachment Level were taken at baseline and after 1, 3 and 6 months. Tooth movement was initiated two weeks after the surgery, with activation of orthodontic appliance every 2 weeks.

Results: All the periodontal variables after completion of the treatment were almost similar to the baseline values showing no attachment loss or increased pocket depth. Orthodontic treatment time with this technique reduced to nearly one-third the time of conventional orthodontics.

Conclusion: Alveolar augmentation were used in an effort to enhance and strengthen the periodontium, reasoning that the addition of bone to alveolar housing, ensures root coverage as the dental arch expanded. Controlled clinical and histological studies are needed to understand the biology of tooth movement, the effect on teeth and bone, post-retention stability, and determining the status of the periodontium and roots after treatment.

Key words: Regional Accelerated Phenomenon Corticotomy Periodontally Accelerated Osteogenic Orthodontics

INTRODUCTION

The average length of orthodontic treatment is two years depending on the treatment options and individual characteristics. To increase efficiency, orthodontists have tried various approaches to decrease treatment time. Corticotomies have recently attracted attention, which uses bone healing mechanisms in combination with orthodontic loadings to decrease treatment time. Periodontally accelerated osteogenic orthodontics (PAOO) may be considered as intermediate therapy between orthognathic surgery and conventional orthodontics for reducing treatment time. PAOO is a therapeutic procedure that helps orthodontic tooth movement by accelerated bone metabolism due to controlled surgical damage. This is not a new procedure, although it was initially based more on techniques using osteotomy instead of approaches with corticotomy. The procedure has several advantages, such as reduced treatment time and facilitation of dental arch expansion. It also makes possible differential tooth movement (i.e., impacted teeth) and shows improved post-orthodontic stability.1,2

In 1893, for the very first time Cunningham presented “Luxation, or the immediate method in the treatment of irregular teeth by using mesial and distal interseptal osteotomies with a circular saw to reposition palatally inclined maxillary teeth. The most important feature was the fact that this combined active surgical-orthodontic treatment reduced the procedure time to one-third that of conventional treatment and allowed more predictable treatment in older patients. Köle popularized the procedure in the English literature with his “bony block” technique. He reported some cases in which interdental vertical corticotomy and subapical horizontal osteotomy was combined dividing the alveolar process in entirety apical to the ends of the roots correcting retrusive and protrusive incisors.3 Bell and Levy published the first experimental study of alveolar corticotomy in 49 monkeys in 1972 and demonstrated vascularity of dental pulp and surrounding medullar bone that distinct avascular zones are progressively recovered after 3 weeks postoperatively, except for the central incisors.4 Thus Corticotomy has been developed that prevents injury of the periodontium and pocket formation, and also prevents devitalization of a single tooth or a group of teeth and enhanced orthodontic tooth movement. Heinrich Frost (1983) for the first time found a direct correlation between the severity of bone corticotomy and/or osteotomy and the intensity of the healing response, leading to accelerated bone turnover at the surgical site. This was designated as “Regional Acceleratory Phenomenon” (RAP). Frost described it as a regional reaction of both hard and soft tissues to noxious stimuli, characterized by an acceleration of most normal processes. An
increase in osteoclastic activity and a hastening of alveolar ridge resorption have been observed in the maxilla and mandible following the application of a bony insult.\(^5\)

Wilcko et al described an innovative strategy of combining corticotomy alveolar surgery with alveolar grafting in a technique referred to initially as accelerated osteogenic orthodontics (AOO) and more recently as periodontally accelerated osteogenic orthodontics (PAOO). This technique combines fixed orthodontic appliances, labial and palatal/lingual corticotomies, and bone grafting. Tooth movement was initiated 2 weeks after surgery, and every 2 weeks thereafter by activation of the orthodontic appliance.\(^4\)\(^5\) Wilcko et al were first to suggest that tooth movement assisted with corticotomy may be due to a demineralization-remineralization process rather than bony block movement based on the phenomenon of Regional Accelerated Phenomenon (RAP).\(^5\)

Thus corticotomy is defined as a surgical procedure where by only the cortical bone is cut, perforated and mechanically altered but the medullary bone is not changed. Thus the periodontal corticotomy procedure actually accelerates the orthodontic treatment while maintaining the periodontal hard and soft tissues integrity. The aim of this paper is to present effect of periodontally accelerated osteogenic orthodontic treatment on the periodontium.

**CASE REPORT**

A female patient with age 21-23 yrs were recruited who reported to the Department of orthodontics with the chief complaint of protruded teeth in upper front teeth region. No signs or symptoms of temporomandibular dysfunction were noted and their intraoral examination revealed Angle's class II div 1 malocclusion with increased overjet of 10 mm ±1mm and requiring extraction of all four first premolars. They were referred to the department of periodontics for evaluation of the periodontal status and for corticotomy procedure treatment plan. They were free from any allergies or medical problems and no long term intake of NSAIDS were reported. Various periodontal variables like pocket probing depth, gingival index(GI)(Loe and Silness 1963), plaque index(Pl) (Silness and Loe 1967), and clinical attachment levels were taken to check for the gingival and periodontal health status and the subject was diagnosed with having healthy periodontium. Full mouth pre and post IOPAs and OPG (Fig.6,7) were taken for the radiographic diagnosis. There was no bony defects present as was evident on the OPG. Extra oral photographs showed protrusive upper and lower lips with acute nasolabial angle.

The objectives behind the treatment were to retract the maxillary anterior teeth and to correct the overjet and overbite by preserving the periodontal structures integrity.

**MATERIALS AND METHODS**

**Orthodontic Considerations and Surgical Procedure**

The study was conducted with informed consent of subject and ethical clearance from ethical clearance committee of the institution. (Institute of Dental Sciences, Bareilly. (U.P) India.) Routine blood investigations were done before the commencement of the surgical procedure.

After recording complete baseline periodontal variables as mentioned earlier and oral prophylaxis the patient was treated using .022” MBT slot bracket. After orthodontic alignment and levelling for 2 months using a 014” and 016” NiTi wire and after extraction of both upper first bicuspids(Fig.1),corticotomy procedure was planned. Under adequate local anesthesia (1:80,000 adrenaline) a full thickness mucoperiosteal flap was reflected with extensions made from maxillary canine of one side to the other side reflecting beyond the root apices. After reflecting the flap from both the palatal and labial side, corticotomy cuts were given in the alveolar bone with a high speed handpiece with no.2 straight and round carbide burs.

The vertical cuts were made to extend from 2 mm apical to the crestal bone and were extended apically 1-2 mm beyond the apex of the roots in the interradicular space mid way between the root prominences. These vertical cuts were joined by the horizontal cuts apically. Similar technique was followed to complete the decortication on palatal side. After complete decortication of the alveolar bone, solitary perforations were made in the alveolar bone over the radicular surface with the help of round burs. (Fig.3,4) After bleeding has been controlled demineralized freeze-dried bone allograft (DFDBA) was placed over the entire decorticated area both labially and palatally. (Fig.5) The flaps were repositioned and closed with interrupted silk sutures and pack was placed. Subjects were prescribed antibiotics and NSAIDS for 5 days and short term corticosteroids for minimal swelling and discomfort. Subject was recalled after 24 hours for a checkup and they were again recalled after 7 days for suture removal. All the subjects reported minimal swelling and discomfort after the corticotomy procedure.

The retraction was started on a rectangular .017 x .025 stainless steel arch wire with 250-300 gm force applied after 2 weeks of the corticotomy procedure. The en masse retraction was done using sliding mechanics with the help of a closed coil spring. The active treatment was continued for 4 months till the extraction spaces were closed and overjet became normal. All the periodontal variables were recorded 1 month after the surgical procedure as well as after the extraction space closure around 4-6 months.

**RESULT**

After the corticotomy procedure, the orthodontic treatment objectives were met in just \(\frac{2}{3}\) to 1/3 of the reported conventional treatment time. Periodontal examination of anterior teeth revealed no increase in pocket depths or gingival inflammation or recession. The protrusive facial profile was improved. The proclination of upper anterior teeth was eliminated; the large overjet was reduced to normal. No bone resorption was seen after the completion of the treatment. On the panoramic and periapical radiographs taken at the end of treatment, well-aligned and parallel roots of the teeth were noted. (Fig.2) No periapical pathology or resorption of the roots was detected in the treated area.

**DISCUSSION**

Periodontally Accelerated Osteogenic Orthodontics can play an important role in the comprehensive treatment of patients’ occlusal and esthetic needs, as this procedure has shown optimal results regarding increased alveolar bone thickness, decreased treatment time , reduced patient discomfort of long term use of brackets and also increased the long term stability of the orthodontic treatment with healthy periodontium.\(^7\) The results of present study are in accordance with the results of the study done by (Wilcko et al 2001;2003;2008)\(^3,5\) in which the corticotomy procedure has reduced the treatment time and the
teeth moved 3-4 times faster than the conventional orthodontics. According to Wilcko et al it is the placement of the bone graft which is additional step that is believed to be responsible for the increased post-treatment stability and increased alveolar bone width as well as maintainable periodontium. The results of this study has shown surgical complications to be minimal with PAOO. The plaque scores were initially slightly raised after the placement of the orthodontic appliance as the subjects experienced some difficulties in reaching optimal plaque scores but at the end of the treatment the scores were not high and are of not much concern. The pocket depth and attachment changes demonstrate that the surgical procedure was not damaging to the periodontal tissues as any increase in pocket depth and clinical attachment loss was not found after the completion of the treatment and follow up. Longitudinal studies have shown that shallow sites lose approximately 0.5 mm of probing attachment after periodontal surgery where as in our study, we could not observe any attachment loss of clinical significance. In addition, the orthodontic treatment had improved the clinical attachment of some teeth which were out of alignment prior to the treatment. No Gingival recession was found and the interdental papillae were preserved, ensuring a good post-treatment esthetic results and stability. The corticotomy restricted to the cortical bone layer minimized the injury of the vital structures as stated by Kole who showed the importance of preserving an intact spongiosa using this technique for the first time. The observation of the post-operative periapical radiographs revealed no apical root resorption during the treatment. However, this type of phenomenon is mostly being observed after non-surgical orthodontic treatment. The incidence of root resorption by use of corticotomy is decreased when compared with conventional treatment because of the use of the bone grafts. The frequency of other possible complications, such as ankylosis and devitalization, is unknown, but such complications have not been reported.

CONCLUSION
Periodontally Accelerated Osteogenic Orthodontics is a promising adjuvant technique, indicated for many situations in the orthodontic treatment of adults without adversely affecting the periodontium. Controlled clinical and histological studies are needed to understand the biology of tooth movement with this procedure, the effect on teeth and bone, post-retention stability, measuring the volume of mature bone formation, and determining the status of the periodontium and roots after treatment.

REFERENCES
LIST OF PHOTOGRAPHS

Fig.1 Pre-operative Left Lateral Intraoral view after extraction of first premolars

Fig.2 Post-operative left lateral Intraoral view after space closure

Fig.3 Corticotomy cuts on the maxillary labial aspect after full mucoperiosteal flap reflection

Fig.4 Corticotomy cuts on the maxillary Palatal aspect after full mucoperiosteal flap reflection

Fig.5 Bone graft (DFDBA) placement after placement of corticotomy cuts

Fig.6 Pre-operative OPG

Fig.7 Post-operative OPG