

Alveolar Corticotomies : A Review & A Case Report

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Abstract

Alveolar Corticotomy-assisted orthodontic treatment is an effective technique that has shown to reduce longer time required for orthodontic treatment which has gradually led to its acceptance and popularity as an adjunct to the orthodontic treatment. This technique includes selective alveolar decortication in the form of decortication lines and dots performed around the teeth that are to be moved. It leads to increased tissue turnover and a transient osteopenia, which is followed by a faster rate of orthodontic tooth movement which offers several advantages, including faster tooth movement, shorter treatment time, enhanced post-orthodontic treatment stability and extended envelope of tooth movement. This article presents a comprehensive review of the literature, including historical background, indications, and contraindications along with a case report on Corticotomy.

Keywords: Corticotomy, PAOO (Periodontally Accelerated Osteogenic Orthodontics), tooth movement

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Introduction

Ideal esthetic, restorative and reconstructive dental treatments are facilitated by favorably positioned teeth and an enhance dmuco-gingival complex.¹ Patients requiring comprehensive dental rehabilitation, correction of malocclusion or tooth alignment, frequently require orthodontic treatment in order to obtain acceptable esthetic and functional treatment outcome.¹ However, orthodontic treatment requires 2-3 years which can be an obstacle in undergoing ideal rehabilitative dental care. By combining periodontal surgery (corti-cotomy) with orthodontic treatment the time required for traditional orthodontic therapy is reduced by 60-75%. This article is a series of various orthodontic cases that have been treated successfully with satisfactory results within a short span of time using the PAOO technique.¹

Definition

Alveolar corticotomies (ACS) are defined as a surgical intervention limited to the cortical portion of the alveolar bone. In osteotomies both cortical and trabecular bone material is removed in considerable quantities with incisions piercing the cortical layer, and at the same time penetrate minimally into the bone marrow.²

Attempts to shorten the time needed for tooth movement can be divided into three categories:

- (1) Local administration of chemicals,
- (2) Physical or mechanical stimulation of the alveolar bone, such as the use of direct electrical current or magnets, and
- (3) Surgery, including dental distraction and alveolar corticotomies.³

History

The first reports on surgical approaches to correct poorly positioned teeth are assigned to L. C. Brian, in 1892, and G. Cunningham, in 1893.⁴ The former reported such cases at the Meeting of the American Dental Society of Europe and the latter presented the possibility of immediate correction of irregular teeth during the Dental Conference in Chicago that year.

* Some fifty-odd years later, in 1959, Köle⁵ used a combination of interradicular corticotomies and supra-apical osteotomies to speed up tooth movement. This treatment approach never gained widespread acceptance, probably due to the association of horizontal subapical osteotomies, which posed considerable risks to the periodontium and tooth pulp vitality.⁶ Furthermore, the use of removable orthodontic appliances provided poor control of

tooth movement, which inevitably compromised orthodontic treatment outcome.

In 1975, Du□ker⁷ performed the first animal study replicating the technique described by Köle.⁵ A few years later, subapical osteotomies were replaced by cuts limited to the cortical portion of the alveolar bone. Hence the first description of a surgical attempt to enhance orthodontic treatment using only corticotomies, thereby reducing the risks inherent in the previous approach. Furthermore, the use of fixed orthodontic appliances increased the control and efficiency afforded by this therapeutic combination.⁸

* The use of ACS as an aid to orthodontic therapy remained limited. However since 2001, there have been renewed attempts at popularizing this therapeutic approach. A modified, more localized surgical technique proved very effective in helping to intrude supra-extruded molars with magnets.⁹

* In addition, another variant—which expands the technique and combines it with lyophilized bone grafts—was presented as a means to accelerate and significantly shorten conventional orthodontic treatment time.¹⁰

* Wilcko brothers—an orthodontist and a periodontist—reported a 1/2 to 1/3 reduction in traditional orthodontic treatment time, their publications and conference presentations aroused intense curiosity, mainly because they were based solely on case reports. In this context, many clinical orthodontists and researchers began to study into this subject in order to gain an in-depth understanding of how alveolar corticotomies affect orthodontic movement.¹⁰

Indications

1. Enhanced correction of severe bimaxillary protrusion.¹¹
2. Closure of complex skeletal open bites,¹² facilitated molar intrusion with removable appliances.¹³
3. Intrusion and molar uprighting combining.¹⁴
4. ACS and mini-implants.¹⁴
5. Optimization of treatment of patients with cleft lip and palate.¹⁵
6. To accelerate corrective orthodontic treatment, as a whole,
7. To facilitate the implementation of mechanically challenging orthodontic movements,¹⁵
8. To enhance the correction of moderate to severe skeletal malocclusions.¹³
9. Resolve crowding and shorten treatment time.¹⁶

10. Accelerate canine retraction after premolar extraction
11. Enhance post orthodontic stability
12. Facilitate eruption of impacted teeth
13. Facilitate slow orthodontic expansion
14. Molar intrusion and open bite correction¹³

Contraindications & Limitations

Despite an increasing number of reports on the use of alveolar corticotomies as an aid to orthodontic treatment, few studies have reported setbacks when employing this combined treatment. Recently, however, Wilcko et al gave an objective account of scenarios where the use of ACS-orthodontics should be avoided, i.e.,

- (1) Patients showing any sign of active periodontal disease,
- (2) Individuals with inadequate lytreated endodontic problems,
- (3) Patients making prolonged use of corticosteroids,
- (4) Persons who are taking any medications that slow down bone metabolism, such as bisphosphonates and NSAIDs.¹³
- (5) Patients on long term steroid therapy due to the presence of devitalized areas of bone
- (6) Patients with compromised width of the attached gingiva.¹³

Advantages

1. Enhanced skeletal malocclusion treatment (i.e., an increase in the limits of tooth movement and a decreased need for extractions)¹³
2. Decreased treatment times (increased rate of tooth movement)
3. Increased alveolar volume and a more structurally complete periodontium (correction of preexisting fenestrations and dehiscence)
4. Alveolar reshaping, enhances patient□s profile
5. Simultaneous recovery of shallow unerupted teeth
6. In certain situations, the additional alveolar bone can also provide improved lip posture
7. Less likelihood of root resorption.¹⁵
8. History of relapse has been very low
9. There is less need for appliances and head gear
10. Both metal and ceramic brackets can be used¹⁷

Disadvantages¹⁷

1. Expensive procedure
2. Mildly invasive procedure and like all surgeries it has risk of some pain, swelling, and the possibility of infection.

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3. Patients who take NSAIDs on a regular basis or have other chronic health problems will not be treated with this technique.¹⁷

Complications

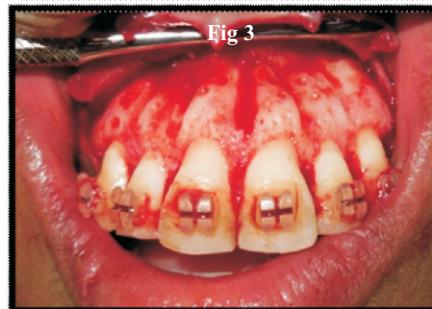
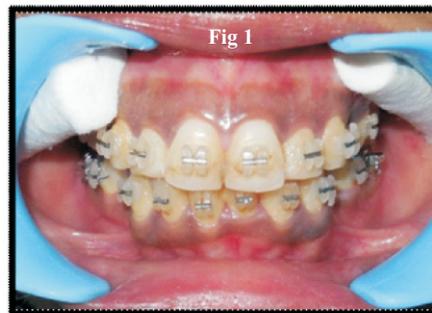
Although Periodontal accelerated osteogenic orthodontics may be considered a less-invasive procedure than osteotomy-assisted orthodontics or surgically assisted rapid expansion, there have still been several reports regarding adverse effects to the periodontium after corticotomy, ranging from no problems to slight interdental bone loss and loss of attached gingiva, to periodontal defects observed in some cases with short interdental distance.^{18,19,20} Subcutaneous hematomas of the face and the neck have been reported after intensive corticotomies.^{21,22} In addition, some post-operative swelling and pain is expected for several days. No effect on the vitality of the pulps of the teeth in the area of corticotomy was reported.²¹ Long-term research on pulpal vitality after rapid movement has not been evaluated in the literature. In an animal study, Liou et al.²² demonstrated normal pulp vitality after rapid tooth movement at a rate of 1.2 mm per week. However, pulp vitality deserves additional investigation. It is generally accepted that some root resorption is expected with any orthodontic tooth movement.²³ An association between increased root resorption and duration of the applied force was reported.^{24,25,26} The reduced treatment duration of Periodontal accelerated osteogenic orthodontics may reduce the risk of root resorption. Renet al.²⁷ reported rapid tooth movement after corticotomy in beagles without any associated root resorption or irreversible pulp injury. Moon et al.²⁸ reported safe and sufficient maxillary molar intrusion (3.0 mm intrusion in two months) using corticotomy combined with a skeletal anchorage system with no root resorption. Long-term effect of Periodontal accelerated osteogenic orthodontics on root resorption requires further study.

Case Report

A female patient was referred from Department of Orthodontics to Out Patient Department of Department of Periodontics for rapid movement of the premolars in the upper front teeth region. A detailed case history revealed the medical and family history to be non-significant. Consent was taken from the patient and a corticotomy procedure was planned out for remodelling of the bone.

The patient was given routine oral prophylaxis and was called after a week for the buccal corticotomy procedure (Fig 1). After administration of local anaesthesia a full thickness flap extending from the distal line angle of the canine to the mesial line angle of the premolar of opposite side was raised. The flap was raised on the buccal side so as to access the interdental bone and for proper visualization (Fig 2). Following this 2 mm holes at 3 mm distance from one another were drilled on the buccal as well as the interdental bone. Holes were drilled in the midline dissecting the area where the flap was raised. Next holes were also drilled on either side of the midline so that

the whole area could undergo osseous remodelling that promotes rapid movement of teeth (Fig 3). Bleeding was elicited from these drilled holes and a depth of 1.5-2 mm was checked and confirmed. After the bleeding was arrested the flap was approximated (Fig 4). Orthodontic forces were installed for closure of the space immediately after surgical procedure. The patient was recalled after 1 week time for removal of the sutures and no post-operative complication was reported by the patient.

**Discussion**

A more recent surgical orthodontic therapy was introduced by Wilcko^{10,17} which included the innovative strategy of combining corticotomy surgery with alveolar grafting in a technique referred to as Accelerated Osteogenic Orthodontics (AOO)¹⁶ and more recently to as

Periodontally Accelerated Osteogenic Orthodontics (PAOO).²⁹ This technique advocated for comprehensive fixed orthodontic appliances in conjunction with full thickness flaps and labial and lingual corticotomies around teeth to be moved. Bone graft consisting of demineralized freeze-dried bone and bovine bone with clindamycin was applied directly over the bone cuts and the flap was sutured in place. Tooth movement was initiated two weeks after the surgery, and every two weeks thereafter by activation of the orthodontic appliance.¹⁷ It is reported that this technique will reduce treatment time to one-third the time of conventional orthodontics. Alveolar augmentation of labial and lingual cortical plates were used in an effort to enhance and strengthen the periodontium, reasoning that the addition of bone to alveolar housing of the teeth, using modern bone grafting techniques, ensures root coverage as the dental arch expanded. They advocated using the PAOO for treatment of moderate to severely crowded Class I and Class II. Several reports indicated that this technique is safe, effective, extremely predictable, associated with less root resorption and reduced treatment time, and can reduce the need for orthognathic surgery in certain situations.^{10,16,17}

Conclusion

PAOO is a promising technique that has many applications in the orthodontic treatment of adults as it helps to overcome many of the current limitations of this treatment, including lengthy duration, potential for periodontal complications, lack of growth and the limited envelope of tooth movement. The mechanism behind ACS can be summarized as the induction of bone metabolism via decortication lines and points around the teeth to be moved to enhance bone and periodontal turnover, resulting in a transient stage of osteopenia during treatment. This enhances and accelerates tooth movement if followed by a short period of orthodontic appliance treatment. ACS effects and mechanisms were confirmed by recent well designed histological studies. However, further randomized human studies are needed to confirm the claimed advantages of this technique and to evaluate the long term effects.

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