Corticotomy facilitated orthodontics: Review of a technique

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Abstract  Corticotomy found to be effective in accelerating orthodontic treatment. The most important factors in the success of this technique is proper case selection and careful surgical and orthodontic treatment.

Corticotomy facilitated orthodontics advocated for comprehensive fixed orthodontic appliances in conjunction with full thickness flaps and labial and lingual corticotomies around teeth to be moved. Bone graft should be applied directly over the bone cuts and the flap sutured in place. Tooth movement should be initiated two weeks after the surgery, and every two weeks thereafter by activation of the orthodontic appliance.

Orthodontic treatment time with this technique will be reduced 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.

Corticotomy facilitated orthodontics is promising procedure but only few cases were reported in the literature. 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.

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1. Introduction

Dental arch crowding is one of the most common form of malocclusion. Two conventional methods to resolve dental arch crowding through orthodontics are extraction and non-extraction. Extraction as a remedy for dental arch crowding is usually reserved for moderate to severe conditions. Non-extraction therapy is usually used to resolve mild to moderate crowding and usually results in proclination of the incisors.

One of the main disadvantages of orthodontic treatment is time. Most of conventional orthodontic treatments require
Corticotomy facilitated orthodontics has been employed in various forms over the past to speed up orthodontic treatments. It was first introduced in 1959 by Kole as a mean for rapid tooth movement. It was believed that the main resistance to tooth movement was the cortical plates of bone and by disrupting its continuity, orthodontics could be completed in much less time than normally expected. Kole’s procedure involves the reflection of full thickness flaps to expose buccal and lingual alveolar bone, followed by interdental cuts through the cortical bone and barely penetrating the medullary bone (corticotomy style). The subapical horizontal cuts connecting the interdental cuts were osteotomy style, penetrating the full thickness of the alveolus. He suggested that since the blocks of bone were being moved rather than the individual teeth, the root resorption would not occur and retention time will be minimized. Because of the invasive nature of Kole’s technique, it was not difficult to understand why it was never widely accepted.

Duker (1975) used Kole’s basic technique on beagle dogs to investigate how rapid tooth movement with corticotomy affects the vitality of the teeth and the marginal periodontium. The health of the periodontium were preserved by avoiding the marginal crest bone during corticotomy cuts. It was concluded that neither the pulp nor the periodontium was damaged following orthodontic tooth movement after corticotomy surgery (Duker, 1975). The results helped to substantiate the belief regarding the health of crestal bone in relation to the corticotomy cuts. Design of the subsequent techniques has taken this into consideration; the interdental cuts are always left at least 2 mm short of the alveolar crestal bone level.

Suya (1991) reported corticotomy-assisted orthodontic treatment of 395 adult Japanese patients. Suya’s technique differed from Kole’s with the substitution of a subapical horizontal corticotomy cuts in place of the horizontal osteotomy cut beyond the apices of the teeth (corticotomy: thinning of cortical plate without penetrating medullary bone, osteotomy: complete cut through cortical plate to medullary bone). Fixed orthodontic appliances were used. Some cases were completed in 6 months, other cases were completed in less than 12 months. Suya contrasted his technique with conventional orthodontics in being less painful, producing less root resorption, and exhibiting less relapse. Outstanding results and extreme patient satisfaction with corticotomy procedures were reported. He believed that the tooth movements were made by moving blocks of bone using the crowns of the teeth as handles. Completing tooth movement in 3–4 months were recommended, after which time the edges of the blocks of bone would begin to fuse together (Suya, 1991).

A more recent surgical orthodontic therapy was introduced by Wilcko et al. (2000, 2001, 2003, 2008) which included the innovative strategy of combining corticotomy surgery with alveolar grafting in a technique referred to as Accelerated Osteogenic Orthodontics (AOO) (Wilcko et al., 2000, 2001, 2003) and more recently to as Periodontally Accelerated Osteogenic Orthodontics (PAOO) (Wilcko et al., 2008). 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. Wilcko et al. (2000, 2001, 2003, 2008) 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 (Wilcko et al., 2000, 2001, 2003; Ozturk et al., 2003; Fischer, 2007; Lee et al., 2007; Sebaoun et al., 2007; Nowzari et al., 2008).

A study was conducted on 65 Korean adult female patients with bimaxillary dentoalveolar protrusion to compare orthodontic treatment outcomes, anterior segmental osteotomy, and corticotomy-assisted orthodontic treatment; it was concluded that orthodontic treatment and corticotomy-assisted orthodontic treatment are indicated for patients with severe incisor pronclination with normal basal bone position, although corticotomy-assisted orthodontic treatment has the advantage of shorter treatment duration. Anterior segmental osteotomy is recommended for bimaxillary dentoalveolar protrusion patients with gummy smile, basal bone prognathism, relatively normal incisor inclination, and relatively underdeveloped chin position (Lee et al., 2007).

2. How is tooth movement with corticotomy facilitated orthodontics differing from tooth movement with conventional orthodontic treatment?

Corticotomy surgery initiates and potentiates normal healing process (Regional Acceleratory Phenomena) (Wilcko et al., 2000, 2001, 2003, 2008). Regional Acceleratory Phenomena (RAP) is local response to a noxious stimulus describes a process by which tissue forms faster than the normal regional regeneration process. By enhancing the various healing stages, this phenomenon makes healing occur 2–10 times faster than normal physiologic healing (Frost, 1983). The RAP begins within a few days of injury, typically peaks at 1–2 months, usually lasts 4 months in bone and may take 6 to more than 24 months to subside (Wilcko et al., 2000, 2001, 2003, 2008).

A recent histological study showed that selective alveolar decortication induced increased turnover of alveolar spongiosa (Sebaoun et al., 2008). The surgery results in a substantial increase in alveolar demineralization, a transient and reversible condition. This will results in osteopenia (temporarily decrease in bone mineral density). The osteopenia enables rapid tooth movement because teeth are supported by and moved through trabecular bone. As long as tooth movement continues, the RAP is prolonged. When RAP dissipates, the osteopenia disappears and the radiographic image of normal spongiosa reappears. When orthodontic tooth movement is completed, an environment is created that favors alveolar re-mineralization.

After proper case selection, orthodontic appliances are better to be placed one week prior to the surgery. Standard brackets, archwires, and normal orthodontic force level can be used. Surgery can be done in a normal clinical setting with or without sedation. Clinic preparation should follow the same protocol used for any oral surgical procedures. After administration of local anesthesia, crevicular incision is made buccally and lingually extending at least two to three teeth beyond the area to be treated. Full thickness (mucoperiosteal) flap is reflected on both buccal and lingual aspects beyond the apices of the teeth if possible (Fig. 1a and b). Care should be exercised not to damage any of the neurovascular bundles exiting the bone and not to disturb muscle attachments. Any interdental papillary tissue remaining interproximally should be left in place. After flap reflection, selective decortication can be performed on both buccal and lingual sides. Vertical corticotomy cuts are made between the roots using a diamond round bur (size 2) stopping just short of the alveolar crest (about 3 mm). These cuts are connected beyond the apices of the teeth (when possible) with a scalloped horizontal cuts. Cortical perforation can be made at selective areas to increase blood supply to the graft material (Fig. 2). Care should be taken not to injure the anterior loop of the inferior alveolar nerve that could extend several millimeters mesial to the mental foramen and be positioned just beneath the buccal cortical plate.

Bone graft materials [Autograft (Nowzari et al., 2008), mix of Autograft + Allograft, Allograft + Xenograft, or Xenograft + Alloplast] are then placed over the decorticated areas (Fig. 3a and b). Antibiotics can be mixed with bone graft. Wilcko et al. (2000, 2001, 2003, 2008) recommended the use of mix of demineralized freeze-dried bone and bovine bone with clindamycin. Care should be taken not to place an excessive amount of bone graft which might interfere with flap placement. If there is any recession in the teeth, it can be treated at the same time with connective tissue graft or acellular dermal matrix allograft (AlloDerm) (Fig. 4).

The mucoperiosteal flap is then sutured with interrupted 4–0 suture being careful to preserve the interdental papillae. Postsurgical instructions are the same as any standard oral surgical procedures. Antibiotics, analgesics, and antiseptic mouthwash should be given to the patient. The sutures are removed after two weeks.

Figure 1 (a, b) Full thickness flap is reflected on both buccal and lingual aspects beyond the apices of the teeth.

Figure 2 Vertical corticotomy cuts are made between the roots stopping just short of alveolar crest. The cuts are connected beyond the apices of the teeth with scalloped horizontal cuts and cortical perforations are made at selective areas.

Figure 3 (a, b) Bone graft materials are placed over the decorticated areas.
Two weeks post-surgery, accelerated orthodontic treatment can be resumed. The intervals for orthodontic adjustments averaged two weeks, ranging from 1 to 3 weeks. During orthodontic treatment, the patient should be in 3 months recall visits to the periodontist to assess the oral hygiene and assure good periodontal health.

4. Advantages of PAOO

- Reduced treatment time: this technique will reduce treatment time to one-third the time of conventional orthodontics (Wilcko et al., 2000, 2001, 2003, 2008).
- History of relapse reported to be very low (Suya, 1991; Wilcko et al., 2000, 2001, 2003, 2008; Fischer, 2007; Nowzari et al., 2008).
- The technique has its roots in orthodontic research and treatments (Kole, 1959a,b,c; Duker, 1975; Suya, 1991; Wilcko et al., 2000, 2001, 2003, 2008; Fischer, 2007; Nowzari et al., 2008).
- In the ten years since PAOO was first applied, the patients’ outcomes were good (Wilcko et al., 2000, 2001, 2003, 2008).

5. Disadvantages of PAOO

- Extra-surgical cost.
- Mildly invasive surgical procedure, and like all surgeries, it has its risks. Post-surgical crestal bone loss and recession may occur.
- Some pain and swelling is expected, and the possibility of infection.
- Not applicable to all cases, proper case selection is necessary to attain a good result. Maxillary and mandibular arch decrowding with normal skeletal relationship and incisors retraction are the main indications (Wilcko et al., 2000, 2001, 2003, 2008).

6. Conclusion

- PAOO is relatively new procedure; only few cases were reported in the literature. 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.
- Long-term studies are needed to evaluate the advantages and disadvantages of this technique.
- PAOO is promising procedure; it may be a solid part of the future of orthodontic treatment.

References


