Review Article

Corticotomy assisted orthodontic treatment – A boom to adult orthodontics

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Abstract

Corticotomy assisted orthodontic treatment is a time-honored and effective orthodontic procedure that progressively extended admiration as an adjunct treatment preference for adults. It involves selective alveolar decortication in the form of lines and dots performed around the tooth that are to be moved. It is done to induce a state of increased tissue turnover and a transient osteopenia, which is followed by a faster rate of orthodontic tooth movement. The treatment time is reduced to one-third of that in conventional orthodontics. Its main advantages are reduction of treatment time and post orthodontic stability. The aim of this article is to present a broad review on the corticotomy assisted orthodontic treatment in adults.

Key words

Corticotomy, Decortication, Orthodontic tooth movement.

Introduction

The progress of corticotomy-assisted orthodontic treatment (CAOT) unlocked the access and gave keys to numerous aspects of limitations in the adult orthodontic treatments. This method reduced treatment time, enhanced expansion of the alveolar bone, promoted differential tooth movement, increased traction of impacted teeth and, ultimately, more post-orthodontic stability. The aim of this article was to present contemporary clinical techniques, indications, contraindications, complications and side effects of CAOT in adults.

Contemporary Clinical Techniques

Wilcko developed a patented technique called Accelerated Osteogenic Orthodontics (AOO) [1] or Periodontally Accelerated Osteogenic Orthodontics (PAOO) [2]. This technique is similar to conventional corticotomy except that selective decortication in the form of lines and points is performed, over all of the teeth that are to be moved. In addition, a resorbable bone graft is placed over the surgical sites to augment the confining bone during tooth movement. After a healing period of one or two weeks, orthodontic tooth movement is started and then followed up using a faster rate of activation at two week intervals [1, 2].

Using this technique, Wilcko reported rapid tooth movement at a rate of 3 to 4 times greater than conventional orthodontic movement, which was attributed to a state of reduced mineralization (reversible osteopenia) of the alveolar bone surrounding the involved teeth during the orthodontic movement and not to bony block movement, as claimed by Köle [1-3].

The concept of reversible osteopenia i.e., demineralization occurs in the alveolar bone and the remaining collagenous matrix of the bone is transported with the tooth during its movement, which is then re-mineralized after the orthodontic movement. This fetched new concepts to the CAOT field, including bone matrix transportation and osteopenia-facilitated rapid tooth movement [3].

The CAOT Technique

The PAOO technique described by Wilcko is as follows: full-thickness flaps are reflected labially and lingually using sulcular releasing incisions. The releasing incision can also be made within the thickness of the gingival attachment or at the base of the gingival attachment (mucogingival junction). Vertical releasing incisions can be used, but they should be positioned at least one tooth away from the “bone activation". Flaps should be carefully reflected beyond the apices of the teeth to avoid damaging the neurovascular complexes exiting the alveolus and to allow adequate decortication around the apices. Selective alveolar decortication is performed in the form of decortication cuts and at points up to 0.5 mm in depth, combined with selective medullary penetration to enhance bleeding. This poses little threat to tooth vitality and makes PAOO much safer than the osteotomy technique, in which cuts extend into the medullary bone around the teeth that are to be moved. Adequate bio-absorbable grafting material is placed over the injured bone. Flaps are then repositioned and sutured into place. Sutures should be left in place for a minimum of two weeks. Tooth movement should start one or two weeks after surgery. Unlike conventional orthodontics, the orthodontic appliance should be activated every two weeks until the end of treatment after PAOO [4].

Indications and Clinical Applications

Several clinical applications for CAOT have been reported. Corticotomy was used to facilitate orthodontic tooth movement and to overcome some shortcomings of conventional orthodontic treatment, such as the long required duration, limited envelope of tooth movement and difficulty of producing movements in certain directions. These applications include the following:

1. Resolve Crowding and Shorten Treatment Time

Corticotomy and osteotomy were used in orthodontics primarily to resolve crowding in a shorter period of time. Several authors have described cases in which moderate and severe crowding was treated without extraction by corticotomy/osteotomy-assisted orthodontics and in shorter periods of time [1-3, 5]. It has been shown that corticotomy is efficient in reducing the treatment time to as little as one-fourth the time usually required for conventional orthodontics [3]. A reduced chance of root resorption [6, 7], less oral hygiene-related enamel decalcification and better patient cooperation and acceptance are possible

advantages when lengthy orthodontic treatment is avoided.

2. Accelerate Canine Retraction after Premolar Extraction

Canine retraction after premolar extraction is a lengthy step during the extraction stage of orthodontic treatment. Canine retraction was accelerated by corticotomy in two animal studies. Both studies demonstrated faster canine retraction when compared to conventional orthodontic retraction of the canines [8, 9].

3. Enhance Post-Orthodontic Stability

Stability after orthodontic treatment may not always be achievable. Little has shown that 10 years after orthodontic treatment, only 30% of patients had satisfactory alignment of the mandibular incisors [10]. Stability was reported as one of the advantages of corticotomy-assisted orthodontics [5]. Corticotomy-facilitated orthodontic treatment was found to result in better retention compared to conventional orthodontic treatment [5, 11]. The improved stability was attributed to the increased turnover of tissues adjacent to the surgical site. Unfortunately, there is still no strong evidence for enhanced stability after CAOT in the literature.

4. Facilitate Eruption of Impacted Teeth

Surgical traction of impacted teeth, especially the canines, is a frustrating and lengthy procedure. A study by Fischer showed that under the same periodontal conditions, the corticotomy-assisted approach produced faster tooth movement during traction of palatally impacted canines compared to conventional canine traction methods at the end of either treatment [12].

5. Facilitate Slow Orthodontic Expansion

A limited number of successful techniques are available for the treatment of maxillary arch constriction; these include surgically assisted rapid palatal expansion (SARPE) and slow palatal expansion. These techniques are aggressive in nature and less accepted by patients. The presence of non-growing alveolar bone that confines the teeth in the predetermined space available in the alveolus limits transverse tooth movement [13]. CAE is an effective technique for the treatment of maxillary transverse deficiency in adults and is assumed to provide greater stability and better periodontal health than conventional expansion, which can be less effective, dangerous and unstable in many patients. In addition, CAE allows differential expansion as well as unilateral expansion in a more controlled way than conventional expansion.

CAE can be a good alternative to conventional orthodontic mechanics in the treatment of unilateral cross-bites in adults, which are either less efficient, patient-dependent, or accompanied by unnecessary side effects such as over-expansion on the normal side, canting of the occlusal plane and compromised vertical dimension [14, 15]. Performing corticotomy on only the constricted side helps to overcome these unnecessary side effects. The decorticated side is assumed to exhibit reduced resistance to expansion and faster tooth movement, making the effect of any bilateral expansion appliance unilateral.

6. Molar Intrusion and Open Bite Correction

CAOT has also been used in the treatment of severe anterior open bite in conjunction with skeletal anchorage [16, 17]. Moon, et al. achieved sufficient maxillary molar intrusion (3.0 mm intrusion in two months) using corticotomy combined with a skeletal anchorage system with no root resorption and with no patient compliance required [17]. Olivieria, et al. also reported 4 mm of molar intrusion in 2.5 months using corticotomy in one patient and 3 to 4 mm in 4 months in another patient [18]. Hawang and Lee demonstrated intrusion of supra-erupted molars using corticotomy, full-time use of magnetic appliances and night-time use of a vertical-pull chin-cup [19]. Yao, et al. achieved a 4 mm molar intrusion using skeletal anchorage in 7.6 months [20].Sherwood, et al. obtained a 4 mm intrusion in 6.5 months using mini-titanium plates [21], and Enacar, et al.

registered approximately 4 mm intrusion in 8.5 months [22].

7. Manipulation of Anchorage

CAOT was used in the treatment of bimaxillary protrusion as an adjunct to manipulate skeletal anchorage without any adverse side effects in only one-third of the regular treatment time [23]. CAOT was also used to achieve molar distalization. After performing segmental corticotomy around the molars, the anchorage value and resistance of the molars to distal movement were effectively reduced without the use of any extra anterior anchorage devices [24].

Contraindications and Limitations

Patients with active periodontal disease or gingival recession are not good candidates for CAOT. In addition, CAOT should not be considered as an alternative for surgically assisted palatal expansion in the treatment of severe posterior cross-bite. CAOT also should not be used in cases where bimaxillary protrusion is accompanied with a gummy smile, which might benefit more from segmental osteotomy [25].

Complications and Side Effects

Although CAOT 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 [23, 26-28]. Subcutaneous hematomas of the face and the neck have been reported after intensive corticotomies [29]. 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 [29]. Long-term research on pulpal vitality after rapid movement has not been evaluated in the literature.

It is generally accepted that some root resorption is expected with any orthodontic tooth movement [30]. An association between increased root resorption and duration of the applied force was reported [31, 32, 33]. The reduced treatment duration of CAOT may reduce the risk of root resorption.

Conclusion

CAOT is a promising technique that has many applications in the orthodontic treatment of adults because 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 CAOT 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. PAOO effects and mechanism were confirmed by recent well designed histological studies. However, further randomized testing in humans is still needed to confirm the claimed advantages of this technique and to evaluate the long term effects.

References

1. Wilcko WM, Wilcko MT, Bouquot JE, Ferguson DJ. Rapid orthodontics with alveolar reshaping: two case reports of decrowding. Int J Periodontics Restorative Dent., 2001; 21: 9–19.
2. Wilcko MT, Wilcko WM, Nabil F. Bissada An evidence-based analysis of periodontally accelerated orthodontic and osteogenic techniques: a synthesis of scientific perspectives. Semin Orthod., 2008; 14: 305–16.
3. Wilcko WM, Ferguson DJ, Bouquot JE, Wilcko MT. Rapid orthodontic

decrowding with alveolar augmentation: case report. World J Orthod., 2003; 4: 197–205.

4. Wilcko MT, Wilcko WM, Pulver JJ, Bissada NF, Bouquot JE. Accelerated osteogenic orthodontics technique: a 1-Stage surgically facilitated rapid orthodontic technique with alveolar augmentation. J Oral Maxillofac Surg., 2009; 67: 2149–59.
5. Hajji SS. The influence of accelerated osteogenic response on mandibular de-crowding [thesis] St Louis: St Louis Univ; 2000.
6. Machado I, Ferguson DJ, Wilcko WM, Wilcko MT, AlKahadra T. Root resorption following orthodontics with and without alveolar corticotomy. J Dent Res., 2002; 80–301.
7. McFadden WM, Engstrom C, Engstrom H, Anholm JM. A study of the relationship between incisor intrusion and root shortening. Am J Orthod Dentofacial Orthop., 1989; 96: 390–6.
8. Ren A, Lv T, Zhao B, Chen Y, Bai D. Rapid orthodontic tooth movement aided by alveolar surgery in beagles. Am J Orthod Dentofacial Orthop., 2007; 131: 160.e1–10.
9. Mostafa YA, Fayed MM, Mehanni S, ElBokle NN, Heider AM. Comparison of corticotomy-facilitated vs standard tooth-movement techniques in dogs with miniscrews as anchor units. Am J Orthod Dentofacial Orthop., 2009; 136: 570–7.
10. Little RM. Stability and relapse of dental arch alignment. In: Burstone CJ, Nanda R, editors. Retention and stability in orthodontics. Philadelphia: Saunders; 1993, p. 97–106.
11. Nazarov AD, Ferguson DJ, Wilcko WM, Wilcko MT. Improved retention following corticotomy using ABO objective grading system. J Dent Res., 2004; 83: 2644.
12. Fischer TJ. Orthodontic treatment acceleration with corticotomy-assisted exposure of palatally impacted canines. Angle Orthod., 2007; 77: 417–20.
13. Vanarsdall RL., Jr Transverse dimension and long-term stability. Semin Orthod., 1999; 5: 171–80.
14. Lindner A. Longitudinal study on the effect of early interceptive treatment in 4-year-old children with unilateral crossbite. Scand J Dent Res., 1989; 97: 432–38.
15. Brin I, Ben-Bassat Y, Blustein Y, et al. Skeletal and functional effects of treatment for unilateral posterior crossbite. Am J Orthod Dentofacial Orthop., 1996; 109: 173–79.
16. Kanno T, Mitsugi M, Furuki Y, Kozato S, Ayasaka N, Mori H. Corticotomy and compression osteogenesis in the posterior maxilla for treating severe anterior open bite. Int J Oral Maxillofac Surg., 2007; 36: 354–57.
17. Moon CH, Wee JU, Lee HS. Intrusion of overerupted molars by corticotomy and orthodontic skeletal anchorage. Angle Orthod., 2007; 77: 1119–25.
18. Oliveira DD, de Oliveira BF, de Araújo Brito HH, de Souza MM, Medeiros PJ. Selective alveolar corticotomy to intrude overerupted molars. Am J Orthod Dentofacial Orthop., 2008; 133: 902–8.
19. Hwang H, Lee K. Intrusion of overerupted molars by corticotomy and magnets. Am J Orthod Dentofacial Orthop., 2001; 120: 209–16.
20. Yao CC, Wu CB, Wu HY, Kok SH, Chang HF, Chen YJ. Intrusion of the overerupted upper left first and second molars by mini-implants with partial-fixed orthodontic appliances: a case report. Angle Orthod., 2004; 74: 550–7.
21. Sherwood KH, Burch JG, Thompson WJ. Closing anterior open bites by intruding molars with titanium miniplate anchorage. Am J Orthod Dentofacial Orthop., 2002; 122: 593–600.

22. Enacar A, Pehlivanoglu M, Akcan CA. Molar intrusion with a palatal arch. J Clin Orthod., 2003; 37: 557–9.
23. Iino S, Sakoda S, Miyawaki S. An adult bimaxillary protrusion treated with corticotomy-facilitated orthodontics and titanium miniplates. Angle Orthod., 2006; 76: 1074–82.
24. Spena R, Caiazzo A, Gracco A, Siciliani G. The use of segmental corticotomy to enhance molar distalization. J Clin Orthod., 2007; 41: 693–9.
25. Lee JK, Chung KR, Baek SH. Treatment outcomes of orthodontic treatment, corticotomy-assisted orthodontic treatment, and anterior segmental osteotomy for bimaxillary dentoalveolar protrusion. Plast Reconstr Surg., 2007; 120: 1027–36.
26. Nishida M, Iizuka T, Itoi S, Hyo Y, Ono T. Clinical study of corticotomy by Kole's method. J Jpn Oral Surg Soc., 1986; 3: 81–4.
27. Kwon HJ, Pihlstrom B, Waite DE. Effects on the periodontium of vertical bone cutting for segmental osteotomy. J Oral Maxillofac Surg., 1985; 43: 952–5.
28. Dorfman HS, Turvey TA, Hill C. Alterations in osseous crestal height following interdental osteotomies. Oral Surg Oral Med Oral Pathol., 1979; 48: 120–5.
29. Oztürk M, Doruk C, Ozeç I, Polat S, Babacan H, Biçakci AA. Pulpal blood flow: effects of corticotomy and midline osteotomy in surgically assisted rapid palatal expansion. J Craniomaxillofac Surg., 2003; 31: 97–100.
30. Owman-Moll P, Kurol J, Lundgren D. Continuous versus interrupted continuous orthodontic force related to early tooth movement and root resorption. Angle Orthod., 1995; 65: 395–402.
31. Harry MR, Sims MR. Root resorption in bicuspid intrusion: a scanning electron microscope study. Angle Orthod., 1982; 52: 235–58.
32. Kvam E. Scanning electron microscopy of tissue changes on the pressure surface of human premolars following tooth movement. Scand J Dent Res., 1972; 80: 357–68.
33. McFadden WM, Engstrom C, Engstrom H, Anholm JM. A study of the relationship between incisor intrusion and root shortening. Am J Orthod Dentofacial Orthop., 1989; 96: 390–6.