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Corticotomy–An Accelerated Orthodontic Procedure

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Abstract **Review Article**

Corticotomy found to be effective in accelerating orthodontic treatment. It involves selective alveolar decortication in the form of decortication lines and dots performed around the teeth 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. This technique has several advantages, including faster tooth movement, shorter treatment time, safer expansion of constricted arches, enhanced post-orthodontic treatment stability and extended envelope of tooth movement.

Keywords: orthodontic treatment, teeth, tissue, transient osteopenia.

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INTRODUCTION

Corticotomy is a surgical procedure used to reduce orthodontic treatment time. This procedure involves the removal of the cortical bone that strongly resists orthodontic force while keeping the marrow bone to maintain blood circulation and continuity of bone tissues to reduce risk of necrosis and facilitate tooth movement [1]. The concept of regional acceleratory phenomenon and the skeletal anchorage system using screw and plate were introduced and developed in the 21st century enabling the application of orthopedic force beyond conventional orthodontic force, so corticotomy has been applied across cases. Also, various modified methods of accelerated orthodontics, mainly minimally invasive techniques have been introduced to reduce the patient's discomfort and complications following surgery [2-4].

HISTORICAL BACKGROUND

Corticotomy has roots in orthopedics going back to the early 1900s. In 1892, it was first defined as a linear cutting technique in the cortical plates surrounding the teeth to produce mobilization of the teeth for immediate movement [5]. Köle introduced a surgical procedure involving both osteotomy and corticotomy to accelerate orthodontic tooth movement, based on the concept that teeth move faster when the resistance exerted by the surrounding cortical bone is reduced via a surgical procedure. Köle further explained that the reduced resistance enhances an en bloc movement of the entire alveolar cortical segment, which is connected by softer medullary bone, including the confined teeth, when exposed to orthodontic forces [4]. This theory of en bloc movement to enhance tooth movement prevailed in several subsequent reports [5]. Suya specified that most orthodontic treatments should be completed in the first three to four months after corticotomy and before fusion of the tooth-bone units [6]. Generson et al. reported about cases treated using a corticotomy- only technique for accelerated tooth movement, which led to successful results [7]. Frost 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 “Regional Acceleratory Phenomenon” (RAP). RAP was explained as a temporary stage of localized soft and hard-tissue remodeling that resulted in rebuilding of the injured sites to a normal state through recruitment of osteoclasts and osteoblasts via local intercellular mediator mechanisms involving precursors, supporting cells, blood capillaries and lymph [8]. This accelerated remodeling is influenced by bone density and the hyalinization of the periodontal ligament [9].

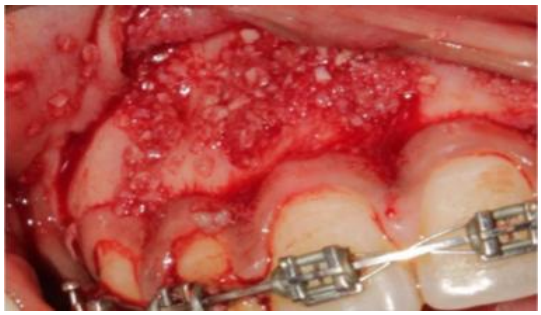
Surgical technique [10]

1. Flap design

Full thickness flap is elevated towards the coronal aspect and partial thickness towards the apical portion to avoid tension at the time of closure.

2. Decortication: Corticotomies are done in mid interdental areas, using no 2 carbide bur.

3. Bone Graft: Commonly de-proteinized bovine bone, decalcified free-dried bone allograft and autogenous bone grafts are used.



4. Primary closure: For predictable bone augmentation, flap should be closed without excessive tension. Flap is usually sutured at the mid line in the interproximal areas followed by other areas.

Indications and Clinical Applications

Corticotomy is 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 [11]. It has been shown that corticotomy is efficient in reducing the treatment time to as little as onefourth the time usually required for conventional orthodontics [12].

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 [13, 14].

3. Enhance Post-Orthodontic Stability

Stability after orthodontic treatment may not always be achievable. Stability was reported as one of the advantages of corticotomy-assisted orthodontics [15]. Corticotomy-facilitated orthodontic treatment was found to result in better retention compared to conventional orthodontic treatment. The improved stability was attributed to the increased turnover of tissues adjacent to the surgical site [15, 16].

4. Facilitate Eruption of Impacted Teeth

Surgical traction of impacted teeth, especially the canines, is a frustrating and lengthy procedure. A study by Fischer [17] 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.

5. Facilitate Slow Orthodontic Expansion

A limited number of successful techniques is 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 [18]. Yen et al. reported a cleft patient with palatal constriction in the upper arch

who was treated via corticotomy assisted expansion (CAE) after surgical closure of a palatal fistula [19]. CAE is an effective technique for the treatment of maxillary transverse deficiency in adults and is 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 overexpansion on the normal side, canting of the occlusal plane and compromised vertical dimension [20, 21]. 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 [22]. 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 [23]. Hawang and Lee [24] demonstrated intrusion of supra-erupted molars using corticotomy, full-time use of magnetic appliances and night-time use of a vertical-pull chin-cup. Intrusion can also be obtained using other orthodontic treatment approaches without selective corticotomies; however, this requires a longer active treatment time.

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. CAOT was also used to achieve molar distalization. After performing segmental corticotomy around the molars, the anchorage value and resistance of the molars to distalmovement were effectively reduced without the use of any extra anterior anchorage devices [25].

CONTRAINDICATIONS [26]

1. Patients showing any sign of active periodontal disease
2. Individuals with inadequately treated 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.

ADVANTAGES [27]

1. Corticotomy procedure causes minimal changes in the periodontal attachment apparatus.
2. It has been proven successfully by many authors to accelerate tooth movement.
3. Bone can be augmented; thereby preventing periodontal defects.
4. Nutritive function is also maintained.

DISADVANTAGES [27]

1. Invasive procedure leading to high morbidity.
2. Chances of damage to adjacent vital structures.
3. Postoperative pain and swelling.
4. Chances of infection or avascular necrosis.
5. Low acceptance by the patient.

CONCLUSION

CAOT is a promising technique that has many applications in the orthodontic treatment because it helps to overcome many of the current limitations of treatment. Although corticotomy is an invasive procedure, RAP appears to reduce the resistance of bone during tooth movement, thereby shortening the period of orthodontic treatment and minimizing adverse effects on teeth. The CAOT procedures do not seem to involve major complications, such as root resorption, affection at periodontal level or pulpal vitality, in comparison to conventional orthodontic treatments.

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