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Review Article

Dentoalveolar Surgery and Orthodontics: A Literature Review

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Abstract

Dentoalveolar surgical procedures in orthodontic treatment may be an alternative method to reduce treatment time and improve outcome in adolescent and adult patients. This article reviews surgical clinical practice in orthodontic treatment, indications and biological principles, as well as the limitations and risks of surgical techniques.

Keywords: Dentoalveolar surgery; Orthodontics; Corticectomy

Introduction

In Chile, the demand for orthodontic treatments in the public and private dental system grows every year. The duration of these treatments has always been one of the greatest concerns, both for patients and orthodontists, determining an average duration of 33.9 months [1].

Other authors describe that the duration of orthodontic treatment, which is affected by numerous factors, such as the severity of the case, the treatment plan, the professional's clinical capacity, the need for extractions and patient compliance, usually ranges from 24 and 36 months in current clinical situations [14,15].

1. UNAB Dental Surgeon, Meritant specialty of Orthodontics.
2. UNAB Dental Surgeon, Meritant specialty of Maxillofacial Surgery and Traumatology.

This leads to the need to search for complementary procedures to conventional treatment to reduce the duration of treatment and at the same time improve results, in terms of aesthetics and function, which has a positive impact on the quality of life of the patient.

In modern Public Health, cost efficiency is an important objective, so that a treatment that extends too long in time violates the aforementioned objective, so clinical efforts must be oriented to be effective. Likewise, the longer the treatment duration, the higher the costs associated with the patient and the higher the percentage of treatment refusals due to this reason. In turn, shorter treatments reduce the probability of undesirable side effects such as root resorption and problems induced by the accumulation of bacterial plaque such as white spots, cavities or periodontal diseases [1].

In this way, given this constant demand for shorter treatments, new studies have been carried out with different approaches to increase the effectiveness of orthodontic treatment by shortening its duration.

Dental displacement during orthodontics occurs as a consequence of a biological process, characterized by a remodeling of the alveolar bone and the periodontal ligament in response to a force, which promotes extensive cellular and molecular changes in the periodontium [12]. Bone remodeling processes are initiated when an orthodontic force is applied to the periodontium which, in turn, generates an aseptic inflammatory response. This inflammation alters the homeostasis and microcirculation of the periodontal ligament, creating areas of ischemia and vasodilation, a fact that results in the release of various biological mediators, such as cytokines, chemokines, growth factors, neurotransmitters, arachidonic acid metabolites, and hormones. These molecules trigger a series of cellular responses that promote bone resorption by osteoclasts at pressure sites and bone formation by osteoblasts at stress sites [13].

In orthodontics, surgical procedures can be extremely helpful in movements that will not normally occur without this assistance or will be extremely slow and will avoid unnecessary or difficult tooth movements, to reduce risk [3].

In this sense, there is a growing number of publications that emphasize dentoalveolar surgery combined with orthodontic treatment as an alternative method for adolescents and adults [2].

However, surgery can be associated with discomfort, morbidity and discomfort for the patient, a fact that favors that this technique is not the first option for some patients. And its effect on the overall duration of treatment is limited by the indication for the procedure, the timing of surgery, and the skill of the practitioner. Also, the number of appointments and chair time required to finish treatment may not decrease due to the shorter recommended intervals between check-ups. Therefore, it is difficult to determine whether any reduction in the duration of treatment would outweigh the additional cost of the surgical procedure. [twenty-one]

The evaluation of the updated bibliographic data reveals the main techniques used in orthodontic surgery. The most com-

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monly described include dentoalveolar osteotomy (interdental or subapical), dentoalveolar ostectomy (interdental ostectomy, wegde-shaped), dentoalveolar microfracture, dentoalveolar corticotomy, dentoalveolar corticoectomy, and dental distraction [2].

Dentoalveolar osteotomy complementary to orthodontic treatment The dentoalveolar osteotomy is related to a complete resection of the bone a (cortex and medulla) that surrounds a tooth, respecting the muscular attachments, the mucosa and periosteum to maintain an adequate blood supply in the bone fragment and dental pulp [2].

In this technique, the teeth are mobilized with their supporting structures and repositioned to the desired position either immediately during surgery or after surgery through the application of orthodontic forces for a short time [2].

The approach in a first stage includes dissection of the vestibular flap with vertical interdental cuts, which extend from the vestibular region to the piriformis opening, where they can be unified by means of an anatomical space or by means of a horizontal cut in the lower region of the nasal floor [25].

After completing the vertical or horizontal cuts, the newly formed tooth-bone segment is repositioned by finger pressure or mobilized for a certain period by the application of orthodontic forces. Protecting the integrity of the tissue with palatal mucosa on at least one side is essential in this first stage.

The second stage includes the initial palatal flap dissection and palatal bone osteotomy. It is recommended to wait four to five weeks to maintain an adequate blood supply even though the palatal mucosa appears healthy in seven to ten days.

This second stage is followed by a labial osteotomy after three or four weeks in the second phase with mobilization and repositioning of the newly formed tooth-bone segment [25].

As a disadvantage of this procedure, is the concern about the secondary effects that could be generated, such as the loss of dental vitality, vascular necrosis of the bone segment, gingival recession, loss of the bone crest with the consequent formation of the periodontal sac, delay in segment movement due to bone interference and traumatic occlusion.

To prevent these complications, a careful evaluation and adequate surgical planning must be carried out, considering the proximity of the roots and using small drills in the osteotomy to obtain the greatest possible connection of the bone segments, especially at the apex of the alveolar ridge.

Since bone healing is complete within four to six weeks, immediate postsurgical mobilization of the segment using orthodontic forces should be performed within two to four weeks, to avoid loss of the benefits obtained with surgery.

Consequently, bone manipulation through surgical intervention, whether orthognathic or dentoalveolar, becomes intriguing for orthodontists based on the alteration associated with bone biology of tooth movement [2].

Dentoalveolar Microfracture Technique

In this technique, after interdental and horizontal cuts are applied, the final movement of the bone segment is performed through fractures using osteotomes. Medeiros and Bezerra report that fixation is carried out using an archwire, obtaining a healthy and healed periodontium in a period of eight months [26].

A microfracture technique combined with corticectomy can reduce treatment time.

Dentoalveolar Corticotomy Assisted by Orthodontic Treatment (CAOT)

This conventional orthodontic assistance surgical procedure is considered as one of the modern methods that aims to reduce treatment time and overcome some limitations, especially in adult patients. [5] In this way, it is postulated as the safest and most effective therapeutic option to enhance tooth movement during orthodontic treatment. [9]

A corticectomy is defined as a surgical procedure whereby only the cortical bone is cut, perforated, or mechanically altered. [16]

Other authors define it as the surgical procedure of controlled osteotomy limited to the cortical bone table, generally the buccal, minimally invasive, which as an additional advantage allows a pattern of bone remodeling with little risk of damage to the periodontal tissues [2,3].

For many years it has been debated in the literature and different CAOT techniques have been described. In 1956, Köle introduced the so-called bony-block theory to accelerate tooth movements in orthodontic treatments.

A new surgical technique was introduced in 2001 by the Wilcko brothers: first called AOO (Accelerated Osteogenic Orthodontics) and later PAOO (Periodontal Accelerated Osteogenic Orthodontics) and registering the technique as a whole under the name Wilckodontics. (Wilcko, Wilcko, Pulver, Bissada and Bou- quot, 2009; Wilcko and Wilcko, 2013) [8].

PAOO is developed in three phases

1. Selective alveolar corticotomy: Using a full thickness flap, preserving the aesthetics of the papilla. After this, interproximal cuts of 0.5 mm deep limited to the buccal and lingual cortices.
2. Bone graft: The second phase consists of performing alveolar augmentation procedures by placing xenogeneic or autogenous regeneration material in the decortication areas, with the placement of resorbable collagen membranes being optional. The flap is sutured with simple non-absorbable stitches and is removed 1-2 weeks after the intervention.
3. Application of orthodontic forces: The placement of appliances is recommended 1 week before the corticotomy. The start of treatment should be done after surgery, postponing it for a maximum of 2 weeks. Activations of the forces should be carried out every 2 weeks for 4 months [22].

In 2006, a new method was introduced to preserve the integrity of the periodontium: lifting a full-thickness flap and performing interproximal corticotomies with piezoelectric devices. Although the goal was to achieve a safer procedure, elevation of the flap increased the risk of postoperative complications and discomfort [17]. To solve this problem, a new surgical technique, PiezocisionTM, was introduced. A vestibular, interradicular transmucosal approach is performed, which allows the insertion of the piezoelectric instrument to perform a 3 mm deep corticotomy. This technique is especially indicated in patients with fine biotypes since it respects the soft tissues and favors their healing. Hard and / or soft tissue grafts can be added through a tunneling procedure. [18,19].

On the other hand, the most recent explanation of the biological mechanism behind CAOT concluded that localized selective decortication surgery in combination with conventional orthodontic tooth movement results in rapid alveolar bone

remodeling in the bone marrow cavities, leading to a less hyalinization of the periodontal ligament and absence of the lag phase during later stages of orthodontic treatment [7]. This was used to explain the evident decrease in root resorption on the side of the corticotomy, an apparently additional advantage of CAOT.

Other authors propose that the decorticated bone is demineralized and presents a remodeling phase (3–4 months) as a response of the tissue to the induced surgical trauma, which reduces the resistance to orthodontic forces, time that is used for movement fast of the teeth [24].

Regarding the results obtained by this technique, the rate of movement achieved is 1-2 mm / week, compared to 1mm per month obtained through normal orthodontics [10].

Other authors found an acceleration of tooth movement in 2-2.5 times compared to tooth movement by conventional or non-surgically assisted orthodontics. In addition, it was classified as safe in terms of periodontal health and presented low or no risk of root resorption [4].

Direct benefits in canine traction, slow expansion, open bite correction, treatment of dentoalveolar bimaxillary protrusion, and molar intrusion have also been described [6].

However, there is no evidence to support that dentoalveolar corticotomy assisted by orthodontic treatment improves the movement of ankylated teeth, post-extraction socket closure, post-orthodontic stability or transverse expansion [4].

In addition, there are authors who state that the corticotomy facilitates an acceleration of tooth movement for only 4 months, after that the rate of movement returns to normal. [eleven]

However, clinical experience has led to the statement that recurrence after treatment facilitated by corticotomy is minimal due to increased support in the root after healing and loss of tissue memory due to bone turnover and remodeling processes. [twenty-one]

One of the limitations of corticotomy is the volume of the buccal bone table. Given that the procedure requires lifting the flap to full thickness beyond the dental apices, it would be contraindicated in areas with absence of the buccal bone tables, which would result in recession of the marginal tissue.

Additionally, the periodontal clinical parameters and the volume of the buccal bone table of the teeth subjected to corticotomy remain stable after the procedure.

Dental Distraction

Distraction osteogenesis is a biological process of new bone formation between the surfaces of bone segments that are gradually separated by incremental traction.

In distraction of the periodontal ligament and in dentoalveolar distraction, bone strength is surgically reduced, allowing new bone to be generated in the osteotomy or corticotomy area. [twenty]

This technique responds to a recent and innovative use of distraction osteogenesis applied to orthodontic tooth movement, moving individual dental segments quickly and reducing orthodontic treatment time. [twenty]

Regarding the results, the generation of new bone has been described at an approximate speed of 1 mm per day. [twenty]

It has been observed that the best time to initiate tooth movement with orthodontics is when the tooth space is fibrous and bone formation has just begun.

Conclusion

Despite the various techniques described in the literature, the evidence points to surgical methods as the most effective means of accelerating tooth movement in orthodontic treatment [9].

More clinical and histological studies are needed to understand the biology of tooth movement using these techniques.

More research is required, with well-designed studies, in the field of acceleration of tooth movement during orthodontics, with additional attention to optimal application protocols, overall treatment duration, adverse effects, and cost-benefit analy-

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