Journal of Oral Biology and Craniofacial Research 11 (2021) 63–65

Contents lists available at ScienceDirect

Journal of Oral Biology and Craniofacial Research

journal homepage: www.elsevier.com/locate/jobcr

Tunnel Regenerative Corticotomy (TURC): A modified approach in surgically-assisted orthodontics

Federico Brugnami [a], Alfonso Caiazzo [b], Pushkar Mehra [c,*]

[a] Private Practice of Periodontics, Rome, Italy
[b] Private Practice of Oral Surgery and Implantology, Salerno, Italy
[c] Boston University School of Dental Medicine, Boston, MA, USA

ARTICLE INFO

Keywords:
Tunnel technique
Corticotomy
Accelerated orthodontics
Bone regeneration
Osteogenic

ABSTRACT

We present a modified surgical technique which encompasses a combination of surgically-assisted accelerated orthodontics and guided bone regeneration for combined surgical and orthodontic management of dental crowding and maxillary transverse deficiency malocclusions with minimally invasive surgery, in a rapid manner, and without the use of general anesthesia.

Introduction

"Surgically-assisted" or "Surgically-Facilitated" orthodontic treatment (also known in the literature as Accelerated Orthodontics, Corticotomy, Wilckodontics®, and PAOO®) has been gaining popularity as an outpatient, office-based oral surgical procedure. Besides having the advantage of reducing the duration of orthodontic therapy, it has the potential to expand the existing alveolar base, thereby allowing for dental crowding resolution without extractions.[1–3] The technique has also been shown to minimize the risk of iatrogenic bone dehiscences and fenestrations, especially when orthodontic movements need to occur outside the bone envelope.[2,3]

The traditional corticotomy procedure requires a full-thickness mucoperiosteal flap elevation followed by particulate bone grafting, which is relatively invasive. Recently a flapless, less invasive procedure (Piezocision ®) has been proposed but positioning of the bone graft is difficult with this technique. Additionally, the placed graft tends to get displaced apically especially in the lower dental arch.[4] We present a new surgical technique (Tunnel Regenerative Corticotomy) (TURC), which is less invasive and flapless, permits a corticotomy to be performed with concomitant bone grafting with the ability to precisely position the grafting material.

Surgical technique

A 14.7-year-old male presented with a class II division I malocclusion, deep bite, maxillary transverse deficiency, and severe crowding in the upper and lower jaw (Fig. 1a). The patient and his referring dentist and orthodontist were interested in correction of the dental crowding and malocclusion while avoiding dental extractions. Presurgical cone bean CT scan (CBCT) demonstrated that buccal plate was extremely thin or absent in most of the areas where the tooth roots would have to be positioned orthodontically to gain the required arch space without premolar extractions. A treatment plan was developed whereby concomitant corticotomy and guided bone regeneration (GBR) would be performed with subsequent rapid orthodontic expansion of the maxillary dental arch using a palatal appliance. The patient was bracketed approximately two weeks before surgery and the palatal expansion appliance inserted 3 days subsequently. Localized regional corticotomies were performed under local anesthesia in the bilateral maxillary lateral and mandibular anterior regions since these areas were planned for orthodontic expansion. The maxillary palatal expansion appliance was cemented on the same day of surgery. The expander was activated one turn per day for two weeks.

The TURC approach consists in a tunnel elevation of the flap through multiple vertical incisions (Fig. 1b). The number and length of the incisions may vary depending on different factors, such as the extent of the area to be treated and the anatomy of the patient's mouth. Generally, one incision for every two teeth is sufficient. The incisions extend from the mucogingival line to the mucosa for approximately 0.5–1.0 mm. This size of the incisions permits the insertion of a Woodson or small periosteal elevator, performing the corticotomies and allowing the placement of a membrane and bone grafting material. An intrasulcular incision is also

* Corresponding author. 635 Albany Street, Suite G-447, Boston, MA, 02118, USA.
E-mail address: pmehra@bu.edu (P. Mehra).

https://doi.org/10.1016/j.jobcr.2020.11.017
Received 17 September 2020; Received in revised form 22 November 2020; Accepted 23 November 2020
Available online 28 November 2020

Fig. 1a. Preoperative intraoral condition showing thin soft tissue and prominent root prominences on the alveolus.

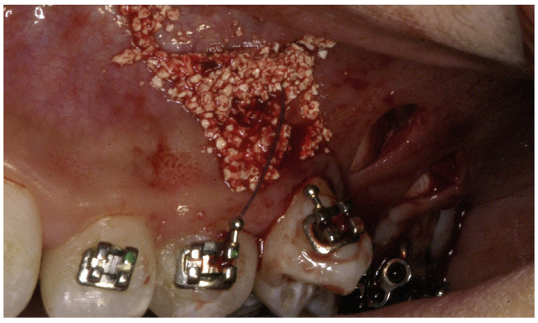

Fig. 1b. A series of small vertical incisions is performed to allow periosteal elevators insertion to detach the mucoperiosteum and insert a membrane. Xenogeneic bone graft is then placed over the native bone under the membrane.

performed 360° around each tooth where augmentation is planned. All periodontal soft tissue components have to be lifted coronally in order to gain sufficient space to correctly position the graft at the level of the marginal bone. A series of small periosteal elevators with different angulations are introduced into the incisions to detach the mucoperiosteal components from the underlying bone. The goal is to create enough space to carry out both the corticotomy procedure and grafting of the area. The corticotomy is then performed through the vertical incisions with a piezoelectric scalpel under irrigation. These "surgical bone insults" are carried out for approximately the entire length of the contiguous teeth at a depth of about 3 mm to create sufficient regional acceleratory phenomenon (RAP). Care is taken to remain at least 3 mm apical from the crest of the bone to avoid possible necrosis of interproximal marginal bone. A gentle displacement of the mucosa at the level of the vertical incisions is performed so as to enable the piezoelectric scalpel into the interproximal areas where no additional incisions are required. Once the corticotomy is completed, an acellular dermal collagen matrix of animal origin (e.g.: Mucoderm ® - Botiss Biomaterials, Zossen, Germany) is trimmed to allow subperiosteal insertion. We do not recommend soaking the membrane in saline as in this application, the stiffness of the Mucoderm facilitates its insertion under the periosteum over large areas. Once positioned, the matrix is anchored in place with 5–0 resorbable sling sutures. Once the matrix is secured, a xenogeneic bone graft is placed with a sterile carrier in consecutive loads (Fig. 1b). Care is taken to place the graft in the most coronal position possible. Once a sufficient quantity of graft has been placed, a digital pressure is exerted over the area to ensure an even distribution of the graft in order to attempt to counteract the apical migration of the particles. The vertical incisions are closed with interrupted sutures. Orthodontic treatment for resolution of crowding and concomitant arch expansion is initiated 3–7 days after surgery. Postoperative clinical examination a 13 months later showed resolution of malocclusion and crowding with increased soft tissue thickness (Fig. 2a). CBCT images verified the increase in maxillary buccal plate dimension (Fig. 2b).

Discussion

Gingival recession is a complication that can accompany conventional orthodontic therapy. The risk of recession is higher in select areas like the mandibular anterior region. Buccal/labial tooth movements are more likely to cause apical displacement of the gingival margin. Similarly, it has been shown that treatment of transverse dental constriction using orthodontic movement predisposes to bone resorption when teeth are repositioned outside bone, which then secondarily leads to loss of gingival attachment.[4–7] If moderate to severe dental crowding is to be treated without dental extractions, there is often a significant discrepancy between the space available and space required. Dental and/or surgical expansion is often recommended to gain the required amount of space. It is agreed that for the teeth to be moved labially and buccally while the arch is being expanded without increased risk of gingival recession, the roots of the dentition should remain in bone during and after treatment.[8–10]

There are two other techniques described in the literature related to the area of accelerated orthodontics and these are Piezocision ®, and Periodontally Accelerated Osteogenic Orthodontics (PAAO). Piezocision was described by Dibart, and while it allows for a flapless corticotomy (surgical insult of the cortical bone) to be performed, it is not optimal, in our experience, for simultaneous bone grafting. Although a "tunnel" has been described in the Piezocision technique, it is meant to position a soft tissue (connective tissue) graft; there is no attempt to lift the mucoperiosteal complex above the CEJ to create space for particluate bone grafting. If bone grafting is employed, the material often tends to migrate apically. In contrast, PAOO was popularized by the Wilcko's and involves a combination of corticotomy and use of a particulate bone graft to augment all four quadrants of the alveolus with extensive full-thickness flap elevation. When compared to PAOO, our technique differs as it is flapless and segmental, as it only involves tissue manipulation and grafting of the areas where an expansion movement is expected. We find that TURC is less invasive and better tolerated by patients when compared to traditional PAOO.

The lifting of the mucoperiosteal complex coronally is possible if there is as we make a 360 sulcular incision around each single tooth involved in the procedure. This modification prevents injuring the papillae and allows for proper PAOO (corticotomy and bone graft) without elevating a flap. In our experience, this modo use of this technique regenerates bone even in the most coronal portion of the alveolus. We are in the process of accumulating data regarding a larger case series with longer follow-up. Although, more long-term data and multicenter studies are needed to validate the results, the ability to increase the quantity and quality of bone in the alveolus appears to be promising.

Conventional treatment at our center for the case presented would have been multiple dental extractions or a surgically-assisted rapid palatal expansion procedure to gain the required space. The former option would have resulted in loss of permanent teeth and a prolonged

Fig. 2a. Postsurgical photograph showing expanded alveolus, resolved dental crowing and improved appearance of soft tissue structures.

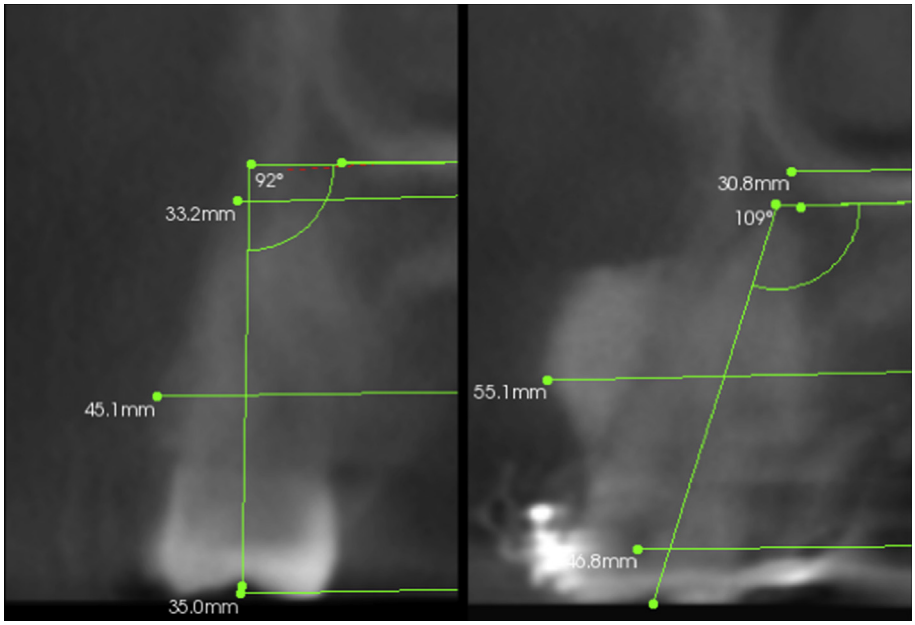

Fig. 2b. Preoperative and postoperative CBCT images demonstrating significant increase in the thickness of buccal plate despite a concomitant maxillary expansion procedure and orthodontic repositioning of teeth labially/buccally.

period of orthodontic treatment to consolidate the multiple extraction spaces. Contrastingly, the latter option would have likely required hospital-based anesthesia and more invasive surgery, besides a longer treatment duration.

The combination of concomitant use of surgically-assisted orthodontics (corticotomy) and GBR (using bone graft material and a membrane) as shown in this article gives surgeons an *office-based option* without flap refection. It has the potential to correct certain malocclusions in a *rapid manner* while having the ability to augment alveolar bone and reduce the risk of gingival recession with minimally invasive surgery.

Declaration of competing interest

None of the authors have any conflicts of interest and there are no disclosures.

References

1. Lund H, Grondahl K, Grondahl HG. Cone beam computed tomography evaluations of marginal alveolar bone before and after orthodontic treatment combined with premolar extractions. *Eur J Oral Sci*. 2012;120:201–211.
2. Engelking G, Zachrisson B. Effects of incisor repositioning on monkey periodontium after expansion through the cortical plate. *Am J Orthop*. 1982;82:23–32.
3. Wilcko MT, Wilcko WM, Bissada NF. An evidence-based analysis of periodontally accelerated orthodontic and osteogenic techniques: a synthesis of scientific perspective. *Semin Orthod*. 2008;14:305–316.
4. Brugnami F, Caiazzo A. Tissue Engineering to expand the basal bone, modify the periodontal biotype and lowering the risks of orthodontic damage to the periodontium. In: *Orthodontically Driven Corticotomy: Tissue Engineering to Enhance Orthodontic and Multidisciplinary Treatment*. first ed. Ames, IA: John Wiley & Sons Inc; 2015.
5. Wennstrom JL, Lindhe J, Sinclair F. Mucogingival therapy. *Ann Periodontol*. 1996;1:671–701.
6. Graber LW, Vanarsdall RL, Vig KWL. *Orthodontics: Current Principles & Techniques*. fourth ed. St. Louis, MO: Mosby; 2005.
7. Bassarelli T, Dalstra M, Melsen B. Changes in clinical crown height as a result of transverse expansion of the maxilla in adults. *Eur J Orthod*. 2005;27(2):121–128.
8. Garib DG, Henriques JF, Janson G, et al. Periodontal effects of rapid maxillary expansion with tooth-tissue borne and tooth-borne expanders: a computed tomography evaluation. *Am J Orthod Dentofac*. 1996;126:749–758.
9. Richman C. Is gingival recession a consequence of an orthodontic tooth size and/or tooth position discrepancy? *Comp Cont Educ Dent*. 2011;32(1):62–69.
10. Brugnami F, Caiazzo A, Mehra P. Can corticotomy (with or without bone grafting) expand the limits of safe orthodontic therapy? *J Oral Bio Craniofac Res*. 2017;8(1):1–6.