In this fast-paced and self-conscious society, time and aesthetics have become increasingly important and the number of adult patients looking for aesthetic and comfortable alternatives to traditional fixed appliance therapies is increasing significantly. One of the biggest challenges an adult orthodontic patient faces is the time spent wearing the appliance: to accelerate orthodontic tooth movement and shorten treatment duration is thus a topical issue. Corticotomy is an effective and safe technique to accelerate orthodontic treatment; however, corticotomies are associated to significant post-operative discomfort and are time consuming. Alternative minimally invasive procedures combining micro-incision with selective tunneling hard and soft tissue grafting and piezoelectric incision, have thus been developed to shorten surgical time and to limit patient discomfort and to increase periodontal safety. The association of mini-invasive surgical approaches and aesthetic and comfortable appliances, like aligner orthodontics, could increase the acceptance rate of adult patients. On the basis of these considerations and with the aim of a further improvement of minimally invasive procedures an innovative, outpatient, simplified tunneling procedure combining piezoelectric cortical incisions, bone tissue grafting and clear aligners has been designed and will be here described.

Keywords: Corticotomy; Orthodontics; Minimally invasive; Outpatient; Clear aligners

Introduction

In this fast-paced and self-conscious society, time and aesthetics have become increasingly important and the number of adult patients looking for aesthetic and comfortable alternatives to traditional fixed appliance therapies is increasing significantly. One of the biggest challenges an adult orthodontic patient faces is the time spent wearing the appliance: to accelerate orthodontic tooth movement, and thus shorten treatment duration, is thus a topical issue [1]. Corticotomy is an effective and safe technique to accelerate orthodontic treatment: surgical wounding of cortical bone potentiates tissue reorganization and healing, by a transient burst of localized hard and soft tissue remodeling. The so called Regional Acceleratory Phenomena (R.A.P.) healing is a natural localized reaction of soft and hard tissues in response to an injury, characterized by increased perfusion, bone turnover and increased bone density. It is well known that surgical trauma of the cortical bone increases the expression of several inflammatory cytokines, which leads to more osteoclast and, consequently, greater bone remodeling process [2]. The time available to accelerate tooth movement is thus limited to the 2-3 months following corticotomy. During the reactive and reparative phases 4-6 mm of tooth movement might be expected, doubling the normal rate of orthodontic tooth movement. A recent review of the existing literature reported that tooth movement was found to be slightly quicker with surgically assisted orthodontics in comparison with conventional treatment over periods of one month (MD 0.61 mm; 95% CI 0.49 to 0.72; P value <0.001) and three months (MD 2.03 mm; 95% CI 1.52 to 2.54; P value <0.001) [3]. However, corticotomies are associated to significant post-operative discomfort, are time consuming and may require patient sedation: moreover are associated to post-operative morbidity and periodontal risks mainly due to the flap elevation. Alternative minimally invasive procedures combining micro-incision with selective tunneling hard and soft tissue grafting and piezoelectric incision, have thus been developed to shorten surgical time and to limit patient discomfort and to increase periodontal safety. The association of mini-invasive surgical approaches and aesthetic and comfortable appliances, like aligner orthodontics, could increase the acceptance rate of adult patients. On the basis of these considerations and with the aim of a further improvement of minimally invasive procedures an innovative, minimally invasive, simplified tunneling procedure combining piezoelectric cortical incisions and bone tissue grafting has been designed and will be here described.

Materials and Methods

A 24 years old male presented with a bilateral molar class I malocclusion, severe crowding, open bite and reduced upper arch width (Figure 1). In order to avoid the palatal surgical expansion and considering the conclusions by Bhattacharya et al. according to which alveolar corticotomies not only can accelerate the orthodontic treatment but also provide the advantage of increased alveolar width to support the teeth and overlying structures, corticotomies were selected to assist the Invisalign® (Align Technology, San José, CA, USA) orthodontic treatment [4]. A cone beam computed tomography (CBCT) scan was collected among all the conventional orthodontic and surgical diagnostic data in order to design the surgical assisted orthodontic treatment
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plan. CBCT data were very helpful in reviewing the orthodontic treatment plan via the Clin Check® planning in order to obtain a maxillary arch expansion of about 4 mm in the premolar region with staging set at 0.25 mm per aligner. A total duration of 30 months of treatment was forecasted. The patient did not report any systemic contraindication to surgery and provided written informed consent to the described procedures. All the statements of the Declaration of Helsinki were followed. The day when surgery was scheduled, the patient performed mouth-rinse containing 0.2% chlorhexidine for 1 minute pre-operatively and Mepivacaine (carbocaine 2% AstraZeneca S.p.a. Milan, Italy) with adrenaline 1:100.000 was infiltrated to reduce bleeding at the surgical site. Full-thickness vertical gingival incisions were performed along the median and both in lateral frenula using a number 15 blade and not extending to the keratinized gingiva. Full thickness incisions were made cutting the mucosa to the periosteum, allowing the blade to touch the alveolar bone. A sharp periosteal elevator allowed wide subperiosteal tunneled dissection over the roots of the involved teeth, both mesially and distally (Figure 2). Subsequently, a piezoelectric micro saw (Surgysonic Moto® Esacrom S.r.l. Imola, Italy) was introduced into the tunnel created underneath the flap and interproximal corticotomies extended through the entire thickness of the cortical layer, just barely penetrating the medullary bone were performed between the dental roots following the long axis of the alveolus and stopping at a distance of 2 mm from the papilla up to the vestibular fornix, 4-5 mm above the apex of the teeth, not penetrating the maxillary sinus. Endoscopic assistance through fiber optic was not necessary because of the direct sight allowed by the frenula incisions. An established augmentation procedure was performed in this case. The suture of the vertical incisions using PGA 3–0 thread (Omnia S.p.a, Fidenza, Italy) in the muscular layer and Silk 3–0 thread (Ethicon, Johnson & Johnson, Somerville, NJ, USA) on the mucosa complete the surgical procedure. Prophylactic amoxicillin 2 gr per day medication was prescribed for one week; pain killing was achieved using Paracetamol 500 mg + Codeine 30 mg three times a day restricted to the first postoperative days to avoid interference with the RAP. Orthodontic treatment was resumed on the same day using Invisalign® aligners. During the RAP phase aligners were changed every 5 days, reducing of about one third the normal protocol of aligners changing (14 days).

Figure 1: patient upper arch before and after treatment and Clincheck image.

Figure 2: The minimally invasive surgical access.

Result

This approach permitted to reduce the duration treatment forecasted from 30 to 18 months. Nor dentinary hyper sensibility neither loss of tooth vitality, nor adverse periodontal events neither significant reduction in crestal bone height and no evidence of apical root resorption effects were clinically and radiographically noticeable during 12 months of follow-up evaluation. A TC Cone Beam was collected to evaluate final results (Figure 3).

Discussion

The biologic limit of orthodontic tooth movement includes the pre-treatment alvolar bone and the surrounding soft tissues. Historically surgery was required in order to overcome these limits but periodontally accelerated osteogenic orthodontics’ (PAOO) methods, published in the last 15 years including flapless ‘piezocision’ and transmucosal micro-osseous perforations, have been demonstrated effective in reducing overall orthodontic treatment times. However, these techniques have not been widely embraced by the orthodontic community since they associated with post-operative discomfort and a high risk of complications leading to a low acceptance by the patient. These are also the main reasons why minimally invasive corticotomies techniques were introduced: furthermore the possibility of restoring alveolar volume and periodontium integrity in a single stage procedure makes this minimally invasive approaches even more attractive [5,6]. The physical injury determined by the corticotomy evokes regional acceleratory phenomena (RAP) that involves a temporary

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References


