Selective Alveolar Corticotomy to Intrude Overerupted Maxillary First Molars: Analysis of Pulp Vitality

Corticotomía Alveolar Selectiva para la Intrusión de los Primeros Molares Superiores Extruidos: Análisis de la Vitalidad Pulpar

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ABSTRACT: The excessive and prolonged orthodontic treatment might result in loss of pulp vitality. Selective alveolar corticotomy is an alternative to accelerate the orthodontic treatment in adults. This study aimed to evaluate the impact of selective alveolar corticotomy associated with orthodontic intrusion on pulp vitality of overerupted maxillary first molars. Six individuals with extruded maxillary first molars were randomly selected to undergo corticotomy as coadjuvant therapy for intrusion. Pulp vitality was evaluated with thermal (Endo-Ice and Heated gutta-percha) and electric tests before the surgical procedure and after intrusion (90 days). The intrusion of all teeth was obtained (mean 2.26 ± 0.52 mm), and all teeth responded positively to pulp vitality tests before and after intrusion. This suggests that selective alveolar corticotomy did not promote pulp damage, and can be considered an effective and safe auxiliary method to intrusion of overerupted maxillary molars.

KEY WORDS: selective alveolar corticotomy, orthodontics, dental pulp test.

INTRODUCTION

Tooth movement in adults induced by orthodontic treatment has increased significantly over the last years. However, age increase difficult orthodontic tooth movement due to a reduction in the proliferation of the periodontal ligament cells, in the synthesis of organic matrix and collagen, in alkaline phosphatase activity and in cell differentiation, which also leads to a decrease in the number of osteoblast precursor cells (Ren et al., 2002).

Selective alveolar corticotomy is an alternative to accelerate the orthodontic treatment in adults. It is a surgical procedure in which only the cortical bone is cut, drilled or mechanically altered (Bhattacharya et al., 2014). After this procedure, the bone tissue initially is in a biological state called the Regional Acceleratory Phenomenon (RAP), characterized by an increased perfusion, bone turnover and decreased bone density, followed by intense remineralization and production of young bone tissue, which will be replaced by mature and more compact bone tissue (Frost, 1983; Gantes et al., 1990).

The rapid tooth movement obtained after the selective alveolar corticotomy local physiological changes such as reduced bone density and therefore less resistance to tooth movement (Hassan et al., 2010), and increase in osteoblastic and osteoclastic

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activity in the alveolar bone derived from RAP (Murphy et al., 2009). Selective alveolar corticotomy associated with orthodontic treatment may also be indicated for the extrusion of ankylosed teeth, nonextraction treatment of crowding, canine distalization and intrusion of overerupted maxillary molars (Oliveira et al., 2008; Wlicko et al., 2008; Akay et al., 2009; Bertossi et al., 2011; Kisnisci & Iseri, 2011).

Although excessive and prolonged orthodontic treatment might result in loss of pulp vitality (Hamersky et al., 1980), it has been reported that there is insufficient scientific evidence to prove that adequate orthodontic forces damage the human dental pulp in terms of reducing pulpal blood flow and irreversible alterations in pulpal response (Javed et al., 2015). In addition, surgically facilitated tooth movement promotes more rapid orthodontic tooth movement and the impact of this approach on pulp vitality of these teeth is also inconclusive (Kisnisci & Iseri; Hoogeveen et al., 2014; Kharkar et al., 2010; Hernández-Alfaro & Guijarro-Martinez, 2012; Liou & Huang, 1998; Sukurica et al., 2007).

Therefore, the aim of this pilot study was to evaluate the impact of selective alveolar corticotomy associated with orthodontic intrusion on pulp vitality of overerupted maxillary first molars.

MATERIAL AND METHODS

Before commencement of the study, appropriate ethics approval was obtained from the Pontifical Catholic University of Minas Gerais (PUC-Minas) Human Research Ethics Committee (Ethics Approval Number: CAAE 0126.0.213.000-08). The study was conducted in full accordance with the World Medical Association Declaration of Helsinki.

Participants selection. Individuals with overerupted maxillary first molars, and who had maxillary teeth that would allow assembly of the orthodontic appliance required for intrusion of the extruded maxillary first molars were included in the study. All patients received information about the study and signed a free informed consent form according to Resolution 196/6 of the National Health Council and to the Declaration of Helsinki (2000).

The following were excluded from the sample: individuals who presented chronic or aggressive periodontitis, and problems of a systemic nature that would contra-indicate the proposed treatment (i.e., pregnant women or diabetes patients). After application of the inclusion and exclusion criteria, 6 females with an age-range of 20-35 years, with extruded maxillary first molars were selected to undergo corticotomy as coadjuvant therapy for intrusion, and a sample with 6 maxillary first molars was created. Images of a representative individual may be observed in Figure 1.

Orthodontic Procedures. Brackets (GAC, Dentsply GAC International, Bohemia, NY, USA) were bonded to all teeth, except the maxillary first molars to be intruded. On the maxillary second molars and premolars, a double tube was welded to allow insertion of the stainless steel archwire (.021” x .025”), which would promote the stabilization of these anchorage units, and allow insertion of the heat activated wire (Neo-sentalloy®, Dentsply GAC International), that would promote the intrusion of the maxillary first molars. It was necessary to open the top tube of the maxillary second premolars to allow a step to be made on the steel wire in the apical direction, which would not interfere in the intrusion movement. These teeth were aligned and leveled with nickel-titanium wire and the round stainless steel wires until it was possible to stabilize them with stainless steel archwire (.021”x.025”). After this the bracket was bonded on the maxillary first molar to be intruded, and after the surgical corticotomy procedure, the heat activated wire was used. The participants were examined every 15 days to follow-up the orthodontic intrusion. Images of a representative individual with the orthodontic apparatus may be observed in Figure 2.

Selective Alveolar Corticotomy. The surgical protocol used was based on a previously described procedure11. Surgery was performed under local anesthesia. A complete flap was performed on the vestibular and palatine surfaces to expose the alveolar bone in the region of the maxillary first molar.

The cortical bone was perforated, using a spherical surgical bur (Meisinger® Tungsten Carbide Bur, 2.0 mm, Neuss, Germany), with abundant and continuous irrigation with cooled saline solution. Vertical cuts were made in the cortical bone in the mesial, distal and interproximal regions, beginning (mesial and distal) 2 to 3 mm apically in relation to the alveolar crest and extending (interproximal) 1 to 3 mm above the root apex.
Small perforations, equivalent to the bur diameter, were made within the area circumscribed by the cuts to increase RAP stimulus, seeking to maintain the depth of the perforation within the cortical thickness. After careful irrigation, the flap was repositioned and appropriately sutured.

Evaluation of the quantity of first molar intrusion. Evaluation was made by means of superimposition of complete cephalometric tracings of the facial structures and the maxilla, originated from lateral radiographs of the face (teleradiographs) obtained before treatment and after molar intrusion.

Pulp Vitality. In order to assess whether the intrusion of upper molars associated with selective alveolar corticotomy would have a deleterious effect on the neurovascular bundle of these teeth, thermal (Endo-Ice and Heated gutta-percha) and electric tests were performed before and at the end of intrusion.

RESULTS

Regarding molar intrusion, the protocol adopted promoted intrusions that ranged from 1.71 mm to 2.92 mm (mean 2.26 ± 0.52 mm) in the maxillary first molars. In addition, the protocol did not change the response to thermal or electrical tests of the intruded maxillary molars (Table I).

DISCUSSION

Corticotomy was first mentioned at the end of the 19th century (Bhattacharya et al.; Hoogeveen et al.). This surgical procedure has become an interesting alternative to increase the rate of tooth movement in adults (Andrade et al., 2014), being an alternative to reduce the treatment time and increase the stability of orthodontic treatment for complex occlusal problem (Kole, 1959).

In daily clinical routine, overerupted maxillary molars are frequently observed. This type of problem occurs in the adult population as a result of early loss of antagonist tooth (Oliveira et al.). In these situations, the intrusion of molars configures as the best treatment option.

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In this work, as described in other studies (Kravitz et al., 2007; Landes et al., 2008; Melo et al., 2008), a segmented arch made of heat activated nickel-titanium alloy wire, with the other teeth as anchoring agents, was used to intrude overerupted maxillary molars. This method was chosen because it was simple and was not influenced by other mechanisms to obtain the movement of intrusion, as would occur with the use of orthodontic mini-implants.

The pulp vitality of these teeth was evaluated by thermal and electric tests. The results related to the period of time necessary for the intrusion of maxillary first molars reveal that pulp vitality was not affected by the adopted protocol. Previous studies in which the intrusion of teeth was obtained in a period of approximately 120 days after corticotomy reported similar results (Oliveira et al.; Mostafa et al., 2009).

In contrast, other studies reported changes in pulp vitality of teeth undergoing certain types of surgically facilitated orthodontic treatment such as segmental distraction osteogenesis (Kinsky & Iseri; Kharkar et al.; Liou & Huang). Regarding the orthodontic movement after selective alveolar corticotomy, some authors reported the absence of pulp damage to teeth undergoing this treatment, but did not describe the type of pulp vitality test used (Gantes et al.; Hernández-Alfaro & Guijarro-Martínez).

The occurrence of injury, inflammation or degeneration of the pulp tissue seems to be directly associated with rapid orthodontic movement, which promotes a specific release of neurotransmitters (neuropeptides) that affects blood flow and cellular metabolism, resulting in changes in the neurovascular system of this tissue (Hamilton & Gutmann, 1999). In a previous study that evaluated the pulp vitality of teeth undergoing moderate (50 g) and severe (300 g) intrusive orthodontic forces, electrical and thermal (heated gutta-percha) tests were performed to assess pulp involvement of teeth intruded, their histological analysis was carried out on extracted teeth. The results showed that although some teeth did not respond to the electrical test, all the teeth responded positively to the thermal test. In addition, pulp stones were formed only in the severe-force group, and odontoblast disruption, vacuolization, moderate vascular congestion, and no necrosis were observed in both force. According to these authors, the pulp vitality test is crucial to monitor the state of the dental pulp, and the thermal test is considered more accurate for the assessment of pulp vitality than electrical test (Han et al., 2013).

According Chen & Abbott (2009), patients with a history of trauma, extensive restorations and old age have reduction in the size of the pulp chamber due to dentin deposition, isolating the pulp against changes in temperature and consequently causing false-negative results. Regarding the electric test, the false-positive result can be caused by the conduction of electrical current to the periodontal tissues (Rowe & Pitt Ford, 1990). However, according to Peters et al. (1994) rarely two tests (thermal and electric) show false results.

In this study, the assessment of pulp vitality was performed by means of thermal (heat and cold) and electric tests, revealing that the surgically facilitated orthodontic treatment associated with a more rapid tooth movement did not have a negative impact on the neurovascular bundle of these teeth, indicating that selective alveolar corticotomy, unlike subapical osteotomies (Bell & Levy, 1972), does not cause risks related to the pulp vitality of teeth involved.

CONCLUSION

The selective alveolar corticotomy was shown to be an effective and safe auxiliary method to intrude overerupted maxillary first molars. This surgically facilitated orthodontic treatment did not promote pulp damage. However, the results of this study should be interpreted considering the small sample used.

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antes del procedimiento quirúrgico y después de la intrusión (90 días). Se obtuvo la intrusión de todos los dientes (media 2.26 ± 0.52 mm) y todos los primeros molaras respondieron positivamente a las pruebas de vitalidad pulpar, antes y después de la intrusión. Los resultados sugieren que la corticotomía alveolar selectiva no promueve daño pulpar y se puede considerar un método eficaz y seguro para ayudar a la intrusión de molaras extruidas.

PALABRAS CLAVE: corticotomía alveolar selectiva, ortodoncia, prueba de la pulpa dental.

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