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Traction of Palatal Impacted Teeth: Description of a New Orthosurgical Technique

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ABSTRACT

Introduction: Impacted teeth are a routine finding in orthodontics and oromaxillofacial surgery, particularly impaction of maxillary teeth detected during examination of deciduous teeth and confirmed by radiographs or CT scans. This study describes a new technique for the traction of palatally impacted teeth, a procedure for which technical difficulties are often encountered.

Report: A description of a new orthosurgical technique for the traction of palatal impacted teeth.

Conclusion: Clinical observations revealed that this novel technique made impacted tooth traction easier, particularly for the treatment of palatally impacted teeth.

Keywords: Maxilla; Orthopedic Appliances; Impacted Tooth.

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INTRODUCTION

Impacted teeth, often seen in Orthodontics and Oromaxillofacial Surgery offices, are routinely detected during the examination of deciduous teeth and confirmed on radiographs or CT scans.[1] Abnormal eruptions may be subdivided into accelerated, delayed, failed or deviated from the direction of permanent tooth eruption[2].

Tooth impaction is the total or partial absence of eruption of a tooth after the normal eruption age or period[3]. Tooth impaction affects 25% to 50% of the general population, with a prevalence of maxillary canine impaction, particularly into the maxillary bone, that ranges from 0.92% to 4.3%[4]. The analysis of impaction by sex reveals that it is two times greater among women (1.17%) than men (0.51%)[4]. The rate of bilateral maxillary canine impaction is also high, at a rate of 8% of the patients[4].

Maxillary tooth impaction is a common problem in teeth that take a long time to develop and follow a long eruption path[3]. According to some authors, the cause of impaction may also be associated with the prolonged retention of the deciduous tooth, the deviation of the permanent tooth germ due to trauma, or the idiopathically insufficient eruptive force of that tooth[5]. Sometimes the early loss of a deciduous tooth may also lead to changes in eruption, as the space previously occupied by the deciduous tooth may close because of lateral movements of neighboring teeth[1,3].The diagnosis of tooth impaction is based on a careful history, as well as a detailed clinical examination and imaging evaluation[6,7]. Patient history should include age and family history of tooth agenesis or impaction. Moreover, the time of eruption should be examined against imaging studies, and the difference between normal and possibly abnormal phases should be noted[6,7]. Using all these resources, diagnosis becomes easier, and the patient's pathology may be thoroughly investigated, which provides the information necessary to choose the correct treatment for each case[6,7].

Imaging studies are extremely important, particularly during diagnosis and orthosurgical treatment[3-5]. Cone bean computed tomography (CBCT) is currently a widely-used tool for the evaluation of tooth impaction, as it provides data for an accurate definition of whether teeth are supernumerary or impacted. The use of CBCT has allowed orthodontist and oromaxillofacial surgery and trauma specialists to diagnose the type of impaction, the feasibility of traction to the dental arch, or the indication of tooth extraction and later local rehabilitation[1,3-5]. The initial choice of treatment of impacted maxillary canines is conservative, that is, exposure of the impacted tooth surgically followed by guided traction using orthodontic resources[6,7]. Several techniques for conservative treatment are found in the literature, all of which attempt to position the tooth in the dental arch[6-8]. However, in case of tooth ankylosis, when the attempt to move the tooth fails, surgical removal should be indicated. This study describes a new technique for the traction of teeth impacted in the hard palate, a procedure for which technical difficulties are often encountered.

Technical description

Manufacture of a modified quad-helix appliance

This technique uses a modified conventional quad-helix appliance that has an arm that projects to one or two sides to apply traction to the impacted teeth. A series of cases of patients that were treated using this technique had a high success rate.

The modified quad-helix appliance should be manufactured so that the arm, to which the traction wire will be connected, emerges at a point very close to where the canine is impacted, that is, at a point where the traction force may be applied to the tooth in the direction of its long axis, or very close to it **(FIGURE 1)**. The appliance is fixed and cemented to conventional orthodontic bands on the permanent molars (teeth # 16 and #26).

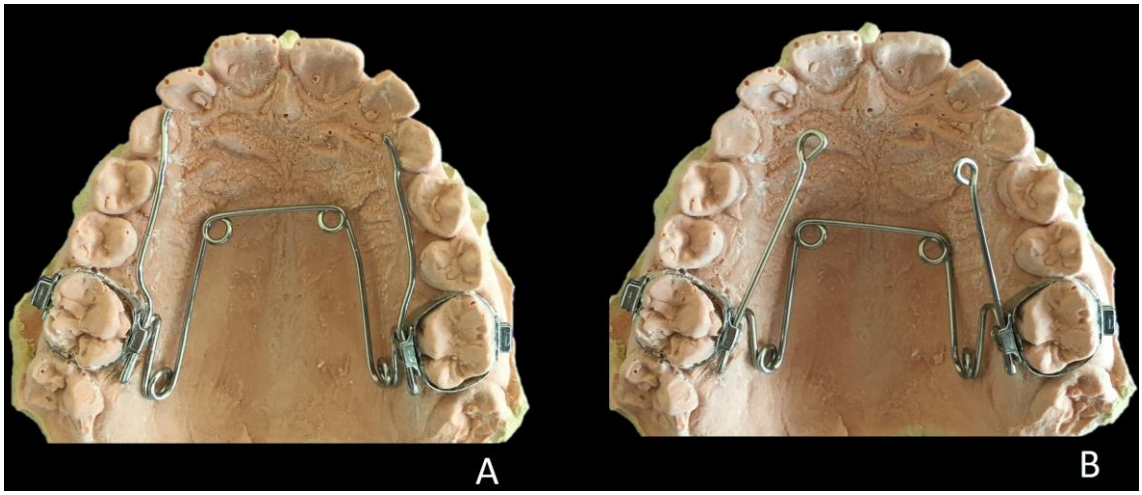

Figure 1. Comparison of conventional (A) and modified (B) quad-helix appliance on plaster mold where model of maxillary arch was prepared together with previously placed orthodontic bands. Arm of modified quad-helix appliance (B) is very close to point where teeth are impacted, which facilitates accurate future traction in direction of long axis of teeth.

Surgery

Patient initial evaluation should include questions about their medical history, as well as about any medication used routinely, past and current diseases, allergies and other clinical and systemic conditions of interest. Regardless of current clinical conditions, all patients should undergo routine pre-operation blood tests (WBC and RBC counts, coagulation tests, kidney and liver function tests), and if any abnormal results are noted, subsequent pre-surgical medical examinations should ensure that their health conditions are back to normal.

After this initial phase, all patients enrolled in our case series and described below underwent CBCT scanning to determine the exact position of the impacted teeth. Moreover, their orthodontic records were requested at the same visit to obtain a complete evaluation of both orthodontic and surgical conditions.

All patients received an orthodontic button for impacted canine traction. The procedure was conducted under local anesthesia with 2% mepivacaine and epinephrine at 1:100.000. An envelope incision was made in the distal portion of the maxillary second premolar to the distal portion of the maxillary lateral incisor on the opposite side using a 15C blade mounted on a round scalpel handle. A mucoperiosteal flap was elevated using a Molt periosteal elevator, the nasopalatal vascular and nervous bundle was located and held with Halstead forceps for 5 minutes for local hemostasis, the bundle was sectioned, and mucoperiosteal elevation was completed. After the coronal portion of the impacted tooth was accurately identified, osteotomy was performed using a #8 round Carbide bur on a straight handpiece and a 1:1 surgical motor at 20,000 rpm. All the clinical crown of the tooth was exposed, hemostasis was achieved using sterilized gaze and cotton, and 37% phosphoric acid was applied for 30s for etching of the dental enamel on the exposed area. After that, saline solution was used for abundant irrigation for 60s, together with aspiration. After a dry environment was established, a tooth traction hook with a chain attached (MORELLI Ortodontia®, Sorocaba, Brazil) was bonded using an adhesive specific for that purpose (Transbond XT, 3M ESPE DO BRASIL Ltda., Brazil). After that, the hook was tested applying traction to the whole set a few times to confirm adequate bonding, saline solution was used for abundant irrigation, tissues were positioned back in place, and a simple suture was applied using 910 4-0 polyglactin (VICRYL™, Ethicon, ©Johnson &

Johnson do Brasil Indústria e Comércio de Produtos para Saúde Ltda., São Paulo, Brazil).

Cementing the modified quad-helix appliance and beginning traction

Seven days after surgery, the patients underwent the first review, at which time the appliance was cemented and traction was initiated **(FIGURE 2).** Mean traction force was measured using a specific dynamometer (MORELLI Ortodontia®, Sorocaba, Brazil); the appliance was activated at a force of about 100 g for all the treatment phase. As the impacted tooth underwent traction, new activations were made every 15 days directly on the arm of the quad-helix appliance until the tooth was fully exposed **(FIGURE 3)**.

Figure 2. Modified quad-helix appliance cemented in mouth during activation, and visualization of maxillary canine crowns. Arm of appliance is right below clinical crown, and force applied produces only tooth extrusion movement.

Figure 3. Presentation of clinical case shows progression of traction of teeth #13 and #23. Arms, to which traction button is fixed, end right below previously impacted teeth. Seven days after surgery (A), appliance was cemented and traction began, to be followed by subsequent monthly activations; (B) 60 days after traction began; (C) 180 days after traction began, when quad-helix appliance was removed and conventional orthodontic treatment was initiated.

Clinical Case

A 16-year old white girl was seen for a review visit after four years living abroad, where she had no dental follow-up. During history taking, the patient denied any systemic diseases, use of chronic medication, or any previous surgery. Her main compliant was the fact that she had not lost teeth #53 and #63, although she was not sure whether they were deciduous or permanent teeth. She also reported not having received any clinical dental care for about four years. Initially, a panoramic radiograph, requested for general

assessment of dentition, showed that teeth #13, #23 and #27 were impacted. The patient was aware of these impactions, as well as of the options of orthosurgical treatment consisting of bonding of a traction button followed by orthodontic treatment **(FIGURE 4)**.

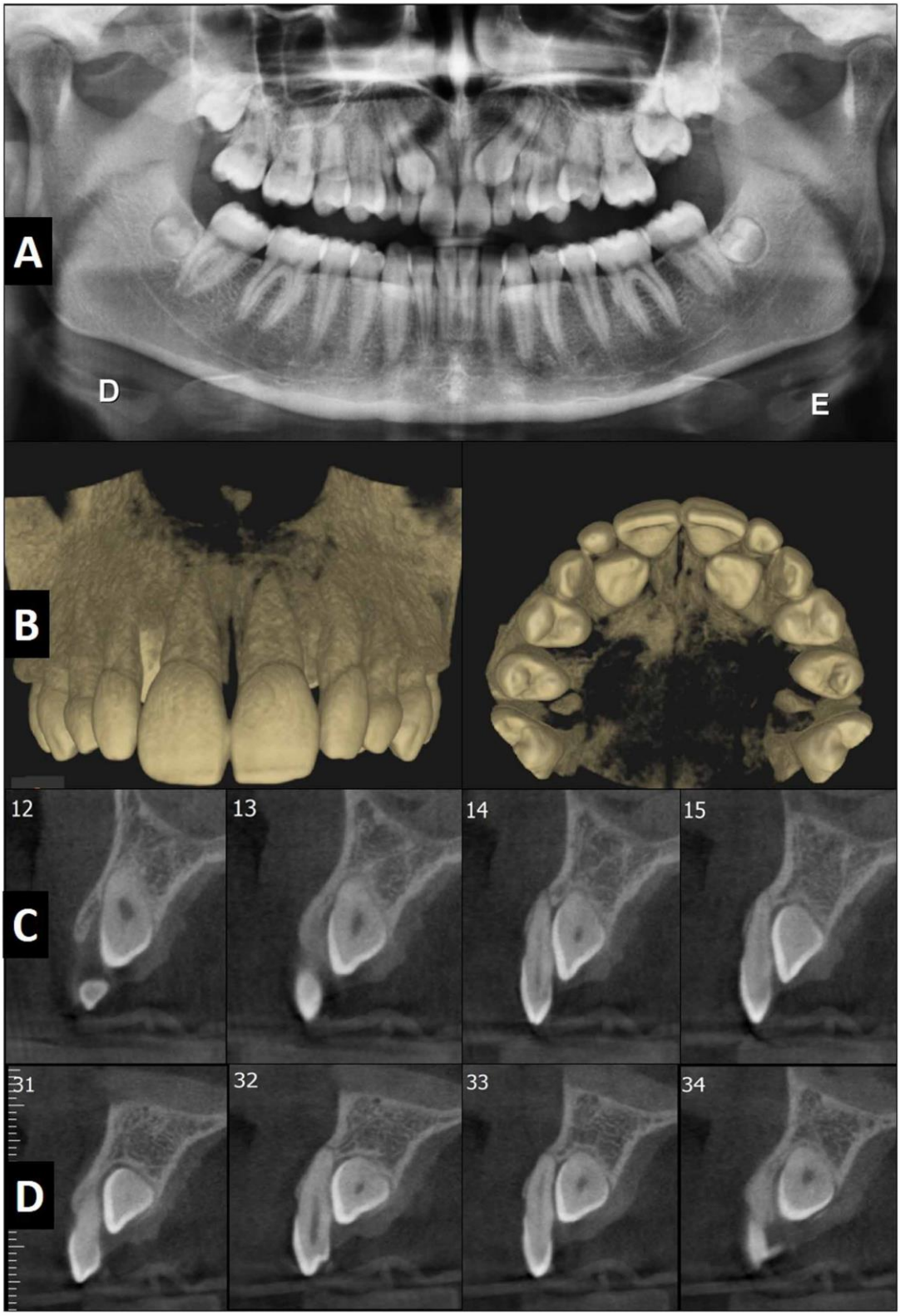

Figure 4. Imaging studies used for surgical planning of orthodontic hook bonding: complete orthodontic records containing panoramic radiograph (A) and 3-D cone beam computed tomographic scans (B), as well as palatal axial views that show exact position of teeth #13 (C) and #23 (D).

Routine laboratory test results were normal, and the surgery was performed to bond the traction button to teeth #13 and #23, as described above. On the 7th day after surgery, after the removal of stitches, the quad-helix appliance was cemented and the traction process was initiated by applying a 100-g force, measured using an orthodontic dynamometer. The conventional period of activations, until the impacted teeth were exposed, was six months, with monthly visits. After the eruption of the teeth, the modified quad-helix appliance was removed, and conventional orthodontic treatment began. A fixed orthodontic appliance was used to obtain the necessary space for the maxillary canines, the remaining deciduous teeth were extracted, and the case was completed.

Discussion

Permanent teeth are essential for a harmonious smile, as well as for a stable and well-balanced functional occlusion[1]. Therefore, maxillary canines have a fundamental role in orthodontic planning[1-3]. Radical treatments that include their extraction are contraindicated, particularly in young patients, because they may compromise orthodontic results and limit the chances of giving the patient a normal canine occlusion[1-3]. Moreover, esthetic results will also be compromised because the nasogenian sulcus will be absent, which makes the face seem older, and there will be some upper lip support deficiency.

Maxillary canines have a long and complex eruption path, beginning anatomically in the lateral region of the piriform fossa and moving toward their final position for eruption in the dental arch. Their eruption takes twice as long to complete and, therefore, they are susceptible to changes in their path from odontogenesis to normal occlusion. This may lead to buccal or palatal eruptions of the primary dentition, as well as undesired tooth impactions.

The most common causes of generalized delays in tooth eruptions, which may affect canine eruption, are classified as primary or secondary[6,7]. One of the primary causes is the absence of root resorption of the deciduous tooth, trauma to the germs of deciduous teeth, lack of space in the dental arch, permanent tooth germ rotation, premature closure of root apices and eruption of canines in areas of palatal fissures[1.4.5]. The secondary causes include abnormal muscle pressure in the region, feverish conditions, endocrine disorders and vitamin D deficiency[1,4,5]. The cases reported here were basically characterized by prolonged retention of the tooth germ by deciduous teeth and the unavailability of space in the dental arch.

The technique described in this study includes the use of a modified quad-helix appliance with an anterior arm to facilitate traction of the impacted tooth[9,10]. This appliance, cemented to orthodontic bands on the maxillary first molars, provides adequate stability, as well as anchorage, which is important for the traction of the impacted tooth[9.10]. The great advantage of this appliance and this technique is the possibility of positioning the arm of the appliance exactly below the crown of the impacted canine, which provides vertical traction during tooth extrusion. The quad-helix appliance is activated in the mouth, in the long axis of the arm, using a force of about 100 g. The use of excessive force is contraindicated and unnecessary in these cases, because this technique provides traction without the application of forces at a greater angle, until the tooth crown is completely exposed. A treatment that achieves tooth displacement using adequate and not excessive force may bring gains in total treatment time, less trauma to tissues, lower resorption risk for neighboring teeth and impacted teeth, and less activation pain, because the force is applied in the physiological direction, the same direction that the tooth would follow under normal conditions.

Orthosurgical treatments are the first choice to resolve maxillary canine impactions, which require the surgical exposure of the teeth and orthodontic guidance by means of directed

traction for the eruption[1,4,5]. Therefore, treatment objectives depend on the position of the canine in relation to neighboring teeth and its position in the alveolar process, presence of root dilacerations, changes in its eruptive capacity, and the full development of the root and apex. The impacted canine, moreover, may not move orthodontically, which may suggest possible ankylosis[2-7]. In this case, other thecniques described in the literature, such as apicectomy, segmented osteotomy, surgical repositioning of the impacted tooth, or even canine extraction, should be taken into consideration. The space may then be filled by the premolar, a prosthesis or, more recently, an osseointegrated implant[6-8]. The use of the technique described in this study resulted in easier traction of palatally impacted canines, at a shorter time than for the conventional procedure in which the force is applied by a fixed orthodontic arch wire. The mechanical force applied in the direction of the long axis of the canine is believed to result in a more physiological and easier eruption, which will take a shorter time than when the force is applied at a greater angle. This may be the factor that makes traction easier when using this technique, in which the force generated by the orthodontic appliance acts upon a point very close to the exposed or surgically detected canine crown and, more importantly, in which low forces (about 100g) are applied in the most adequate direction of traction.

The number of necessary activations does not follow a specific protocol, because the teeth impacted in the maxilla may be very close to the palatal mucosa, but may also be in an opposite position, under the floor of the nasal fossa, and each case has its own needs. Therefore, activations should respect the patient's characteristics, and the total exposure of the clinical crown in itself will indicate the removal of the modified quad-helix appliance and the placement of the fixed orthodontic appliance to complete the treatment. Activations should be made monthly, following conventional orthodontic routines.

The technique described here introduces, in a general context, an important protocol change in comparison with those described in international literature, particularly in the procedure for traction of impacted canines[11-14]. Fixed orthodontic appliances are usually placed before the surgery that bonds the traction hook, with extraction of the deciduous tooth that is in the space that should be occupied by the impacted tooth, and the space for the permanent tooth should be opened using coil springs. The technique described here begins with the manufacture of a modified quad-helix appliance, with placement of bands on the permanent maxillary first molars, impression and manufacture of the appliance and surgery to bond the traction hook. All the steps described are performed without extraction of the remaining deciduous teeth, which ensures the preservation of the space before the placement of the fixed orthodontic appliances and, mainly, preserves local esthetics. Moreover, there will be no need, in this phase, of provisional bonding, which results in better conditions for eating, oral hygiene and, more importantly, improved sociability for the adolescent patient, who may face social difficulties due to the fact that some anterior teeth may be missing.

The use of the modified quad-helix appliance results in an overall shorter orthodontic treatment time, at a mean duration of 6 months. In all cases mentioned here, traction time was within this time frame, and response was positive in 100% of the patients. This technique may be used in the case of palatally impacted maxillary teeth with an indication of traction. Patient acceptance is good and biological response is rapid and adequate for the treatment of this condition. The great advantages of this treatment protocol seem to be the preservation of esthetics, as deciduous teeth are not extracted until the permanent teeth erupt in the mouth, and, mainly, as traction is more effective because the main force applied to the impacted teeth has a physiological direction, which will result in extrusion without lateral movements.

The technique described here is effective for the exposure and traction of canines impacted in the maxilla and has an esthetic advantage, because it prolongs the presence of deciduous teeth, results in faster orthosurgical treatment and is applied at a more physiological vector of forces, precluding the application of forces at greater angles.

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