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Clinical case

Orthodontic Traction of the Impacted Upper Permanent Central Incisor: Report of Two Cases

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ABSTRACT

Introduction: Impaction of the permanent upper central incisor is a rare condition, affecting between 0.05% and 3-4% of patients. It most commonly appears during the mixed dentition phase. Impaction may be caused by obstructive factors such as supernumerary teeth or trauma affecting root formation. This condition can have a significant impact on a patient's aesthetics, function, and psychological well-being. Orthodontic traction is an effective therapeutic strategy

for managing these cases. **Objectives:** To demonstrate the effectiveness of orthodontic-surgical treatment through traction and torque control in impacted teeth due to supernumerary teeth. **Case Presentations:** Case 1: A 9-year-old female patient with early mixed dentition and absence of the permanent upper left central incisor. A surgical exposure was performed, followed by orthodontic traction using a buccal button and a traction arm. Eruption of the permanent upper left central incisor was achieved in approximately 8 weeks, followed by the placement of fixed appliances for alignment. Case 2: An 8-year-old male patient with early mixed dentition and an impacted permanent upper right central incisor. Surgical exposure was performed; a McNamara expander was used for traction. Traction allowed the eruption of the permanent upper right central incisor in 28 weeks, followed by the application of fixed appliances for alignment. **Conclusions:** Orthodontic traction –complemented by surgical intervention to remove obstructions– proved effective in both cases, achieving the eruption of impacted incisors without significant sequelae. Careful planning of the direction and magnitude of applied force is crucial for successful treatment. Early intervention is key to avoiding complications and ensuring favorable aesthetic and functional outcomes.

Keywords: Dental impaction, orthodontic traction, surgical exposure, surgical orthodontics

INTRODUCTION

The term dental impaction refers to a tooth with a three-quarter root formation that has not erupted into the oral cavity in the expected chronology, generating an alteration in the eruptive sequence[1]. Impaction of the upper permanent central incisor is of low prevalence, ranging from 0.05% to 3-4% worldwide[2,] and generally occurs in the first stage of mixed dentition[1]. It has the advantage that it can be easily diagnosed by the parents and/or guardians of the children, due to its conspicuous absence in their arch[3]. However, when detected, it has a great functional, psychological, social, and, above all, esthetic impact on the pediatric patient[1,2,4].

The etiology of impaction of the upper permanent central incisor can be divided into two groups: obstructive or traumatic. Obstructive causes include the presence of supernumerary teeth, odontomas, pathological lesions, fibrotic gingiva, and lack of space due to maxillary compression[5,6], and *mesiodens* is the most common cause[2]. On the other hand, dental trauma at an early age before the eruption of permanent teeth generates damage to the cells responsible for the formation of the root of the unerupted tooth germ, affecting the degree of its development and orientation[5], which can lead to ectopic teeth, dilacerations, and ankylosis[1]. Idiopathic causes such as shape anomalies, lack of coordination between the root resorption of the deciduous tooth and the eruption of the permanent tooth, and ankylosis are also described in the etiology of the impaction of these teeth[6].

Consequences of impaction of the upper permanent central incisor include reduction of the arch perimeter with mesial displacement of adjacent teeth, midline deviation, lesions in neighboring teeth, cysts, and esthetic and functional implications due to the absence of the anterior tooth[7]. The therapeutic approach should involve the identification of its cause and timely diagnosis[8] that should be complemented with the use of imaging tests, such as orthopantomography and/or *Cone Beam Computed Tomography* (CBCT) to verify the presence and position of the impacted tooth, evaluate morphology and structure of the impacted tooth and

evaluation of obstacles or pathological lesions. CBCT is the most accurate element in determining a treatment plan for tooth impaction. It provides more precise information on the location and dental relationship concerning adjacent structures[1,9].

Among the treatment options for impacted maxillary incisors, the creation of spontaneous space for eruption, surgical exposure, and orthodontic traction or extraction of the impacted incisor followed by prosthodontic rehabilitation are described. Orthodontic traction has been reported as the treatment with the most favorable results both esthetically and functionally[3,4]. Surgical exposure of an impacted tooth can be performed using an open or closed technique. It has been stated that an open technique could present esthetic disadvantages due to the scarring of the soft tissues and the gingival contour that could be irregular. The closed surgical exposure technique is performed by cementing a button and then covering the tooth again to ideally allow the gingival tissue to remain unaffected; however, it could present disadvantages such as possible ankylosis, slower movement, and orthodontic mechanics that are more difficult to perform[10].

This paper aims to present two cases of patients in first-stage mixed dentition, which were part of an orthodontic-surgical treatment using traction and torque control of an ectopic and impacted permanent upper central incisor caused by a supernumerary tooth.

PRESENTATION OF CLINICAL CASES

CASE 1

Female patient, 9 years of age, with a non-contributory medical history, convex profile, skeletal class II. In the intraoral analysis, a first-stage mixed dentition was observed, absence of tooth 21, bilateral molar neutroclusion, moderate upper and severe lower dentoalveolar discrepancy, favorable transverse relation, upper dental midline deviated one millimeter to the left compared to the facial line and the lower dental midline centered with the facial midline (Figure 1. A-D). In the CBCT analysis, performed with Nemotec® software, tooth 21 was observed in intraosseous evolution in a high position, horizontal and parallel to the occlusal plane, with incomplete root formation, with a distance of 26.39 millimeters to the incisal edge of the contralateral central incisor, and associated with a supernumerary tooth in a high position in relation to the floor of the nostrils, with a conical coronary shape located towards the palate (Figure 2. A-B). In the first phase of treatment, we started with the extraction of the supernumerary tooth, and then tooth 21 was approached through a closed surgical exposure performed by a maxillofacial surgeon. During the same surgery, a labial button and a palatal reinforcement button were installed with a 0.9 Ferderhard (FH) stainless steel ligature for traction. A centric biteblock was installed, which consisted of a cemented interocclusal device made in a digital articulator to maintain masticatory functionality and avoid premature contacts, and which has a central button to provide rigidity. The button was activated ¼ turn daily for 12 days. From this button, a traction arm was made in stainless steel wire of 0.8 FH caliber, activating the traction 15 days after surgery every four weeks, and leaving the marginal gingiva slightly ischemic with a force of approximately 50 grams (VTSYIQI model ATG-500-2 ® tension meter) (Figure 3. A-B).

At the four-week control, exposure of a coronary third of tooth 21 was observed (Figure 3. C), and at the 8-week control, there was a favorable evolution with an almost complete exposure of the labial side of tooth 21 (Figure 3. D). At week 8, the centric bite block was removed, and self-ligating fixed appliances were installed, cco prescription 2x4 for a better alignment of

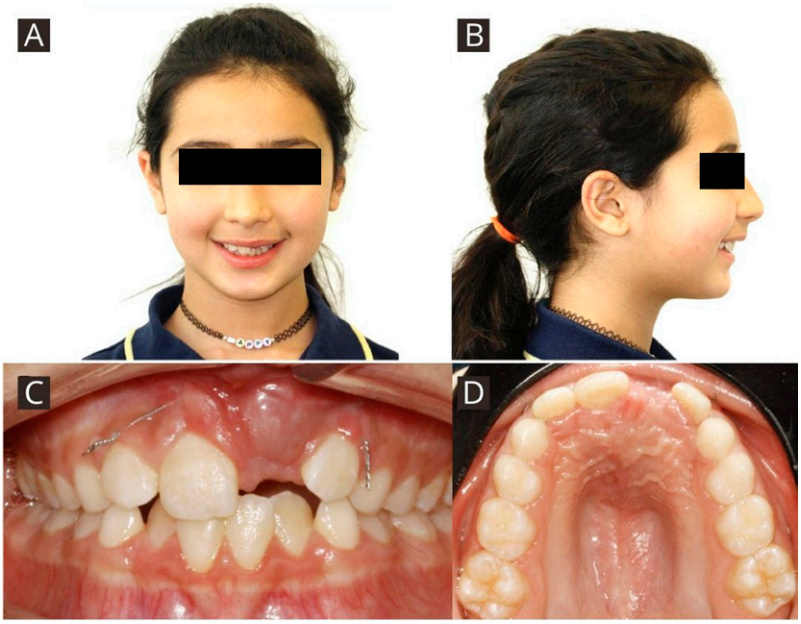

Figure 1. Initial photographs. A. Frontal extraoral. B. Profile. C. Intraoral frontal. D. Intraoral upper occlusal.

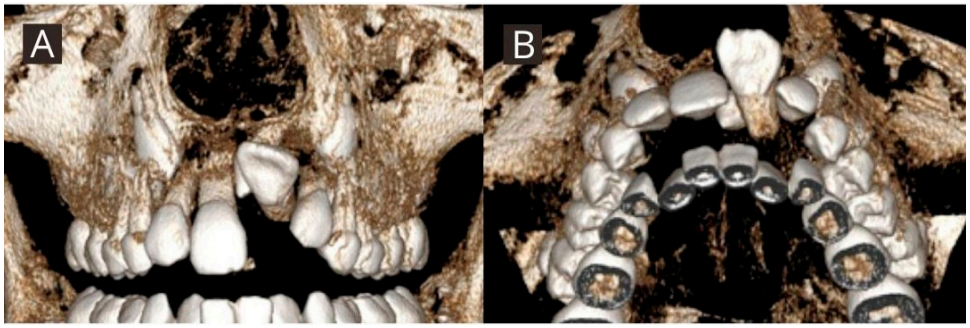

Figure 2. Three-dimensional representation of initial position of tooth 21 assessed in CBCT. A. Frontal view. B. Axial view.

the upper incisor group with a sequence of thermo-activated NiTi archwires 0.014" - 0.016" - 0.018" -- 0.017" x 0.025" and then, a 0.019" x 0.025" stainless steel archwire (Figure 3. E). During traction, only the labial button was used to generate a more favorable force vector with posterior-occlusal direction and thus improve the periodontal prognosis of tooth 21.

CASE 2

Male patient,8 years old, with a non-contributory medical history. Convex profile, skeletal class II. The intraoral analysis showed mixed dentition, the first phase, partially erupted tooth in the area of tooth 11, mesial rotation of tooth 21, bilateral molar distoclusion, severe upper and moderate lower dentoalveolar discrepancy, unfavorable transversal relation, and centered

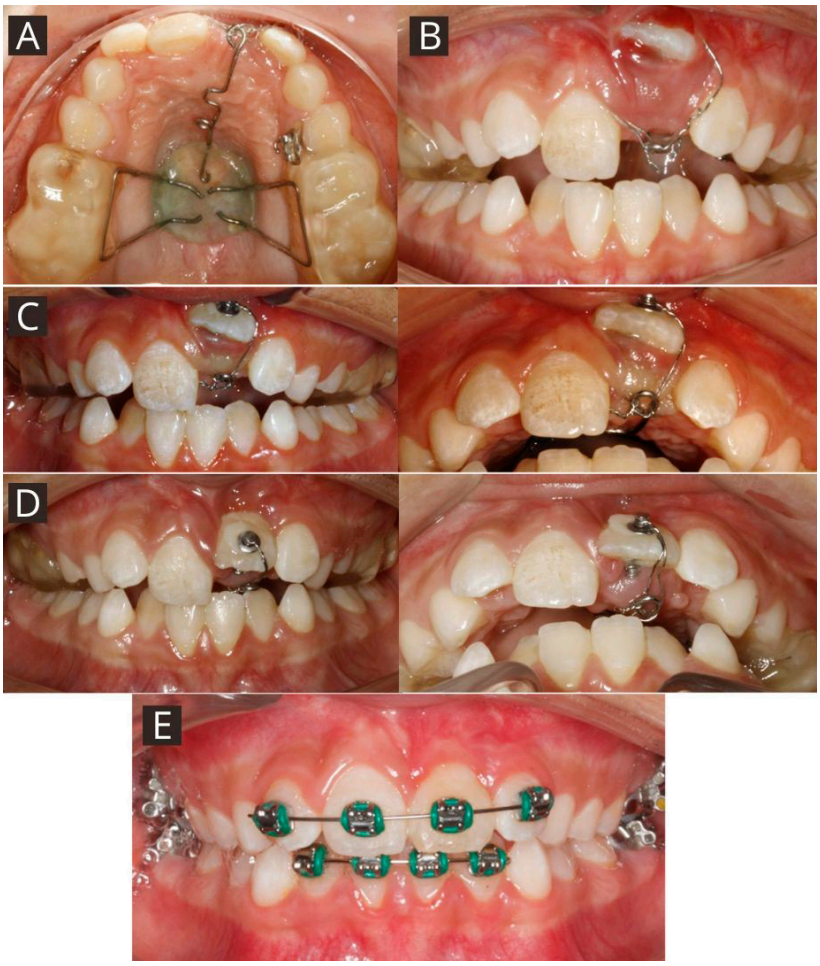

Figure 3. Treatment photographs. A. Centric Bite block installation with traction arm. B. Activation of traction arm. C. Control at 4 weeks of traction. D. Control at 8 weeks of traction. E. Installation of 2x4 fixed appliances for alignment of the upper incisor group.

dental midlines (Figure 4. A-D). In the CBCT analysis, performed with Nemotec® software, tooth #11 was observed in intraosseous evolution in a high position, perpendicular to the occlusal plane with incomplete root formation, located in a labial direction, with a distance of 19.57 millimeters to the incisal edge of the contralateral central incisor, and the presence of a partially erupted supernumerary tooth, with a conical crown shape in the area of tooth 11 (Figure 5. A-B)

The surgical approach to tooth 11 was performed with closed surgical exposure by a maxillofacial surgeon and labial and palatal reinforcement buttons with a 0.9 FH stainless steel ligature for traction were installed during the surgical procedure. Extraction of the supernumerary tooth was performed before dental exposure surgery. A McNamara-type expander with an acrylic palatal extension, a palatal traction arm with 0.9 FH wire, and a single central screw with ¼ of daily activation for 20 days were placed to achieve a 5 mm expansion (Figure 6. A). Tubes were added labially and palatally to the expander for an eventual titanium beta molybdenum cantilever (TMA). The maxillary expansion was done as planned and 15 days after surgery, the palatal traction arm was activated with a force of 50 grams (VTSYIQI model ATG-500-2 ® tension gauge) approximately every four weeks, leaving the marginal gingiva slightly ischemic.

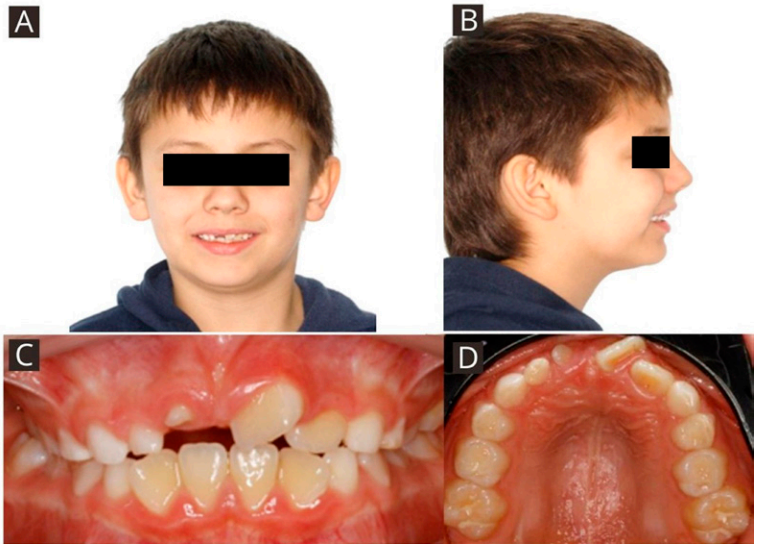

Figure 4. Initial photographs. A. Frontal extraoral. B. profile.
C. Intraoral frontal. D. Intraoral upper occlusal.

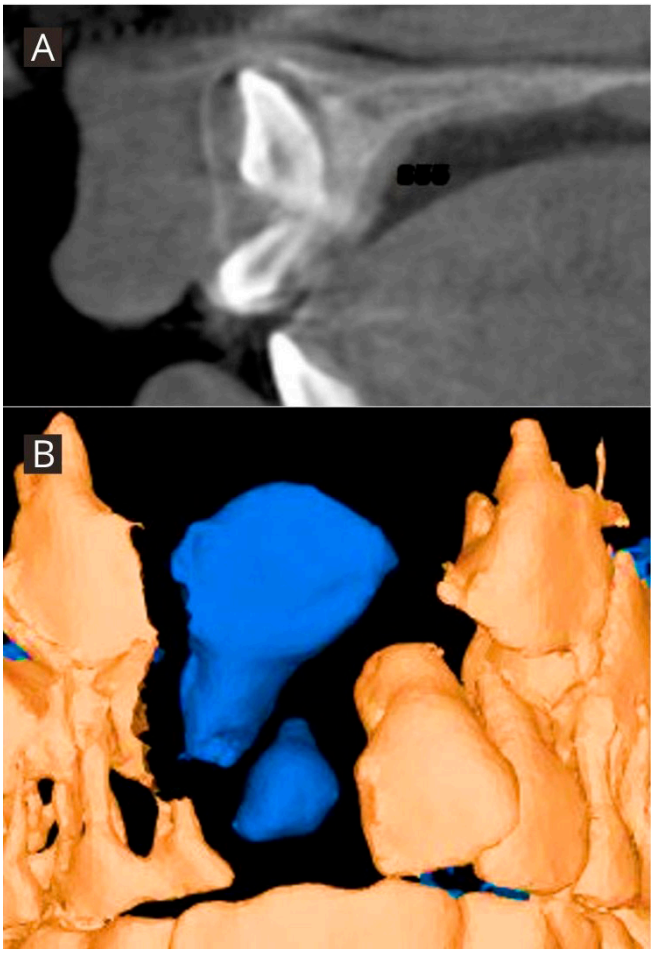

Figure 5. Tomographic images. A. The initial sagittal section of tooth 11 was evaluated in CBCT.
B. Three-dimensional representation of initial position of tooth 11 evaluated on CBCT, frontal view.

At 20 weeks, exposure of the labial button of tooth 11 was observed (Figure 6. B). The expander was removed at 28 weeks (Figure 6. C) and fixed appliances were placed for alignment and leveling of the upper incisor group. The same archwire sequence of the first case was employed: 2x4 self-ligating brackets, cco prescription for a better alignment of the upper incisor group with the following sequence of thermo-activated NiTi archwires: 0.014" - 0.016" - 0.018" - 0.017" x 0.025" and then, 0.019" x 0.025" steel archwires. Figure D shows the evolution of 1 year of treatment with fixed appliances. During traction, only the labial button was used to generate a more favorable force vector in a posterior-occlusal direction and thus improve the periodontal prognosis of tooth 11. The tubes that were added to the expander were not used.

The results obtained are favorable for both cases. Regarding case number one, in the tomographic control, tooth 21 shows favorable periodontal support, root parallelism, and a 1:1 crown-root ratio (Figure 7. A-B). Regarding case number two, in the tomographic control, tooth 11 presents a good position in the arch, decreased root length, and periodontal support with a reserved prognosis (Figure 8. A-B). Both cases clinically presented a good position in the arch and did not show mucogingival defects after traction.

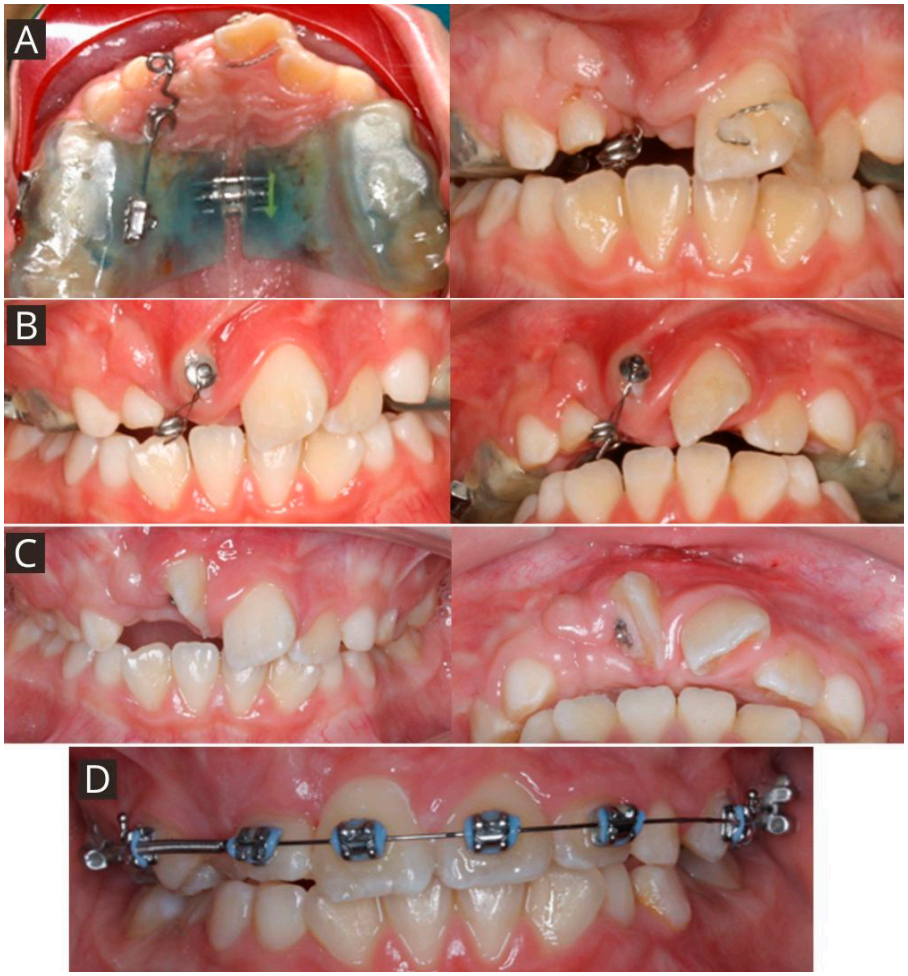

Figure 6. Follow-up clinical photographs. A. Installation of McNamara expander with acrylic palatal extension, palatal traction arm with 0.9 FH wire, and single central screw. B. Control at 20 weeks of traction. C. Control at 28 weeks of traction. D. Installation of fixed appliances for alignment and leveling of the upper incisor group.

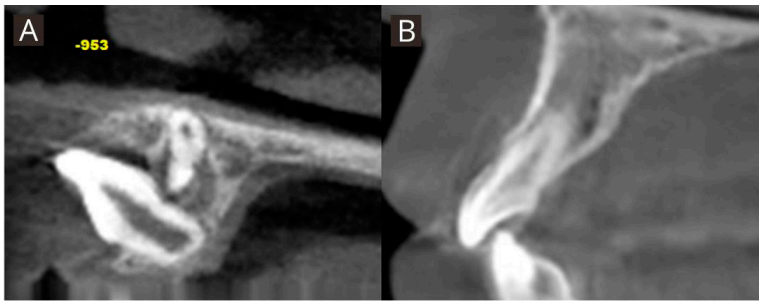

Figure 7. Tomographic images. A. Initial evaluation of tooth 21 in CBCT, sagittal section. B. Final evaluation of tooth 21 in CBCT, sagittal section.

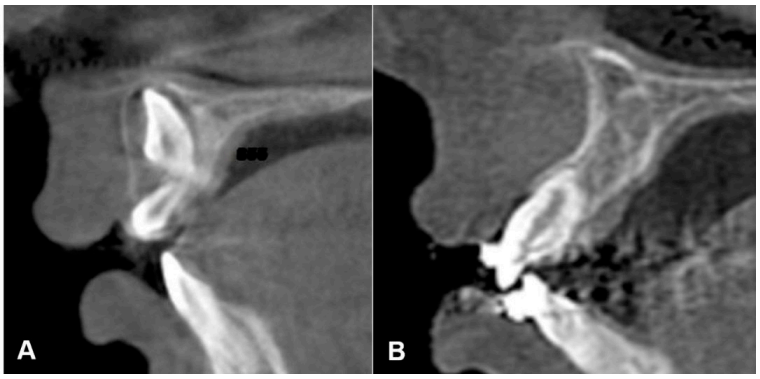

Figure 8. Tomographic images A. Initial sagittal section of tooth 11 evaluated in CBCT. B. Final sagittal section of tooth 11 evaluated in CBCT.

DISCUSSION

Several studies mention that the treatment for impacted incisors due to obstruction consists primarily of the elimination of the agent that obstructs the eruption pathway of the affected tooth[11]. Following the removal of the obstruction, Prillaman *et al.*[12] suggest that if the location of the unerupted tooth is favorable, spontaneous eruption is anticipated, which is described as possible by creating space in the arch.

Leyland *et al.*[13] observed that if the obstruction is due to a supernumerary tooth, as in the cases hereby presented, the recommended age for its extraction is between 8 and 9 years of age, with a success rate of spontaneous eruption that fluctuates between 49-91%. On the other hand, other authors suggest that in cases of unfavorable location, orthodontic-surgical management is recommended, consisting of the elimination of the obstruction complemented with orthodontic traction[1,3,14].

Orthodontic surgical procedures have been reported as the therapeutic option with the most favorable esthetic and functional results[15]. However, Jiang *et al.*[4] discuss that there may be a risk of traction failure and lack of torque control of the impacted incisors, the latter being a common problem when the traction force is applied only at one point of the impacted teeth, which is why biomechanical planning of the orthodontic traction vector is fundamental[4,16].

In cases where the removal of the obstruction is performed without adjuvant orthodontic traction, there is a significant increase in the total duration of treatment and a decrease, in turn, in the effectiveness of the treatment[1]. It has been shown that the chances of eruption of an impacted tooth increase to 90% when surgical exposure is combined with orthodontic traction[9].

It has been widely described that the orthodontic-surgical treatment of impacted teeth is relatively long. The traction phase of the exposed cases was efficient, with an approximate duration of 5 months, in contrast to what was postulated by Chaushu *et al.*[5] which was approximately 8 +/- 4.5 months. It has also been shown that the treatment time is related to the height of the impacted tooth, whether or not the root presents dylacerations, and the inverse position in which it is found, as presented in both cases[9,17]. Early approaches are preferable when impacted teeth are present, since a delay may imply secondary alterations such as dilacerations, ankylosis of the affected teeth, or root resorptions of the adjacent dentition[1]. To weigh the prognosis of orthodontic traction, factors such as the patient's age, available space, degree of root development, position and angulation of the impacted tooth, relationship with adjacent teeth, degree of perception of the problem by both the patient and the tutor and patient's cooperation during treatment, should be considered[2,8].

In both cases, the impacted incisor was successfully incorporated into the arch without endodontic and mucogingival sequelae. The traction vector should ideally be diagonal, downward, and towards the palate, as in the cases hereby described. This allowed the impacted teeth to erupt with attached gingiva, favoring their periodontal prognosis, without the need for complementary soft tissue surgery, because it has been demonstrated that when connective tissue on the labial surface prevails, an esthetic gingival border is obtained in the incisors symmetrically[10]. Additionally, the space available for tooth alignment was sufficient for the upper permanent central incisor to achieve its anatomical position in the arch; a maxillary expander was necessary in one of the cases to increase the arch perimeter. The age of both patients was optimal to eliminate the supernumerary teeth without complications.

Finally, the frequency, magnitude, and direction of the force applied in the traction of the tooth was important, since it was controlled with an activation of 50 grams every four weeks. It is essential to define these protocols from the beginning of the treatment plan, in order to optimize the expected movement of the impacted tooth and to achieve a good prognosis.

CONCLUSIONS

The impaction of the permanent central incisor represents a challenge in orthodontic practice. It requires an accurate and timely diagnosis, which allows the orthodontist to focus on achieving an efficient treatment plan. The early approach in patients with impacted teeth helps us to avoid secondary complications that can compromise the prognosis of our patients.

To obtain favorable results, it is necessary to make an evaluation that considers all the local and general factors presented by the patient and ensures that the traction is performed with controlled forces and in the appropriate direction, along with clinical and imaging follow-ups in the short, medium and long term.

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