Case Report

Multidisciplinary approach to restore esthetics and function in a young patient with three consecutive impacted teeth: a case report with 18-month follow-up

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ABSTRACT

This case report describes the orthodontic treatment of an 11-year-old patient with three maxillary impacted teeth on the right side. Cone-beam computed tomography showed that these teeth were close together, with the lateral incisor in a lower position, followed by the central incisor, and the canine in a more apical position. Treatment included applying traction to these teeth. A transpalatal arch was used as an anchorage device, and surgical exposure of the lateral incisor was performed for traction with an elastic chain toward the hook welded to the 0.017 × 0.025-inch steel segmented arch. Subsequently, the central incisor was surgically exposed, elastic chains were used, along with a 0.016-inch steel arch with a box loop for correcting the tooth position. The canine spontaneously began to erupt, and a 0.017 × 0.025-inch TMA segmented arch with boot loop was used to control rotation and torque of the canine during its distalization. Once these three teeth were in the arch, treatment was finished in the usual manner. For esthetic improvement, gingivoplasty was performed in the maxillary arch. Eighteen-month follow-up showed that orthodontic treatment allowed preservation of the natural teeth, the contour of gingival support, and avoidance of prosthetic rehabilitation, reestablishing the patient's esthetics and function, with satisfactory stability. (*Angle Orthod.* 2023;93:603–614.)

KEY WORDS: Impacted teeth; Fixed orthodontic appliances

INTRODUCTION

Dental impaction may be due to several etiological factors, including genetic conditions, lack of space, failure of deciduous tooth resorption and prolonged retention of these teeth, presence of intraosseous cysts, and trauma in the region.[1,2] When trauma occurs in children up to 4 years of age, the primary tooth may be displaced, causing damage to the permanent tooth germ, which may result in impaction.[2] In general, dental impaction generates imbalance in the patient's function and affects smile esthetics when anterior teeth are involved, directly compromising the patient's quality of life.[3]

Treatment of impacted teeth is challenging. After performing a patient examination, and considering the family's preference, the first step is deciding if orthodontic traction is possible or if the impacted teeth should be removed. It is important to alert patients about treatment duration, which can be longer in cases with impacted and dilacerated roots.[4] The biomechanical approach to orthodontic traction requires application of light and continuous forces.[5] To avoid side effects, different archwire cross sections and/or orthodontic bends, as box and T loops, could provide more controlled movement.[6] Both metal and elastic chains may be used to promote controlled extrusion with programmed forces. In addition to this mechanical complexity, surgical and periodontal procedures associated with orthodontic treatment may be necessary to expose the teeth and adjust gingival levels after orthodontic treatment.[7]

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Accepted: February 2023. Submitted: November 2022.
Published Online: March 20, 2023

Figure 1. Pretreatment photographs.

This article describes a case of an 11-year-old girl with a history of trauma after a fall from standing height, with impaction and displacement of the upper central and lateral incisors and upper canine on the right side.

Diagnosis and Etiology

An 11-year-old female patient arrived at the Orthodontic Clinic of the State University of Rio de Janeiro with a history of trauma at the age of 4 years, which resulted in early loss of deciduous teeth and delayed eruption of the upper central and lateral incisors and upper canine on the right side. She had good general health.

The patient was in the mixed dentition. There was an overjet of 1 mm, increased overbite, Class II molar relationship on the right side and Class I on the left side, and upper and lower dental midlines were shifted to the right by 2 and 1 mm, respectively. The profile was convex, and there was a passive lip seal, with a low smile line (Figures 1 and 2).

The panoramic radiograph showed that the upper central and lateral incisors and upper canine on the right side were impacted, while the other teeth were in their normal eruption process. Cephalometric radiography indicated a Class II skeletal relationship and a hyperdivergent mandibular plane. The upper left central incisor was well positioned, and the lower central incisor was protrusive (Figure 3; Table 1).

Cone-beam computed tomography (CBCT) showed that the three impacted teeth were close together, with the lateral incisor in a lower position, followed by the central incisor, and the canine in a more apical position. The three teeth showed incomplete root formation and the incisors were in a horizontal position, parallel to the occlusion plane, while the canine was in a vertical position, almost perpendicular to the incisors (Figure 4).

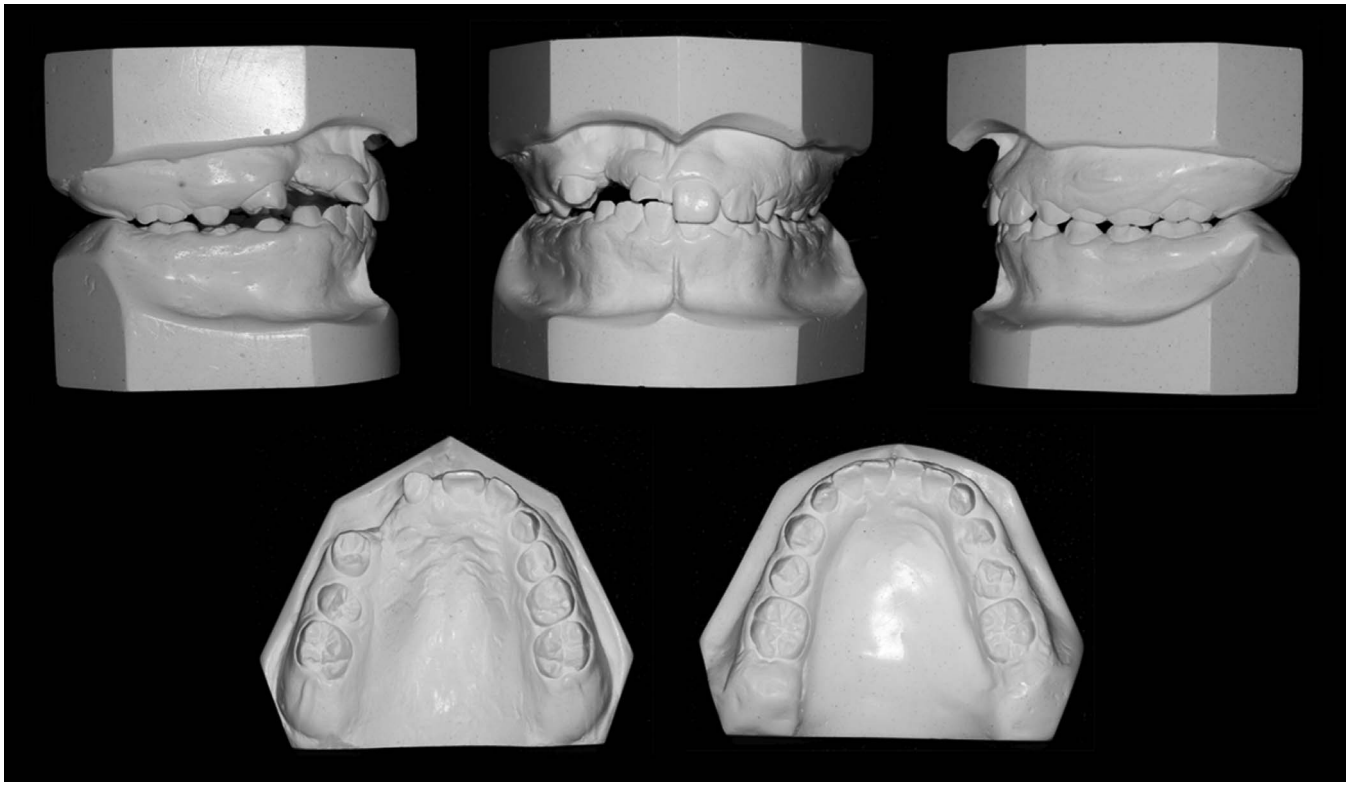

Figure 2. Pretreatment dental casts.

Treatment Objectives

The goals of treatment were (1) to readjust the patient's esthetics and function by repositioning impacted teeth, (2) to align and level the arches to establish adequate overbite and overjet, (3) to obtain Class I molar and canine relationships, and (4) to improve the patient's smile and facial profile.

Treatment Alternatives

The following treatment alternatives were considered: (1) orthodontic traction of the three impacted teeth, alignment and leveling of the arches, and establishment of Class I; (2) extraction of the impacted teeth and orthodontic treatment to align and level the arches, obtain Class I and provide adequate space for future dental implants; and (3) orthodontic traction of the lateral incisor that was positioned more favorably, alignment and leveling of the arches, establishment of Class I and provide adequate space for future dental implants.

These treatment options were discussed with the patient's parents. Considering that the patient was too young to plan for dental implants, the option to extract three permanent teeth from an 11-year-old patient would be very invasive and could cause harm to the bone and gingival tissue in the region, which could compromise subsequent prosthetic rehabilitation. Likewise, if only the lateral incisor was erupted, dental implants would still be necessary in a young girl, leading to the same possible limitations for future prosthetic rehabilitation. Therefore, it was decided to use traction for all the impacted teeth and correct the patient's occlusion with orthodontic treatment.

Treatment Progress

Considering the space present in the upper arch to properly position the impacted teeth, orthodontic treatment began with placement of a cemented transpalatal arch on the first permanent molars to prevent mesial movement and tipping of the molars. A hook was welded to the transpalatal arch to support traction if necessary. Brackets with a Roth prescription, 0.022 $\times$ 0.028-inch slot (American Orthodontics, Sheboygan, Wis), were bonded on the upper arch. As shown in the CBCT exam, the first tooth to be erupted was the lateral incisor. Therefore, a closed surgical exposure technique of the upper right lateral incisor was performed to erupt this tooth, and the deciduous maxillary right canine was extracted at that time. Initially, the lateral incisor was pulled with an elastic chain toward the hook welded to the 0.017 $\times$ 0.025-inch steel segmented arch (American Orthodontics) tied to the first molar and premolars on the right side. This was to move the tooth distally to facilitate posterior

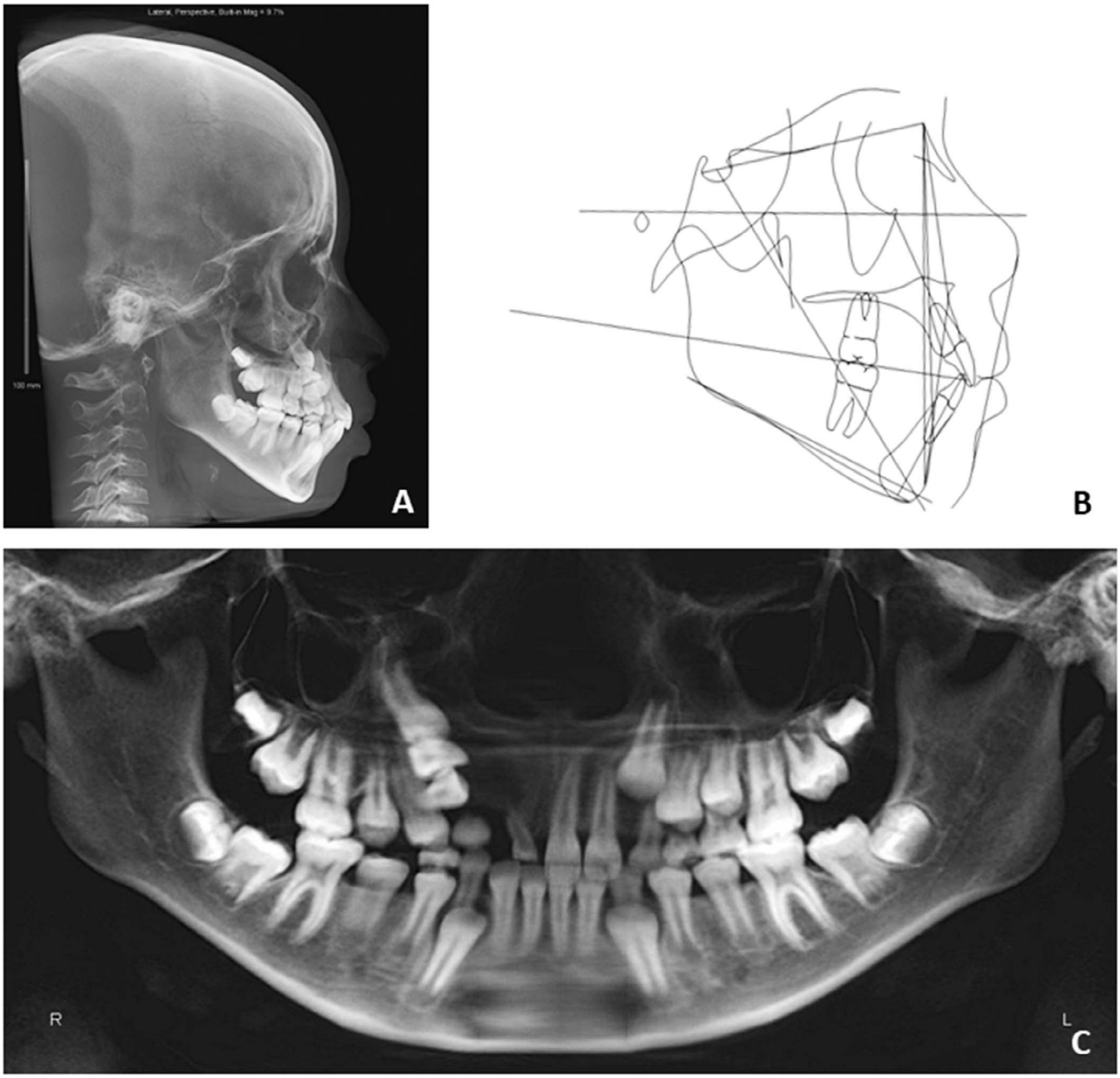

Figure 3. Pretreatment radiographs and tracing. (A) Lateral cephalometric radiograph. (B) Lateral cephalometric tracing. (C) Panoramic radiograph.

traction of the central incisor. If the lateral incisor had been moved directly to the mesial, it would have been necessary to move the central incisor around the lateral incisor, making treatment sequencing more difficult. After complete eruption of the lateral incisor, a 0.016-inch nickel-titanium arch was inserted (American Orthodontics), and a button was placed on the palatal surface of the lateral incisor to perform torque for rotation mechanics with elastic chain, using the deciduous lateral incisor to help in these mechanics (Figure 5). After rotation, a bracket was placed on the lateral incisor, and alignment and leveling was accomplished with continuous 0.016- and 0.018-inch nickel-titanium arches and 0.020-inch steel (American Orthodontics).

Subsequently, the central incisor was surgically exposed, using a similar technique, and a button was placed for erupting it with an elastic chain toward the deciduous lateral incisor. After proclination of the central incisor, the deciduous lateral incisor was removed, and a bracket was placed on the central incisor for leveling and alignment with a 0.016-inch

Table 1. Pretreatment and Posttreatment Cephalometric Measures

Measurement	Norm	Pretreatment	Posttreatment
SNA, °	82	86	86
SNB, °	80	82	83
ANB, °	2	4	3
Wits appraisal, mm	1	−2	−2
Mandibular plane to SN (SN-GoGn), °	32	36	33
FMA, °	25	27	23
IMPA, °	87	91	94
Maxillary incisor-NA (U1-NA), °	22	24	25
Maxillary incisor-NA (U1-NA), mm	4	4	7
Mandibular incisor-NB (L1-NB), °	25	32	34
Mandibular incisor-NB (L1-NB), mm	4	7	9
1 – 1, °	130	120	118
UL-S, mm	0	3	2
LL-S, mm	0	7	6

steel arch with a box loop bent to correct rotation (Figure 6). Brackets were bonded on the lower teeth, and leveling and alignment were performed with 0.014- and 0.018-inch nickel-titanium arches and 0.020- and 0.019 × 0.025-inch steel arches.

At this point, the upper canine spontaneously began to erupt. Subsequently, treatment continued with mesial movement of the lateral incisor with an elastic chain on the 0.020-inch steel arch.

While the upper canine was passively erupting, a 0.019 × 0.025-inch steel arch was inserted to improve torque of the lateral incisor, which had a marked palatal root inclination. For distal movement of the canine, which at this time was in close relationship with the lateral incisor, a bracket was placed and a power arm was welded between the premolars for traction of the canine with a distal force vector using an elastic chain (Figure 7). Subsequently, to control rotation and torque of the canine during its distal traction, a 0.017 × 0.025-inch TMA segmented arch with a boot loop was inserted into the auxiliary tube of the first molar, and an active open spring was inserted between the first

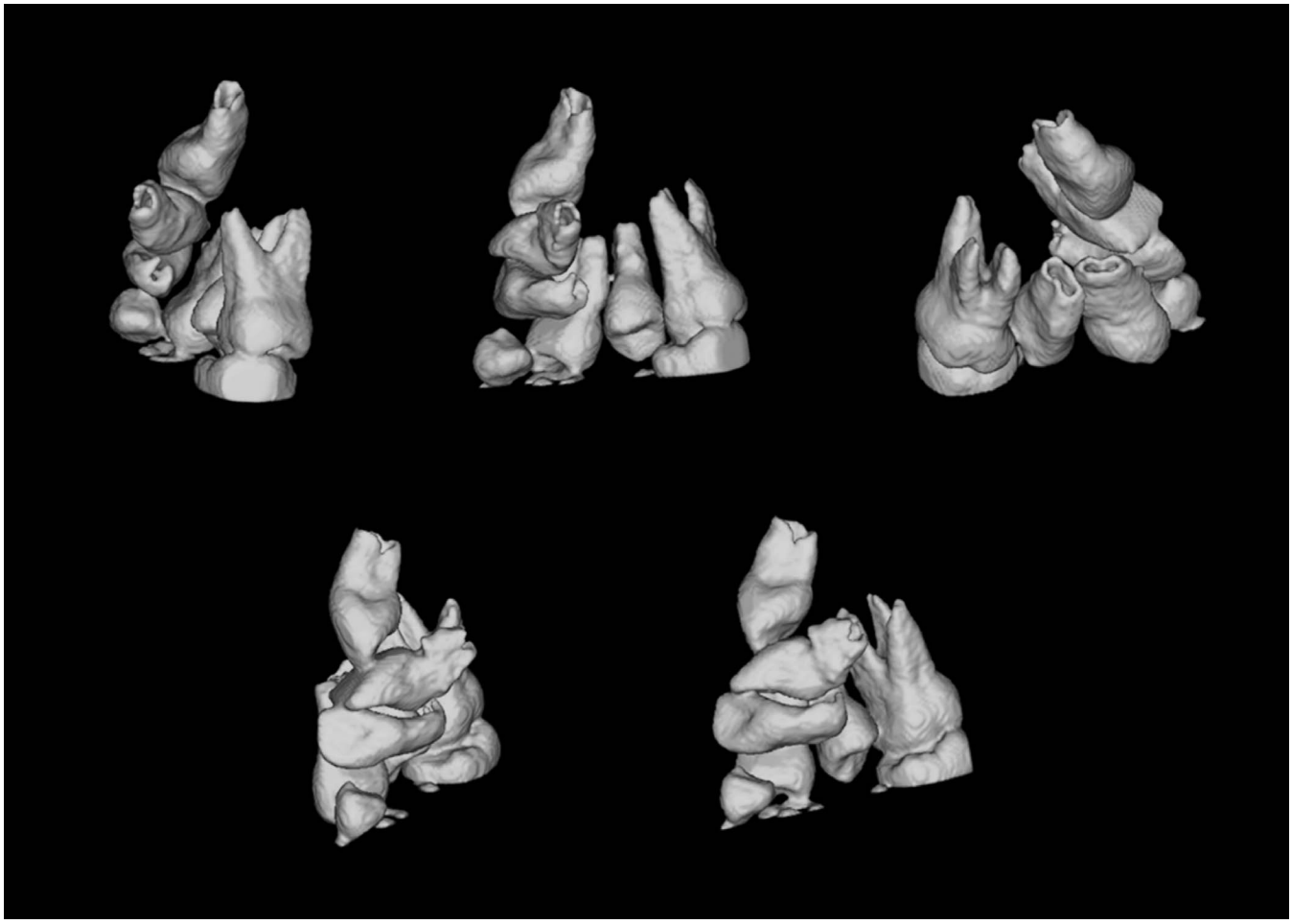

Figure 4. Tomographic segmentation of impacted teeth.

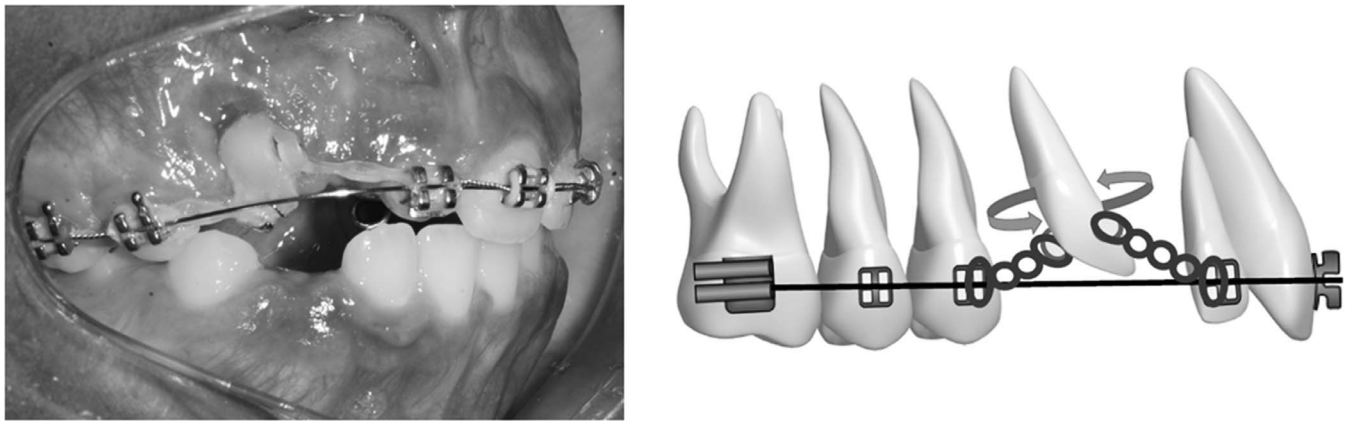

Figure 5. After surgical exposure of the lateral incisor, forces in opposite directions were applied for rotation mechanics with chain elastics.

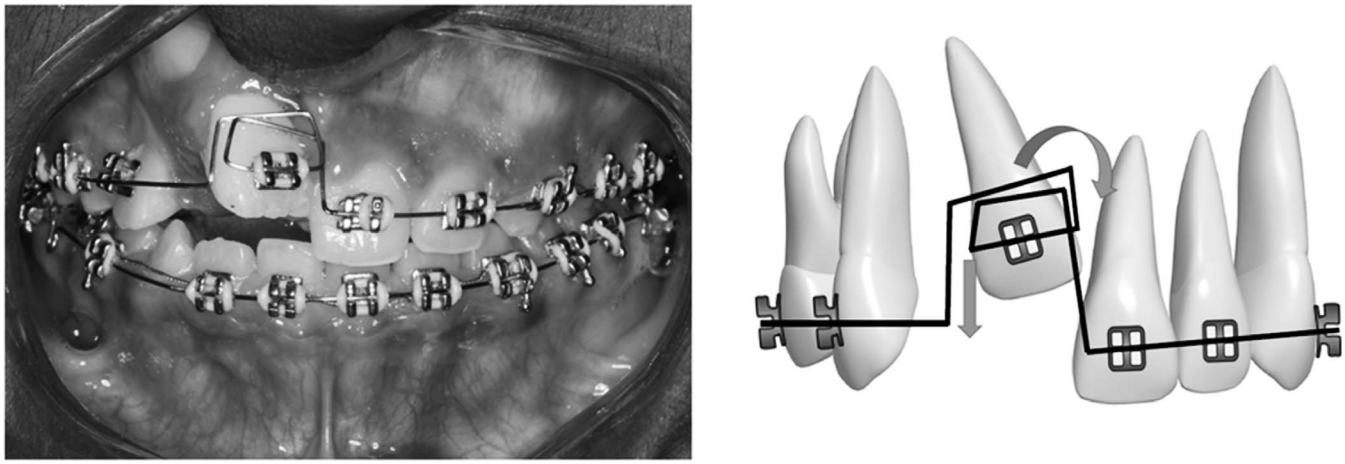

Figure 6. Box loop for correcting central incisor rotation and to extrude the tooth.

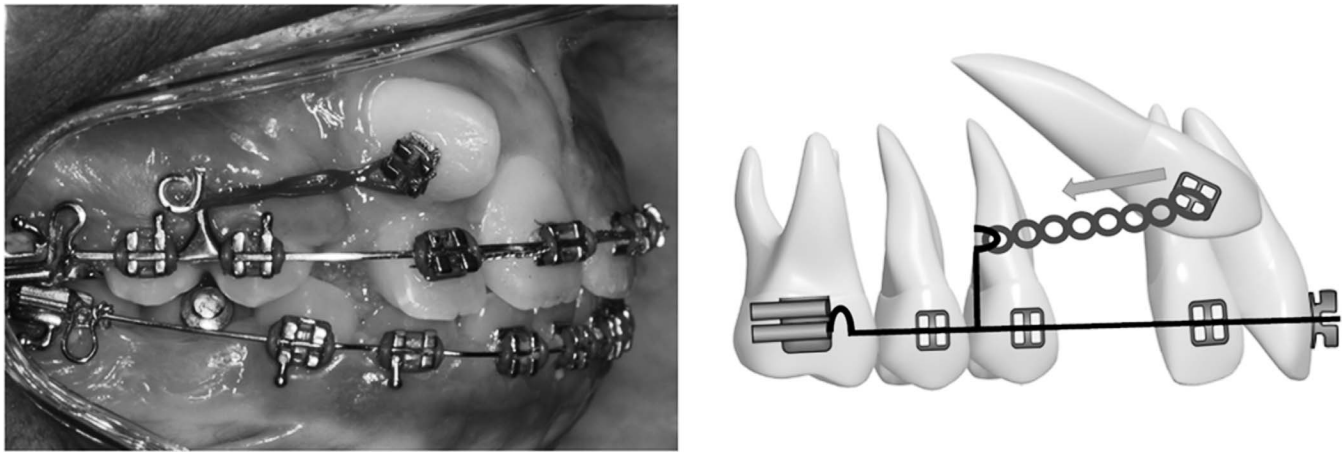

Figure 7. Canine distalization with chain elastic placed on a power arm welded to a 0.019 × 0.025-inch steel arch.

premolar and the incisor to obtain sufficient space for the canine (Figure 8). After distal movement, the segmented archwire was removed, and a 0.014-inch nickel-titanium archwire was inserted as an overlay on the 0.019 × 0.025-inch steel archwire for canine traction. To finish the case, continuous alignment and leveling were performed, now including the canine, with 0.016 × 0.022-inch nickel-titanium arches, 0.018 × 0.025-inch thermo-activated nickel-titanium, and 0.019 × 0.025-inch steel arches. During this finishing phase,

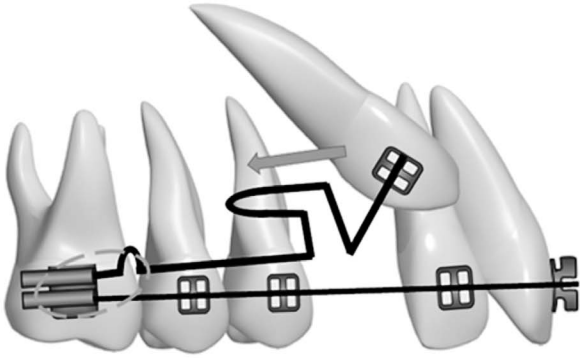

Figure 8. A 0.017 × 0.025-inch TMA segmented arch with boot loop to control torque and rotation during canine distalization. An active open spring was inserted to obtain sufficient space for the canine.

intermaxillary Class II and vertical elastics were used to obtain Class I molar and canine relationships with adequate overjet and overbite.

After 6 years of active orthodontic treatment, the appliances were removed. A removable upper wrap-around retainer was delivered to be worn 24 hours per day, and a lower fixed 3-3 retainer of 0.028-inch steel wire was bonded. Unfortunately, a few days after removing the appliances, the right central incisor relapsed (Figure 9). Thus, partial treatment was suggested to the patient to correct the tooth position. Brackets were bonded from the right first premolar to the left first premolar, and continuous alignment and leveling with 0.018-inch nickel-titanium and 0.019 × 0.025-inch steel arches (American Orthodontics) were performed (Figure 10). After 6 weeks, the right central incisor was in a better position, and the brackets were removed. At this time, an upper fixed 3-3 retainer of 0.020-inch steel wire was bonded (Figures 11, 12, and 13), and the patient underwent gingivoplasty from the upper right second premolar to the upper left second premolar, except on the three teeth that were impacted, to improve gingival margins of the upper teeth (Figure 14).

Figure 9. Intraoral photograph with upper right central incisor misalignment.

Treatment Results

Traction of impacted permanent teeth allowed reestablishment of the patient's esthetics and function. Orthodontic treatment achieved adequate overjet and overbite as well as Class I molar and canine relationships. There was improvement of the patient's smile line and the convex profile was maintained, without compromising facial esthetics. Gingivoplasty was important to improve the uneven gingival margins. The panoramic radiograph showed satisfactory root parallelism, without significant root resorption of the erupted teeth and highlighted root dilaceration of these teeth. The upper right lateral incisor showed a radiolucency at the apex, and the patient was referred

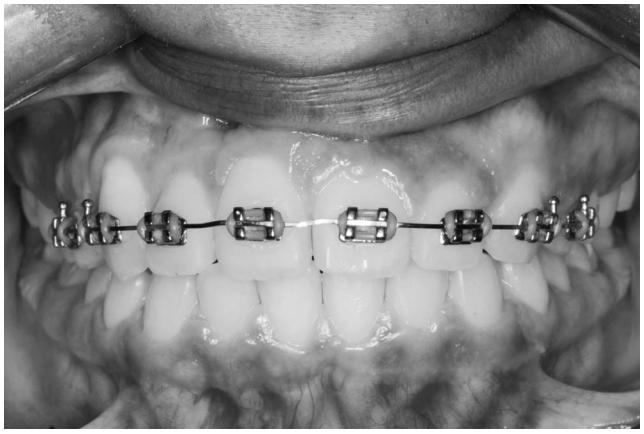

Figure 10. Partial treatment to correct upper tooth position.

Figure 11. Posttreatment photographs.

to an endodontist, who decided to perform root canal treatment. Cephalometric radiography indicated a Class I dental relationship and satisfactory position of the upper central incisor, and the lower central incisor remained protrusive (Figure 13; Table 1). The treatment approach enabled satisfactory results with adequate stability 18 months after appliance removal (Figure 15).

DISCUSSION

This case report included the diagnosis, treatment decisions, and progress of three impacted teeth in an 11-year-old patient. The traction of the three impacted teeth was the option chosen to preserve natural teeth and the contour of gingival support and to avoid the need for prosthetic rehabilitation. Despite these advantages, it is important to clarify that this option can extend treatment duration, especially because three dilacerated teeth were involved and the patient was in the mixed dentition.[4,8,9]

To correctly diagnose a patient with impacted teeth, CBCT exam is essential.[10] In this case, CBCT was necessary to decide if it was possible to orthodontically erupt the teeth and to identify the proximity of the roots and intraosseous positions. Also, CBCT was important to determine the sequence of tooth traction and direction of forces that should be applied, in order to avoid damaging other teeth as well as to guide the surgical exposure of lateral and central incisors.

The lateral incisor had a dilacerated root, a frequent condition in which there is incisor and canine impaction.[11] The lateral incisor traction was performed with a light force, to displace it in the palatal direction. This maneuver was important to extrude the lateral incisor without contact with the other impacted teeth.

Dental trauma could alter the length and form of the root. In the present case, the maxillary central incisor had a dilaceration and buccal inclination. These

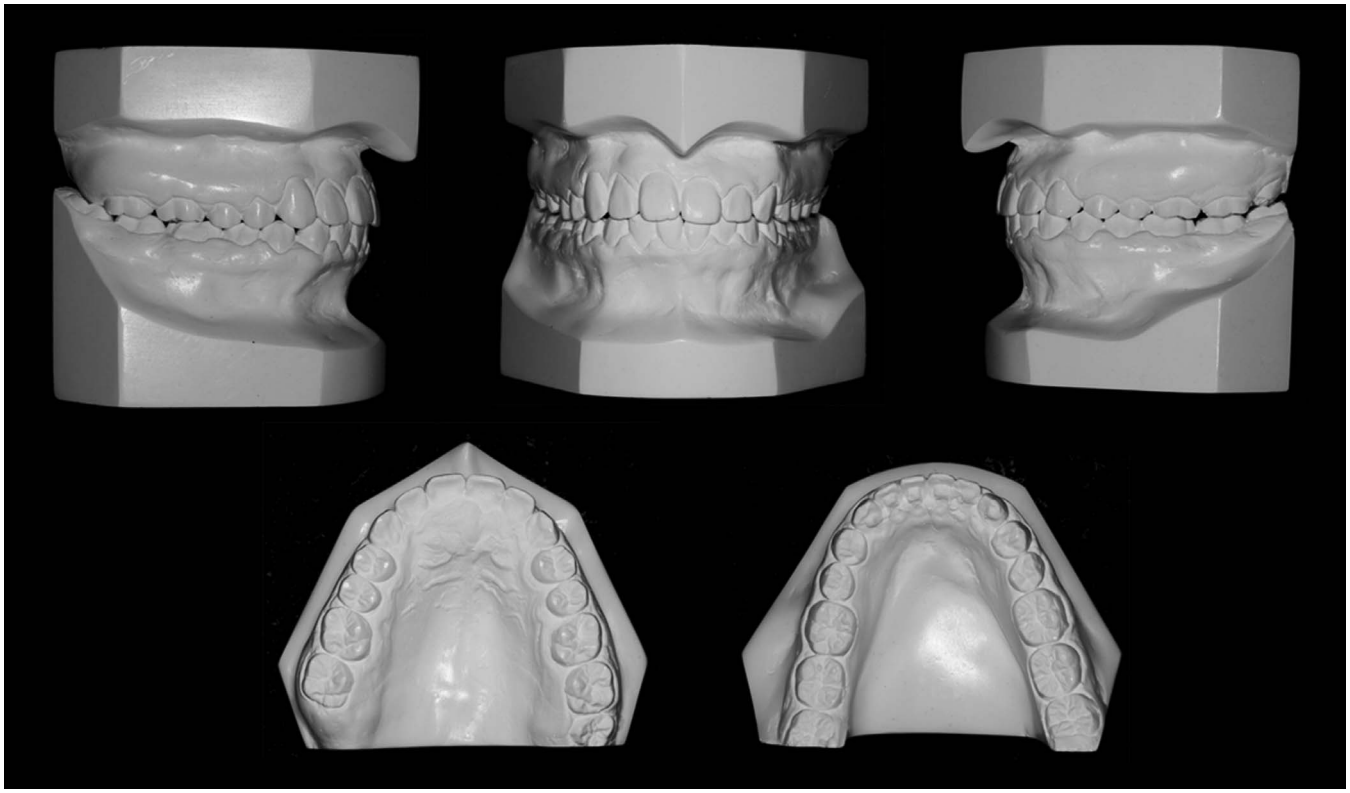

Figure 12. Posttreatment dental casts.

abnormalities did not prevent the success of orthodontic movement despite the difficulty in applying traction.[12,13] To move the central incisor, a box loop was used to properly control the root and crown inclinations during extrusion. The advantages of these mechanics are the low cost involved, simple treatment option for an orthodontist, easy for maintaining adequate hygiene, and that it is a noninvasive procedure. Considering the root dilaceration, torque needed to be applied to avoid buccal movement of the apex when extruding and positioning the incisor correctly.[14]

A retrospective study[15] showed that when the upper central incisor is impacted, the ipsilateral canine is often positioned superiorly in comparison with the unaffected site. Anterior trauma cases also have more prevalent and severe canine displacement.[16] In the present case, the canine was the most superior tooth and erupted passively, showing mesial angulation of the root, being the last one to be tractioned.

To upright and extrude the upper canine, a segmented TMA arch with a boot loop was used. The segmented arch is frequently used to close spaces in orthodontic extraction cases, as first described by Burstone.[17] The boot loops also provide predictable movement, allowing for controlled movement of the crown and root through the alveolar bone. Another advantage of these mechanics include the low cost involved, simple treatment option for an orthodontist, easy maintenance for adequate hygiene, and that it is a noninvasive procedure.

After appliance removal, the right central incisor relapsed, and partial treatment was performed to realign this tooth. Since an upper removable retainer was not sufficient to maintain the results, a fixed retainer was bonded in the upper arch. The unlevel anterior gingival margins were explained to the patient, and although she was fearful of additional surgical procedures, she accepted this periodontal approach. To decrease the invasiveness of this procedure, the periodontist decided not to perform an esthetic crown-lengthening surgery. Gingivoplasty was performed from the upper right second premolar to the upper left second premolar, except for the three tractioned teeth. This procedure improved smile esthetics but did not achieve totally leveled gingival margins due to the patient's anatomical periodontal features. Despite that, the patient was satisfied with the results obtained and did not wish to undergo further gingival surgery, probably due to her fear for surgical procedures and the fact that she had a low smile line, which prevented exposure of the uneven gingival margins during smiling (Figure 11).

Despite the long treatment time and the dilacerated roots of the impacted teeth, significant root resorption

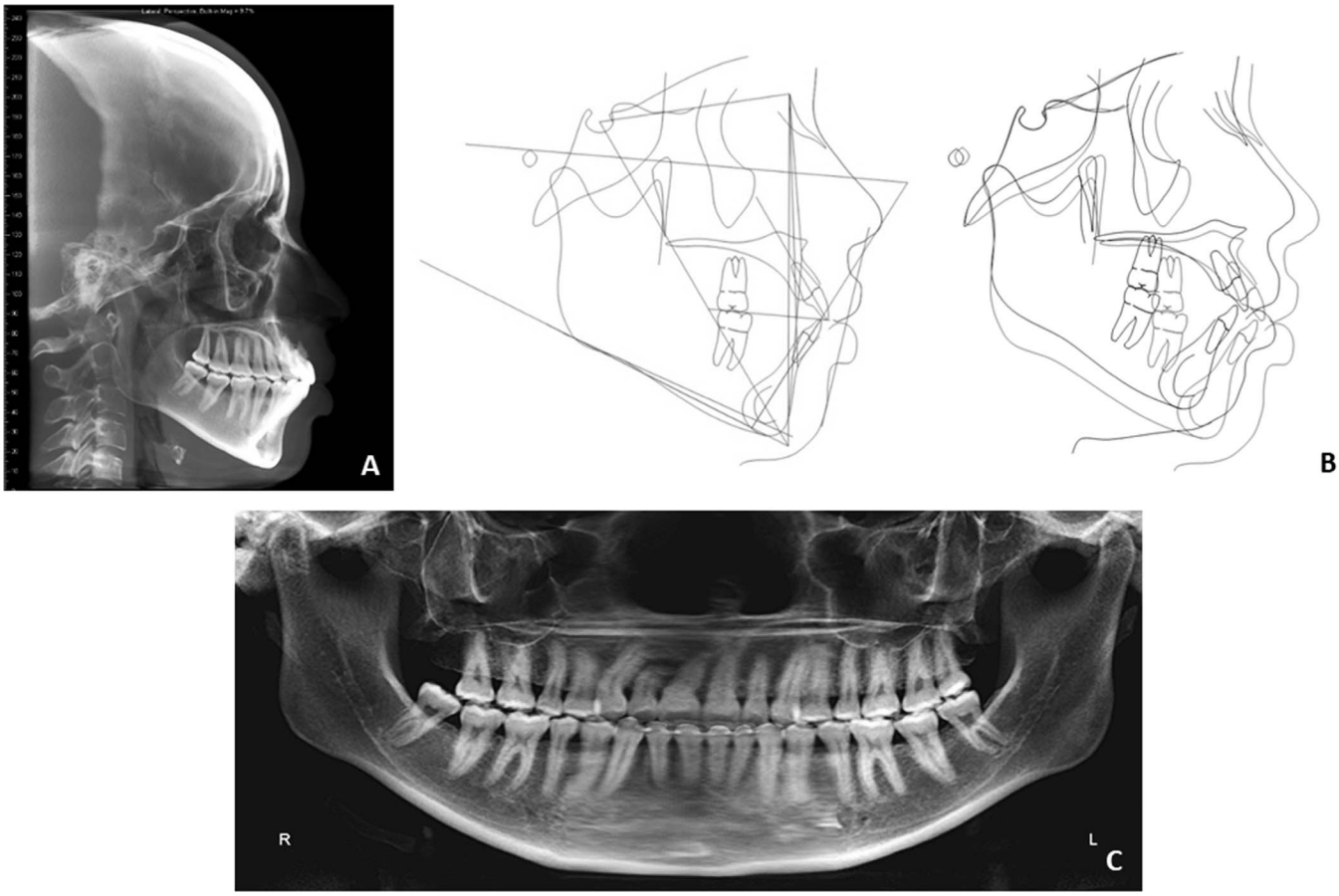

Figure 13. Posttreatment radiographs and tracing. (A) Lateral cephalometric radiograph. (B) Lateral cephalometric tracing and superimposition. (C) Panoramic radiograph.

Figure 14. Immediately after gingivoplasty of upper teeth.

was not seen at the end of treatment.[18] Mechanical control with light forces throughout the treatment may explain this. One limitation of the present case was the long orthodontic treatment time, which can be explained in part by the characteristics of academic treatment and the coronavirus disease pandemic (the patient spent almost 1 year without attending orthodontic appointments). The anterior gingival margins also remained at different levels, although the patient was satisfied with the results obtained after gingivoplasty and understood the necessity for partial retreatment after, since the upper removable retainer was not sufficient to maintain the results, confirming the necessity of a fixed retainer in cases with tractioned teeth.

CONCLUSIONS

- This case report showed that the proposed treatment, including orthodontic, surgical, and periodontal approaches, allowed preservation of natural teeth, reestablishing the patient's esthetics and function.
- The advantages of the orthodontic biomechanics presented in this article include the low cost involved,

Figure 15. Eighteen-month follow-up photographs.

simple treatment option for an orthodontist, easy maintenance of adequate hygiene, and the fact that it was a noninvasive procedure.

- In cases of anterior tooth traction, fixed retention is recommended to avoid relapse of the previously impacted teeth.

ACKNOWLEDGMENTS

This article was supported in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brazil (CAPES) – [Finance Code 001] and by the Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ).

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