Case Report

Orthodontic management of a patient with an impacted maxillary canine associated with severe palatal root dilaceration of the adjacent first premolar

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ABSTRACT

The incidence of maxillary canine impaction is estimated at approximately 1.7% of the population and is multifactorial in etiology. Several case reports suggest a potential relationship between canine impaction and root dilaceration of the adjacent premolar, indicating mechanical interference due to their proximity. In such cases, when avoiding tooth extractions is desired, it is crucial to consider specific clinical approaches to prevent contact with the dilacerated root during traction. This case report describes traction of an impacted maxillary canine in a female patient resulting from severe palatal root dilaceration of the adjacent first premolar. The canine was surgically exposed and traction was initiated after endodontic therapy and root sectioning of the affected premolar. After 24 months of orthodontic treatment, the results were satisfactory, with adequate gingival contour, 2 mm overjet and overbite, and a Class I relationship of canines and molars. No apparent root resorption was observed, and bone structure was preserved. A multidisciplinary approach is fundamental for the success of treatment in such cases, enabling achievement of a functionally and esthetically stable occlusion while avoiding tooth extractions. (*Angle Orthod*. 0000;00:000–000.)

KEY WORDS: Canine traction; Deviated premolar root; Endodontic surgery; Impacted canine; Management impacted teeth

INTRODUCTION

Maxillary permanent canines are the most commonly impacted teeth in the anterior dentition, second only to mandibular third molars, with an estimated prevalence of 1.7% as reported by Ericson and Kurol.[1] Most cases are unilateral, and women are twice as likely as men to be affected.[2]

In addition to a possible genetic etiology,[3] according to Bishara, canine impaction can result from various general etiological factors (endocrine disorders, fever, radiation) or local factors (discrepancies between tooth size and arch length, prolonged retention or early loss of the deciduous canine, abnormal position of the tooth germ, etc.).[4] Case reports suggest a relationship between maxillary canine impaction and root dilaceration of the adjacent premolar, indicating possible mechanical interference due to their spatial proximity.[5–8] Some authors describe different clinical approaches to address impacted canines while avoiding root dilaceration of the adjacent premolar. These include orthodontic maneuvers to redirect the canine away from the premolar root trajectory, extraction of the premolar, and endodontic treatment followed by sectioning of the dilacerated root.[9–11]

The aim of this case report is to describe the traction of an impacted maxillary canine associated with severe palatal root dilaceration of the adjacent first premolar.

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Figure 1. Pretreatment facial and intraoral photographs.

Diagnosis and Etiology

A 14-year-old female patient sought treatment at a private clinic to begin orthodontic treatment, complaining about the failure of eruption of the permanent maxillary left canine. With no history of systemic diseases or trauma, the initial examination revealed a balanced facial pattern and a skeletal Class I relationship (Figures 1 and 2) (Table 1). Intraoral examination identified a Class II subdivision right molar relationship, deviation of the upper midline to the left, coincidence of the lower midline with the face, well-positioned upper and lower incisors, and absence of the permanent maxillary left canine. Panoramic radiography revealed the impacted canine, associated with severe root dilaceration of the adjacent first premolar, as well as the presence of a supernumerary tooth in the region of the mandibular right second premolar (Figure 3). Cone-beam computed tomography (CBCT) imaging highlighted the atypical morphology of the palatal root of the maxillary left first premolar, characterized by a pronounced curvature, contributing to the buccal impaction of the canine (Figure 4).

Treatment Alternatives

In cases with impacted canines, different treatment options may be considered, such as extraction of the canine and mesial movement of the first premolar, extraction of the canine followed by prosthetic replacement, or surgical exposure with orthodontic traction. Given the patient's age and bone growth potential, the chosen option was surgical exposure and orthodontic traction of the impacted tooth. However, the traction path was compromised by the root morphology of the adjacent premolar. Therefore, endodontic treatment would be required, which was complicated by the pronounced curvature of the root, as well as sectioning of the palatal root of the maxillary left first premolar. If

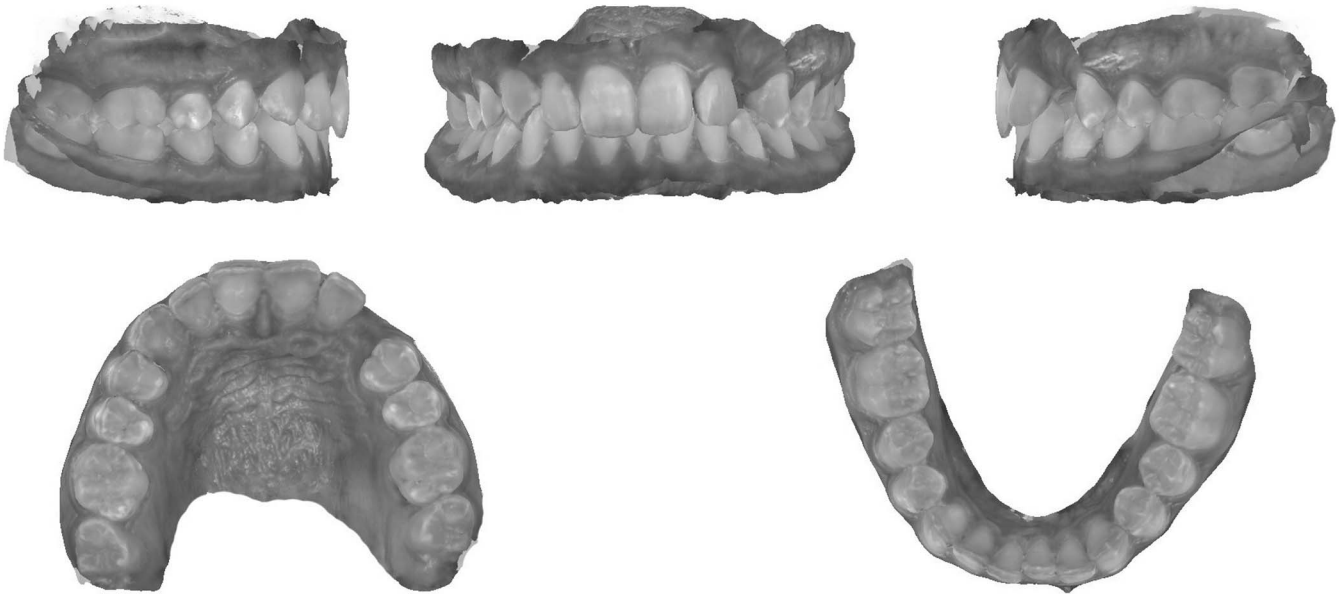

Figure 2. Pretreatment digital dental casts.

this were not feasible, the alternative would be extraction of the premolar to clear the path for canine traction.

Treatment Progress

Fixed 0.022-inch orthodontic appliances, Alexander prescription, were bonded in both arches, except for the impacted canine (GAC MicroArch, Fuchu-shi, Tokyo, Japan). The upper and lower first molars received cemented bands with soldered tubes, and the lower second molars were bonded with Roth prescription tubes. The patient was referred for endodontic evaluation and subsequent treatment of the upper left first premolar, despite the tooth exhibiting vitality and being asymptomatic. The procedure was completed in a single session using state-of-the-art nickel-titanium rotary files (Wave One Gold, Pro-Taper Gold), which, due to their high flexibility, allowed for control of the tooth's complex anatomy with the assistance of optical microscopy (Zeiss) (Figure 5). The canals were obturated with gutta-percha cones and bioceramic sealer (Bio C Sealer, Angelus). The access cavity was sealed with a polymerizable composite resin (Beautifil II, Shofu Inc.). The patient was

Table 1. Cephalometric Measurements

Measurement	Norm	SD	Pretreatment	Posttreatment
ANB (°)	1.6	1.5	3.6	3.1
Convexity (NA-APo) (°)	6.0	3.0	6.5	4.1
Facial Angle (FH-NPo) (°)	88.2	3.0	89.5	90.6
FMA (MP-FH) (°)	24.3	4.5	22.8	25.0
FMIA (L1-FH) (°)	64.4	8.5	75.1	59.5
IMPA (L1-MP) (°)	95.0	7.0	82.2	95.4
Interincisal Angle (U1-L1) (°)	130.0	6.0	148.2	119.0
L1 - NB (°)	25.3	6.0	13.8	29.9
L1 - NB (mm)	4.0	1.8	1.7	5.7
Lower Lip to E-Plane (mm)	−2.0	2.0	−1.7	0.5
Occ Plane to SN (°)	14.4	2.5	18.5	12.7
Pog - NB (mm)	2.1	1.7	1.3	2.2
SNA (°)	82.0	3.5	81.5	82.2
SNB (°)	80.9	3.4	77.9	79.1
Soft Tissue Convexity (°)	133.5	4.0	128.1	130.0
U1 - NA (°)	22.8	5.7	14.5	28.0
U1 - NA (mm)	4.3	2.7	1.5	5.2
U1 - SN (°)	102.7	5.5	95.9	110.2
Upper Lip to E-Plane (mm)	−5.1	2.0	−4.6	−3.0
Wits Appraisal (mm)	−1.0	1.0	0.2	2.0
y-axis — Downs (SGn-FH) (°)	60.4	3.4	57.3	58.2

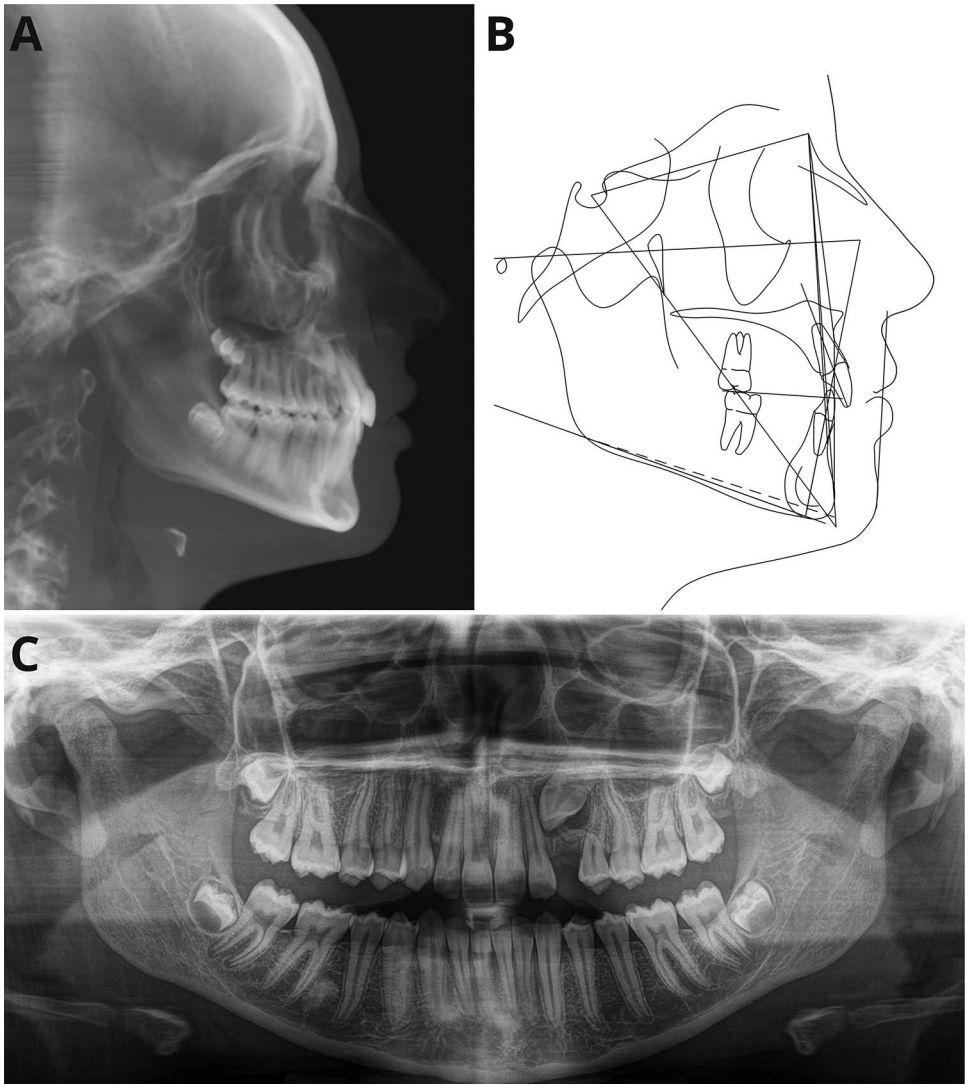

Figure 3. Pretreatment radiographs: (A) Lateral cephalogram; (B) Cephalometric tracing; (C) Panoramic radiograph.

then referred for a single-session surgery to section the dilacerated root (Figure 6), perform surgical exposure, and bond a bracket to the canine for traction. A 0.017 × 0.025-inch beta titanium wire was used as a base arch, allowing traction with a nickel-titanium spring tied to the bracket bonded to the exposed maxillary left canine. A compressed spring was used between the lateral incisor and the left first premolar to create space for canine traction (Figure 7). After 8 months of traction, the canine was better positioned in the oral cavity, enabling bracket rebonding and its inclusion in a 0.015-inch multifilament alignment arch, progressing to the alignment and levelling phase with 0.016-inch, 0.018-inch, and 0.0200-inch stainless steel arches, and finishing with a 0.017 × 0.025-inch rectangular stainless steel arch. Intermaxillary elastics were used to correct the right molar relationship to Class I. After 24 months of treatment, a 0.70-mm stainless steel fixed lower retainer bonded to the canines was installed, along with an upper wraparound nighttime retainer.

Treatment Results

At the end of treatment (Figures 8 and 9), adequate gingival contour and proper dental intercuspation were achieved, resulting in 2 mm of overjet and overbite, as well as Class I canine and molar relationships. Radiographic examination (Figures 10 and 11) revealed root parallelism, except for the roots of the maxillary second premolars due to mesial dilaceration. No evident root resorption was observed, and the bone structure was preserved.

DISCUSSION

This case report describes the traction of an impacted maxillary canine associated with severe palatal root

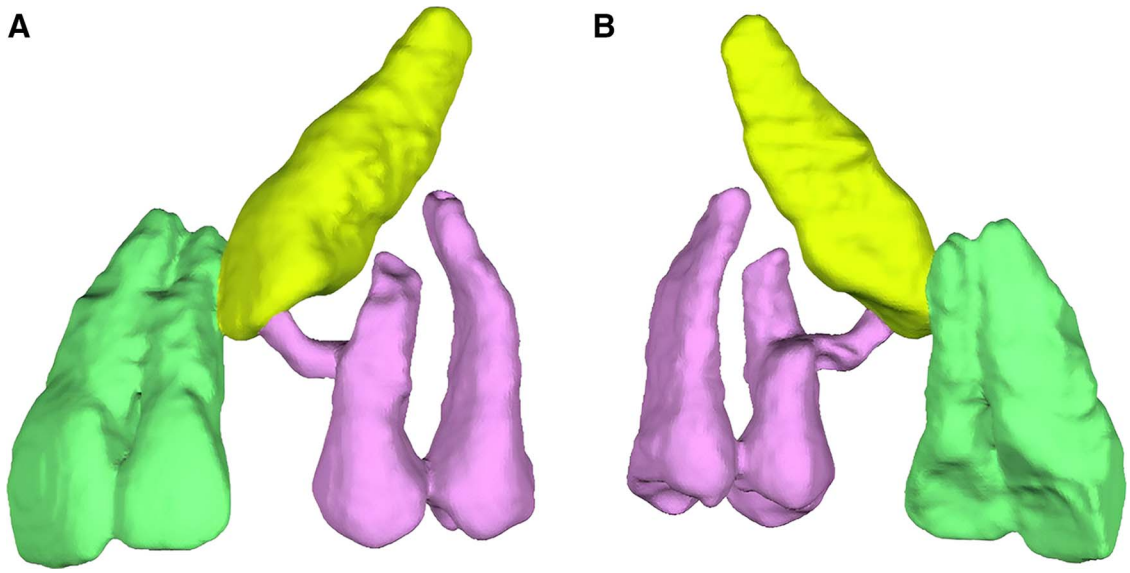

Figure 4. CT scan segmentation showing atypical morphology of the palatal root of the left maxillary first premolar, contributing to the buccal impaction of the left maxillary canine. (A) Buccal view. (B) Palatal view. CT indicates cone-beam computed tomography.

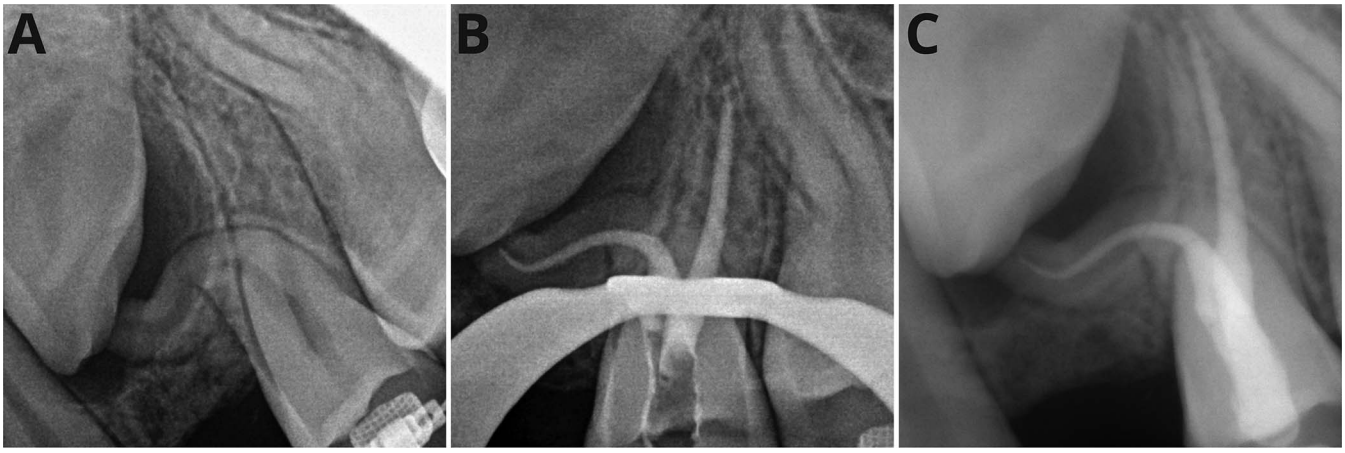

Figure 5. (A) Initial stage of endodontic treatment. (B) Obturation stage of endodontic treatment. (C) Final stage of endodontic treatment.

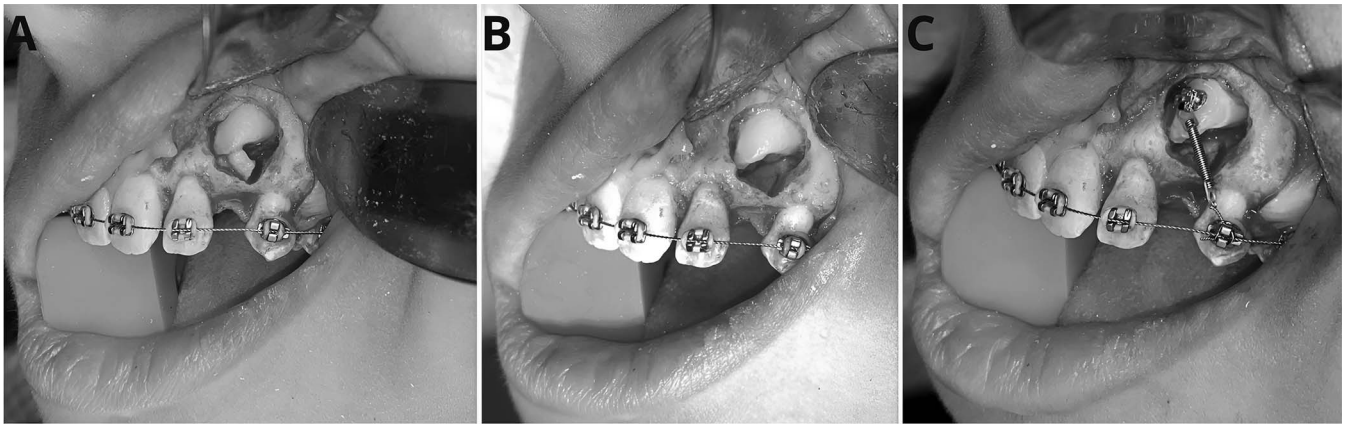

Figure 6. (A) Session surgery to perform surgical exposure. (B) Section the dilated root. (C) Bond a bracket to the canine for traction.

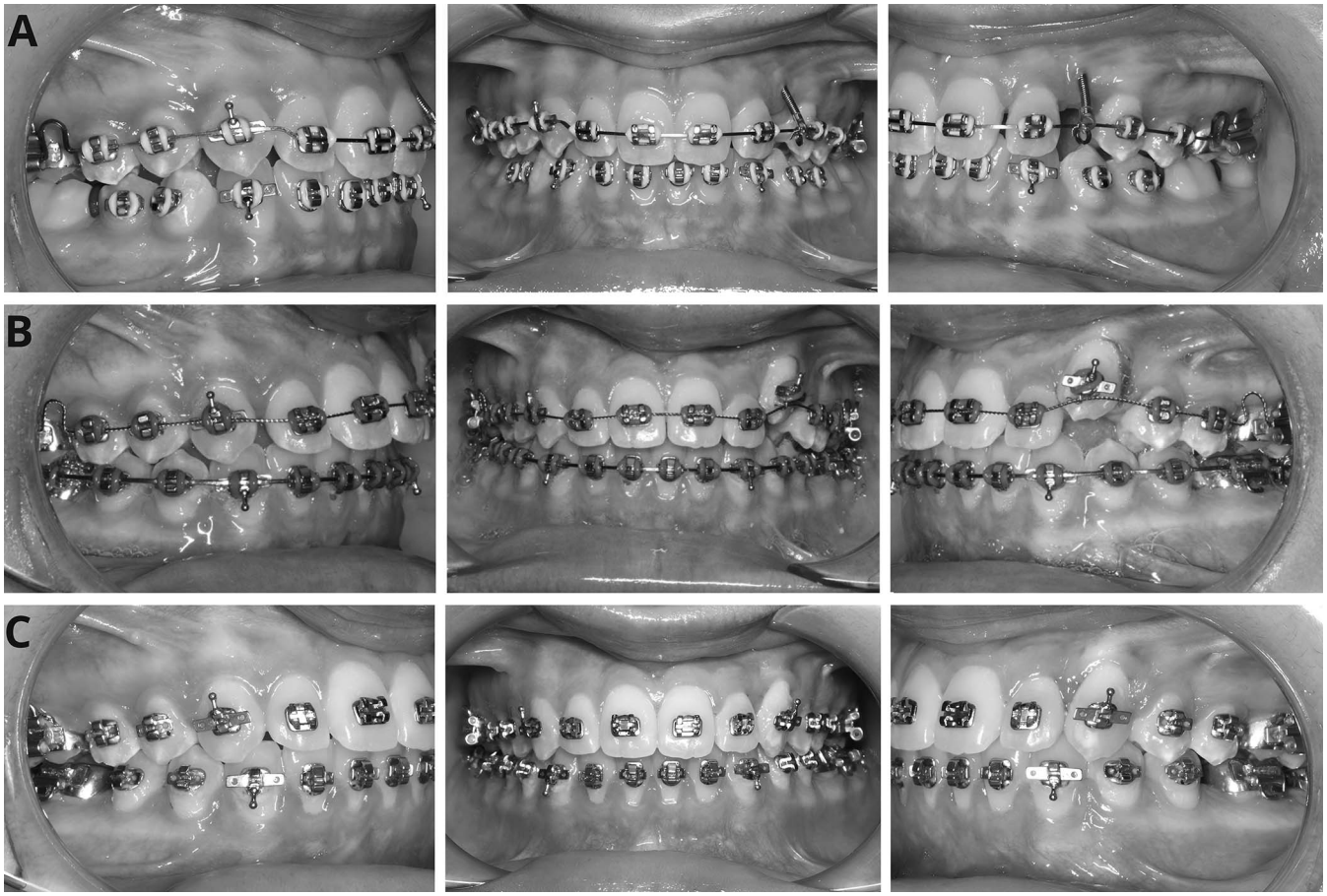

Figure 7. Treatment progress. (A) 1-month follow-up result. (B) 6-month follow-up result. (C) 16-month follow-up result.

dilaceration of the adjacent first premolar, after endodontic treatment and root sectioning of the affected premolar.

Dilaceration is an abnormal curvature or angulation of the root or crown of a tooth, making orthodontic movement of teeth with dilacerated roots more complex and time-consuming due to the increased risk of impaction and root resorption.[12–14] Etiological factors of root dilaceration may include inadequate space for development, proximity to anatomical structures such as the cortical bone of the maxillary sinus or nasal fossa, supernumerary teeth, ankylosis, or prolonged retention of deciduous teeth.[12,15] Additionally, dental trauma, especially when root dilaceration occurs in incisors, may be involved.[12,16] However, in posterior teeth, trauma may not be the primary etiological factor, as this region is less likely to have a history of trauma, suggesting a possible genetic influence in such cases.[12,15] In the present case, the patient had no history of trauma.

Some cases of impacted maxillary canines associated with root dilaceration of the adjacent premolar have been reported, with impactions occurring both palatally[9–11] and buccally.[5–7] In the present case, the patient exhibited buccal impaction of the permanent maxillary left canine. According to Pedullà et al.,[11] three possible explanations exist for this clinical situation: (1) deviation of the premolar palatal root may have caused the canine impaction; (2) the impacted canine may have caused root deviation of the adjacent tooth; or (3) both events may be coincidental. As discussed in previous studies,[9,11] the coincidence hypothesis was ruled out and the conclusion was that the premolar root dilaceration likely caused the canine impaction. This conclusion was supported by the patient's positive maxillary arch discrepancy, the favorable eruption path of the maxillary left canine, and the less pronounced root dilacerations observed in the maxillary second premolars.

Cone-beam computed tomography (CBCT) was requested to ensure proper orthodontic planning and a more accurate prognosis, as root dilaceration of the adjacent premolar can cause mechanical interference, contributing to canine impaction. Therefore, careful analysis of the root morphology of adjacent teeth was essential.[8] Various orthodontic techniques have been described in the literature for redirecting the canine's path to avoid severe root dilaceration, including extraction of the affected premolar, particularly when there is

Figure 8. Posttreatment facial and intraoral photographs.

insufficient arch space for proper tooth alignment.[9] However, in patients with positive, null, or mild crowding discrepancies, root sectioning may be the preferred option, as it avoids the need for closing large subsequent spaces which would complicate and prolong treatment.[6,8,10,11] When none of these approaches are viable, extraction of the impacted permanent canine may be considered, with retention of the deciduous canine as an alternative.[7]

The canine plays an essential role in smile esthetics, positioned over the canine eminence, which supports the alar base and upper lip. When properly aligned and leveled, canines ensure adequate proportions of the anterior teeth and a harmonious smile line. Functionally, they contribute to posterior disocclusion during lateral excursive movements.[17] Performing canine traction without extractions allows for natural dental and periodontal architecture, enabling a better response to biological changes over time.[17] Additionally, some authors have associated the absence of lateral disocclusion guidance from canines with a high incidence of abfraction in the cervical region of the maxillary first premolars, which may be considered a disadvantage in space closure options.[18]

In the present case, the patient exhibited a positive arch length discrepancy and a favorable eruption path for the maxillary left canine. CBCT revealed that the palatal root of the first premolar was responsible for the impaction, causing mechanical interference. Consequently, the chosen treatment approach involved endodontic treatment followed by sectioning of the palatal root of the affected first premolar and surgical exposure with orthodontic traction of the impacted canine. The patient's age was a significant factor in the clinical decision-making process. The esthetic concern caused by the absence of a tooth in the

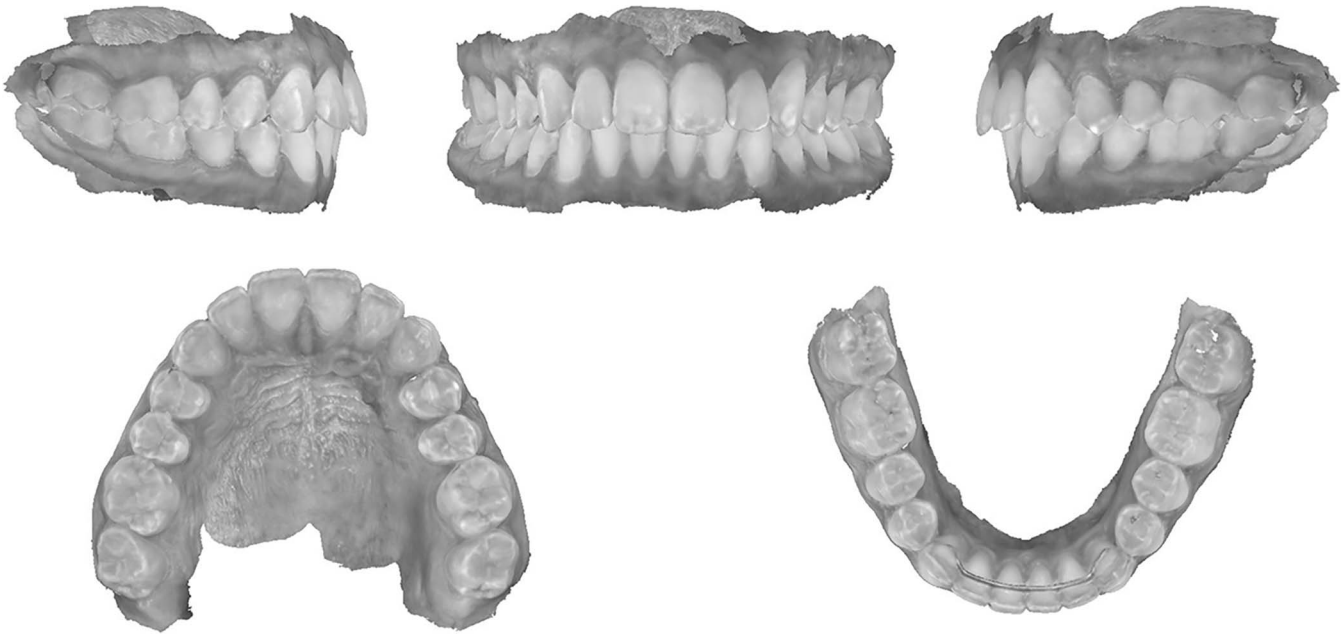

Figure 9. Posttreatment digital dental casts.

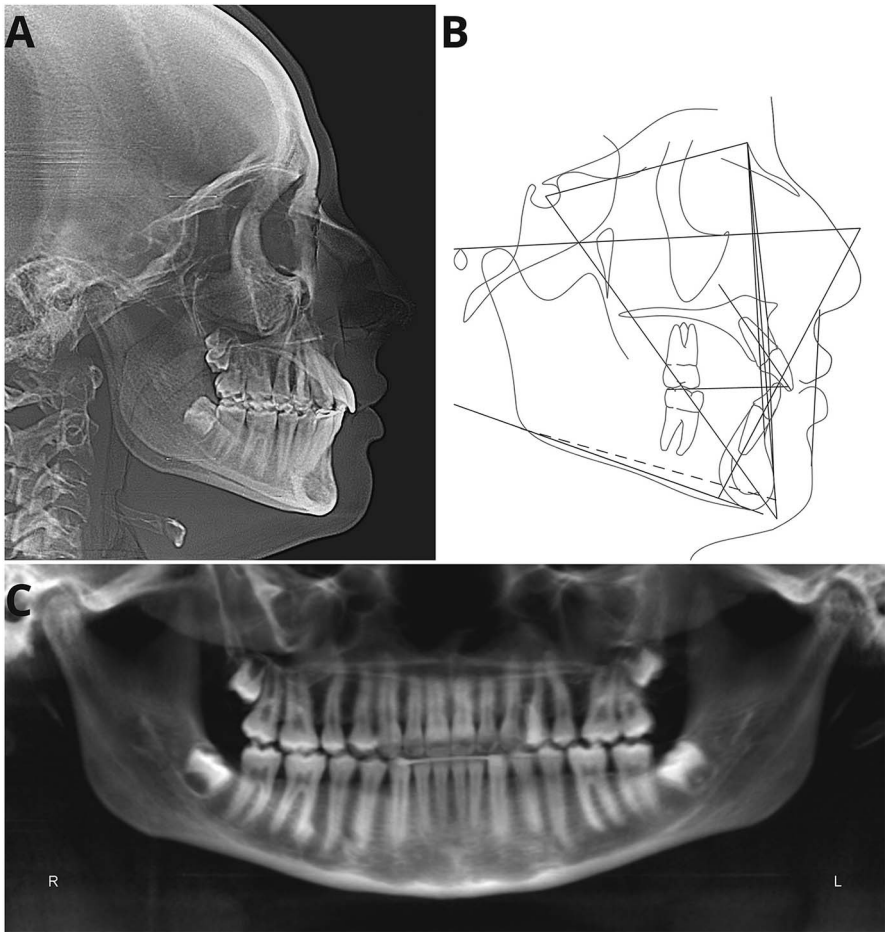

Figure 10. Posttreatment radiographs: (A) Lateral cephalogram; (B) Cephalometric tracing; (C) Panoramic radiograph.

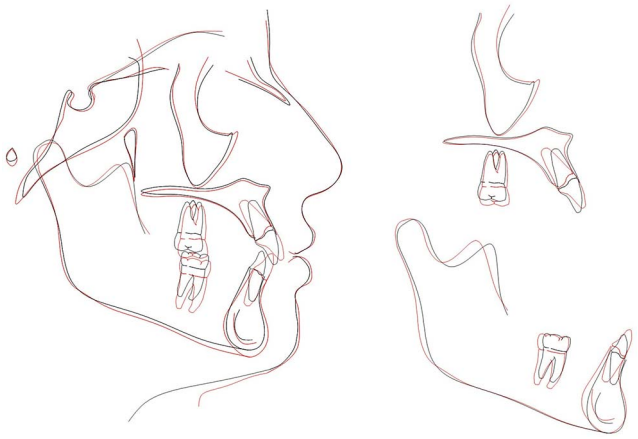

Figure 11. Cephalometric superimpositions of pretreatment and posttreatment images.

anterior region raised concerns for the parents and orthodontists and posed a potential psychological burden on the patient.[19] At just 14 years old, maintaining space for future implants would risk loss of alveolar bone height and thickness, as implant placement would need to be delayed until growth was complete.[20] Therefore, if the combined endodontic treatment and palatal root sectioning of the premolar were not feasible or failed, the alternative treatment would involve extraction of the first premolar, followed by mesial movement of the maxillary posterior teeth on the left side, ultimately resulting in a Class II molar relationship on the left.

Although reports indicate that the approach used in this case has a good prognosis, with periodontal stability and absence of root resorption,[9–11] long-term follow-up is essential to monitor for a potentially unfavorable biological response. If any changes in prognosis occur, the patient will be at an appropriate age to receive implants.

CONCLUSIONS

- Traction of impacted maxillary canines, especially when there is significant root dilaceration of adjacent premolars, requires an individualized treatment plan and a multidisciplinary approach.
- Initially, it is necessary to clear the traction path by removing the obstructive factor, facilitating eruption and subsequent orthodontic alignment of the canine. This approach achieves periodontal stability and avoids root resorption, promoting a favorable outcome.

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