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A simple approach to correct ectopic eruption of maxillary canines

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This case report describes the orthodontic treatment of a patient with severe crowding; the maxillary right canines were ectopic, positioned far to the buccal side, and superimposed on the lateral incisors in near-transposition. Treatment included extraction of the 4 first premolars. A transpalatal bar was used as an anchorage device, and beta-titanium T-loop springs (0.019 × 0.025″) were used to better control the ideal force applied to retract the maxillary canines. A segmental T-loop spring was used as if it were a modified system of the segmental archwire technique. After the canines were retracted and space created for the anterior teeth, the latter were included in the treatment and the treatment was finished in the usual manner. Excellent results were achieved, both esthetic and functional. The treatment choices and their straightforward approach were appropriate, yielding predictable and stable results in the long term. (Am J Orthod Dentofacial Orthop 2019;155:871-80)

The ectopic impaction and eruption of permanent maxillary canines are frequent and extremely challenging conditions in dental practice.[1] One-third of impacted canines are located buccal to the dental arch,[2] and their etiology is related to a deficient dental arch perimeter.[3]

The eruption path of the maxillary permanent canine is not only long and winding, but slightly buccal in relation to the dental arch. Moreover, its eruption occurs after that of the lateral incisor and the first premolar. Therefore, any approximation between the roots of these teeth decreases the space available for the canine and may cause their intraosseous retention or ectopic eruption, usually manifested by an exaggerated buccal position.[4]

Teeth alignment plays an important role in facial esthetics and facial harmony,[5] and the presence of maxillary dental crowding is esthetically less acceptable when the 4 maxillary incisors are misaligned. The presence of crowding associated with canine ectopic eruption located buccal to the dental arch further motivates patients to seek orthodontic treatment.[6,7]

In the present case report we describe the orthodontic treatment of a female patient with severe dental crowding, with maxillary canines positioned excessively to buccal (ectopic) and superimposed on the lateral incisors in near-transposition. The treatment involved extracting the 4 first premolars, the use of a transpalatal bar and the use of segmental archwires with T loops with helicoids for the retraction of the ectopic canines. At the end of treatment, the aims were achieved with optimal esthetic balance as well as excellent occlusal relationships, which provided outstanding long-term stability.

DIAGNOSIS AND ETIOLOGY

A 13-year-9-month-old girl presented for clinical care at the University's Orthodontics Program, accompanied by her mother, with the chief complaint of misaligned teeth. According to her medical history she was in overall good health. The clinical examination revealed a slightly convex facial profile with a proportional lower third of the face, diminished nasolabial angle, slight protrusion of the lips and normal display of the maxillary incisors on smiling (Fig 1). During the intake interview the habit of onychophagia was reported. The mandibular closure pattern showed no deviation and neither did the temporomandibular dysfunction.

The presence of the right maxillary primary canine was noted, as well as space deficiency in the maxillary

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All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
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Submitted, September 2017; revised and accepted, November 2017.
0889-5406/$36.00

https://doi.org/10.1016/j.ajodo.2017.11.046

Fig 1. Pretreatment photographs.

Fig 2. Pretreatment dental casts.

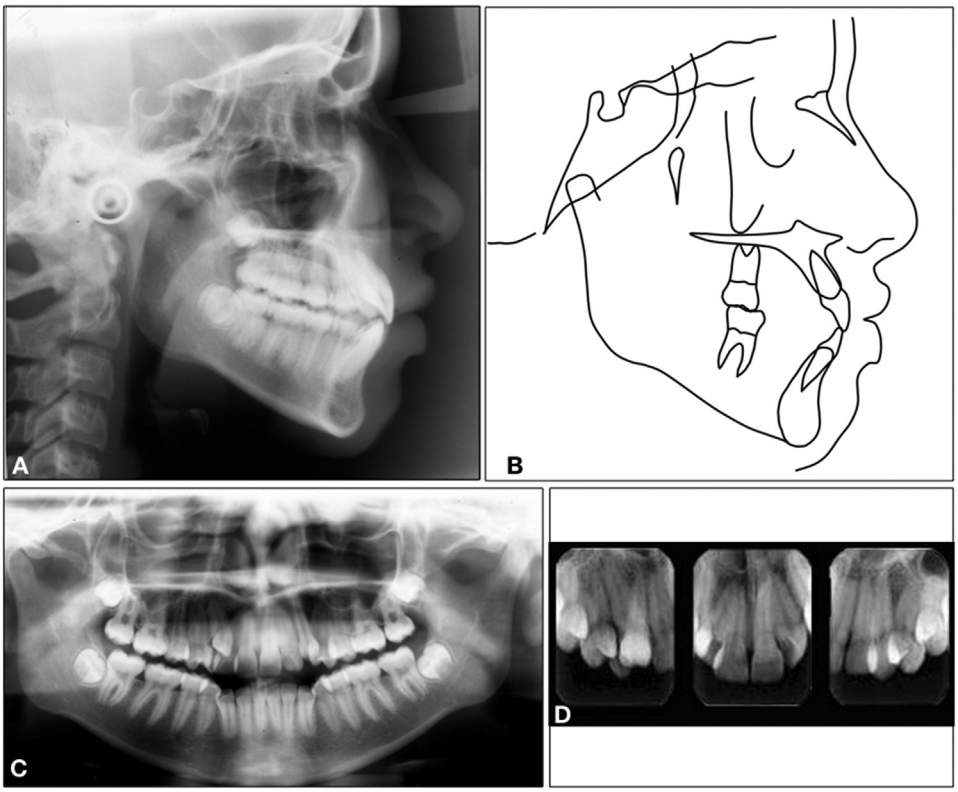

Fig 3. Pretreatment radiographs and tracing. **A,** Lateral cephalometric radiograph; **B,** lateral cephalometric tracing; **C,** panoramic radiograph; **D,** periapical radiographs of the maxillary anterior dentition.

arch of approximately −15 mm and severe crowding of the anterior teeth. Furthermore, the maxillary canines presented virtually superimposed buccal to the maxillary lateral incisors or nearly transposed. The mandibular arch presented with moderate crowding of the anterior teeth with a space deficiency of approximately −6 mm and curve of Spee of 1 mm. When in occlusion, the maxillary laterals showed a dental crossbite, which appeared more severe on the right side, in addition to an overbite and an overjet of 2 mm. The upper and lower dental midlines coincided with each other and with the face, and a Class I molar relationship was present. Both the maxilla and the mandible showed severe lack of gingival leveling in the anterior segments. The left mandibular central incisor was the most buccally positioned tooth and presented with some mild gingival retraction (Fig 2).

Dental radiographic examination revealed the presence of all permanent teeth and the right maxillary primary canine. The third molars were in the final stage of crown formation but lacked space for their complete eruption. Root contours seemed normal and no pathologic lesions were detected (Fig 3).

Table. Cephalometric measurements

Measurement	*Norm*	*Before treatment*	*After treatment*	*4-year follow-up*
Age		14 y 6 mo	17 y	21 y 2 mo
Skeletal pattern				
SNA (°)	82	85	86	86
SNB (°)	80	83	83	83
ANB (°)	2	2	3	3
Wits (mm)	0-2	−4	−1	−1
Convexity (°)	0	2	4	4
Y-axis (°)	59	63	60	62
Facial angle (°)	87	85	87	86
SN-GoGn (°)	32	29	28	28
FMA	25	28	26	26
Dental pattern				
IMPA (°)	90	102	96	97
1.NA (°)	22	30	20	22
1.NA (mm)	4	7	4	4
1.NB (°)	25	36	28	28
1.NB (mm)	4	6	3, 5	3, 5
1.1 (°)	130	114	130	127
1.SN (°)	103	115	109	109
Profile				
UL-S line (mm)	0	2	0	0
LL-S line (mm)	0	4	0	0

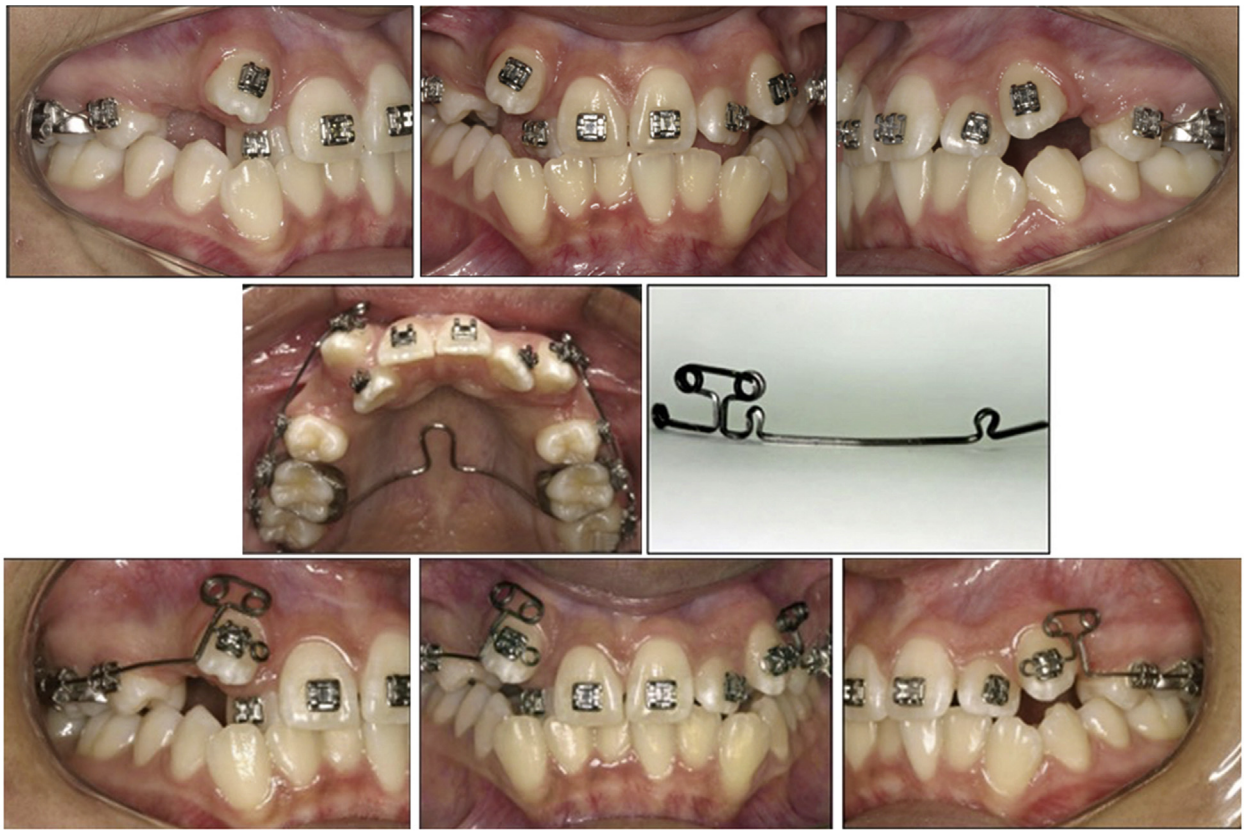

Fig 4. Mechanical approach.

The cephalometric analysis (Fig 3; Table) disclosed a good relationship between maxilla and mandible (ANB 2°), with a slight protrusion of the maxilla (ANS 85°) and mandible (SNB 83°), a good vertical relationship (GoGn.SN 30°, FMA 28°, Y-axis 63°), and a slight projection of the upper and lower lips relative to the Steiner S-line (S-LS 2 mm, S-LI 4 mm). The maxillary incisors were projected labially (1-NA 7 mm, 1.NA 30°, 1.SN 116°) and the mandibular incisors were slightly proclined to labial (1-NB 6 mm, 1.NB 36°, IMPA 102°).

TREATMENT OBJECTIVES

The treatment objectives were to: (1) improve facial profile; (2) eliminate upper and lower crowding and create space for maxillary canines; (3) maintain Class I molar relationship and establish normal canine relationship; (4) correct lateral incisor crossbite; (5) maintain overjet and overbite; (6) obtain functional occlusion with stable occlusal contacts in centric relation and during protrusion and laterality movements, and (7) ensure stability results.

TREATMENT ALTERNATIVES

Owing to the presence of severe localized crowding in the anterior area of both dental arches, a slight labial inclination of the incisors, an excellent Class I molar relationship, and a slightly convex facial profile, we proposed orthodontic treatment with extraction of the 4 first premolars and the use of fixed appliances, followed by retraction of the upper canines with proper anchorage control.

If the dental arches were to be aligned and leveled with no concern for extractions or the distal movement of posterior teeth, the treatment might have resulted in a protruding facial profile as well as dental protrusions.

Any approach involving the distal movement of teeth to create space by using different mechanisms (eg, skeletal anchorage) might prove challenging and time consuming and would inevitably require the extraction of the third molars.

Considering the significant space deficiency, notably in the upper arch, the facial features, the lack of spaces for the third molars, and the optimal Class I molar relationship, any alternate treatment that did not involve the

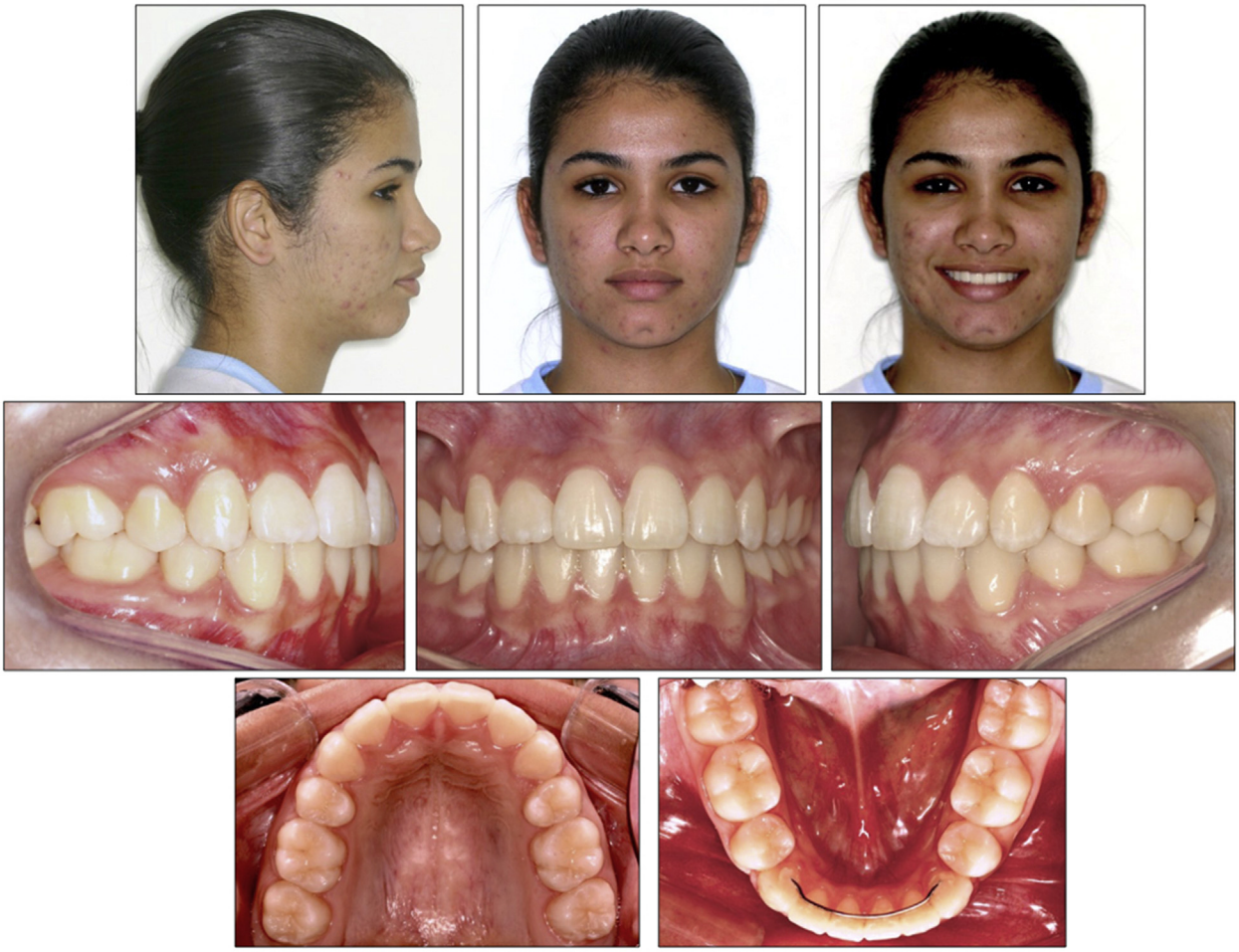

Fig 5. Posttreatment photographs.

extraction of the first 4 premolars would have been unpredictable and questionable, as well as complex.

TREATMENT PROGRESS

The treatment started with placement of a fixed transpalatal bar on the first maxillary molars. These molars received headgear tubes if greater anchorage control was needed, and 0.022 × 0.028″ standard edgewise twin brackets.

In the upper arch to create space for the maxillary canines the primary canines and first premolars were extracted. Tubes were bonded to the second molars and brackets to the upper second premolars and canines. Next, springs in the T-loop shape with helicoids were bent from rectangular tungsten-molybdenum alloy (beta-titanium) wire, 0.019 × 0.025″, as shown in Figure 4.

The springs were fitted from the canines to the second molars, and the omegas were activated away from the tubes of the second molars. The mesial and distal legs of the T-loops were made at different heights, because the mesial was shorter than the distal leg, to ensure that the extrusion force was as biologic as possible (Fig 4). Gradually this difference between the heights of the legs was diminished, providing extrusion and leveling of the canines in the dental arch.

To maintain the omegas away from the second molar tubes and to provide greater activation during canine retraction, additional omega loops were made to shorten the spring horizontal segment (Fig 4). Very light force was applied when the springs were activated to move the canines lingually and distally and to extrude them without compromising the bone and gingival structure.

After the maxillary teeth had been retracted and consequently the required space had been created in the anterior area, all maxillary teeth were included in the treatment, aligned and leveled with the use of 0.014″, 0.018″, and 0.019″ × 0.025″ nickel-titanium

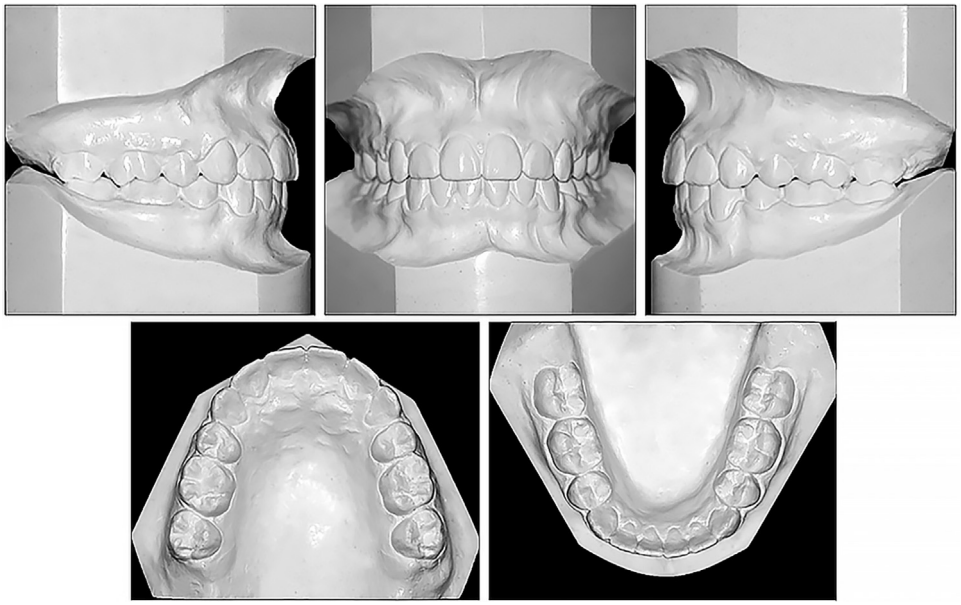

Fig 6. Posttreatment dental casts.

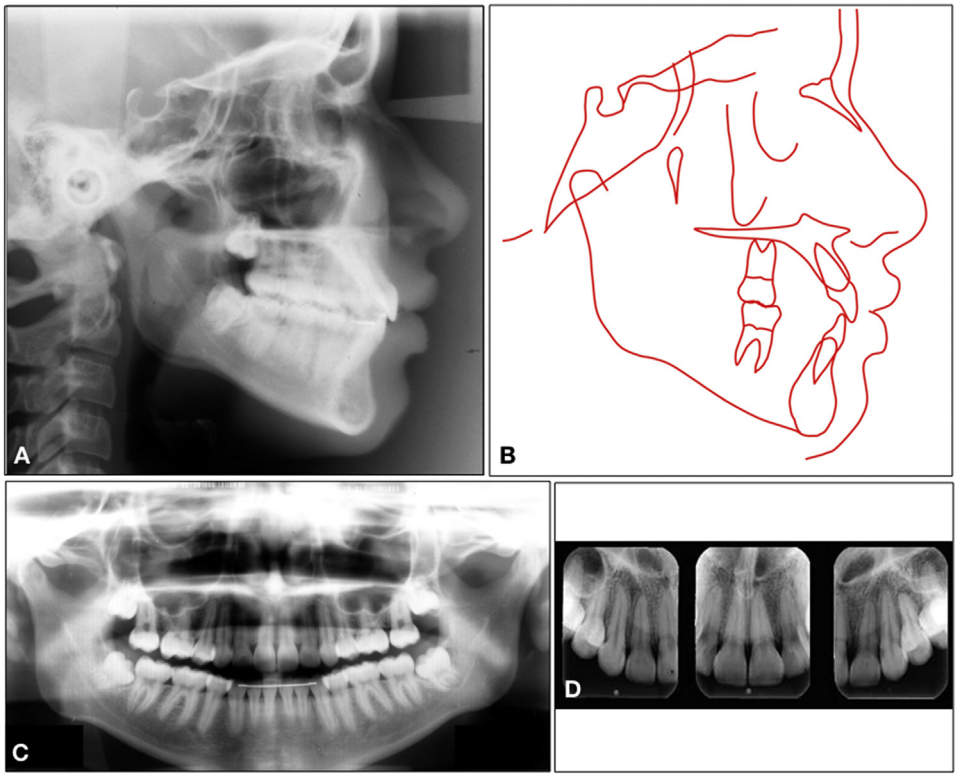

Fig 7. Posttreatment radiographs and tracing. **A,** Lateral cephalometric radiograph; **B,** lateral cephalometric tracing; **C,** panoramic radiograph; **D,** periapical radiographs of the maxillary anterior dentition.

wires. It proved necessary, to create more space for the right upper lateral incisor, to use an open nickel-titanium spring compressed between the canine and central incisor. Thereafter, the right upper lateral incisor was included with the alignment and leveling archwires.

In the mandibular arch, the appliance was placed on all teeth with the use of the same system, except for the first premolars, which were removed. The mandibular teeth were aligned and leveled with the use of 0.014″, 0.018,″ and 0.019″ × 0.025″ nickel-titanium wires. Canine retraction was performed by extending elastomeric chains from the posterior teeth to the canines using 0.019 × 0.026″ rectangular stainless steel archwires. Next, the mandibular incisors were included in the alignment and leveling procedure. Minor remaining spaces were closed with the use of elastomeric chains.

Owing to some mesial tipping of the roots of the lower canines (Figs 1-3), bracket rebonding of these teeth was carried out to their best possible positions and then a new leveling of the lower dental arch enabled a satisfactory root parallelism of these teeth (Figs 5-7).

Finishing was accomplished by means of symmetric and coordinated archwires, maintaining the original dental arches form with the use of 0.019 × 0.026″ stainless steel archwires. This phase required enhancing buccal root torque in the lateral maxillary incisors.

Removable wraparound retainers were used on the maxilla, and fixed 0.028″ stainless steel wire retainers were bonded only to the canines on the mandibular arch.

TREATMENT RESULTS

Outstanding results were achieved with an improved facial profile and smile harmony (Fig 5). The molar relationship was preserved in Class I and occlusal contacts were obtained between all of the other teeth, especially the canines. Overjet and overbite were maintained and the midlines remained coincident with each other and with the face (Figs 5 and 6). A mutually protected occlusion was obtained with stable contacts in centric relation and efficient protrusive movements, as well as right and left laterality movements.

A balanced gingival contour was obtained in both dental arches, particularly by leveling the gingival margin of the left central mandibular incisor with the other incisors. A mild unevenness can be seen between the zeniths of the maxillary lateral incisors, but with no significant esthetic impairment given a significant overall periodontal improvement (Fig 6).

Radiographic analysis (Fig 7) revealed a good appearance of the ridges and trabecular bone, as well as appropriate root parallelism. The cephalometric and tracing analysis (Fig 7; Table) and superimposition of the tracings (Fig 8) indicate that the anteroposterior relationship between maxilla and mandible (ANB 3°, ANS 86°, SNB 83°) was maintained, as well as the facial proportions (SN-GoGn 27°, FMA 26°, Y-axis 60°).

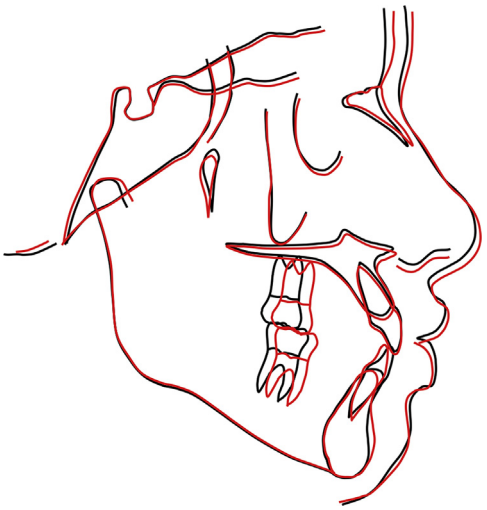

Fig 8. Superimposed cephalometric tracings.

Improvement was noted in the facial profile and position of the lips (S-LS 0 mm, S-LI 0 mm). Superimposition showed a slight uprighting of the lower incisors with the upper incisors remaining in virtually the same position. Furthermore, there was some loss of proportional anchorage in the upper and lower molars (Fig 8).

Extracting the first 4 premolars enabled excellent results with superior stability 4 years after removal of the fixed appliance (Fig 9).

DISCUSSION

Orthodontists often encounter dental eruption abnormalities during the development of dentition. These abnormalities are primarily related to ectopia. Eruption disorders associated with transposition occur in the maxilla in 76% of cases, predominantly involve canines (90%), premolars (71%), or lateral incisors (20%), and defy early diagnosis owing to their multifactorial character.[8-10]

In the present case, a pseudotransposition was revealed by radiography, which was characterized by crown ectopia of the maxillary canine, positioned mesial in relation to the lateral incisor and with a root apex located distal to the lateral incisor.[8] Esthetically and functionally, it is recommended in these cases that the transposed teeth be moved to their normal position in the dental arch.[11,12]

Early diagnosis and interception at an optimal time is the best approach for intervention in these cases.[13]

Fig 9. Photographs at the 4-year follow-up.

Corrective treatment was the choice in the present case because of the advanced stage of the dentition when the patient sought treatment. Important factors were taken into account in determining the ectopia treatment plan for maxillary canines. The positioning of crowns and roots of canines and upper lateral incisors, the absence of root resorption, the degree of crowding, and the patient's motivation were noted.

Different types of mechanisms have been described for correcting tooth transposition with distinct levels of severity.[9,14,15] Therefore, to preserve supporting tissues and prevent dental trauma and resorption, in addition to performing the treatment in a predictable way and within a shorter period of time, we decided to extract the first 4 premolars and place a spring in a modified segmental archwire to ensure the proper positioning of the maxillary canines in the dental arch.

Canine retraction with a T-loops with helicoids on a tungsten molybdenum (beta-titanium) alloy wire, especially with the spring legs at different heights in the initial stages (Fig 4), allowed proper control of the force system[16-18] with good tooth movement at a lower friction rate, no undesirable effects on the adjacent teeth,[14,17,18] and appropriate anchorage control.[17-19] After canine retraction, the treatment was conducted conventionally.

Appropriate anchorage control in the upper arch was established with the use of a transpalatal arch and the posterior teeth during canine retraction. Studies have shown that the use of an isolated transpalatal arch does not provide maximum anchorage in cases of premolar extraction when incisors are retracted.[20-22] However, the anchorage provided by the transpalatal arch may be considered to be equivalent to skeletal anchorage when retracting only canines.[23,24]

The mild improvement in the gingival retraction of the lower left central incisor which was positioned more to buccal resulted from a slight uprighting of these anterior lower teeth and the elimination of possible occlusal traumas.[25,26]

In the maxillary arch, even after the buccal movement of the right maxillary lateral incisor through torque control, the gingival margin of this tooth remained positioned more incisally than the left lateral incisor. This may be due to a thicker band of attached gingiva, which made it less prone to retraction during root movement toward the buccal side.[27]

By establishing a Class I relationship, proper overbite and overjet, occlusal contacts in all teeth, and a coincident centric relation with centric occlusion, it was possible to achieve occlusal stability and satisfactory smile esthetics.

In cases where canine ectopia is present, with or without transposition, the correct diagnosis for the positioning of this tooth in its respective bone bases proves to be vital. Tooth movement should be performed preferably in the center of the alveolar ridge and in areas where the band of attached gingiva is at its largest.

It should be emphasized that a proper biomechanical control, with simple procedures, combined with the need to create spaces for tooth movement (which includes the need for extractions), are some of the essentials of orthodontic practice.

Planning in this case proved to be satisfactory to the extent that the patient's esthetics and balanced occlusal relationships were fully restored with a successful treatment with long-term stability.

CONCLUSIONS

Based on the favorable results, it would be safe to assert that the treatment adopted in this clinical case was the most appropriate. Because of the large space deficiency for the canines and the facial features, premolar extractions were critical to treatment success. Controlled movements of the canines with the aid of segmental T-loop springs with helicoids and proper anchorage control enabled a simple and predictable approach.

ACKNOWLEDGEMENTS

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at https://doi.org/10.1016/j.ajodo.2017.11.046.

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