Case Report

Treatment of maxillary canine transposition

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ABSTRACT

Transposition of maxillary teeth is an eruptive disturbance occurring in approximately 1 of every 300 orthodontic patients. Such cases are frequently very challenging in terms of treatment planning and orthodontic management. The canine is one of the most commonly transposed teeth, ectopically positioned with either the lateral incisor or the first premolar. This case report illustrates unique orthodontic treatment, describes treatment procedures, and presents the final outcome of bilateral maxillary canine-lateral incisor complete transpositions in which the involved teeth were moved to their clinically normal position in the dental arch without extracting premolars. (*Angle Orthod.* 2020;90:873–880.)

KEY WORDS: Dental transposition; Malocclusion; Orthodontics

INTRODUCTION

Transposition has been described as an interchange in the position of two permanent teeth within the same quadrant of the dental arch.[1] The canine is the most commonly transposed tooth, with ectopic eruption mesial to the lateral incisor or distal to the first premolar.[2,3]

Tooth transposition is a relatively rare phenomenon (0.33% prevalence),[4] more commonly observed in female patients[5–10] and in the maxilla than in the mandible.[9,11] Unilateral canine transposition happens more frequently (79%) and is more prevalent on the left side (69%).[11–13] Bilateral transposition has been reported in 5% of the cases.[6] Tooth transposition represents a multifactorial condition; both genetic[5,11,14–17] and environmental[5,7,8,18,19] factors seem to be involved in its etiology. Early diagnosis and treatment are suggested, but this requires a complex and lengthy treatment protocol and a cost-benefit evaluation.[20]

Peck et al.[6] classified transpositions as follows: (1) maxillary canine-first premolar, (2) maxillary canine-lateral incisor, (3) maxillary canine to first molar site, (4) maxillary lateral incisor-central incisor, (5) maxillary canine to central incisor site, and (6) mandibular lateral incisor-canine. The aims of orthodontic treatment are to restore the dental occlusion and provide favorable facial esthetics while maintaining temporomandibular joint and periodontal health.[21–24] There are several potential treatment options for dental transposition: tooth extractions, surgical repositioning, surgical-orthodontic approach to reverse and correct the transposition, or orthodontic treatment keeping the teeth transposed.[8,25–27] When the transposed tooth is unerupted, surgical exposure of the dental crown followed by careful orthodontic traction to avoid damage to the roots of adjacent teeth is required.[28]

This case report illustrates the correction of a canine-lateral incisor transposition in which the roots of the lateral incisors were moved palatally before the transposition was corrected to decrease the risk of root resorption and bone loss. The surgical and orthodontic procedures are detailed, and the final outcome is presented in which the involved teeth were moved to their clinically normal anatomic positions within the dental arch.

Diagnosis and Etiology

A 12-year, 10-month-old female patient sought orthodontic treatment with the chief complaint of an interincisal diastema and unerupted permanent upper canines. A previous orthodontist had proposed extract-

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Accepted: May 2020. Submitted: December 2019.
Published Online: September 8, 2020

Figure 1. Pretreatment photographs.

ing the impacted canines and repositioning the upper first premolars in the positions of the extracted teeth with cosmetic restorations to improve esthetics.

Clinical examination was performed, general and dental history were recorded, and orthodontic records including cone beam computed tomography images were obtained (Figures 1 through 4). The patient was healthy; exhibited good oral hygiene; and had no harmful oral habits, caries, or any periodontal problems that contraindicated orthodontic treatment. There was no history of trauma to the oral region. The maxillary canines were impacted buccally to the incisors, with the crowns between the central and lateral incisors bilaterally, in close contact with the roots of the central incisors (Figure 4).

Facial analysis showed a mesocephalic facial pattern, good chin-neck and nasolabial angles, facial symmetry and balanced facial thirds, adequate smile height, and upper incisors that were not visible on display at rest. However, the patient had a mild maxillary deficiency with protrusion of the upper

Figure 2. Pretreatment dental casts.

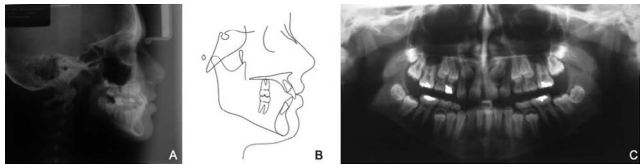

Figure 3. Pretreatment radiographs and tracing. (A) Lateral cephalometric radiograph. (B) Lateral cephalometric tracing. (C) Panoramic radiograph.

incisors and an arch size discrepancy in the lower premolar region (Figures 1 through 3; Table 1).

Treatment Objectives

Although non-extraction treatment posed significant challenges in this case, facial balance and the growth pattern were the main considerations when treatment objectives were contemplated. The various conditions present, such as transposition, tooth impaction, Class III tendency, and tooth size/arch size discrepancy were all taken into consideration. In order to carry out such treatment, various approaches were planned, such as rapid maxillary expansion, reverse pull facial mask, skeletal temporary anchorage devices (TADs), corticotomies, and orthodontic fixed appliances.

Treatment Alternatives

Treatment options in this case included either extraction or non-extraction of the maxillary canines, with risks and benefits for both choices. The easiest and most obvious alternative would have been extraction, with the first premolars replacing the canines. However, in the long term, this alternative could have resulted in a significant negative impact on facial appearance since the patient presented with a relative maxillary deficiency with proclined upper incisors. In the mandible, a tooth size/arch size discrepancy was present, and the lower incisors were upright.

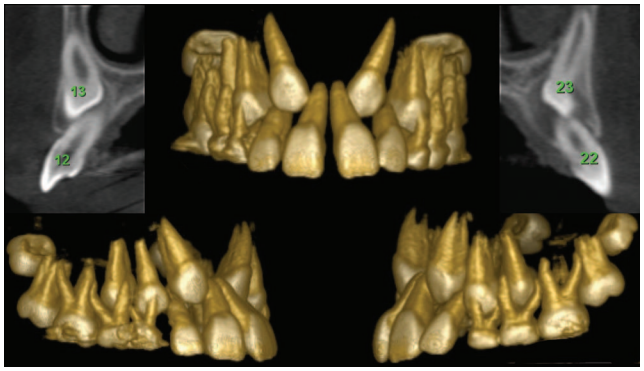

Figure 4. CBCT images showing bilateral, buccally impacted maxillary canines between the roots of the upper central and lateral incisors.

Table 1. Cephalometric Measurements

Measurement	Norm	Before Treatment	After Treatment	3.5-y Follow-up
Age	Not applicable	12 y 10 mo	16 y 00 mo	19 y 06 mo
Skeletal pattern				
SNA (°)	82.0	81.1	81.4	81.8
SNB (°)	80.0	78.9	78.9	80.8
ANB (°)	2.0	2.3	2.5	1.9
SND (°)	80.0	76.7	76.2	77.9
Convexity (NA-Apo) (°)	10.5	1.4	2.9	2.5
FMA (°)	26.0	25.8	23.5	23.5
Occipital plane to SN (°)	14.4	15.0	19.1	18.2
Sn.GoGn (°)	32	33.8	34.4	34.8
Y-Axis (SGn.SN) (°)	59.4	69.4	69.9	69.8
Dental pattern				
U1-NA (°)	22.0	28.4	27.7	28.7
U1-NA (mm)	4.0	7.2	6.4	5.8
L1-NB (°)	25.0	24.3	31.7	31.1
L1-NB (mm)	4.0	4.1	7.0	6.8
IMPA (°)	95.0	89.7	97.6	97.4
Profile				
Upper lip – S line (mm)	0.0	(-) 1.4	(-) 0.3	(-) 0.5
Lower lip – S line (mm)	0.0	0.2	1.5	1.7
H line to tip of nose (mm)	n/a	7.3	5.1	5.6
Pog – NB (mm)	1.0	3.0	2.3	1.9

The second option, without extraction of the maxillary canines, would provide a better chance of facial balance with age. However, treatment mechanics would be much more complicated, and treatment duration would be extended. Both of these options were presented to the patient and her parents, and it was decided that the benefits of this approach would balance the risks. Adverse facial growth could not be ruled out; therefore, this was also taken into consideration; the family was informed about this possibility and the possible need for orthognathic surgery in the future.

Treatment Progress

Treatment started August 2010 and ended October 2013; therefore, 38 months were necessary to complete treatment. Initially, a Haas-type rapid maxillary expander was activated two quarter-turns per day with a Petit-type facial mask used at night (Figure 5). The rationale was to increase the maxillary perimeter to create more space for the canines and to upright the upper incisors, while improving the sagittal maxillomandibular relationship. In the mandible, a Lip Bumper was used to increase transverse arch dimensions, tip the first molars distally, and tip the lower incisors labially. These mechanics were used for a year, at which time a second phase of treatment was started with the installation of TADs between the roots of the upper premolars. Buccal osteotomies were performed to facilitate traction of the maxillary canines.

Fixed orthodontic appliances were bonded using passive self-ligating brackets (Damon System, Ormco Corporation, Orange, CA, USA). Since the canine crowns were labial to the roots of the lateral incisors in a transposed position, correcting the position of the canine could have damaged the nearby lateral incisors roots. Therefore, a transpalatal arch was placed to increase anchorage and to allow bodily retraction of the maxillary lateral incisors so that the canines could be moved distally with less risk of contact between the crown of the canines and the roots of the lateral incisors. To optimize distal root movement of the upper laterals with a line of force closer to center of

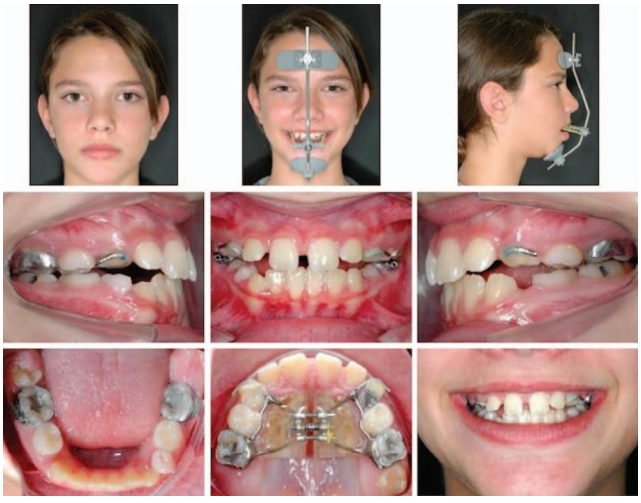

Figure 5. Treatment progress (rapid maxillary E=expansion and face mask).

Figure 6. Treatment progress (TADs between upper premolar roots to distalize the canines, elastomeric traction from a TPA to lingual buttons with wire extensions on the lingual aspect of the upper lateral incisors).

resistance, lingual buttons with power arms were bonded on the lingual aspects of these teeth. Once the lateral incisors started to move in the palatal direction, elastomeric chains were placed from the TADs to the canines to distalize them at the same time with forces calibrated at 60 g (Figures 6 and 7).

As this phase progressed, the remaining maxillary teeth and all mandibular teeth were bonded, and 0.013″ CuNiTi wires were placed followed by 0.014″ CuNiTi with 0.012″ × 0.030″ open coil springs to create space for the upper lateral incisors and canines (Figures 8 and 9). The subsequent archwires were 0.016″ × 0.025″ and 0.018″ × 0.025″ CuNiTi to begin torque correction since leveling with round wires increased the proclination of the upper anterior teeth. In addition, 0.019″ × 0.025″ stainless steel wires were placed and interproximal reduction was performed on the upper anterior teeth (Figures 10 and 11). Care was taken to leave the rectangular stainless steel archwires

Figure 7. Treatment progress (panoramic radiograph of the same treatment phase as Figure 5).

Figure 8. Treatment progress (brackets bonded on the other teeth of the maxilla and mandible to allow the use of open coil spring).

for 8 months so that there was time to incorporate proper torque. At the end of treatment, when the brackets were removed, a fixed 3 × 3 lower retainer was placed in the lower arch, and a 1-mm acetate invisible retainer in the upper arch (Figures 12 to 14).

Treatment Results

Treatment was deemed successful since no major injuries were observed, and there was no significant root resorption, bone loss, or gingival recession. Additionally, no extractions, with the possible exception of the third molars, were needed. Facial balance was maintained in both the frontal and lateral views, at resting lip position and smiling.

Figure 9. Treatment progress (0.013″ CuNiTi archwires were placed followed by 0.014″ CuNiTi with 0.012″ × 0.030″ open coil springs to create space for the upper lateral incisors and canines).

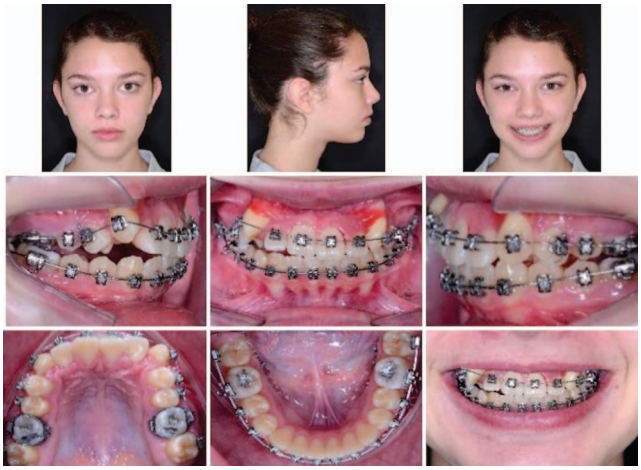

Figure 10. Treatment progress (0.016″ × 0.025″ and 0.018″ × 0.025″ CuNiTi archwires were used to begin torque correction since leveling with round wires increased the proclination of the upper anterior teeth).

Figures 15 and 16 show the stability of the treatment by means of photographs and radiographs at the 3.5-year follow-up. Superimposed cephalometric tracings (initial, final, and control after 3.5 years), as well as their numeric values, showed the improvement in the profile, mainly caused by clockwise rotation of the mandible (Figure 17; Table 1).

DISCUSSION

Dental transpositions may be one of the most challenging conditions in orthodontics, depending on which teeth are involved and their positions relative to the adjacent teeth. Most of the time, the maxillary canines are involved, either exchanging positions with the lateral incisors or with the first premolars.[2,3,5,7] The

Figure 11. Treatment progress (0.019″ × 0.025″ stainless steel archwires were placed and interproximal reduction was performed on the upper anterior teeth).

Figure 12. Posttreatment photographs.

resulting occlusion, albeit the negative esthetic impact, is impaired since the protrusive and lateral mandibular excursions are frequently compromised and future stability of the dentition might be jeopardized.

Transposition may occur bilaterally or on one side only, and it has been reported more frequently in females. Possible etiology is related to hereditary traits, but local factors may not be totally ruled out in selected cases.[5–10] Pediatric dentists should correctly identify transpositions and understand the therapeutic possibilities. The correction of the transposition is important and must be done as soon as possible.[20]

For the most frequently observed transposition, canines × lateral incisors, many treatment modalities have been proposed depending on the degree of difficulty and age of patient: (1) correction of the transposition, (2) maintenance of the transposition and cosmetic reconstruction of the teeth involved, or (3) extraction of either the lateral incisor or the canine.[8,25–27] The most challenging of these three options is the correction of the transposition if the two teeth involved are totally transposed. It requires comprehensive treatment planning and careful consideration of the mechanics. There is an increased risk of developing root resorption, bone loss, gingival recession, and ankylosis. Several factors influence treatment choice: which teeth are affected, location of crowns and roots,

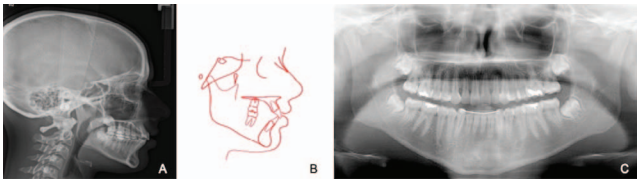

Figure 13. Posttreatment radiographs and tracing. (A) Lateral cephalometric radiograph. (B) lateral cephalometric tracing. (C) Panoramic radiograph.

Figure 14. Posttreatment dental casts.

degree of resorption, malocclusion, clinician experience, and patient motivation.[29] In this particular case, this was all taken into consideration and the decision to correct the transposition was made in light of the patient's facial analysis and cephalometric craniofacial pattern. Signs of maxillary deficiency in the facial analysis and a Class III tendency on cephalometric analysis influenced the decision to maintain the full complement of maxillary teeth, with the possible exception of the third molars.

Treatment mechanics and appliance design need to be individualized for each patient.[30] Different types of appliances have been described to resolve transpositions, such as sectional arches, springs, and transpalatal arches.[31,32] One of the first challenges in this case was controlling anchorage and applying forces with the least amount of side effects possible. Two types of anchorage were used—TADs and a transpalatal arch—and both helped control the side effects of the mechanics used.[33,34]

Figure 15. Photographs at the 3.5-year follow-up.

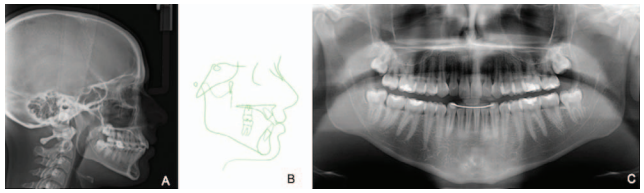

Figure 16. Radiographs and tracing at the 3.5-year follow-up. (A) Lateral cephalometric radiograph. (B) Lateral cephalometric tracing. (C) Panoramic radiograph.

First, it was necessary to create space so that the canine crown could clear the lateral incisor root. In order to bodily retract the lateral incisors, a lingual button with a wire extension was bonded on the lingual surface, and a force was applied closer to the center of resistance. Once this was accomplished, the upper canines were retracted using two TADs placed between the roots of the premolars.

Light forces (around 60 g) were used throughout treatment, and elastomeric chains were calibrated to generate this force level. Passive self-ligating appliances were used to try to minimize friction and, therefore, decrease side effects.

As treatment progressed, it was necessary to disclude the teeth using bite turbos placed on the lower first molars, particularly to facilitate palatal movement of the lateral incisors. Once the canines approached their desired mesiodistal positions, the maxillary lateral incisors were brought back labially. Brackets were then bonded on the canines, and an open coil was placed between the central incisors and the canines to distalize the canines. The side effect of the combination of the open coil spring with a round flexible archwire was protrusion of the upper anterior teeth, which was corrected later using $0.019'' \times 0.025''$ stainless steel archwires and interproximal reduction. Active torque was applied by the archwire for 8 months, until better axial inclinations were obtained. A small diastema was recurrent on the mesial aspect of

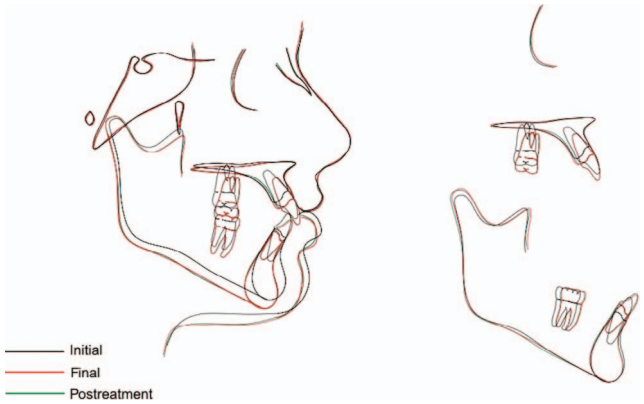

Figure 17. Superimposed cephalometric tracings.

the upper right canine and, since the overjet and midlines were satisfactory, was closed with composite.

The final occlusion was acceptable, especially considering the initial condition and the amount of tooth movement achieved. Midlines were coincident and, although the molar and canine relationships were slightly Class II, protrusive and lateral functions of the anterior teeth were established. This was still present at the 3.5-year follow-up, with no major negative signs or symptoms. The final position of the upper incisors was maintained with a minimal 1° increase. It should be considered that they were already labially compensated at the beginning of treatment, so gingival health and stability warrant long-term follow up.

Gingival recession and root resorption are other important factors to be considered among the major posttreatment iatrogenic effects that concern clinicians in canine transposition cases.[32,35] In this case report, the impacted canines were completely transposed with the lateral incisors. Initially, the canines were located between the central and lateral incisors but without resorption of the adjacent roots, both at the beginning and end of treatment. Thus, although this approach was rather challenging and took extended time to complete, the final results, both dentally and facially, were deemed to be very satisfactory, especially considering the degree of difficulty the case presented initially.

CONCLUSIONS

- Transposition requires substantial treatment planning and careful mechanics in order to achieve acceptable results. Several factors should be considered, such as the positions of the root apices, esthetic and acceptable occlusion, patient compliance, and treatment time. This case report demonstrates the possibility of decreasing risk of root resorption, bone loss, and gingival recession by moving the root of the lateral incisor away from the path of the crown of the canine when the transposition is being corrected.

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