Orthodontic correction of a transposed maxillary canine and first premolar in the permanent dentition

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The patient was a 16-year-old Japanese girl whose chief complaints were crowding and transposition of the maxillary canine and first premolar. A setup model was used to preoperatively align the teeth in their transposed positions. The amount of postoperative reshaping was estimated for the occlusal surfaces of the teeth. However, the patient did not wish to have her teeth reduced by reshaping or to have composite materials for restorative camouflage. Because she strongly expected alignment of her teeth in the correct intra-arch position, her transposed teeth were corrected without extraction of the transposed teeth. Cone-beam computed tomography was used to obtain more detailed information about the transposition, and the direction of tooth movement was examined. Although the duration of the treatment was long, both the crowns and the roots of the transposed teeth were aligned correctly. (Am J Orthod Dentofacial Orthop 2012;142:524-33)

Transposition of teeth is defined as an interchange of position of 2 teeth in the dental arch, and its incidence is relatively rare.1,2 The maxillary canine and first premolar transposition is most frequently described in the literature, followed by transposition of the maxillary lateral incisor with the canine. Unilateral transpositions have been reported more often than bilateral transpositions, and the left side has been more frequently involved than the right.3-5 Transposition can be complete or incomplete.6 In a complete transposition, both the crowns and the entire root structures of the involved teeth are found in their transposed positions. In an incomplete transposition, the crowns might be transposed, but the root apices still remain in their normal positions. Several factors should be considered when making an orthodontic treatment plan for transposed teeth. In extraction treatment, many patients are treated by extraction of either tooth. In nonextraction treatment, patients undergo alignment of teeth in their normal positions or in their transposed positions. Whichever treatment is selected, several factors (positions of the crowns and roots, gingivae of the transposed teeth, caries risk, and duration of treatment) should be considered when making an orthodontic treatment plan for transposed teeth. This case report demonstrates the successful alignment of a complete maxillary canine and first premolar transposition in their normal positions with nonextraction treatment. Good results have been maintained for 2 years after active orthodontic treatment.

DIAGNOSIS AND ETIOLOGY

The patient was a 16-year-old Japanese girl. Her chief complaints were crowding and transposition of the maxillary right canine and first premolar. She had no orthodontic history. The pretreatment facial photographs showed a symmetric facial pattern with a straight profile (Fig 1). The intraoral examination showed an Angle Class III molar relationship bilaterally. All permanent teeth were erupted, and the maxillary right deciduous canine was retained. The maxillary right permanent canine had erupted in an ectopic position between the 2 premolars. The maxillary right first premolar was in scissorbite. The arch length discrepancies were −4.3 mm in the maxillary arch and −1.9 mm in the mandibular arch. She had +3.0 mm of overjet and +2.0 mm of overbite. Both maxillary and mandibular dental midlines nearly coincided with the facial midline (Figs 1 and 2). On
radiographic examination, the root of the maxillary right deciduous canine was mostly resorbed, and both the crowns and the roots were transposed (Fig 3). Dental computed tomography scans showed that the root of the right canine was between the premolars, and the root of the first premolar was close to the crown of the canine but not resorbed (Fig 4). Maxillary canine and first premolar transposition is the most frequent type of transposition. Several etiologies of transposition have been proposed: genetic origin, trauma, interchange of the position of the developing tooth buds, lack of deciduous canine root resorption, early loss of deciduous teeth, and prolonged retention of deciduous teeth. Because of the high incidence of retained deciduous canines associated with tooth transpositions, some authors have reported that deciduous teeth are the primary etiologic factor of this anomaly. In this patient, a possible etiology of transposition included the retained deciduous canine. In the lateral cephalometric radiograph, the maxilla was positioned posteriorly, and the mandible was positioned normally relative to Japanese standards (SNA, 78.2°; SNB, 76.7°; ANB, 1.5°). The patient had a skeletal Class III relationship. The inclination of the maxillary incisors was normal, but the mandibular incisors showed a lingual inclination (Fig 5, Table). From these findings, the patient was diagnosed with an Angle Class III malocclusion with crowding and transposition of the maxillary right canine and first premolar.

**TREATMENT OBJECTIVES**

The treatment objectives were to correct the transposition, establish the natural tooth order by extraction of the maxillary right deciduous canine without extraction of the transposed tooth, establish a functional Class I molar and canine relationship with coincident dental midlines, create ideal overbite and overjet, and correct the lingual inclination of the incisor.

**Fig 1. Pretreatment facial and intraoral photographs.**
TREATMENT ALTERNATIVES

The following alternatives were considered for the transposed teeth: (1) extraction of all first premolars, (2) extraction of the maxillary right canine or first premolar, (3) nonextraction treatment and alignment of the teeth in the transposed order, and (4) nonextraction treatment and correction of the transposition.

In considering these treatment alternatives, the following factors were taken into account. Because the facial appearance was satisfactory for a Japanese girl, she did not need retraction of the lips. Treatment with extraction of the 4 first premolars would have required extensive linguoclination of the maxillary and mandibular incisors, or it would have required extensive mesial movement of the molars.

In addition, if either the maxillary right first premolar or the canine had been extracted, that dental arch would have become asymmetric, and the treatment mechanics would have become difficult. Therefore, we evaluated how the transposed teeth could be aligned without tooth extractions. Because both the crown and the root were transposed in the maxillary right first premolar and canine, aligning the teeth in the transposed order would probably have required a shorter treatment time than correcting the transposition. Correction of a transposition poses a high risk of damaging the teeth or the supporting structures. Thus, alignment of the involved teeth in their transposed positions seemed to be the best alternative, but the patient strongly desired alignment of the teeth in their correct positions. Dental computed tomography showed that the roots of the transposed teeth were in close proximity, but root resorption was not observed. From a diagnostic setup model (Fig 6), if the teeth were to have been aligned in their transposed positions, extensive reshaping and camouflage restoration might have been required. We decided to attempt treatment without extraction of the transposed tooth and with correction of the transposition to achieve a functional Class I canine and molar relationship.

TREATMENT PROGRESS

After the maxillary right deciduous canine was extracted, a transpalatal arch and a lingual arch were placed on the maxillary arch as anchorage. The maxillary
Right first premolar was protracted with an elastic chain in a palatal direction with an intentional mesial rotation (Fig 7). The mesiodistal root width of the maxillary first premolar was narrower than its buccolingual diameter. Therefore, we mesially rotated the first premolar to prevent its contact with the canine root. In addition, the canine was mesially protracted with an elastic chain from a buccally extended hook off the lingual arch. The positional relationship between the canine and first premolar improved after 3 months of treatment. Thus, edgewise appliances (0.018 × 0.025 in) were placed on the maxillary teeth. Mesial movement of the maxillary right canine began with the placement of an open-coil spring between the canine and the second premolar (Fig 7). The first premolar was aligned in the dental arch, while improving its rotation (Fig 7). At 16 months, edgewise appliances were placed on the mandibular teeth. Attainment of correct intercuspation, and ideal torque and root parallelism were considered. Forty-eight months later, all edgewise appliances were removed, and bonded retainers and wraparound retainers were fabricated to maintain the alignment.

**TREATMENT RESULTS**

Adequate facial proportions were obtained at the end of treatment (Fig 8), and the upper and lower lips were slightly retruded. The facial photographs showed a pleasant smile. The crowns and roots of the transposed teeth had been corrected and were in their proper positions. The gingivae of the transposed teeth showed no signs of inflammation. The interproximal sulcus depth was about 2 mm (Figs 8 and 9). Radiographically, root parallelism was acceptable. Slight root resorption was observed on both transposed teeth (Fig 10). A computed tomography scan showed triangular bone resorption at the vestibular cortical bone of the maxillary right canine (Fig 11). The cephalometric superimposition showed a clockwise pattern of mandibular rotation growth. The labially inclined maxillary incisors and lingually inclined mandibular incisors at pretreatment were improved (Table, Figs 12 and 13). A good occlusion was achieved. These results have been maintained for 2 years after active treatment. A computed tomography scan showed that part of the cortical bone was restructured, and a regular cortical contour was observed (Figs 14 and 15).

**DISCUSSION**

In general, 2 treatment alternatives were considered with nonextraction of the transposed tooth: alignment of the teeth in their transposed positions,
and orthodontic tooth movement to the correct intra-arch position.

Many reports discuss improvements of transposed teeth orthodontically.\textsuperscript{7-12} In general, when the transposed teeth are almost completely erupted, the treatment involves alignment in the transposed positions\textsuperscript{3,13,14} or extraction of 1 tooth or both teeth, followed by orthodontic correction.\textsuperscript{15-17} The disadvantages of aligning the teeth in the transposed order are esthetic and functional problems. If the right canine and first premolar had been aligned in their transposed positions, the diagnostic setup model indicated that the right first premolar would have required reshaping of its occlusal surface and restorative camouflage of its small buccal cusp with composite materials.\textsuperscript{18} Thus, the esthetics might have been compromised. However, because the buccal cusp of the first premolar was small, restorative camouflage treatment would have been required by using composite materials. In addition, it was thought that the lingual cusp hindered lateral movement of the mandible, and reduction of the lingual cusp would have been needed. There was a risk of pulpectomy, because it would have been necessary to either reshape the first premolar contour over a wide area or perform crown prosthesis treatment. The disadvantages of attempting to correct transposed teeth are the potential risk of damage to the roots or the supporting structures, or the potentially prolonged treatment. There were some disadvantages in both treatment plans, but orthodontic management of the transposition was selected because of the desires of the patient and her family. The panoramic, periapical,

<table>
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Fig 6. Diagnostic setup model.
and occlusal radiographs would have been useful for confirming the root position, but we decided to take a dental computed tomograph instead to better assess the positions of the canine and the premolar. Dental computed tomography is useful in a thorough examination of the position of impacted and transposed teeth, and it allows dentists to obtain 3-dimensional information without exposing patients to high levels of radiation from medical computed tomography scans.\textsuperscript{19,20} The dental computed tomograph showed neither root contact between the canine and the first premolar nor root resorption. It was thought that adequate displacement was possible if we paid attention to the direction of movement of the tooth roots. The maxillary right first premolar was moved in a palatal direction with accompanying mesial rotation. Root contact was thought to have been prevented at the time of canine mesial drifting, because the mesiodistal root width of the premolar was narrower than its buccolingual diameter. Mesial drifting was initially performed to prevent lingual tipping of the canine root as much as possible, so that a standard edgewise bracket (0° torque) could be placed on the maxillary right canine.

These procedures seemed to produce favorable conditions to minimize the risk of root contact during tooth

Fig 7. Progress intraoral photographs.
Fig 8. Posttreatment facial and intraoral photographs.

Fig 9. Posttreatment dental casts.
movement. However, a long treatment time was needed to control the distal movement of the maxillary right first premolar root and the maxillary right canine torque. The gingivae of the transposed teeth showed no signs of inflammation. The interproximal sulcus depth was about 2 mm. A computed tomography scan showed labial alveolar bone resorption after treatment. However, the scans showed that part of the bone tissue regenerated 2 years after treatment. It was thought to have led to a good treatment result in which a healthy periodontium was maintained, since the patient was young. The patient of Babacan et al.10 was 15 years old at posttreatment, and our patient was 20 years old. Both patients were relatively young, and Babacan et al thought that the young age might have positively affected tissue regeneration.

**CONCLUSIONS**

Dental transpositions can be corrected orthodontically. However, the mechanics are complex, treatment
time is long, and dental tissues can be damaged. The patient’s compliance, esthetics, function, caries risk, and age should all be considered when deciding whether treatment of a transposition should involve tooth extractions, tooth alignment in the transposed order, or orthodontic correction of the transposition. A diagnostic setup model and computed tomography were effective and important in determining the appropriate treatment plan for our patient’s transposed teeth.

REFERENCES


