Orthodontic Correction of Transposed Maxillary Canine and First Premolar in Mixed Dentition

Lan-Tien Lin
*Teamwork Orthodontic Center, Taipei, Taiwan, lanbow722@hotmail.com*

Yi-Min Liu
*Teamwork Orthodontic Center, Taipei, Taiwan*

Yuen-Yung Tsang
*Teamwork Orthodontic Center, Taipei, Taiwan*

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**Recommended Citation**
Lin, Lan-Tien; Liu, Yi-Min; and Tsang, Yuen-Yung (2020) “Orthodontic Correction of Transposed Maxillary Canine and First Premolar in Mixed Dentition,” *Taiwanese Journal of Orthodontics*: Vol. 31 : Iss. 1 , Article 5,
DOI: 10.30036/TJO.201903_31(1).0005
Available at: [https://j.tjo.org.tw/tjo/vol31/iss1/5](https://j.tjo.org.tw/tjo/vol31/iss1/5)

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INTRODUCTION

Tooth transposition is a condition in which a permanent tooth develops and erupts in a position normally occupied by another permanent tooth. Maxillary canine-premolar transposition is the most frequent type of tooth transposition. Unilateral transpositions have been reported more common than bilateral, and the left side involvement were reported more than in the right side. Transposition can be complete or incomplete. Complete transposition means both the crowns and the entire root structures of the involved teeth are switched. Incomplete transposition means that the crowns might be transposed, but the root apices still remain in their normal positions. Genetic origin, prolonged retention of deciduous teeth, supernumerary teeth, and local pathologic processes are possible etiologies. Several factors should be considered when making an orthodontic treatment plan for transposed teeth. In extraction cases, many patients are treated by removing one of either teeth. In non-extraction cases, patients would have dentition alignment in their normal sequence or in transposed position. When making an orthodontic decision, positions of the crowns and roots, gingival line, smile esthetics, occlusal interferences and treatment duration should be considered.
CASE REPORT

Clinical examination

This 12-year-3-month-old boy was referred to our clinic for the treatment of dentition crowding. He was in good general health, but allergic to penicillin.

His pretreatment frontal photographs indicated chin deviation to his right side. Lateral view illustrated a convex facial profile, lip incompetence and mentalis strain (Figure 1).

Intraoral examination revealed that the patient was in late mixed dentition with retained upper deciduous canines and second molars at both sides. It was also found that his upper left teeth, including lateral incisors, deciduous canine and first premolar were all palatally inclined to form a crossbite with lower dentition. While upper left canine was blocked out, located at the buccal side of the upper left first premolar.

Lower dental midline shifted 1 mm to the right. His overbite was 4 mm on the right and 3 mm on the left, and overjet was 4 mm on the right and 5 mm on the left. Bilateral Class I molar relationship was noted (Figure 2).

Figure 1. Initial extraoral photographs. Patient had convex profile with mentalis strain and lip incompetence. His chin deviated to his right side.

Figure 2. Initial intraoral photographs, indicated deep bite, retained 53, 55 63, 65, 22 palatally locked-in, 23 buccally blocked-out and 22, 63, 24 crossbite.
Transposed Canine and Premolar

Panoramic radiograph demonstrated upper right canine was impacted with a large follicle, and left canine was transposed with first premolar (Figure 3). All second molars were unerupted and tooth buds of lower third molars are present.

Pretreatment lateral cephalometric tracing and analysis demonstrated increased $\angle$ANB (5˚), high mandibular plane angle (MP-SN = 38˚), retroclination of upper and lower incisors (U1-NA = 2 mm, U1-SN = 100˚; L1-MP = 85.5˚) (Figure 4). Lower lip was 5 mm protrusion beyond E-line.

Figure 3. Initial panoramic radiograph. 13 impaction with large follicle. 23 and 24 roots complete transposition; 23 displaced buccally and 24 palatally. All second molars erupting and lower third molar tooth buds exist.

Table 1. Cephalometric analysis, before and after treatment.

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>Finish</th>
<th>Norms</th>
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<tr>
<td><strong>Skeletal Analysis</strong></td>
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<td></td>
<td></td>
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<tr>
<td>SNA</td>
<td>83</td>
<td>81</td>
<td>79.4 ~ 82.5</td>
</tr>
<tr>
<td>SNB</td>
<td>78</td>
<td>77</td>
<td>74.6 ~ 77.8</td>
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<tr>
<td>ANB</td>
<td>5</td>
<td>4</td>
<td>4.1 ~ 5.7</td>
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<tr>
<td>SN-MP</td>
<td>38</td>
<td>39</td>
<td>34.2 ~ 38.6</td>
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<td><strong>Dental Analysis</strong></td>
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<td></td>
</tr>
<tr>
<td>U1-NA</td>
<td>1</td>
<td>1</td>
<td>3.8 ~ 7.2</td>
</tr>
<tr>
<td>U1-SN°</td>
<td>97.5</td>
<td>93.5</td>
<td>103.5 ~ 109.1</td>
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<td>L1-NB</td>
<td>6</td>
<td>6</td>
<td>6.1 ~ 9.5</td>
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<tr>
<td>L1-MP°</td>
<td>83</td>
<td>95</td>
<td>91.1 ~ 98.3</td>
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<tr>
<td><strong>Facial Analysis</strong></td>
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<td></td>
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</tr>
<tr>
<td>E-Line</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Upper</td>
<td>1.5</td>
<td>-1</td>
<td>0.8 ~ 3.2</td>
</tr>
<tr>
<td>Lower</td>
<td>5</td>
<td>1</td>
<td>1.2 ~ 4.4</td>
</tr>
</tbody>
</table>
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Diagnosis
The patient was diagnosed as skeletal Class II malocclusion, with high mandibular plane angle. Dental Class I malocclusion, with upper right canine impaction and upper left canine and first premolar complete transposition.

Treatment objectives
The treatment objectives for this patient were to:
(1) Correct upper left canine and premolar transposition into normal tooth position.
(2) Correct upper right canine position.
(3) Achieve normal overjet and overbite.
(4) Establish Angle’s Class I canine and molar relationship.
(5) Achieve maximum intercuspation.

Treatment progress
Upper brackets were bonded on the first appointment. The initial leveling archwire by-passed the upper right second premolar, left lateral incisor and first premolar. Then the patient was transferred to the oral surgeon for the surgical exposure and follicle enucleation of upper right canine. The 016 stainless steel main archwire was used for upper right canine occlusal traction and first premolar retraction (Figure 5). Lateral incisor labial traction on the left side was started on the next appointment. Meanwhile, a bite plane was made for preventing occlusal interferences and facilitate teeth movements. The upper left canine was then protracted to correct the transposition before first premolar was bonded. After 7 months of

Figure 4. Initial cephalometric radiograph. \( \angle \text{ANB}=5^\circ \), high mandibular plane angle, retroclined incisors and protrusive lower lip.

Figure 5. Intraoral photographs at 2nd month. 13 was surgically exposed and started force eruption.
Transposed Canine and Premolar Treatment results

The upper left canine and the first premolar were properly aligned in correct tooth position. Moreover, the impacted upper right canine was successfully exposed and aligned. Ideal overjet and overbite were also achieved. Class I canine and molar relationships were established with correction of the crossbites. A small space remained between the upper left lateral incisor and the canine for resin build up to compensate the Bolton’s discrepancy. The panoramic radiograph showed root proximity between upper left canine and the premolar (Figure 8-11).

treatment, upper left first premolar was bonded for labial movement. Elastomeric chains were used from the first premolar to the first molar both in buccal and lingual sides (Figure 6). At the 16th month, the upper right canine was surgically exposed again with apically repositioned flap. Upper arch was leveled and aligned well after 21 months of treatment, then the lower arch was bonded at the 22nd month for finishing (Figure 7). Total treatment duration was 3 years and 5 months.

Figure 6. Intraoral photographs at 10th month. 13 extrusion by power chains linked to main archwire. 22 already aligned, and 23 protraction by coil spring. 24 retraction and de-rotation by power chain both buccally and lingually.

Figure 7. Intraoral photographs at 1 year 10th month. 13 extruded and aligned. 23 and 24 transposition and all crossbite corrected.

Figure 8. Finished extraoral photographs. More harmonious facial profile was achieved with lower lip retraction, and lips were able to close more easily at rest.
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Figure 9. Finished intraoral photographs. Optimal overjet and overbite were achieved with stable occlusion.

Figure 10. Finished panoramic radiographs. Acceptable root parallelism and no obvious root resorption noted.

Figure 11. Finished cephalometric radiographs. Upper incisors were retracted, while lower incisors proclined. More harmonious facial profile was achieved with lower lip retraction.
Patient came back for follow-up observation for more than 2 years after deboned. The cephalometric radiograph superimposition showed some more growth occurred. His overjet and overbite got better, and the occlusion is stable (Figure 12-14).

Figure 12. Two years and three months follow-up extraoral photographs. Profile changed from convex to straight with the mandible and chin growth.

Figure 13. Two years and three months follow-up intraoral photographs. Better overjet and overbite with stable occlusion.
Figure 14. Two years and three months follow-up cephalometric radiograph. More mandible and chin growth.

Figure 14. Cephalometric superimposition of (a) initial and finish. Upper incisors retroclined while lower incisors proclined. (b) finish and followup. Mandible continued growth.
DISCUSSION

Shapira et al.² had found the characteristic features of the maxillary canine-first premolar transpositions are as followings:

1. Retained deciduous canines.
2. The transposed permanent canine is usually blocked out buccally, and rotated mesiolabially.
3. The transposed first premolar is nearly always rotated mesiopalatally up to 90°; occasionally it is also blocked palatally.
4. Transitional crowding is present in the transposed area, especially when the deciduous canine still retains.

Almost all of the above features were found in this case. The retained deciduous canines were assumed to be the etiology of the impaction and transposition of the upper canines.

There are several treatment options available for canine-premolar transpositions. It might or might not involve extraction of permanent teeth. In the non-extraction treatment option, to maintain the transposition is preferred if the dentoalveolar bone is narrow. Attempting to restore the normal tooth positions could lead to a prolonged treatment period along with some irreversible consequences, such as root resorption and gingival recession. Esthetic and functional rehabilitation should also be taken into considerations because of differences in tooth size, shape, and color, which can occasionally affect the smile esthetic. The first premolar would require reshaping, and the gingival margin would need some gingival recontouring, or extrusion of the canine and equilibration of the cusp. In addition, it might need cusp reduction to reduce the interference between the palatal cusps of the transposed upper premolar and the mandibular canine.

In this case, non-extraction therapy was decided because of retroclined upper and lower incisors. Furtherfacial growth profile improvement can be expected in this 12-year-old boy. Moreover, the following features allow us to correct the transposition treatment plan without extraction:

1. The alveolar ridge is wide.
2. No interferences of tooth movement are expected with canine buccally displaced and premolar palatally displaced.
3. The treatment duration between maintaining the transposition and correcting the transposition wouldn't be too much different, since the management of right canine impaction needs time.
4. Esthetics or functional problems can be preserved.

During treatment, the main difficulties in correcting the altered tooth position are to avoid root interference and resorption, as well as controlling root inclination. Soft tissue management in transposed canines are also a challenge, because most of these canines are buccally displaced which results in narrower attached gingiva. After orthodontic treatment, gingival recession is often noted and will require a further gingival graft. A treatment mechanic for correcting tooth transposition was suggested by Giacomet et al. First of all, first premolar should be moved palatally. The buccally blocked-out canine was then moved to its correct mesiodistal position while in supraversion to avoid root interference. After that, canine was extruded to contact its antagonist, and the palatally displaced premolars was brought back into the arch. Lastly, torque and inclination adjustment were adopted to finish the case.

For this patient, the buccally displaced canine was protracted before aligning the palatally displaced premolar, thus root interferences and resorption were avoided. The premolar was then bonded, retracted and derotated for alignment. Since the upper left canine was not in high position, no special gingival esthetic problem was concerned. On the contrary, upper right canine was so highly impacted; an apically repositioned flap technique was performed several months after surgical exposure to avoid gingival recession.
CONCLUSION

Dental transposition can be corrected orthodontically; the mechanics are not only more complex but also time consuming. There are possible damages to the supporting dental tissues. Patient’s compliance, the practitioner’s skill and experience, esthetic and functional consideration and tooth alignment in the transposed order should all be considered in treatment decisions of dental transposition.

In this case, correction of the transposition was chosen because the condition of alveolar bone housing is better in young patient. Both the crown and root movement of the transposed canine and premolar had no interferences. After treatment, both the crowns and roots were well aligned, ideal occlusion and harmonized lip profile were achieved.

REFERENCES