CASE REPORT

Orthodontic treatment of a complete transposed impacted maxillary canine

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Abstract Tooth transposition is a positional interchange of two adjacent teeth. Transposition most often occurs at maxillary canine. Moving transposed teeth to their normal positions is challenging because this requires bodily movement and translation of one tooth to pass another. This procedure may cause damage to the teeth or supporting structures. We report a case of complete transposition of maxillary canine and lateral incisor. Transposed teeth were successfully moved orthodontically to their normal positions. Multiple mechanics were meticulously applied to achieve complete correction of the tooth positions and to minimize root resorption and/or periodontal defects of canine and lateral incisors. Factors concerning treatment planning for transposed teeth are discussed.

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Introduction

Tooth transposition is a positional interchange of two adjacent teeth. It is identified as complete transposition when the crowns and the roots of the involved teeth exchange places in the dental arch, and incomplete transposition (or pseudotransposition) when the crowns are transposed but the roots remain in their normal positions. Tooth transposition occurs more often unilaterally than bilaterally, with maxillary prevalence, and no sex preference. Tooth transposition is significantly unrelated to dental anomalies, such as congenitally missing teeth, peg-shaped or hypoplastic teeth, and impacted teeth. Although tooth transposition...
may be associated with over-retained deciduous teeth, it is an isolated phenomenon rather than a syndrome.\(^2\)

The etiology of tooth transposition appears to be genetically involved. Transposition most often occurs at maxillary canine.\(^3\) Peck and Peck\(^4\) reviewed 71 articles with a total of 201 cases of maxillary tooth transpositions, and classified 71% of the cases as maxillary canine—first premolar transposition, 20% as canine—lateral incisor, 4% as
This is a report of a case with complete transposition of impacted maxillary canines. Clinical examinations showed normal facial proportions, mild gummy smile, and mild chin deviation to the right side (Fig. 1). The lateral profile was the straight profile. Bilateral maxillary primary canines were over-retained. The overjet was \(-0.5\) mm and the overbite was \(1\) mm. Bilateral Angle Class I molar relationships were noted. There was a \(2\)-\(mm\) space deficiency in the maxillary dentition and a \(2\)-\(mm\) space excess in the mandibular dentition.

A panoramic radiograph revealed that the left maxillary canine was impacted between the central and lateral incisors while the right maxillary canine was impacted between the lateral incisor and the primary canine (Fig. 2). Lateral cephalometric analysis of the pretreatment data indicated a facial pattern of the skeletal Class I jaw relationship with an average mandibular plane angle (Table 1). The left maxillary canine was diagnosed as palatal to the left maxillary lateral incisor using the buccal object rule.

The patient was diagnosed as having mild facial asymmetry and Class I malocclusion with complete transposition of the left maxillary canine and lateral incisor. The treatment objectives were to establish normal overjet and overbite, to align bilateral maxillary canines, and to close mandibular spacing.

Two treatment options were offered to the patient. The first treatment plan was to extract bilateral primary canines and to align the right maxillary canine to its normal position while aligning the left maxillary canine to its transposed position. This treatment option would warrant shorter treatment time; however, the maxillary left canine would need to be reshaped and the lateral incisor restored. Because the left maxillary canine was palatal to the left lateral incisor, sufficient bone was available surrounding the canine, and a favorable crown-to-root ratio was noted for both left maxillary lateral incisor and canine, an alternative treatment plan was to extract bilateral primary canines and to align both maxillary canines into their normal positions. This would cost more time to treat, but would result in better aesthetics and occlusion. The patient chose the second treatment plan.

### Case report

A 24-year-old female attended the Orthodontic Department of National Taiwan University Hospital with the chief complaint of impacted maxillary canines. Clinical examinations showed normal facial proportions, mild gummy smile, and mild chin deviation to the right side (Fig. 1). The lateral profile was the straight profile. Bilateral maxillary primary canines were over-retained. The overjet was -0.5 mm and the overbite was 1 mm. Bilateral Angle Class I molar relationships were noted. There was a 2-mm space deficiency in the maxillary dentition and a 2-mm space excess in the mandibular dentition.

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### Treatment progress

Treatment was initiated with a 0.018-inch slot edgewise appliance (Dentaurum, Ispringen, Germany) placed on the maxillary teeth. After initial leveling and alignment with a 0.016-inch nickel–titanium (NiTi) archwire (ORMCO Corporation, Glendora, CA, USA), the maxillary left canine was surgically exposed and a lingual button with eyelet ligature wire was bonded (Fig. 3A and B). A 0.016-inch × 0.022-inch the titanium-molybdenum alloy of TMA wire (ORMCO Corporation, Glendora, CA, USA) with labial root torque applied on the left lateral incisor allowed labial movement of the root, whereas a transpalatal arch was inserted to facilitate moving the left maxillary canine palatally (Fig. 3C). After the maxillary left canine reached a position palatal enough to bypass the lateral incisor without damage, a maxillary 0.016-inch × 0.022-inch stainless steel main archwire (ORMCO Corporation, Glendora, CA, USA) was placed and a 0.018-inch 0.016-inch archwire placed. The left maxillary lateral incisor and canine were then moved orthodontically to their normal positions.

### Table 1 Cephalometric analysis.

<table>
<thead>
<tr>
<th>Skeletal measurements</th>
<th>Pretreatment</th>
<th>Post-treatment</th>
<th>Norm (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td>83.5°</td>
<td>83.5°</td>
<td>82.5 ± 3.5</td>
</tr>
<tr>
<td>SNB</td>
<td>82.5°</td>
<td>81.5°</td>
<td>77.7 ± 3.2</td>
</tr>
<tr>
<td>ANB</td>
<td>1°</td>
<td>2°</td>
<td>4.0 ± 1.8</td>
</tr>
<tr>
<td>A-Nv</td>
<td>–1 mm</td>
<td>–1 mm</td>
<td>0 ± 2</td>
</tr>
<tr>
<td>Pog-Nv</td>
<td>–5.5 mm</td>
<td>–7.5 mm</td>
<td>–5 ± 8</td>
</tr>
<tr>
<td>NAP</td>
<td>3°</td>
<td>6°</td>
<td>5.1 ± 3.8</td>
</tr>
<tr>
<td>Wit’s appraisal</td>
<td>–7.5 mm</td>
<td>–7 mm</td>
<td>(\theta/\delta:–1)</td>
</tr>
<tr>
<td>SN-FH</td>
<td>5°</td>
<td>5°</td>
<td>5.7 ± 3.0</td>
</tr>
<tr>
<td>SN-MP</td>
<td>31°</td>
<td>33°</td>
<td>33.0 ± 1.8</td>
</tr>
<tr>
<td>UFH/LFH</td>
<td>43.6/56.4</td>
<td>42.8/57.2</td>
<td>45%/55%</td>
</tr>
</tbody>
</table>

**Dental measurements**

| U1-SN | 103° | 104° | 108.2 ± 5.4 |
| L1-MP | 87°  | 85°  | 93.7 ± 6.3  |
| U1-L1 | 139° | 138° | 119.9 ± 8.5 |
| U1-NP | 4 mm | 8 mm | 6.4 ± 2.7   |
| UADH  | 31.5 mm | 33 mm | 29 ± 2   |
| UPDH  | 26 mm | 27 mm | 20 ± 2    |
| LADH  | 45.5 mm | 46.5 mm | 45 ± 3   |
| LPDH  | 38 mm | 38 mm | 35 ± 3    |
inch slot edgewise bracket was bonded on the lingual surface of the maxillary left premolar and a 0.017-inch × 0.022-inch stainless steel extrusive spring was attached on the lingual bracket to move the left maxillary canine occlusally and distally (Fig. 3D). Ten months later, a torquing spring was placed on the main archwire to enhance canine eruption and distalization (Fig. 3E). After the left maxillary canine had erupted into the oral cavity, an additional elastic thread was used to derotate the canine (Fig. 3F). The left maxillary canine was bonded with an edgewise bracket on the buccal side after partial correction of the rotation. The bracket was intentionally bonded upside down to increase labial root torque. A 0.014-inch NiTi overlay wire (ORMCO Corporation, Glendora, CA, USA) was used for initial leveling and alignment of the left maxillary canine (Fig. 3G and H) followed by a continuous 0.016-inch × 0.022-inch maxillary NiTi archwire (ORMCO Corporation, Glendora, CA, USA) to finish leveling. A mandibular orthodontic appliance was placed at the time when the maxillary left canine was almost in its normal position. The total active treatment time was 42 months. The teeth were retained with maxillary and mandibular removable Hawley appliances.

**Treatment results**

The treatment results for this patient were excellent. All teeth were well aligned in their proper positions (Fig. 4). Bilateral Class I occlusion with normal overjet and overbite were achieved. The spacing in the mandibular arch was closed. The maxillary and mandibular dental midlines were coincident to the facial midline. All treatment objectives were obtained. A panoramic radiograph revealed good root parallelism with minimal root resorption (Fig. 5). Post-treatment cephalometric data (Table 1) and the cephalometric superimposition (Fig. 6) showed extrusion of maxillary incisors and molars accompanied with a clockwise rotation of the mandible. The patient was satisfied with her teeth and profile.
Discussion

Among dentitional anomalies, tooth transposition is considered one of the most difficult to manage. Treatment options for these transposed teeth include alignment of teeth in their transposed positions, correction of the teeth to their normal position, and extraction of one or both transposed teeth. Peck and Peck suggested that teeth with pseudotransposition could be corrected into their normal positions; however, correction was not recommended for...
the teeth with complete transposition. Still, very few cases of correction of complete transpositions have been reported. Shapira and Kuftinec stated that the correction was complex and could be damaging to both teeth and supporting structures; all of the reported successful cases have been treated with great care to avoid contact between the teeth when creating the passage for the transposed teeth.

Factors to be considered when making treatment plans for a transposed tooth include dental morphology, occlusal considerations, facial aesthetics, stage of root development, position of the root apices, and treatment time. Extraction is indicated when reshaping is difficult for a transposed tooth with strange crown morphology. The root shape of the tooth and the degree of root completion should also be examined to avoid fenestration especially in cases with root dilacerations. When replacing the canine with the first premolar, the roots of the maxillary first premolar must have proper morphology to allow for the necessary rotation without generating buccal root fenestrations. Because the periapical and panoramic radiographs of this patient did not reveal abnormalities in crown or root forms, the left maxillary canine was considered suitable to be guided into its normal position.

The underlying malocclusion, both morphological and functional, and the possibility of obtaining canine-guided or group function occlusion influence the choice of treatment. This was originally a Class I malocclusion case with no dental protrusion or crowding; thus, a nonextraction treatment plan and translation of the left maxillary canine to its normal position would result in better aesthetics and occlusal relationships. If the left maxillary canine were extracted, posterior teeth would have to be protracted forward in order not to deteriorate the facial profile, and the orthodontic treatment mechanics would be more difficult.

The sufficiency of the buccolingual width of the supporting alveolar bone is an important aspect when moving two adjacent teeth in different directions. Compression and friction during correction can cause iatrogenic damage to the teeth (such as root resorption) and periodontal tissues (such as clefting and recession of gingival tissue). The buccolingual width of the alveolar bone of this patient was sufficient and the left maxillary canine had not erupted; thus, moving the canine into its normal position would be feasible as long as the tooth movement in the three planes of space was fully controlled.
According to a review article concerning the management of impacted maxillary canines, surgical exposure and orthodontic eruption of palatally impacted maxillary canines have minimal effects on the periodontium. Our results showed clinically acceptable periodontal conditions with some palatal gingival recession after treatment. The gingival recession on the palatal side would not cause a major problem because an altered passive eruption was suspected to have occurred. The patient exhibited mild gummy smile and short clinical crowns before the treatment. She had a rather flat smiling arc and excessive display of lower anterior teeth. Thus, we allowed some extrusion of the maxillary incisors to create a more curved and pleasing smiling arc. The problem of excessive gum display may be corrected afterwards by periodontal plastic surgery of the dentogingival junction.

Treatment time for either correction or acceptance of the transposed position must be considered from a cost—benefit point of view. The patient chose to have the canine moved into its normal position, and was well informed that it would cost more time. Cephalometric superimposition (Fig. 6) showed a clockwise rotation of the mandible after the treatment. This implied that vertical control was lost during treatment. Had temporary anchorage devices been included in the treatment plan, the mechanics could have been simplified and the treatment time shortened.

Because the patient preferred moving the maxillary canine to its normal position, controlling the tooth movement in the alveolar bone was very important. Different strategies were used during the treatment (Fig. 7). The first step was to move the canine palatally and move the root of the lateral incisor buccally (Fig. 7A and B). The second step was to let the canine bypass the lateral incisor (Fig. 7C). After the transposed canine had bypassed the lateral incisor, canine derotation and alignment was initiated and the buccal root torque of the lateral incisor was decreased to obtain normal inclination (Fig. 7D and E). The total treatment time for this case was 3 years and 6 months, and the results were satisfactory. With careful control of the tooth movement in the three planes of spaces, transposed teeth may be brought into their normal positions successfully.

References