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The Orthodontic Treatment of Bilateral Impacted Maxillary Canines - A Case Report

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The Orthodontic Treatment of Bilateral Impacted Maxillary Canines - A Case Report

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The maxillary canine impaction is a specific topic in orthodontic treatment. Because of its important role in esthetics and occlusal function, preservation and alignment of the impacted canine would always be the priority in teenage orthodontics. In addition to the routine analysis of the space distribution for the impacted canines, orthodontists should also consider the growth potential to achieve proper treatment outcome.

This case report presents the orthodontic treatment of a 14-year-old boy with bilateral maxillary canine impaction. With fixed orthodontic appliance, the bilaterally impacted canines were successfully aligned into maxillary dentition with good interdigitation. The prevalence, etiology and the occlusal characteristics of maxillary canine impactions, the thinking process of treatment plan setting about growth potential, extraction pattern and design of force delivery system are also discussed in this report. *(Taiwanese Journal of Orthodontics. 29(1): 28-38, 2017)*

Keywords: tooth impaction; maxillary canine

**INTRODUCTION**

Maxillary canine is the second most common impacted tooth subsequent to the mandibular third molars, and the frequency of its impaction is fifty times greater than that of the mandibular canines.¹ Furthermore, the occurrence of impacted maxillary canines was reported twice in women than in men.² It was reported that the prevalence of maxillary canine impaction was around 1-3%, varied from race to race.³
According to literatures, the locations of maxillary canine impaction were reported as 85% in the palatal side and 15% at buccal side in Sweden. However, in Asian population, it was observed that the buccal impactions were more dominant than in the palatal sides. The majority of maxillary canine impaction (92%) occurs unilaterally and only 8% are bilaterally affected. To date, the etiology of impacted maxillary canines is thought to be multifactorial and the exact cause is still unclear. Several theories have been proposed to explain the possible reasons.

The presence of the impacted canine may cause some adverse effects such as migration of the neighboring teeth, cyst formation, external root resorption in itself or neighboring teeth or combinations of both. Since the permanent maxillary canine play an important role of esthetics and guidance of occlusion, the treatment options tend to preserve it instead of remove it.

It has also been reported that the prevalence was varied in different types of malocclusion. The treatment plane should include orthodontic preparation if the tooth could be preserved. The position and orientation of impacted canines affect the difficulty for orthodontic correction. The space distribution and force delivery system should also be well designed and planned before tooth traction. Furthermore, the variations in facial growth pattern can be challenging in teenage patients with growth potential.

This case report presents the orthodontic treatment of a 14-year-old boy with bilateral maxillary canine impaction. The orthodontic analysis indicated the diagnosis of Class II division 1 malocclusion with mild crowding in maxillary dentition and moderate crowding in mandibular dentition. We presented the design of force delivery system to correct the impacted teeth and the consideration of growth pattern for Class II treatment in the teenage patient.

### CASE REPORT

#### Clinical assessment

A 14-year-old boy was referred to our orthodontic department for the main concern of sticking-out upper front teeth and the bilateral maxillary canine impaction. His medical history revealed no known major systemic disease and drug allergy. Extra-oral examination revealed acceptable facial symmetry but convex facial profile and incompetent lip closure (Figure 1).

The intraoral examination presented full permanent dentition except bilateral over-retained primary maxillary canines. Other dental characteristics included 6.0 mm overjet and 5.5 mm overbite; both maxillary and mandibular dental midline deviated 1 mm to the right side of facial midline. The dental space analysis showed mild crowding in the maxillary dentition but moderate in mandibular dentition. The molar relationship was half unit Class II on the left side and Class I on the right side (Figure 2).

![Figure 1. The extra-oral photographs taken before treatment.](image)
Figure 2. The intra-oral photographs and dental models before treatment.

Figure 3. The panoramic radiography before treatment.
The panoramic film revealed bilateral impacted maxillary canines with different orientation (Figure 3). The cone-beam computed tomography (CBCT) further confirmed not only the palatal positioning of both impacted canines but also the radiolucent lesion apical to the previously treated left maxillary primary canine (Figure 4).

The cephalometric analysis presented Class II skeletal relationship with retrognathic mandible and protrusive of maxillary incisors (Figure 5 & Table 1).

**Table 1.** Cephalometric measurements in before and after treatment.

<table>
<thead>
<tr>
<th></th>
<th>Pre-treatment</th>
<th>Post-treatment</th>
<th>Norm</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td>80</td>
<td>79</td>
<td>80</td>
<td>2.5</td>
</tr>
<tr>
<td>SNB</td>
<td>75</td>
<td>76</td>
<td>80.1</td>
<td>2.8</td>
</tr>
<tr>
<td>ANB</td>
<td>5</td>
<td>3</td>
<td>3.0</td>
<td>1.7</td>
</tr>
<tr>
<td>FMPA</td>
<td>29</td>
<td>31</td>
<td>26.2</td>
<td>3.2</td>
</tr>
<tr>
<td>A-NV (mm)</td>
<td>2</td>
<td>0</td>
<td>0.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Pog-Nv (mm)</td>
<td>-4</td>
<td>-2</td>
<td>-5.1</td>
<td>2.9</td>
</tr>
<tr>
<td>LFH/TFH (%)</td>
<td>54.4</td>
<td>56.1</td>
<td>55</td>
<td>2</td>
</tr>
<tr>
<td>E.Md.Length (mm)</td>
<td>112</td>
<td>117</td>
<td>113.5</td>
<td>4.7</td>
</tr>
<tr>
<td>E.Mx.Length (mm)</td>
<td>90</td>
<td>87</td>
<td>84.4</td>
<td>3.7</td>
</tr>
<tr>
<td>Md-Mx dif. (mm)</td>
<td>22</td>
<td>30</td>
<td>24.3</td>
<td>3.0</td>
</tr>
<tr>
<td>ALFH (mm)</td>
<td>67</td>
<td>73</td>
<td>65.6</td>
<td>4.8</td>
</tr>
<tr>
<td>SN / FH</td>
<td>10</td>
<td>10</td>
<td>7.0</td>
<td>2.9</td>
</tr>
<tr>
<td>SN/MP</td>
<td>38</td>
<td>40</td>
<td>33.23</td>
<td>4.29</td>
</tr>
<tr>
<td>U1-SN</td>
<td>112</td>
<td>110</td>
<td>108.9</td>
<td>4.1</td>
</tr>
<tr>
<td>U1 / FH</td>
<td>122</td>
<td>120</td>
<td>116.0</td>
<td>3.9</td>
</tr>
<tr>
<td>U1 / L1</td>
<td>122</td>
<td>118</td>
<td>119.8</td>
<td>6.6</td>
</tr>
<tr>
<td>L1 / Md</td>
<td>88</td>
<td>91</td>
<td>98.0</td>
<td>5.1</td>
</tr>
<tr>
<td>U1-Av (mm)</td>
<td>6</td>
<td>2</td>
<td>5.5</td>
<td>1.6</td>
</tr>
<tr>
<td>U1-NA (mm)</td>
<td>5.5</td>
<td>3.0</td>
<td>4.98</td>
<td>1.65</td>
</tr>
<tr>
<td>L1-APog (mm)</td>
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<td>3</td>
<td>3.9</td>
<td>2.2</td>
</tr>
<tr>
<td>L1-NB (mm)</td>
<td>5</td>
<td>6</td>
<td>6.2</td>
<td>1.6</td>
</tr>
<tr>
<td>PFH / AFH (%)</td>
<td>61.7</td>
<td>59</td>
<td>64</td>
<td>2</td>
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<tr>
<td>Facial axis</td>
<td>86</td>
<td>84</td>
<td>90</td>
<td>3</td>
</tr>
</tbody>
</table>
Diagnosis
1. Class II division 1 malocclusion subdivision (left) on Class II skeletal base
2. Upper arch: anterior dento-alveolar protrusion
3. Bilateral maxillary canine impaction

Treatment objectives
1. To align the bilateral maxillary canines into the dental arch.
2. To achieve proper overjet and overbite.
3. To set up the occlusion on Class I canine and Class II molar relationship.
4. To improve the facial profile.

Treatment Plan
1. Full mouth orthodontic treatment with fixed orthodontic appliance
2. Tooth extraction: 53, 63, 14, 24
3. Transpalatal arch (TPA) with palatal traction hook
4. Surgical exposure of impacted maxillary canines followed by forced eruption
5. Retraction of maxillary anterior dentition
6. Canine to canine fixed retainers in both jaws and bimaxillary Hawley retainers

Treatment procedures
The initial leveling and alignment was accomplished with sequential NiTi wire in the initiation of four months. After extraction of the over-retained primary canines, the transpalatal arch (TPA) with traction hook was placed with 0.017 x 0.025 in. stainless steel working wire (Table 2).

The closed eruption procedures were then performed on the left side first followed by the right side. Once the improvement of orientation and position of the impacted canine was revealed by the radiograph detection, the first premolar on either side would be extracted. A second-time surgical exposure with button attachment was performed on the left maxillary canine by applying force to the traction hook on the TPA (Figure 6). After the impacted crowns being fully exposed, the double wire technique was then used for subsequent alignment. In the 22nd month, both impacted canines were successfully aligned into the maxillary arch.

The treatment of the mandibular dentition mainly focused on the correction of the lingually tilted right

Table 2. Summery of treatment progress.

<table>
<thead>
<tr>
<th>Timetable</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>Full mouth fixed appliance banding and bonding</td>
</tr>
<tr>
<td>1st ~ 4th month</td>
<td>Initial alignment and leveling</td>
</tr>
<tr>
<td>5th month</td>
<td>TPA delivery</td>
</tr>
<tr>
<td>6th month</td>
<td>23 1st surgical exposure</td>
</tr>
<tr>
<td>6th month</td>
<td>13 surgical exposure</td>
</tr>
<tr>
<td>6th ~ 8th month</td>
<td>13 forced eruption</td>
</tr>
<tr>
<td>7th ~ 17th month</td>
<td>23 forced eruption</td>
</tr>
<tr>
<td>8th month</td>
<td>14 extraction</td>
</tr>
<tr>
<td>9th month</td>
<td>24 extraction</td>
</tr>
<tr>
<td>18th month</td>
<td>23 2nd surgical exposure</td>
</tr>
<tr>
<td>22nd month</td>
<td>13 and 23 were aligned into the arch, remove TPA</td>
</tr>
<tr>
<td>29th ~ 32nd month</td>
<td>Finishing and detailing</td>
</tr>
<tr>
<td>36th month</td>
<td>Debanding and debonding Retainers delivery</td>
</tr>
</tbody>
</table>
mandibular second premolar. The open coil spring was used to regain the space following by alignment. The non-extraction and space regain was beneficial for the correction of mandibular dental midline and right side molar relation. In the stage of finishing and detailing, bilateral Class III elastics were used to achieve Class I canine relationship. All the appliances were then removed after obtaining solid interdigititation.

**Results**

At the end of treatment, the two impacted maxillary canines were positioned into proper alignment (Figure 7 & Figure 8). The solid interdigitation was successfully achieved with bilateral full Class II molar relation and Class I canine relation as set in treatment objectives. In the panoramic film, acceptable root parallelism was achieved with minimal root blunting (Figure 9). The cephalometric analysis presented the correction of maxillary incisor proclination after treatment completion. Accompanied with mandibular growth, the original Class II skeletal relation was improved but with increased mandibular plane angle and facial height (Figure 10 & Table 1). The total treatment duration was 32 months. No significant discomfort was complained. For retention, the canine to canine fixed retainers with Hawley retainers in both jaws were applied immediately after removing all the fixed orthodontic appliances.
Figure 8. The intra-oral photographs and dental models taken after treatment.

Figure 9. The panoramic radiograph taken after treatment.
which cause dental anomalies such as congenital missing or peg-shaped lateral incisors due to a developmental disturbance of the dental lamina.\textsuperscript{8}

Other possible etiologies for impacted canines may include one or more of the following local factors such as inadequate space for eruption, early loss of primary canines, abnormal position of the tooth buds etc.\textsuperscript{14-18} The craniofacial disorders such as cleft lip and palate, Pierre Robin syndrome that obstacle maxillary development also present high incidence of maxillary canine impaction.\textsuperscript{14-18}

Furthermore, systemic conditions such as endocrine deficiencies, malnutrition, febrile disease would also account for impacted canines.\textsuperscript{14-18}

In our case, the reduced size of right lateral incisor might match the guidance theory. On the other side, the apical lesion originated from previously treated primary canine would be the local factor leading to the canine impaction with excessive inclination (Figure 4). As for the

\textbf{DISCUSSION}

The maxillary canine impaction is usually diagnosed accompanied with over-retained primary canine. In this report, we presented an uncommon case with bilateral maxillary palatal impaction of maxillary canine. Being the last teeth to develop with the longest path of eruption, the maxillary canines have the highest incidence of impaction after third molars.\textsuperscript{13-18}

Two theories have been proposed to explain the occurrence of the maxillary canine impaction.\textsuperscript{7,8} The guidance theory suggests that the distal aspect of the lateral incisor would guide the canine to erupt. That is, missing or malformation of lateral incisor would leave extra space in the apical part of itself and deflect the eruption path of the canine.\textsuperscript{7} On the other hand, the genetic theory believed that the palatally impacted canines are the result of a combination of multiple gene expressions

\begin{figure}
\centering
\includegraphics[width=\textwidth]{Figure_10.png}
\caption{The lateral cephalometric radiograph and tracing taken after treatment. Solid line, right side; dash line, left side.}
\end{figure}
relation to the pattern of malocclusion, it has been reported that palatal canine impaction occurred most frequently in subjects with Class II division 2 malocclusion with the characteristics of increased transverse dimension in the upper arch,9-12 that was believed to be the potential contributing factor of palatal canine impaction.10

The inclination of the impacted canine is reported to be one of the indicators for assessing difficulty and prognosis of the treatment. It is believed that once the tilting angle between the impacted canine and the midline exceed 25 degrees on the panoramic film, there is higher chance to witness root resorption of neighboring teeth;19 if over 45 degrees, the treatment would be extremely difficult.20 The overlapping degree between lateral incisors and canines is regarded as another indicator for the evaluation of total traction time and prognosis. According to the radiographic image, Grade I represents no overlapping of the canine and the lateral incisor; Grade II indicates the overlapping less than half; Grade III represents the overlapping more than half but not complete, as the the cusp tip of the impacted canine crossing over the lateral incisor reaches Grade IV.21,22 The classifications of impactions in this case were Class II in right right side and Class IV in the left side.

Facing such a challenge, it would be important to inspect the spatial relations between the impacted canine and surrounding environment. Some articles discussed about using specific measurements on panoramic film to evaluate the possible position of the impacted maxillary canines.21-24 The CBCT provided more detail and 3D orientation of impacted tooth for design of force delivery system. With CBCT images we confirmed the spatial position of cusp tips of both canines accompanied with different crown-root inclination (Figure 12). The length of palatal traction hook on TPA was about the crown level of the left impacted maxillary canine to allow straightforward distal traction after exposing the crown surface. This approach was proved to be an effective alternative to temporary anchorage devices (TADs), which might not be suitable to apply on teenage patients.

Because of the excessive overjet and amount of crowding, we adopted non-extraction therapy of the mandibular dentition. It is beneficial to upright the mesially tilted right lower first molar and correct the dental midline as placing an open-coil spring for space regain on the lower right second premolar. The growth potential of patients is another essential issue in treatment of teenaged patients with Class II skeletal base. Based on the structural analysis established by Björk,25 we could not expect strong sagittal mandibular growth of this patient. According to the treatment results, the overall superimposition revealed more dominant growth in vertical than that in sagittal direction as expected (Figure 11).

CONCLUSIONS

It is a challenge for treatment of bilateral maxillary canine impactions. The orthodontists should carefully evaluate possible etiology, growth potential and anatomic conditions of the impacted tooth. Through careful analysis and effective clinical management, the optimal treatment results could be expected. Comprehensive clinical assessments and good communications between patients, parents and orthodontists would always be the foundation of successful treatment outcome.

REFERENCES

Figure 11. The cephalometric superimposition of before (black) and after (red) treatment.

Figure 12. The 3D images revealed bilateral maxillary canine with different crown-root inclination.


