Maxillary canine–first premolar transposition in the permanent dentition: treatment considerations and a case report

Abstract
Transposition is defined as the interchange of position between two adjacent teeth within the same quadrant of the dental arch. Permanent maxillary canine–premolar transposition is the most commonly observed transposition in the human dentition. Its prevalence is relatively low and its aetiology remains unclear, although it has been associated with genetic factors. It may also be related to a combination of localised factors such as malformation of adjacent teeth, tooth agenesis, retention of the deciduous canine and a history of local trauma. Treatment is selected on an individual case basis after thoroughly considering the overall facial and dental characteristics, duration of treatment, cost, patient preference and the orthodontist’s experience. This article provides a case report of maxillary canine transposition in the permanent dentition, successfully managed with orthodontic treatment.

Key words: tooth transposition, ectopic eruption, maxillary canine, orthodontic treatment.

Introduction
Tooth transposition is defined as a type of eruption anomaly where there is either an exchange of position between two adjacent teeth, or the development and eruption of a tooth in a position normally occupied by another non-adjacent tooth. Transposition is classified as complete, where it involves both the crown and the root (with the roots of the transposed teeth parallel to each other), or incomplete, where the crown alone is involved. Transposition of teeth should not be confused with ectopic eruption. By definition, all transpositions are ectopic eruptions but not all ectopic eruptions result in transposition. It is a rare condition with a reported prevalence of 0.13-0.4% in the general population. Patients with tooth transposition may present with concomitant dental anomalies including hypodontia (most often missing the permanent upper lateral incisor), dilacerations, and abnormalities of tooth size/shape (such as peg-shaped teeth). In addition, retention of deciduous teeth (especially the primary canine) is often observed, along with the presence of malaligned adjacent teeth.

Transposition affects teeth of either the maxilla or the mandible, and only rarely occurs simultaneously in both arches. Overall, it is more frequently observed in the maxilla than in the mandible.

Table 1 shows the types of transpositions most frequently seen in the maxillary arch.

<table>
<thead>
<tr>
<th>Table 1: Classification of transposition of permanent maxillary teeth in decreasing order of frequency.</th>
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<tbody>
<tr>
<td>2. Canine–lateral incisor.</td>
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<td>3. Canine on the site of first molar.</td>
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<tr>
<td>5. Canine on the site of central incisor.</td>
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</tbody>
</table>

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Transposition of teeth affects males more frequently than females at a ratio of 3:2.1 In most cases transposition of teeth is observed unilaterally, especially in male patients.10,11 Unilateral transposition appears to be more likely to occur on the left side.1,7,8,17 Nevertheless, bilateral cases have also been reported.5,12-16

The exact aetiopathology of tooth transposition remains unclear but several explanations have been postulated (Table 2).1,4,7,8,10,14,15,18,19

This article reviews the aetiology, diagnosis and treatment options for patients presenting with transpositions of the maxillary canine. Additionally, a case report is presented of the management of a maxillary canine–first premolar transposition.

Maxillary canine transposition

The fact that the maxillary permanent canine transposition is the most commonly seen transposition is attributed to the long eruption path of the maxillary canine, which makes it more vulnerable to deflective movement. The bud of the permanent maxillary canine initially develops at the boundary between the developmental fields of the lateral incisor and the first premolar, located superiorly and palatally, just under the orbital ridge. Following its eruption pathway, the maxillary canine gradually moves more buccally and mesially, where it usually becomes progressively palpable in the labial sulcus. Transposition occurs in cases where the eruption pathway of the upper canine is disturbed under the influence of genetic and/or environmental factors. In such circumstances, the erupting maxillary canine follows a path located more mesially to the lateral incisor or distal to the first premolar. Similar anomalies have also been described in ancient skeletal samples and transposition cannot therefore be regarded as an anomaly of modern times.5,20-22 It has been suggested that transposition of the maxillary canine is genetically determined.1 Findings such as a moderate rate of bilateral occurrence, sex-related differences,1,3,11,18 unilateral left-sided prevalence,1,3 increased prevalence of additional dental anomalies,1,3,11,18 hereditary pattern of occurrence,1,2,11,24 increased prevalence in patients with Down syndrome25 and varying incidence among populations, support a genetic aetiology. In many instances of maxillary canine transposition, the deciduous canine is retained. The result is lack of space in the upper arch for the ectopically erupting permanent canine. In situations of canine–first premolar transposition, the permanent canine is usually rotated mesio-buccally. The first premolar is tipped distally and rotated mesio-palatally. In most cases the transposed canine is buccally positioned and only rarely palatally positioned.5

According to data from epidemiological studies, the prevalence of maxillary canine–first premolar transposition ranges from 0.03-0.51% (Table 3).5,26,27

Maxillary canine transposition is usually associated with aesthetic and functional problems that need to be addressed at an early stage. Timely diagnosis of a developing transposition is the most important factor favouring preventive intervention aiming to restore the normal tooth order. Early intervention greatly improves the prognosis of treatment while minimising the risk of damage to teeth and their supporting tissues.24 Early intervention is facilitated by timely clinical and radiographic examination at the beginning of the late mixed dentition stage of dental development.

Orthodontic treatment considerations in cases presenting with maxillary canine–first premolar transposition

Optimal treatment of maxillary canine–first premolar transposition should be determined after thorough clinical examination, as well as radiographic and dental cast analyses. In general, the available treatment options are:29

- orthodontic treatment, including extraction of the upper first premolars.
- non-extraction orthodontic treatment, where either the transposed teeth are moved to their normal positions,5,30-32 or their positions are accepted and the teeth are aligned to their transposed sites.14,33-35

In maxillary canine transposition, treatment planning should consider treatment duration, difficulty, risks of side effects, dental and facial aesthetics, occlusal function, stability, professional experience and patient preferences.3 The principal aim of treatment is to orthodontically move the transposed teeth to their normal positions, since this benefits dental and occlusal aesthetics, function and stability.1,2,10,12,36 This option will, however, prolong the duration and increase the difficulty of the treatment. In incomplete transposition, where only the coronal part of the canine is affected, canine uprighting is usually the primary objective of orthodontic treatment, provided that adequate space for tooth alignment is available. This facilitates natural tooth order. In more severe cases the position of both the crown and the root of the transposed teeth needs to be corrected. In such situations, treatment is prolonged and more complicated. There is an increased risk of incurring damage to the teeth and their supporting tissues by occlusal interferences, and of developing gingival recession, root resorption and supporting bone loss. Bone loss is most commonly from the buccal alveolar plate.5,28,32

In patients where orthodontic tooth movement to correct intra-arch position is indicated, treatment should initially provide a pathway for the canine movement from its transposed position to its normal site. In

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Table 2: Proposed aetiology of tooth transposition.

- Genetic factors
- Exchange of position between developing tooth buds
- Retention of deciduous teeth, especially the deciduous canines
- Intra-osseous migration of the developing permanent canine
- Trauma to the deciduous teeth
- Cysts or other localised pathology

Table 3: Prevalence of maxillary canine–first premolar transposition.

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thilander and Jakobsson (1968)</td>
<td>Swedish schoolchildren</td>
<td>0.03</td>
</tr>
<tr>
<td>Ruprecht et al. (1985)</td>
<td>Arabian dental patients</td>
<td>0.13</td>
</tr>
<tr>
<td>Burnett (1999)</td>
<td>Composite African sample</td>
<td>0.51</td>
</tr>
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</table>
maxillary canine–first premolar transposition, this is facilitated by pure palatally directed bodily movement of the premolar. This minimises the risk of canine to premolar root interference since the labio-lingual width of the maxillary first premolar is much greater than that of the canine.32 If orthodontically induced mesial movement of the canine is performed too labially, there is an increased risk of gingival recession and buccal bone loss. Therefore, fixed orthodontic appliances with good anchorage and maximum torque control should always be applied to prevent forcing of the canine root against the first premolar. After the canine is moved to its normal position the alignment of the premolar in the arch should follow.36

Case report: a maxillary canine–first premolar transposition

A healthy nine-year-old female patient was referred for orthodontic consultation. Her extra-oral examination showed symmetrical craniofacial features with average facial proportions. Nothing abnormal was detected during a functional evaluation of the stomatognathic system and the temporomandibular joint (TMJ). Intra-oral examination revealed a Class I malocclusion with an almost complete permanent dentition. The upper left canine was palpable in the buccal sulcus located between the two premolars, and its cusp was emerging at the gingival level. The upper left primary canine had exfoliated, leaving its space vacant. The upper left first premolar showed a mesio-palatal rotation. No other dental pathology was observed with the exception of the transposition and some plaque-induced gingival inflammation restricted mostly to the crowded areas (Figure 1).

A panoramic and a peri-apical radiograph revealed the ectopically erupting maxillary left canine in the site between the ipsilateral premolars. Its long axis was parallel to the premolars, thereby determining a complete transposition anomaly of the canine. The lower second molars were partially erupted, while the upper second molars were unerupted. The germs of all four third molars were present in the initial stage of their crown development (Figures 2 and 3). It was decided to commence orthodontic treatment straight away in order to prevent further eruption of the canine at its transposed site. The latter would complicate the orthodontic mechanics and would increase the risk of side effects. The primary treatment aim was to reposition the transposed canine to its normal site and align the labial segment of both arches. A non-extraction orthodontic treatment was chosen and fixed appliances were used on all upper teeth (Figure 4). Upon the restoration of the natural order of the maxillary teeth another stage of teeth levelling was performed. The duration of active orthodontic treatment was 23 months. Following completion, a Hawley-type retainer was used to retain the upper arch (Figure 5).
References