Tooth transposition – A literature review and a clinical case

Beatriz Silva Câmara Mattos1*
José Carlos Mesquita Carvalho1*
Márcio Matusita2*
Ana Paula Pereira Pinheiro Alves2*
1D.D.S., Ph.D.
2D.D.S.
*Department of Maxillofacial Surgery, Prosthesis and Traumatology, School of Dentistry, University of São Paulo, São Paulo, Brazil.

Received for publication: July 15, 2005
Accepted: December 14, 2005

Abstract
Tooth transposition is an anomaly in the position of teeth where two teeth of the same maxillary quadrant change their position in the dental arch. There are different types of transposition, classified according to the involved teeth. The review of the etiology of tooth transposition aims at identifying the factors related to its occurrence, and the purpose of this study is to report a case of cleft lip. Studies indicate higher prevalence of upper Canine – First Premolar transposition compared to other types of transposition, as well as a higher prevalence among females and of its unilateral occurrence. Mx.C.P1 is also related to anomalies in tooth number, especially with the agenesis of the lateral incisor. The clinical case of cleft lip and upper Canine – First premolar transposition presented in this study enables the discussion of aspects regarding the etiology of tooth transposition and of predisposing factors. Both the Mx.C.P1 transposition and cleft lip and palate are related to genetic factors and present a multifactorial inheritance pattern. The importance of prevention and early detection of tooth transposition is reaffirmed, aiming at minimizing the disturbances caused by tooth transposition. Further research on the prevalence of tooth transposition in populations with cleft lip and palate would yield a better insight about the simultaneous occurrence of these dental and oral anomalies. The therapeutic procedures for functional and cosmetic rehabilitation of the reported patient are described.

Key Words:
tooth transposition, cleft lip and palate, tooth agenesis

Correspondence to:
Beatriz Silva Câmara Mattos
Faculdade de Odontologia - Universidade de São Paulo
Av. Lineu Prestes, 2227
05589-900 Cidade Universitária, São Paulo, SP - Brazil
Phone: (011) 55479547
Fax: (011) 51812229
E-mail: bscmatto@usp.br
Tooth transposition is an anomaly described as the positional interchange of two teeth in the same quadrant, altering their normal position in the dental arch. Tooth transposition can be complete, when both the tooth crown and the root are transposed, or incomplete, when only the clinical crown is transposed, but the root apex remains in relatively normal position. The five types of tooth transposition observed in the upper jaw were classified by Peck and Peck according to the teeth involved: 1. Canine – First premolar (Mx.C.P1); 2. Canine – Lateral incisor (Mx.C.I2); 3. Canine to first molar position (Mx.C.M1); 4. Lateral incisor – Central incisor (Mx.I2.I1); 5. Canine to central incisor position (Mx.C.I1).

Tooth transposition can hinder esthetic and functional aspects of dentition. For this reason, it is important to know the variables related to the etiology and prevalence of this anomaly in order to establish possible preventive measures.

The position of the tooth crypt in the maxilla is determined by the shape of adjacent structures, particularly of the teeth located in the anterior maxilla. Physiologic tooth migration and tooth eruption path are extremely influenced by the morphology and growth pattern of local bone tissues. The eruption path, which generally follows root orientation, can be influenced and altered by maxillary spaces, mechanical obstructions and variations in the speed of growth. The upper canine, in its pre-eruptive stage, occupies a relatively high position, adjacent to the apertura piriformis and above the position occupied by pre-erupted premolars. Therefore, upper canines present increased risk of ectopic eruption. Traumatic injuries to primary teeth and bone pathologies such as cyst formation may cause displacement of permanent tooth germs and lead to an abnormal eruption path. Yet, the observation of a high incidence of retained deciduous tooth germs and lead to an abnormal eruption path. Yet, the observation of a high incidence of retained deciduous canine tooth transposition and conoid lateral incisors has pointed towards a cause-effect relationship. It is a matter of speculation whether the retention of a deciduous tooth may cause the displacement of its permanent successor or whether an altered path of eruption may lead to the retention of the deciduous tooth.

Mx.C.P1 transposition is currently considered a tooth position anomaly caused by genetic factors, and presents a multifactorial inheritance pattern. According to Peck and Peck, various observations corroborate the polygenic inheritance theory, such as the high prevalence of dental anomalies related to Mx.C.P1, its bilateral occurrence, familial occurrence and the significant difference in prevalence among males and females.

1. Prevalence

The overall prevalence of this anomaly has been reported to be 0.4%, the incidence in males and females varied according to the type of transposition considered, with both unilateral and bilateral occurrence. The simultaneous occurrence in both dental arches was not reported; neither was the incidence in primary dentition.

Tooth transposition is more frequent and varied in the upper jaw and canines are the teeth most frequently involved. Mx.C.P1 transposition is the most prevalent, with an incidence of approximately 0.13% in the population, representing 71% to 89.2% of the cases observed in the maxilla. A higher prevalence in females is reported, and the following proportions have been observed: M1: F2; M1: F1.55; M1: F3.8 and M2: F3.12. Similar frequencies in both genders have also been described. Although the bilateral form may occur, the unilateral occurrence is more prevalent (4:1), and the left side is the most affected. The incidence varies according to the different populations studied, and a higher prevalence of Mx.C.P1 is observed among Caucasian subjects. However, in a study of the Turkish population, the maxillary canine-lateral incisor was the most frequent transposition, and the same incidence for both sides of the arch and for both sexes was also observed.

The studies show a relation between Mx.C.P1 and variations in the shape, size, number and position of teeth. The absence of one or more permanent teeth was observed in 26% of the patients with one of the various types of tooth transposition and high incidences of tooth agenesis, conoid lateral incisors and/or supernumerary teeth are related to canine transposition. These anomalies are observed in 36.5% of the cases of canine transposition. Tooth agenesis (except for third molar agenesis) and conoid lateral incisors were reported in 49% of the subjects with Mx.C.P1 transposition. Budai et al. reported the simultaneous occurrence of tooth transposition and dental anomalies as follows: tooth transposition and agenesis in 40% of the cases, tooth transposition and conoid lateral incisors in 25% of the cases and tooth transposition and retention of deciduous teeth in 50% of the cases. The absence of one lateral incisor or both was reported in about 25% of the Mx.C.P1 cases. A significant relation (p < 0.001) between lateral incisor agenesis and Mx.C.P1 transposition was observed.

2. Cleft lip and palate and tooth transposition

The related literature has thoroughly reported a higher prevalence of variations in the shape, number and position of teeth in subjects with cleft lip and palate, particularly in teeth adjacent to the alveolar cleft. Tooth agenesis is, for the most part, determined and transmitted by autosomal dominant inheritance with incomplete penetrance and variable expression. The impact of environmental factors also affects the etiology of these anomalies. Agenesis of the permanent lateral incisor is more frequent in subjects with cleft lip and palate. According to Damante et al., agenesis of the permanent lateral incisor is directly related to tooth transposition.
related to the complexity of the cleft, and the permanent lateral incisor is the most frequently absent tooth in cases of cleft lip and palate. A higher incidence of agenesis is not limited to the teeth in the alveolar cleft region; a significantly higher incidence of agenesis of the upper second premolar has been observed in cases of cleft lip and palate. In a study of eruption anomalies in canines adjacent to the alveolar cleft it was observed that canines positioned distally to their primary predecessors were always related to the presence of a supernumerary incisor and, in one case, to the agenesis of the first premolar.

The related literature reports a delay of 0.5 years in the development of teeth in patients with cleft lip and palate, as well as asymmetric tooth development between the healthy and the affected maxillary segment. In addition, the teeth in the affected segment present delayed development. This delay is more severe among young subjects, and, with age, tooth development in these patients becomes progressively similar to that in normal patients.

The occurrence of Mx.C.P1 was reported in six cases of cleft lip and palate (CLP), where two cases of bilateral CLP presented bilateral tooth transposition, two cases of unilateral CLP presented tooth transposition on the same side of the cleft, and two cases of cleft of the secondary palate presented unilateral tooth transposition.

The case of incomplete, unilateral cleft of the primary palate on the right side with transposition of the right canine reported in this study presents bilateral agenesis of the permanent lateral incisors and of the upper second premolars. Tooth agenesis, the most frequent anomaly in human dentition, is described as an autosomal dominant characteristic. The simultaneous occurrence of bilateral incisor agenesis and Mx.C.P1 is reported as evidence of the influence of genetic factors in tooth transposition.

**Clinical Case**

The patient, a boy aged 12 years and 6 months, who had undergone corrective surgery for unilateral cleft of the primary palate on the right side, sought treatment at the Outpatient Clinic of Oral and Maxillofacial Prosthesis, School of Dentistry, University of São Paulo. Upon clinical analysis, we observed bilateral absence of the upper lateral incisors, retention of both the upper left primary canine and second molar, and ectopic eruption of the upper right canine. The upper central incisors were asymmetric, and the central incisor adjacent to the alveolar cleft presented shape anomaly, with converging proximal surfaces and reduced width of the incisal third. The panoramic radiograph showed bilateral agenesis of the upper lateral incisor, of the upper second premolars and of the upper and lower third molars. Based on the concept of a multidisciplinary approach and aiming to improve aesthetics, oral health and function, and to attain stable results, the fundamental objectives of any treatment, the patient was referred to orthodontic treatment.

**Discussion**

The patient presented a very harmonic facial profile. Orthognathic surgery was not considered because no maxillomandibular discrepancy was observed. The occurrence of bilateral anodontia of the upper permanent lateral incisor and of the second premolar is in accordance with observations of a higher prevalence of variations in the number of teeth related to cleft lip and/or palate. The simultaneous occurrence of variations in the shape and number of teeth corroborates the existence of a relation between these two anomalies and Mx.C.P1, even in cases of cleft lip and palate. It is noteworthy that Mx.C.P1, in particular, is today considered a tooth position anomaly which results from the influence of genetic factors and presents a multifactorial inheritance pattern, similarly to cleft lip and palate.
The location of tooth germs in the maxillary anterior region and their eruption path are influenced by bone morphology and development in this region and by spatial conditions and this may explain how the eruption path of the canine was distally deviated in this cleft lip patient, causing the observed tooth transposition. The ectopic eruption of the upper right canine observed in this case characterizes Mx.C.P1 in the maxillary quadrant where the cleft is located, made more severe by the second premolar agenesis. The canine transposed with the first premolar, whose eruption and development were chronologically delayed, and erupted mesially to the permanent first molar. The left canine was located in the position of the lateral incisor and mesially to the primary canine. However, this does not characterize Mx.C.I2, because of the agenesis of the lateral incisor. In this case, it is possible that the eruption path of the left canine was mesially deviated due to the agenesis of the lateral incisor. This led to the eruption of the canine where the lateral incisor should be, and to the persistence of the primary canine. Prevention, based on timely detection of variations in the position of teeth by pediatric dentists, makes early diagnosis and interceptive treatment possible, especially in cases where there is retention of the deciduous teeth. Late diagnosis of complete tooth transposition, when the canine has already reached the occlusal plane, prevents any attempt at its orthodontic correction. Orthodontic correction in these cases would lead to a greater risk of root interference and damage to both the roots and supporting structures. Therefore, the tooth should be positioned in the new sequence presented. Tooth transposition combined with the ageneses observed in this case was esthetically and functionally compromising, requiring orthodontic treatment. When both maxillary canine-premolar transposition and a missing maxillary lateral incisor are present, the substitution of the premolar for the lateral incisor may be an option to avoid prosthetic restorations. However, in this case, not only was there congenital absence of the maxillary lateral incisors, but also of the second premolars. This is what made this case so unique. The treatment consisted in maintaining the canines in their transposed position on both sides of the maxillary arch (Figure 3). The delay in the spontaneous eruption of the right first premolar led to the surgical exposure of its clinical crown for orthodontic traction. Because of the reduced dimensions of the left canine, congenital absence of the lateral incisor and second premolar and because orthodontic correction of its position would take longer, we opted for maintaining its new position in the arch, even though this decision implied in its prosthetic replacement. The tip of the cusp underwent odontoplasty to mimic the anatomy of a lateral incisor (Figure 3). Because of the bilateral impaction of the lower second premolars, the lack of space and the congenital absence of the maxillary second premolars, the orthodontic planning involved the extraction of the lower second premolars. Consequently, the patient attained correction of the deviated maxillary dental midline with Angle’s Class I relationship.

The prosthetic spaces corresponded to a lateral incisor in the maxillary segment where the cleft and Mx.C.P1 transposition were located, and to a canine in the normal segment. After a 6-month period of orthodontic retention, and when occlusal stability was reached, the prosthetic treatment was performed by means of resin-bonded bridges, since the patient refused to be submitted to bone graft in the alveolar cleft area and have implants placed in the prosthetic spaces (Figure 4). Resin-bonded bridges were selected in this case because they conserve the tooth structure of the abutment teeth and are the best option in case of change of future acceptance of bone graft and implants; they provide satisfactory retention and occlusal stability; and they can be quickly manufactured at a low cost. The treatment aimed at attaining a group function relationship on the right and left sides during lateral movements, so that the prosthetic canine on the left side would not disengage the posterior teeth during excursive movements of the mandible. The
objeDrawbacks of the treatment were completely fulfilled.
Although the clinical case reported in this study is not a complex cleft case, the simultaneous presence of bilateral tooth agenesis of lateral incisors and second premolars, and tooth transposition characterizes the strong influence of genetic factors, following a multifactorial inheritance pattern. It would be interesting to observe the prevalence of tooth transposition in populations with cleft lip and palate, since these anomalies are related to the same inheritance pattern. In addition, the presence of the alveolar cleft alters bone morphology and spatial conditions, which might influence the location of the tooth crypt and the eruption path. The unilateral cleft lip case reported in this study corroborates the higher occurrence of unilateral Mx.C.P1, but contradicts the tendency that has been reported in the related literature with regard to side and gender in populations without cleft lip and palate. Complete tooth transpositions, as seen in this case, do not allow prevention or even orthodontic repositioning. However, incomplete tooth transpositions, especially those related to the retention of the primary teeth and intraosseous deviation of permanent teeth might be prevented or intercepted in order to reduce the complexity of the orthodontic treatment.
The treatment of the case reported in this study has a three-year follow-up. The resin-bonded bridges provided stability of the results attained; the patient showed satisfaction and good oral health. In addition, bone graft and implants are a future possibility, since most of the tooth structure of the abutment teeth has been preserved.

References