

Tooth transpositions — a review of the literature and treatment considerations

By Yehoshua Shapira, DMD and
Mladen M. Kuflinec, DStom, DMD, ScD

Transposition of teeth has been observed and reported since the early 19th century. In 1849, Harris,¹ in his first edition of "A Dictionary of Dental Sciences, Biography, Bibliography and Medical Terminology" described transposition as an aberration in the position of teeth: "It sometimes happens that a central incisor is situated between the lateral of the side to which it belongs and the cuspidatus, or that a right central is situated in the place of the left and the left in the place of the right; or that a lateral incisor is situated between the cuspidatus and first bicuspid, and at other times a cuspidatus is found between the first and second bicuspids."

This paper reviews the literature on tooth transposition, discusses possible etiologic factors causing this anomaly, and by presenting several cases, illustrates treatment considerations and alternatives.

Transposition has been described as an interchange in the position of two permanent teeth

within the same quadrant of the dental arch. It is considered a relatively rare developmental dental anomaly of unknown origin.² Transposition is often accompanied by other dental anomalies in the same patient. Missing, small or peg-shaped maxillary lateral incisors, severe rotations and malpositions of the adjacent teeth, retained deciduous teeth, dilaceration and malformation of other teeth have most frequently been reported in conjunction with transposition.³⁻⁵

The anomaly seems to affect almost equally males and females, and although it appears more frequently in the maxillary arch, several cases of transposition have been reported in the mandibular arch.⁶⁻⁹ Interestingly, it has never been observed in both jaws simultaneously, nor is transposition known to occur in the deciduous dentition. While the condition may occur both unilaterally and bilaterally, a greater incidence of unilateral cases has been reported (an approximate ratio of 12 to one). The left side is more frequently involved than the right (ratio of two

Abstract

This paper defines tooth transposition and discusses its history, incidence and possible etiology. An interesting parallel is drawn between tooth transposition and other dental anomalies (number, size, shape and location of teeth). Treatment options are discussed in terms of the age at which the transposition is discovered, as well as in terms of severity and completeness of the anomaly. While a logical and relatively predictable treatment solution should normally be considered, in some selected cases it may be prudent to venture into more complex treatment solutions.

This paper was submitted September, 1988.

Key Words

Transposition • Ectopic eruption • Maxillary canine • Mandibular incisor

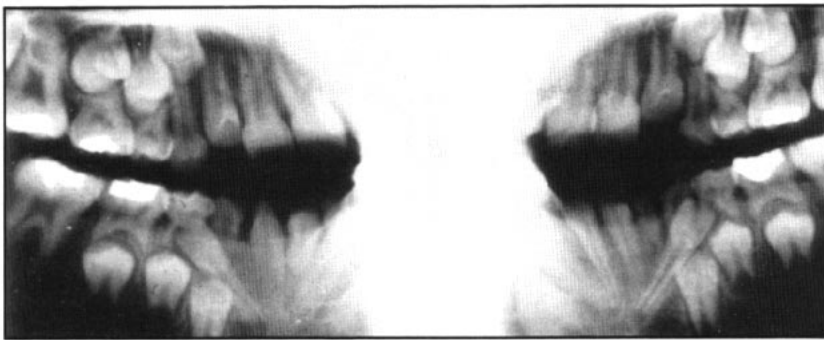


Figure 1
Panoramic radiogram showing the displaced mandibular lateral incisors.

to one).¹⁰ This apparent left side selectivity is consistent with other published reports, but no satisfactory explanation or etiology has been offered thus far.

The maxillary permanent canine is the tooth most frequently involved in transposition. The canine shows the highest incidence of transposition with the first premolar,¹⁰ less often with the lateral incisor,¹¹⁻¹⁴ rarely with the central incisor,¹⁵ and extremely rarely with the second premolar¹⁶ or first molar.^{17,18} In the mandible, where transposition involves the canine and lateral incisor only, a frequency of 0.03 percent was found in the single epidemiologic study of this anomaly among 13,712 school children, age eight to nine years.⁵ Transposition of teeth where the canines are not involved are extremely rare. Only two cases in which transposition was observed between a maxillary central and lateral incisors,¹⁹ and between mandibular second premolar and first molar were reported in the literature.²⁰ Only single, rare cases of a maxillary canine ectopically erupting between the central incisors,^{12,21-22} or distal to the second premolars¹⁷⁻¹⁸ have been reported. Displacement of teeth from one quadrant across the midline to the other side, referred to as transmigration, has also been reported in the mandibular²³⁻²⁷ and the maxillary arches.²⁸ However, these should be considered ectopically erupted teeth, not transpositions.

Transposition may be complete or incomplete. In complete transposition both crowns and entire root structures of the involved teeth are found in their transposed malposition. Conversely, in an incomplete transposition the crowns may be transposed, but the root apices still remain in their relative normal positions.

The maxillary permanent canine has the longest period of development and the longest way to travel from the point of its early formational stage, just under the orbit, to its complete eruption. It starts to calcify at about four to five months after parturition and erupts into the mouth at the age of approximately 12 years. The canine is located in the bony crypt super-

iorly and palatally of the developing premolar buds, in a limited and crowded region of the dense palatal bone. It starts to move downward only after its root development is well underway, and makes its way by a wedging action. It moves labially and mesially between all other teeth in the region. Eruption of the canine is usually through the labial maxillary alveolar bone; often it can be palpated high in the labial sulcus.

Any bony obstruction, insufficient bone development and crowding for other reasons, or resistance of the neighboring teeth, such as a retained deciduous canine, may deflect the permanent canine from its normal eruptive path. When deflected lingually, it may become palatally impacted, lying in an oblique or horizontal position. It may, however, be displaced mesially and become transposed with the lateral incisor, or distally to become transposed with the first premolar.

In the maxilla, the permanent canine has been found to be the most frequently transposed tooth; the permanent lateral incisor is reported to be the tooth most often ectopically displaced in the mandibular arch. The mandibular permanent lateral incisor may deflect from its normal path of eruption and migrate distally along the lingual side of the deciduous lateral incisor and canine to erupt above the developing first premolar, following early loss of the deciduous first molar. The canine, which will erupt in its normal position or slightly mesially, will thus become transposed with the lateral incisor. Therefore, transposition in the maxilla is a result of displacement and migration of the maxillary canine, whereas in the mandible the distal migration of the lateral incisor appears to be the primary reason for the developing transposition.

Etiology

Although several theories have been advanced, the etiology of canine transposition, similar to that of canine impaction, is still obscure. One possible explanation is that transposition occurs as a result of interchange in location between the anlage of the developing teeth.^{10,29-30} Observing the high incidence of deciduous canine retention associated with transposition, others suggest that the retained deciduous canine may be the primary cause for deviation of the permanent canine from its normal path of eruption.^{7,17,29-30} Supporting the migration theory are the rarely reported cases where the canine was found in the position of the second premolar or central incisor. Although these are not true transpositions, the migration of the canine was suggested as an explanation for this anomaly.²²

This theory, however, cannot be offered for the single reported case of transposition in which the canine was not involved.¹⁹ It would, perhaps, be more logical to assume that interchange in position of the anlage of the involved teeth is the causative factor for that specific anomaly.

Although not clear yet, it appears there may be a cause-effect relationship between ectopic eruption of permanent teeth and retained deciduous teeth. Because retention of deciduous canines and lateral incisors was reported in the majority of cases of canine transposition^{3,10} and impaction, it has been suggested that the long retention of the deciduous teeth may be the primary cause for displacement of the permanent tooth from its normal path of eruption. Whether prolonged retention of a deciduous tooth causes displacement of its successor, or an abnormal path of eruption is the reason for retention of the deciduous tooth is a matter of speculation.

Trauma to the deciduous teeth has also been suggested as a factor in the etiology of transposition in the reported cases where dilaceration of the permanent incisor roots were found adjacent to transposed teeth.³¹ Heredity has been offered as a possible explanation for this anomaly, especially when reported bilaterally in siblings.³²⁻³³ Bone pathology, such as a cyst formation may also cause displacement and transposition of the tooth.³⁴

Treatment considerations

Early diagnosis of a developing transposition is based on thorough intraoral examination followed by complete radiographic analysis, preferably at the age of six to eight years. This is especially important for early detection of malposed mandibular permanent lateral incisors. When incipient transposition is detected early enough, interceptive treatment should be initiated to remove retained mandibular deciduous teeth and guide the ectopic lateral incisor to its normal place in the arch. The panoramic radiogram of an 8-year-old girl who was referred for orthodontic consultation, revealed bilateral distal displacement of the mandibular lateral incisors (Figure 1). The retained deciduous lateral incisors and deciduous canines were removed, and the ectopically erupted lateral incisors were uprighted and aligned in their normal positions in the arch. This interceptive procedure prevented the full development of transposition with the erupting permanent canine.

If the mandibular canine and lateral incisor have already erupted in their transposed position, correction to their normal position should usually not be attempted. Alignment in their

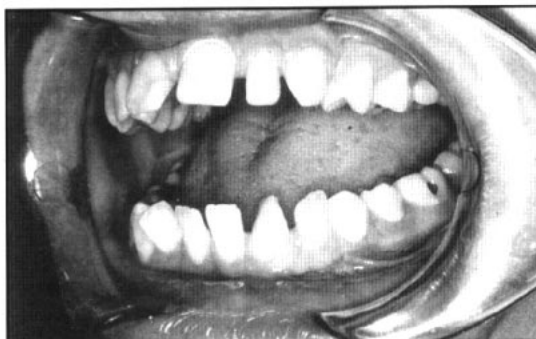


Figure 2A

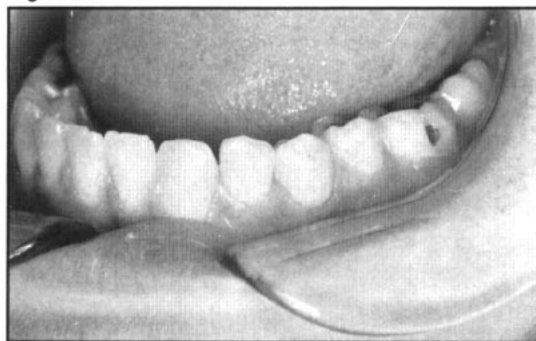


Figure 2B

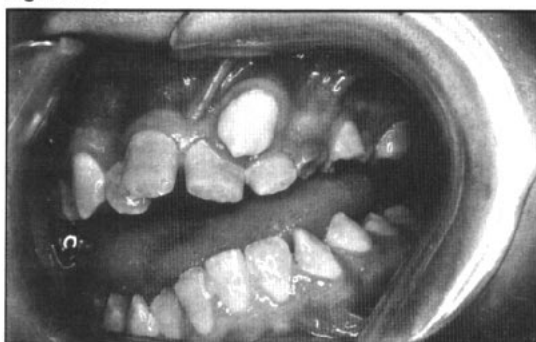


Figure 3A

transposed position with reshaping of their incisal surfaces will not damage the teeth or supporting structures and will present an acceptable esthetic result. This was the treatment approach for a 14-year-old girl who presented with Class I skeletal and dental relationships with unilateral complete transposition of her mandibular left lateral incisor and canine, which were also severely rotated. The left lateral incisor was rotated 180 degrees with its lingual surface facing labially, while the left canine and the right lateral incisor were rotated approximately 90 degrees (Figure 2A). The teeth were correctly rotated and aligned in their transposed positions, and a mandibular anterior fixed retainer was bonded following severing of the gingival supracrestal fibers of the rotated teeth (Figure 2B).

Transpositions in the maxillary arch allow several treatment options to be considered. Esthetically and functionally it is generally preferable to move the transposed teeth to their normal position in the arch. In incomplete trans-

Figure 2
Transposition of the mandibular left lateral incisor and canine.

A—Pretreatment lateral view.

B—Posttreatment lateral view showing the teeth fully aligned in their transposed relationship.

Figure 3B

Figure 3
Incomplete transposition of the maxillary left canine and lateral incisor.

A—Lateral view showing the left canine erupting between the central and lateral incisors. Note the retained deciduous canine.

B—Radiogram showing the crowns of the canine and lateral incisor crossing each other, while the root of the canine is approximately in its normal location.

Figure 4
Bilateral transposition of the maxillary canines and first premolars.

A—Pretreatment occlusal view showing the bilateral transposition, the retained deciduous left canine and the rotated first premolars.



Figure 4A



Figure 4B

B—Pretreatment radiogram showing complete transposition.

C—Posttreatment occlusal view showing alignment of the canines and first premolars in their transposed positions.

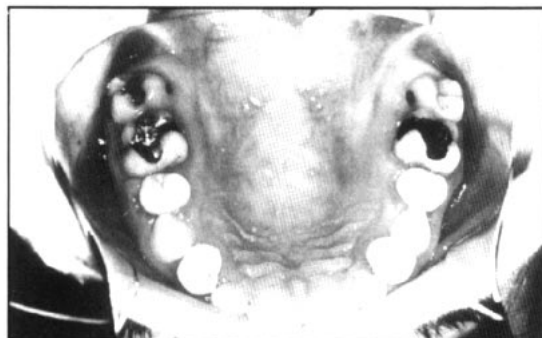


Figure 4C

Figure 5
Radiogram showing an advanced stage in the developing transposition between the maxillary right canine and first premolar. Note the retained deciduous canine.



Figure 5

Figure 6
Occlusal view showing transposition of the maxillary right canine and first premolar.



Figure 6

position, where the crowns are transposed but the root apices are in their relatively normal positions, uprighting and rotating the involved teeth is the procedure most often required to place them in their normal alignment, provided enough space is available in the arch. Treatment required in the 16-year-old boy with incomplete transposition of his maxillary left canine and lateral incisor (Figure 3A,B) consisted of extracting the retained deciduous canine and uprighting the permanent canine to its normal position in the arch.

When a transposition is complete, with root apices in their transposed positions, repositioning the teeth to their normal relationship in the arch is complex and may be damaging to the teeth or supporting structures. Alignment of these teeth in their transposed position is often an acceptable compromise. This option is demonstrated in the treatment of a 17-year-old girl with bilateral complete transposition of her maxillary canines and first premolars. The teeth were aligned in their transposed positions (Figure 4A,B and C).

A similar approach was taken in the developing transposition seen between the maxillary right canine and first premolar in the radiogram of an 11.5-year-old boy (Figure 5). Extraction of the retained deciduous canine and mesially uprighting the first premolar allowed the canine to erupt into its transposed position.

If one of the transposed or adjacent teeth is severely affected by caries or trauma, extraction of that tooth (usually the first premolar) should be considered. This was the treatment undertaken in the complete transposition of the maxillary right canine and first premolar in a 13-year-old boy (Figure 6). The first premolar, which was severely affected by caries and required endodontic treatment, and the retained deciduous canine were extracted. The extraction space was then used for the alignment of the canine and the reduction of incisor crowding.

When sufficient space cannot be gained to align transposed teeth, extraction of the tooth should be considered. This is demonstrated in an 11-year-old boy with transposition of his mandibular right lateral incisor and canine (Figure 7A). The transposed lateral incisor was extracted and the erupting first premolar was aligned in the arch without any orthodontic intervention (Figure 7B).

An unusual treatment approach has been reported, involving substitution of a transposed premolar for a congenitally missing maxillary lateral incisor to avoid an anterior bridge in a young patient.³⁵

More complex treatment options include the attempt to move transposed teeth to their normal positions in the maxillary arch in selected cases, providing alignment in their transposed positions would be esthetically and functionally unacceptable. To avoid root interference or resorption during treatment, and to prevent bony loss at the cortical plate of the labially positioned canine, the transposed tooth (premolar or lateral incisor) should first be moved palatally, enough to allow for a free movement of the canine to its normal place. Subsequently, the other transposed unit can be moved labially, back to its normal position in the arch. While this procedure requires considerably longer treatment, if performed slowly and carefully, the esthetic and functional results are rewarding and justify the complex and prolonged procedure.³⁶⁻³⁷

Summary

A literature review of tooth transposition and its possible etiologic factors were discussed. Several cases of transposition were presented to demonstrate treatment considerations and options. The "pros" and "cons" of aligning transposed teeth in their normal position in both arches were described.

Author Address

Dr. M.M. Kuftinec
Department of Growth and Special Care
School of Dentistry
University of Louisville
Louisville, KY 40292

Dr. Shapira is on the faculty of the Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University, and is currently a Visiting Professor in Orthodontics at the University of Louisville, School of Dentistry in Louisville, Kentucky.

Dr. Kuftinec is Chairman of the Department of Growth and Special Care at the University of Louisville, School of Dentistry, Louisville, Kentucky.

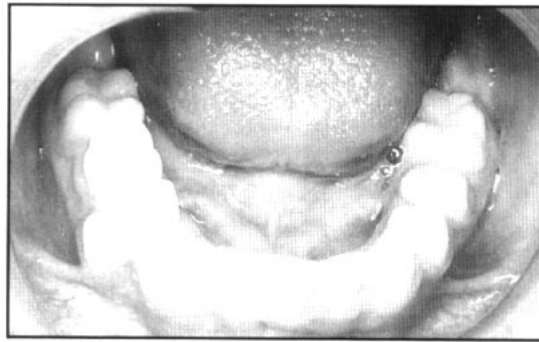


Figure 7A



Figure 7B

Figure 7
Complete transposition of the mandibular right lateral incisor and canine.

A—Pretreatment view showing the 90 degrees rotation of the transposed lateral incisor, and the ectopically erupting first premolar. **B**—Posttreatment view showing alignment of teeth.

References

1. Harris, C.A.: A dictionary of dental sciences, bibliography, bibliography and medical terminology, 1st Ed. p.725, Philadelphia: Lindsay and Blakiston, 1849.
2. Thomas, K.H.: Oral pathology, 2nd Ed. p.415, St. Louis: The C.V. Mosby Company, 1944.
3. Shapira, Y.: Transposition of canines, *J. Am. Dent. Assoc.* 100:710-712, 1980.
4. Newman, G.V.: Transposition: orthodontic treatment, *J. Am. Dent. Assoc.* 94:554-557, 1977.
5. Jarvinen, S.: Mandibular incisor-cuspid transposition: A survey, *J. Pedod.* 6:159-163, 1982.
6. Platzer, K.H.: Mandibular incisor-canine transposition, *J. Am. Dent. Assoc.* 76:778-784, 1968.
7. Shapira, Y.: Bilateral transposition of mandibular canine and lateral incisors: Orthodontic management of a case, *Br. J. Orthod.* 5:207-209, 1978.
8. Shapira, Y. and Kuftinec, M.M.: Orthodontic management of mandibular canine-incisor transposition, *Am. J. Orthod.* 83:271-276, 1983.
9. Kryshtalskyj, B.: A rare case of bilateral mandibular canine-lateral incisor transposition, *Ontario Dentist.* 59:31-35, 1982.
10. Joshi, M.R. and Bhatt, N.A.: Canine transposition, *Oral Surg. Oral Med. Oral Path.* 31:49-54, 1971.
11. Caplan, D.: Transposition of the maxillary canine and the lateral incisor, *Dent. Pract.* 22:307, 1972.
12. Jackson, M.: Transposition of the upper canine and lateral incisor, *Br. Dent. J.* 90:158, 1951.
13. Gholston, L.R. and Williams, P.R.: Bilateral transposition of maxillary canines and lateral incisors: a rare condition, *J. Dent. Child.* 51:58-63, 1984.
14. Dinayar, B.: Orthodontic management of canine transposition, *J. Ind. Dent. Assoc.* 55:323-324, 1983.
15. Jackson, M.: Upper canine in position of upper central incisor, *Br. Dent. J.* 90:243, 1951.
16. Joshi, M.R. and Gaitonde, S.S.: Canine transposition of extensive degree: a case report, *Br. Dent. J.* 121:221-222, 1966.
17. Wood, F.I.: Developmental anomaly with associated canine transposition, *Br. Dent. J.* 104:212, 1958.
18. Hallett, G.E.: A maxillary canine erupting in the first molar region, *Br. Dent. J.* 72:191, 1942.
19. Shapira, Y., Kuftinec, M.M. and Villagordoa, G.: An unusual transposition of the maxillary central and lateral incisors, *J. Dent. Child.* 49:443-444, 1982.
20. Patel, J.R.: Transposed and submerged teeth, *Oral Surg. Oral Med. Oral Path.* 46:599, 1978.
21. Cook, E.F.: Misplacement of upper canine, *Br. Dent. J.* 50:842, 1929.
22. Curran, J.B. and Baker, C.G.: Bilateral transposition of maxillary canines, *Oral Surg.* 36:905-906, 1973.
23. Javid, B.: Transmigration of impacted mandibular cuspids, *Int. J. Oral Surg.* 14:547-549, 1985.
24. Shapira, Y., Mischler, W.A. and Kuftinec, M.M.: The displaced mandibular canine, *J. Dent. Child.* 49:362-364, 1982.
25. Ando, S., Aizawa, K. and Nakashima, T.: Transmigration of the impacted mandibular cuspid, *J. Nihon Univ. Sch. Dent.* 6:66-71, 1964.
26. Fidler, L.D. and Alling, C.C.: Malpositioned mandibular right canine: report of a case, *J. Oral Surg.* 26:405-407, 1968.
27. Pratt, R.J.: Migration of canine across the mandibular midline, *Br. Dent. J.* 126:463-464, 1969.
28. Mahendra, L.: An unusual transposition of maxillary lateral incisor, *J. Ind. Dent. Assoc.* 55:115-117, 1983.
29. Mader, C. and Konzelman, J.L.: Transposition of teeth, *J. Am. Dent. Assoc.* 98:412-413, 1979.
30. Laptook, T. and Silling, G.: Canine transposition — approaches to treatment, *J. Am. Dent. Assoc.* 107:746-748, 1983.
31. Dayal, P.K., Shodhan, K.H. and Dave, C.J.: Transposition of canine with traumatic etiology, *J. Ind. Dent. Assoc.* 55:283-285, 1983.
32. Payne, G.S.: Bilateral transposition of maxillary canine and premolars, *Am. J. Orthod.* 56:45-52, 1969.
33. Allen, W.A.: Bilateral transposition of teeth in two brothers, *Br. Dent. J.* 123:439-440, 1967.
34. Hitchin, A.D.: The impacted maxillary canine, *Br. Dent. J.* 100:1-12, 1956.
35. Nestel, E. and Walsh, J.S.: Substitution of a transposed premolar for a congenitally absent lateral incisor, *Am. J. Orthod. Dentofac. Orthop.* 93:395-399, 1988.
36. Mollin, A.D.: Transposition of teeth, *Quintessence International* 12:45-51, 1977.
37. DeMarinis, U. and DeNuccio, C.: Transposition: therapeutic considerations, *Mondo Orthodontico* 10:51-57, 1985.
38. Stafne, E.C. and Gibilisco, J.A.: Oral roentgenographic diagnosis, 4th Ed. p.28, Philadelphia: W.B. Saunders Company, 1975.