Tooth transpositions associated with dental anomalies and treatment management in a sample of orthodontic patients

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The purpose of this study was to determine the distribution of tooth transpositions in a sample of orthodontic patients, describe the accompanying anomalies and report on the management and therapeutic outcome. Overall, the male to female ratio was 4:3, left side predominance was evident, and there was a high incidence of associated dental anomalies. Attempts to correct tooth order usually resulted in untoward effects on periodontal tissues. Consequently, individual anatomical conditions may be decisive in successful clinical management of such cases.
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INTRODUCTION

Transposition of teeth is a disturbance of eruptive position in which a permanent tooth develops and erupts in the position normally occupied by another permanent tooth.[1,2] More specifically, tooth transposition is defined as the positional interchange of two adjacent teeth, especially the roots, or the development or eruption of a tooth in a position occupied normally by a non-adjacent tooth.[3] This definition applies also to extreme cases of ectopic eruption, each causing a change in the natural order or sequence of the permanent teeth.[4] On the other hand, others use this term to refer only to an interchange in the position of two adjacent teeth within the same quadrant of the dental arch.[5] The extremely rare cases of tooth migration to the other quadrant of the dental arch[6-10] are not regarded as transpositions, but as extreme cases of ectopic eruption.[2]

The frequency of transposition for the general population has been reported between 0.03 per cent[11] and 0.25 per cent.[12] In a study of the putative relationship between tooth transposition, among other congenital tooth anomalies, and malocclusions the frequency of appearance was 0.5 per cent for the Class III patients, while the Class II division 1 subjects exhibited no transposition.[13]

Transpositions are distinguished in complete and incomplete or pseudotranspositions. In complete transpositions both the crowns and the root apices have been transposed. However, in incomplete transposition the apices are found near the normal position, while the crowns exhibit a disturbed position or the alternative.[1,2]

In the deciduous dentition transposition has never been observed.[5] In the permanent dentition, both dental arches have been reported to be involved, more frequently the upper.[1,2,4,5,14-19] Only one report of simultaneous involvement of both dental arches appears to exist in the literature.[20] Maxillary transpositions, most frequently involve the canine and either the first premolar or the lateral incisor.[5] Transpositions that do not involve the canine, such as lateral-central incisor transpositions are extremely rare.[4]

Unilateral transposition has been reported more often than bilateral transposition,[1,2,4,5,14,16,21,22] with a ratio of unilateral to bilateral appearance twelve to one.[23] In cases of unilateral transposition in the maxilla the left side is more frequently involved than the right,[1,2,4,5,14,22] whereas in the mandible the right side prevails.[21,24-26] Cases of bilateral transposition have been symmetrical, except for a report of a male patient, exhibiting transposition of the maxillary canine and the first premolar on the right side and of the mandibular canine and the lateral incisor on the left side.[20] Tooth transpositions have been found more frequently in females than in males.[4,5]

Many congenital tooth anomalies have been observed in cases of transposition. Such anomalies include severe rotations and malpositions, retained deciduous teeth, hypodontia, peg-shaped or small maxillary lateral incisors or malformations of the adjacent teeth.[1,4,5,14,16,18,19,22,27]

Treatment planning for a malocclusion associated with tooth transposition is often challenging because of variation in the position and condition of the involved teeth, time of intervention and space availability in the

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Table 1. Subject data.

	Sex	Age	Angle Class	Transposed teeth	Accompanying anomalies
1	F	12	I	12-13,22-23	45 congenitally missing, 22 small
2	M	12	I	22-23	63 retained
3	F	12	I	22-23	63 retained, 35 congenitally missing
4	F	12	I	22-23	No
5	F	12	II/1	32-33	73 retained
6	M	13	I	13-14	No
7	M	13	II/1	22-23	62, 63 retained, 22 peg-shaped
8	F	13	I	23-24	63 retained
9	F	14	I	23-24	63 retained
10	M	14	I	23-24	No
11	M	14	I	23-24	No
12	F	14	I	32-33	73 retained
13	M	15	I	23-24	63 retained, 25 congenitally missing
14	M	16	I	22-23	No
15	M	16	I	32-33	73 retained
16	M	16	I	42-43	No

dental arch.[4] Best results are achieved when the anomaly is diagnosed and dealt with at early stages.[28] Usually, the transposed order of teeth is retained, since attempts at restoring the natural tooth position may lead to prolonged orthodontic treatment with less than adequate results biologically and esthetically.[28]

Reports of successful restoration of the tooth order are rather infrequent in the literature.[29,30] Especially in the mandible, bone density and limited vestibulolingual dimension of the alveolar process may compromise the therapeutic outcome,[17] while in the maxilla, provided space availability, the possibility of correction is greater.[28]

In the case of canine to first premolar transposition, the esthetic resemblance suggests retaining the transposed tooth order. As to canine to lateral incisor transposition difficulties and uncertainties of root movement may justify the resulting esthetic compromise.[2] On the other hand, in the cases of pseudotranspositions, restoring the natural tooth order is easier and produces the best esthetic outcome.[4]

The purpose of this study was to determine the distribution of tooth transpositions in a sample of orthodontic patients, describe the accompanying anomalies and report on their management and therapeutic outcome.

SUBJECTS AND METHODS

The material for this study was obtained from the records of two orthodontic clinics. The total number of patients with tooth transpositions was sixteen. Seven of the subjects were females and nine were males. At the time the patients sought orthodontic treatment, the age range was twelve to sixteen years old. There was no history of previous trauma to the dentition.

Panoramic radiographs were used to examine the teeth involved and determine the type of transposition. The presence of other accompanying anomalies, i.e. retained deciduous teeth, congenitally missing teeth, supernumerary teeth, tooth malformations, were evaluated clinically and radiographically. Moreover, the type of treatment was recorded as well as the possible side effects.

RESULTS

Three of the total group of 16 subjects with tooth transpositions (19 per cent) exhibited Angle Class II/1 dental anomaly and the rest Angle Class I. Nine of them were males (56 per cent). No subject exhibited transposition involving both the maxilla and the mandible. Bilateral involvement was found only in one case in the maxilla. In cases of unilateral transposition (94 per cent), nine (60 per cent) involved the canine and the lateral incisor and thirteen (86 per cent) were found in the left side of the dental arch (Tables 1, 2).

The majority of transposed teeth (12 cases) were found in the maxillary dental arch (75 per cent). Half of these maxillary tooth transpositions involved the canine and the first premolar and half the canine and the lateral incisor. One subject had bilateral transposition affecting the canine and the lateral incisor in both sides. Maxillary tooth transpositions were found more frequently in males than females (58 and 42 per cent respectively), and left side predominance was evident in 91 per cent of the total maxillary unilateral transposition sample (Tables 2, 3).

In the mandibular arch all transpositions (4 cases) were of the canine and the lateral incisor. Males and females were equally affected and left side localization was observed in 75 per cent of the sample (3 cases) (Tables 2, 3).

Of the subjects studied, in eleven cases (69 per cent) developmental anomalies were observed. Those included over-retained primary teeth (10 cases), undersized lateral incisors (2 cases) and congenitally missing permanent teeth (2 cases) (Table 1).

Four out of sixteen cases (25 per cent), localized in the maxillary dental arch, were treated attempting

Table 2. Summary of cases.

			Male		Female	
	No	%	No	%	No	%
Mx C-P_1	6	38	4	67	2	33
Mx C-I_2	6	38	3	50	3	50
Md C-P_1	-	-	-	-	-	-
Md C-I_2	4	25	2	50	2	50
Total	16	100	9	57	7	43

Table 3. Transposition localization in the maxillary and mandibular dental arch.

	Male		Female		Total	
	Mx	Md	Mx	Md	Mx	Md
Left	6	1	4	2	10	3
Right	1	1	-	-	1	1
Bilateral	-	-	1	-	1	-
Total	7	2	5	2	12	4

Table 4. Orthodontic management and side effects.

	Transposed teeth	Correction of tooth order	Treatment time	Side effects
1	12-13,22-23	No	1.5 year	None
2	22-23	No	1.5 year	None
3	22-23	Yes	2.5 years	None
4	22-23	No	1.5 year	None
5	32-33	No	1.5 year	None
6	13-14	No	1.5 year	None
7	22-23	Yes	2.5 years	Gingival recession / pocket formation in 22
8	23-24	Yes	2.5 years	Gingival recession in 23
9	23-24	No	1.5 year	None
10	23-24	No	1.5 year	None
11	23-24	No	1.5 year	None
12	32-33	No	1.5 year	None
13	23-24	No	1.5 year	None
14	22-23	Yes	2.5 years	Gingival recession / pocket formation in 22
15	32-33	No	1.5 year	None
16	42-43	No	1.5 year	None

correction of tooth order, while the rest were orthodontically treated preserving the teeth in the transposed position. The time of treatment in the correction cases was around 2.5 years, while in the non-correction cases around 1.5 year. Although three of the corrected cases (75 per cent) resulted in loss of periodontal support, exhibiting gingival recession alone (1 case) or in combination with pocket formation (2 cases), tooth maintenance in the dental arch has not been influenced up to now.

DISCUSSION

In the present study a higher prevalence of tooth transposition in males than females for all types of transposition is observed with an approximate ratio of 4:3. This is not in agreement with the majority of reports indicating a female predominance,[3-5,14,31,32] although similar to a report of male to female ratio of 2.5-1.[33]

Similar incidence of canine-lateral incisor and canine-first premolar transposition was observed in the maxillary dental arch, while other authors[4,5,14] reported greater frequency of canine-first premolar and Chattopadhyay and Srinivas[33] of maxillary canine-lateral incisor transposition. In agreement to Plunkett *et al.*[14] all mandibular transpositions were of the canine and the lateral incisor.

Confirming previous investigations, unilateral transposition was more frequently encountered than bilateral transposition.[3-5,14] The only case exhibiting bilateral transposition involved the canine and the lateral incisor. Much higher incidence of bilateral transpositions involving canines and lateral incisors has been reported in the literature.[33]

Left side predominance was evident in the total unilateral transposition sample, as well as in both the maxilla and the mandible. Our results are in agreement with several studies.[3-5,14,30,32] However, other authors in case reports[21,24-26] observe right side predominance in the mandible.

The high incidence of associated dental anomalies (over-retained deciduous canines, small lateral incisors, congenitally missing permanent teeth) observed in other studies,[1,4,5,14,16,18,19,22,27] was confirmed in the present investigation.

As far as treatment strategies are concerned, in most of the cases where the transposed tooth order

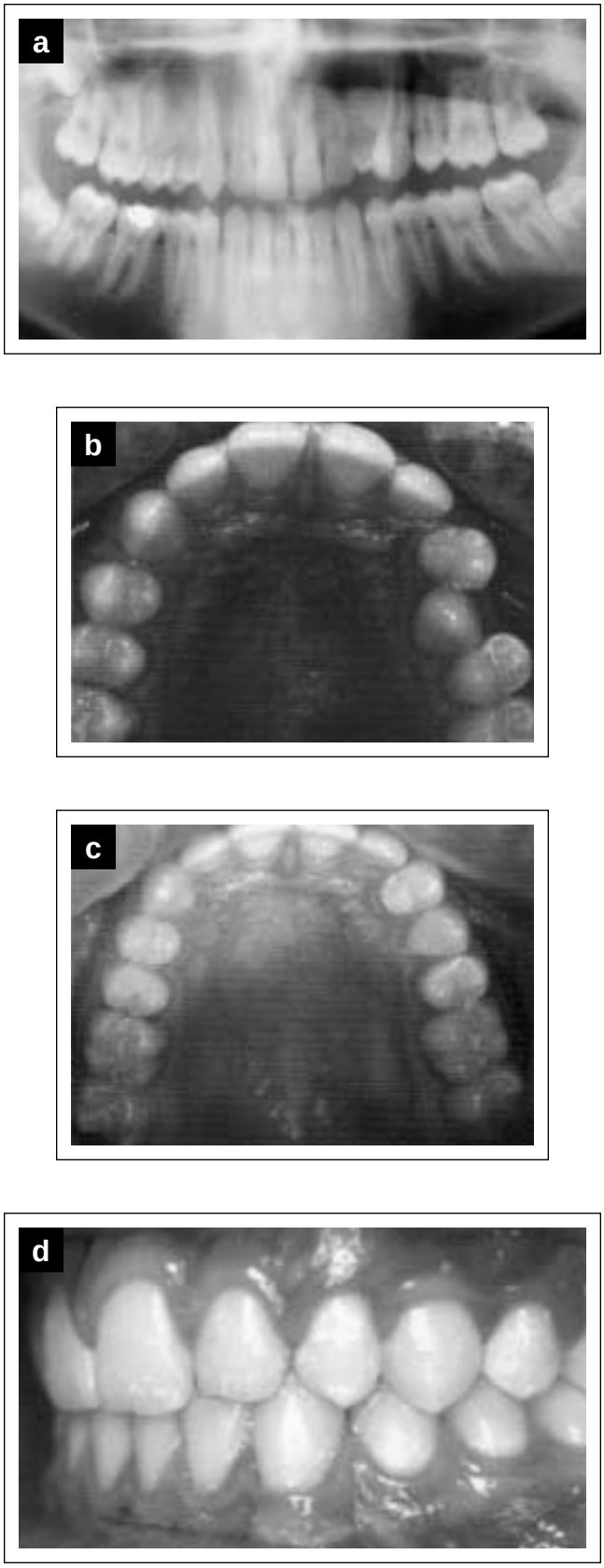

Figure 1. Male 14 years old, transposition 23-24 (Table 1. Case no 10). **a)** Initial panoramic radiograph. **b)** Before treatment. **c)** and **d)** After treatment. Maintenance of transposed order.

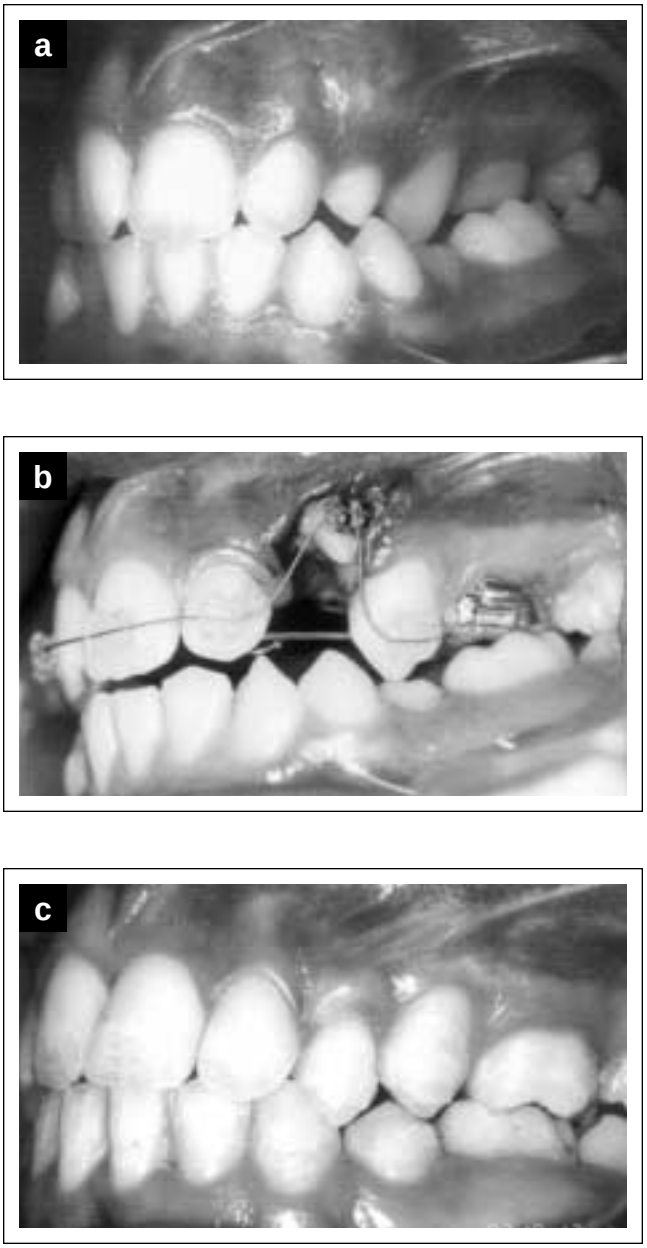

Figure 2. Male 15 years old, transposition 23-24 (Table 1, Case no 13). **a)** Before treatment. **b)** During treatment. **c)** After treatment. Maintenance of transposed order. Compromised esthetics because of teeth contour and size.

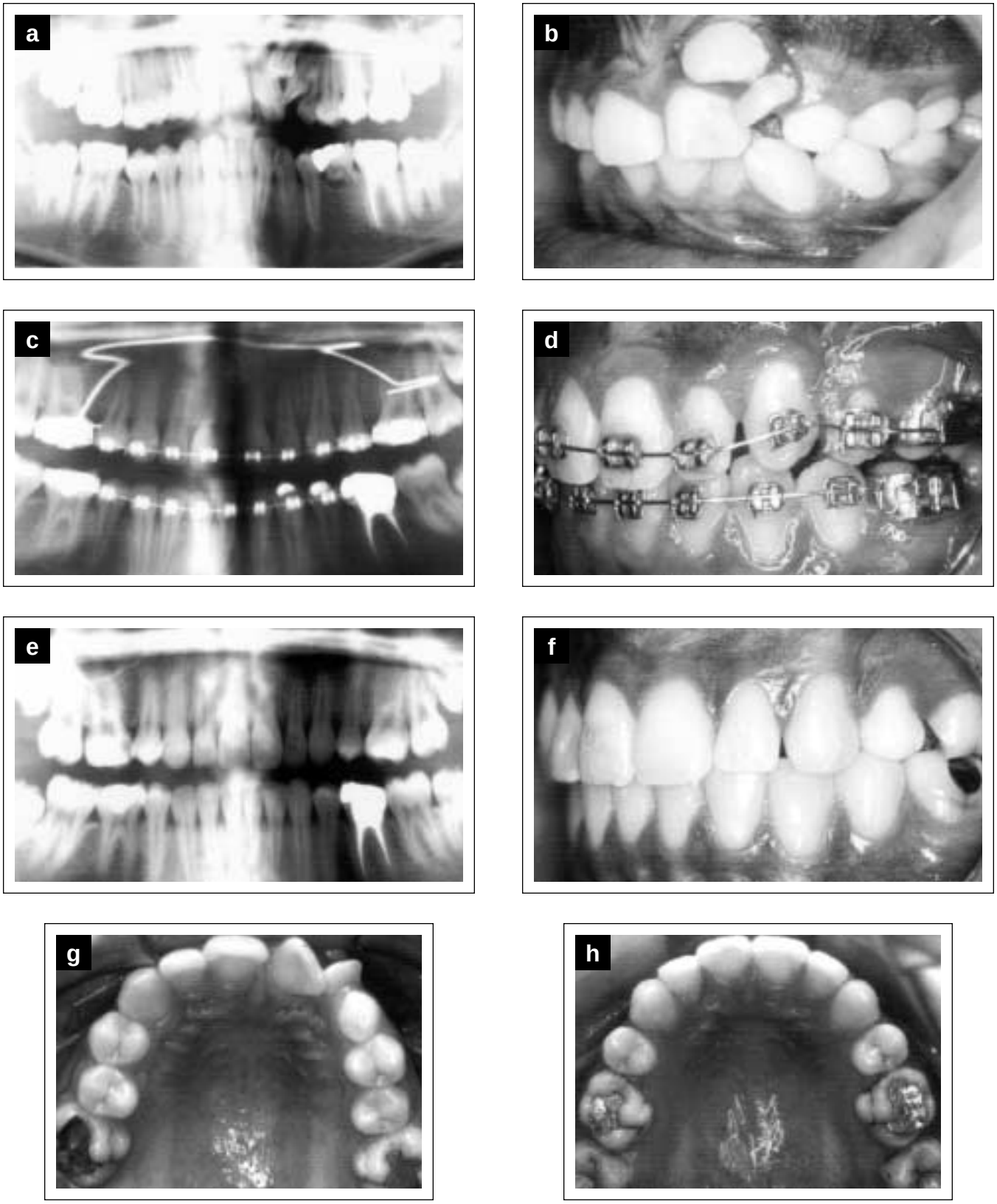

Figure 3. Female 12 years old, transposition 22-23 (Table 1, Case no 3). **a)** and **b)** Before treatment **c)** and **d)** During treatment **e)** and **f)** After treatment. **g)** and **h)** Correction of tooth order with excellent results.

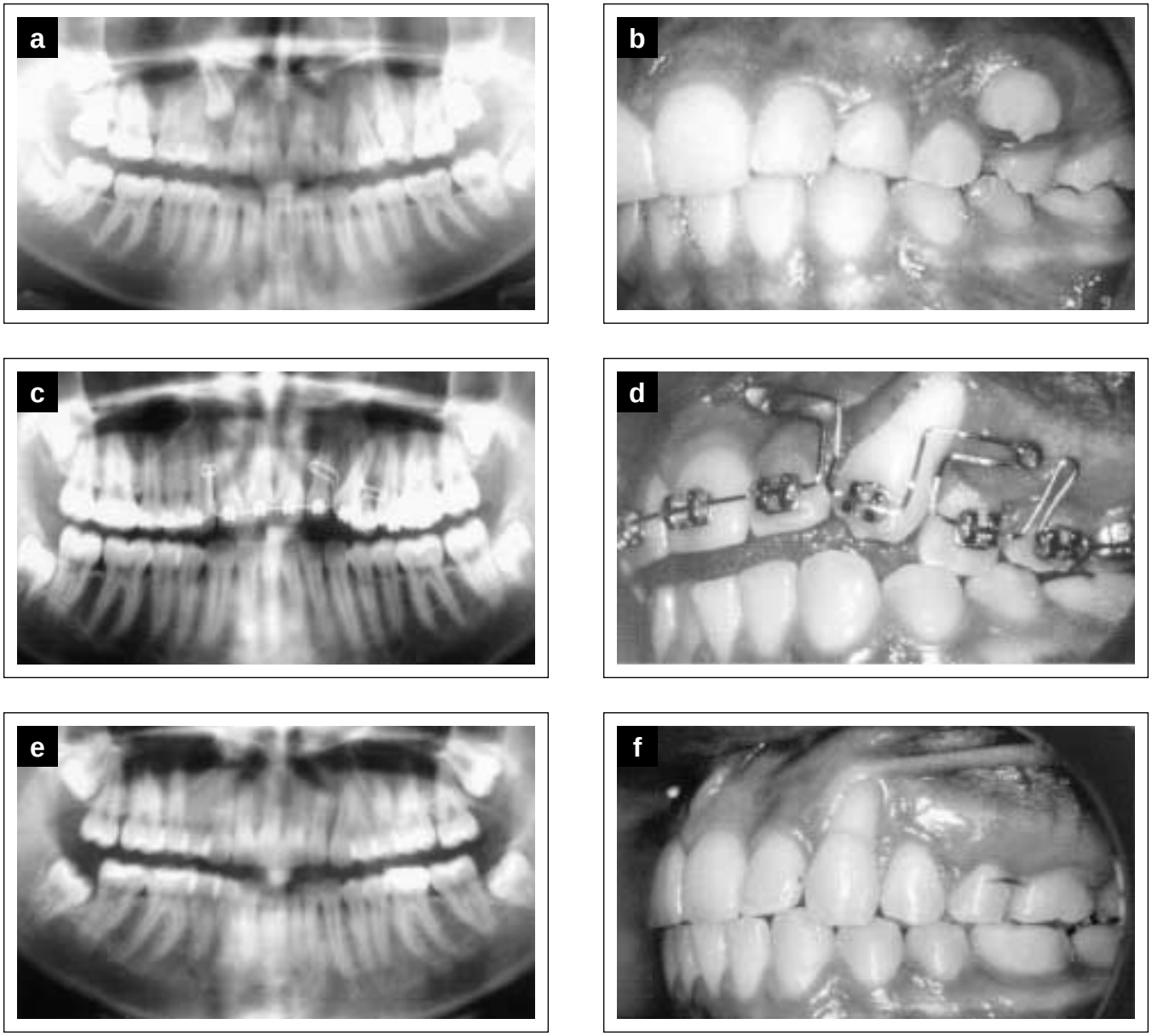

Figure 4. Female 13 years old, transposition 23-24 (Table 1, Case no 2). **a**) and **b**) Before treatment **c)** and **d)** During treatment **e)** and **f)** After treatment. Correction of tooth order. Good occlusion, root parallelization. Periodontal loss without tooth mobility because of long tooth movement and labial position of the canine. Free gingival graft was recommended. It would be better to arrange teeth maintaining the transposed tooth order.

was retained, the esthetic and functional results were adequate and therapy was concluded in a relative short period of time (Figure 1). Esthetic disadvantage resulted in cases of canine-premolar transposition involving a large canine comparative to the premolar (Figure 2). In the cases where normal tooth order was reinstated, the therapeutic outcome was functionally sufficient and in one case overall adequate (Figure 3). However, excessive tooth movement leaded to varying loss of periodontal attachment and concomitant esthetic problems (Figure 4). That happened in three cases and in one of them fixed retention was needed.

CONCLUSIONS

The present investigation revealed that:

1. The male to female ratio was 4:3.
2. The majority of patients exhibited Angle Class I dental anomaly.
3. The majority of transposed teeth were found in the maxillary dental arch (75 per cent), equally involving canine-first premolar and canine-lateral incisor.
4. Mandibular transpositions involved invariably the canine and the lateral incisor.
5. Ninety four per cent of cases exhibited unilateral involvement and left side predominance was evident.

6. There was a high incidence (69 per cent) of associated dental anomalies and especially retained deciduous canines.
7. The cases where correction of tooth order was attempted, were located in the maxillary dental arch, involved elongated mean treatment time and the majority resulted in varying loss of periodontal support.

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