Treatment of Tooth Impaction and Transposition with a Segmented-Arch Technique

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Clinical management of impacted teeth combined with transpositions can be a challenging problem for the orthodontist.[1-16] The segmented-arch technique allows the application of well-defined biomechanical force systems for highly controlled tooth movement. Cantilevers and various types of loops can be designed according to the laws of equilibrium to suit various clinical situations. The results are highly predictable, and undesirable side effects can be minimized and easily monitored.

This article presents two such cases treated with a segmented-arch approach.

Case 1

A 10-year-old male presented with an impacted maxillary permanent right central incisor, lateral incisor, and canine due to an earlier trauma in that region (Fig. 1). Clinical examination revealed that the maxillary midline was shifted 5mm to the right compared to the facial midline. The profile was slightly convex. The patient had a Class I malocclusion on the right side and a Class II on the left. The maxillary arch was constricted, with a crossbite on the left side.

Radiographs showed the developing right maxillary canine in a transposed position between the right central and lateral incisors. The right central incisor was palatally inclined, with the root apex close to the anterior nasal spine. The roots of the deciduous central and lateral incisors were retained, with signs of dilaceration from the trauma.

A Quad Helix* was placed to derotate the maxillary first molars and to expand the maxillary arch, thus correcting the crossbite (Fig. 2). The retained deciduous teeth were then extracted to allow orthodontic alignment of their successors.

After surgical exposure of the impacted teeth, a 50g buccal force was applied to the crown of the maxillary right central incisor with a nickel titanium spring (Fig. 3). Once the tooth had been moved labially into the arch (Fig. 4), a 50g open-coil spring was placed distal to the maxillary right central incisor to open enough space for the lateral incisor and canine and to

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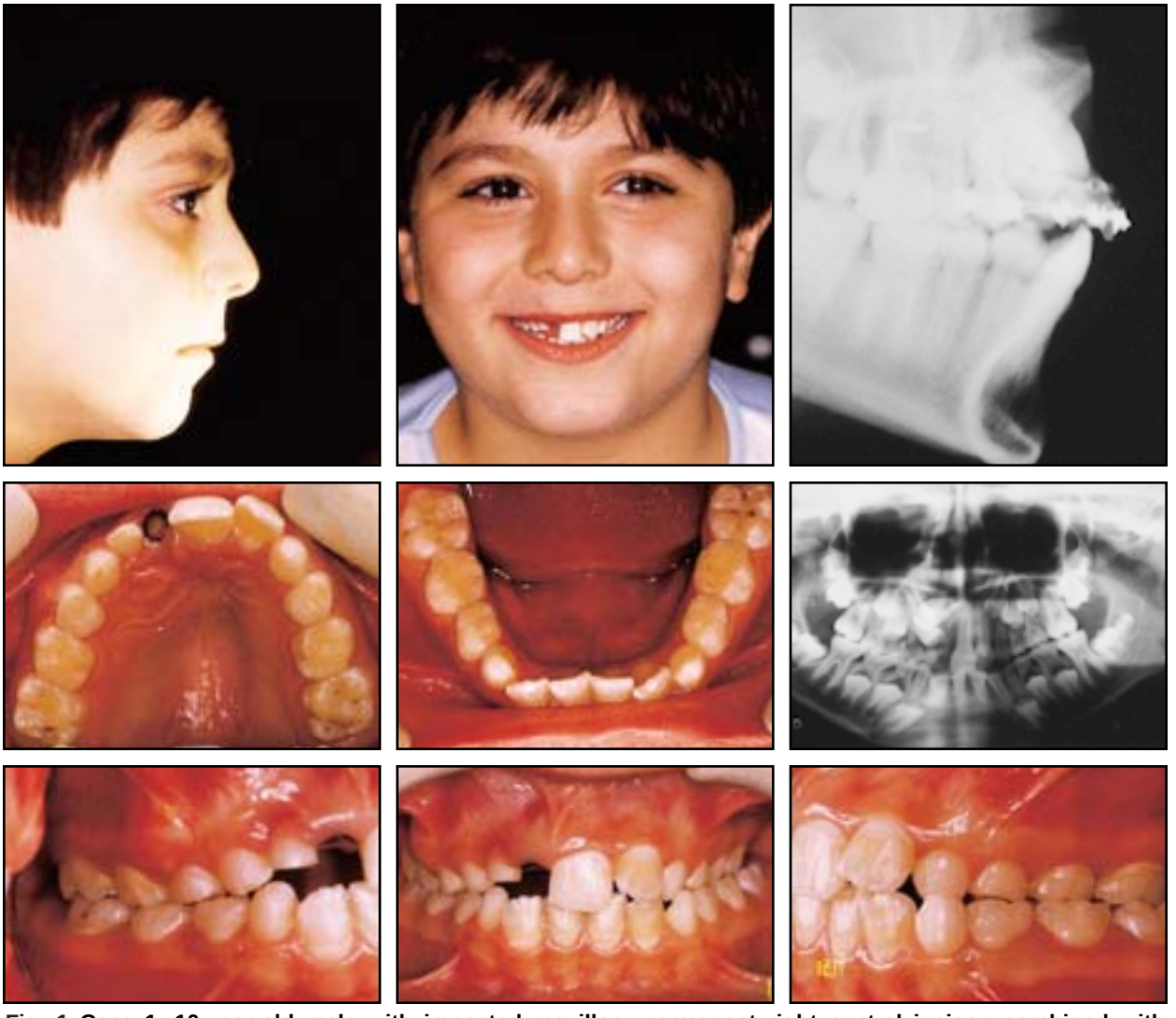

Fig. 1 Case 1. 10-year-old male with impacted maxillary permanent right central incisor, combined with impacted and transposed lateral incisor and canine, before treatment.

Fig. 2 Case 1. Maxillary expansion with Quad Helix. Note transposition between maxillary right canine and lateral incisor and palatal inclination of central incisor.

move the upper midline to the left. At the same time, a 50g nickel titanium spring was applied buccally to a power arm connected to the maxillary right canine for distal inclination of the canine's crown, which would prevent any damage to the palatally placed root of the lateral incisor (Fig. 5).

When the crown of the right canine was distally inclined, an .016" × .022" TMA** cantilever was inserted in the right lateral incisor

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Fig. 3 Case 1. After surgical exposure of impacted teeth, 50g nickel titanium spring used to move central incisor buccally into arch, with lateral incisor displaced distally to make space available.

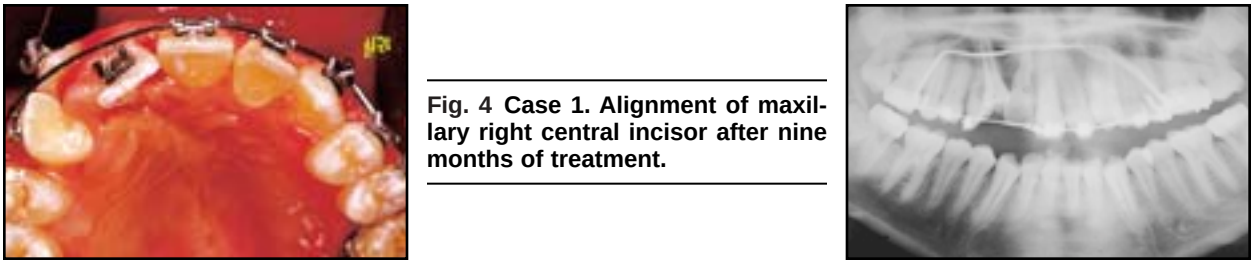

Fig. 4 Case 1. Alignment of maxillary right central incisor after nine months of treatment.

Fig. 5 Case 1. After 12 months of treatment, distal tipping of maxillary right canine with 50g nickel titanium spring connected to power arm; 50g open-coil spring placed distal to maxillary right central incisor to open space for lateral and canine and shift upper midline left.

Fig. 6 Case 1. After 18 months of treatment, uprighting and slight intrusion of maxillary right lateral incisor with .016" × .022" TMA cantilever inserted in bracket slot and ligated mesial to first molar.

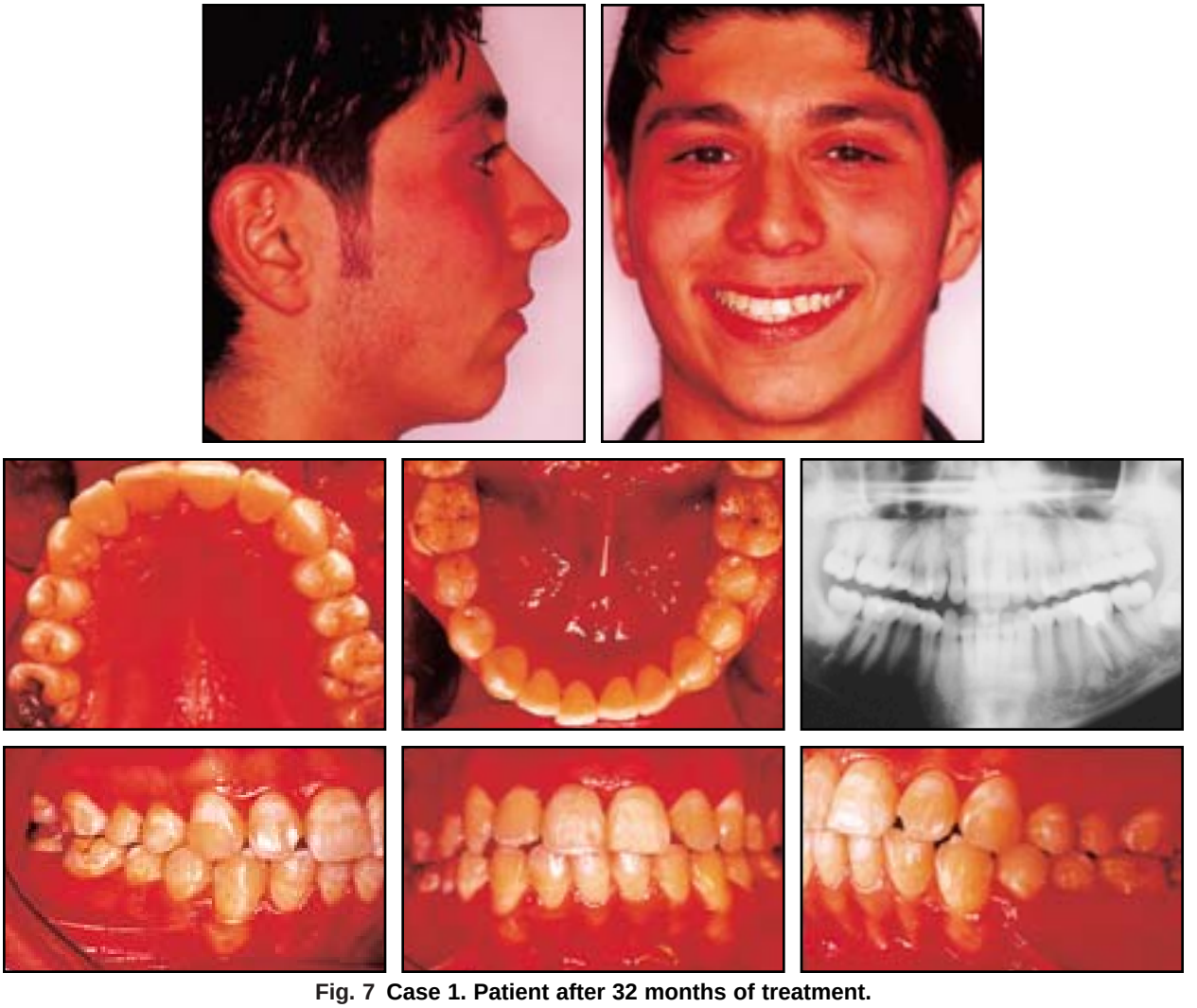

Fig. 7 Case 1. Patient after 32 months of treatment.

bracket slot and ligated mesial to the first molar to upright the root of the lateral incisor and slightly intrude the tooth (Fig. 6).

Fixed appliances were removed after 32 months of orthodontic treatment (Fig. 7).

Case 2

A 14-year-old female presented with a severe dental malalignment in the maxillary left quadrant (Fig. 8). Clinical examination revealed a cant of the maxillary occlusal plane compared to the interpupillary line. The smile appeared more "gummy" on the right side, and the profile was convex.

The patient had a diastema between the two maxillary central incisors. The maxillary left central incisor was severely distally inclined, but the left first premolar was mesially inclined. The maxillary left canine was ectopically displaced and mesially inclined. A mild Class II malocclusion was present on the right side and a more severe Class II on the left. The maxillary arch was crowded and constricted, with a crossbite on

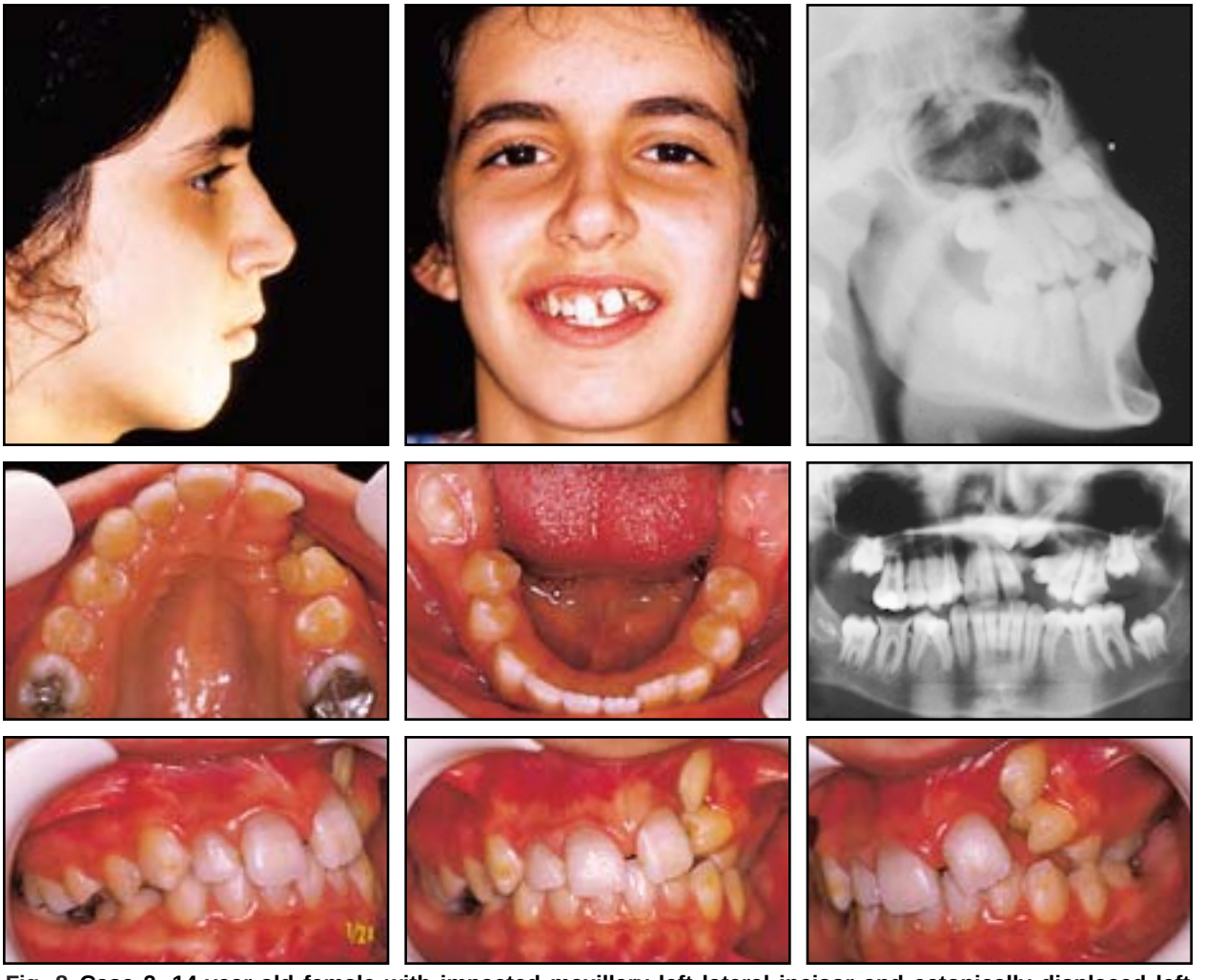

Fig. 8 Case 2. 14-year-old female with impacted maxillary left lateral incisor and ectopically displaced left canine before treatment.

the left side. The maxillary first molars were both mesially rotated; the mandibular first molars had been previously extracted.

Radiographs showed that the left maxillary lateral incisor was distally inclined and impacted above the root apex of the left central incisor by the ectopically displaced and mesially inclined left canine.

Orthodontic treatment was initiated with a transpalatal arch for distal rotation and expansion of the maxillary first molars. An .016" × .022" TMA wire was placed in the maxillary right quadrant for initial leveling and alignment. Once some space had been created distal to the maxillary left second bicuspid, an .016" × .022" TMA double T-loop was used for retraction, root uprighting, and expansion of the maxillary left first and second bicuspids (Fig. 9).

In the mandibular arch, two long .016" × .022" TMA cantilevers with 30g of force per side were used for root uprighting of the second molars and intrusion of the anterior segment

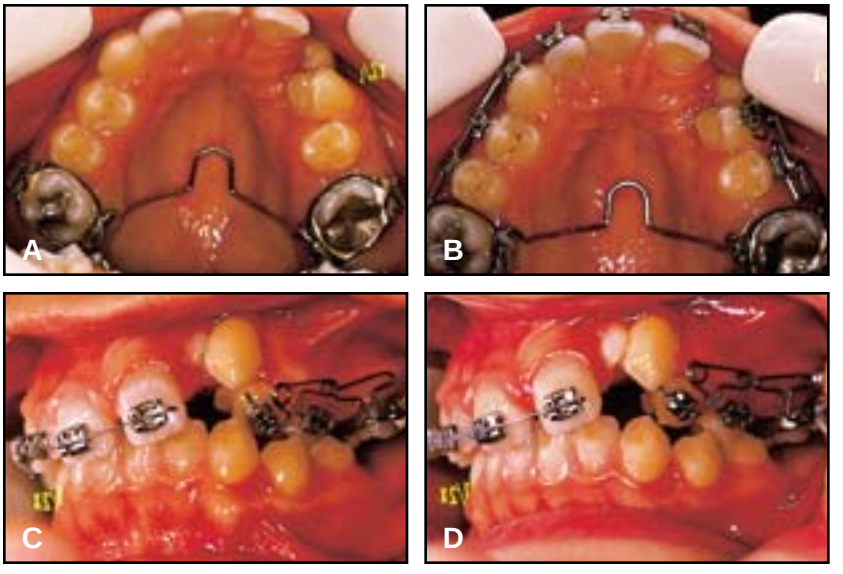

Fig. 9 Case 2. A. Transpalatal arch used for distal rotation and expansion of maxillary first molars. B. After four months of treatment, note space between maxillary left second bicuspid and first molar. C. .016" × .022" TMA double T-loop used for retraction, root uprighting, and expansion of maxillary left first and second premolars. D. After seven months of treatment, note uprighting and space opening between maxillary central incisor and first premolar.

Fig. 10 Case 2. After 11 months of treatment, two long .016" × .022" TMA cantilevers used for uprighting second molars and intruding anterior segment.

Fig. 11 Case 2. A. After 13 months of treatment, .016" × .022" TMA rectangular-loop wire used for extrusion and distal rotation of maxillary left lateral incisor. B. After 16 months of treatment, note extrusion and distal rotation of maxillary left lateral incisor.

(Fig. 10). When the maxillary anterior segment had been aligned, an .016" × .022" TMA rectangular-loop wire was activated for extrusion and distal rotation of the maxillary left lateral incisor (Fig. 11).

Fixed appliances were removed after 24 months of orthodontic treatment (Fig. 12).

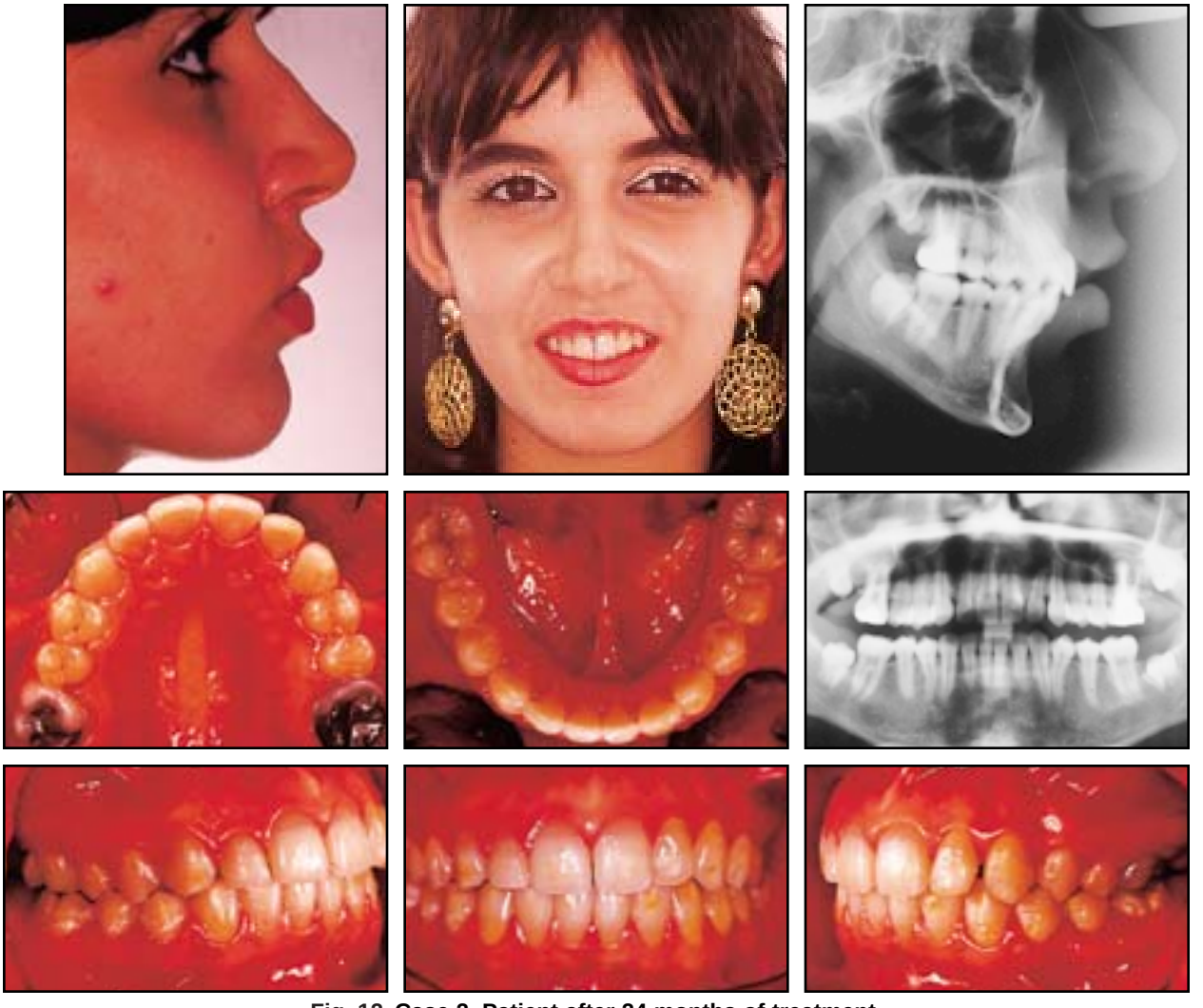

Fig. 12 Case 2. Patient after 24 months of treatment.

Discussion

Transposition may occur as a result of an interchange in location between the anlage of the developing teeth.[11,17] Another theory is that a retained deciduous canine causes a deviation of the permanent canine from its normal path of eruption.[9,18] Trauma to the deciduous teeth has also been suggested as a factor in cases where dilaceration of the permanent incisor roots was found adjacent to transposed teeth.[19] Genetics may contribute, especially when transposition occurs bilaterally in siblings.[20] Bone disease and other local factors, such as a tumor or cyst, can also cause displacement and transposition of a tooth.[11,21]

The maxillary permanent canine has the longest path of eruption of any tooth; it develops just below the orbit above and palatal to the first premolar and lateral incisor, and subsequently moves labially and mesially. Any bony obstruction, insufficient bone development, crowding, or resistance of the neighboring teeth—such as a

retained deciduous canine—may deflect the permanent canine from its normal path. When deflected lingually, it can become palatally impacted, lying in an oblique or horizontal position. It may also, however, be displaced mesially and become transposed with the lateral incisor, or be displaced distally to become transposed with the first premolar. This is why the maxillary canine is more likely than any other tooth to become impacted or transposed.[11]

Treatment options in transposition cases include alignment of the teeth in their transposed positions, extraction of one or both transposed teeth, and orthodontic movement into the correct positions in the arch. When incipient transposition is detected early enough, interceptive treatment can sometimes be successful with minimal damage to the surrounding tissues. At a later stage, however, repositioning of transposed teeth is a fairly complicated procedure. All factors, including the positions of the root apices, esthetic and functional occlusion, patient cooperation, and length of treatment, should be considered in designing the treatment plan.

In cases of incomplete transpositions, uprighting and rotating the involved teeth is the usual procedure for achieving normal alignment, provided sufficient space is available in the arch. With complete transpositions, if the permanent teeth have already begun to erupt, it is usually an acceptable compromise to guide them into their transposed positions, thus avoiding the risk of damaging the teeth or the supporting structures.

To avoid any root interference or resorption during treatment of a transposition between a lateral incisor and canine, the lateral incisor should first be moved palatally enough to allow free movement of the canine into its normal position. The lateral incisor can later be moved labially back into its normal position. Although this procedure requires significantly longer treatment, it is probably justified by the improved outlook for long-term functional and esthetic stability.

As shown here, the segmented-arch approach is the best choice for alignment of impacted and transposed teeth with maximum three-dimensional control of tooth movement and a minimum of round-tripping and iatrogenic damage. The low load-deflection ratio and wide range of activation of nickel titanium springs and TMA wires enable them to deliver relatively constant forces and moments throughout orthodontic therapy, without the need for frequent reactivations and appliance adjustments.

REFERENCES

1. Thilander, B. and Jakobsson, S.O.: Local factors in impaction of maxillary canines, Acta Odontol. Scand. 26:145-168, 1968.
2. Dachi, S.F. and Howell, F.V.: A survey of 3,874 routine full-mouth radiographs, II. A study of impacted teeth, Oral Surg. Oral Med. Oral Pathol. 14:1165-1169, 1961.
3. Fournier, A.; Turcotte, J.Y.; and Bernard, C.: Orthodontic considerations in the treatment of maxillary impacted canines, Am. J. Orthod. 81:236-239, 1982.
4. Stellzig, A.; Basdra, E.K.; and Komposch, G.: The etiology of canine tooth impaction: A space analysis, Fortschr. Kieferorthop. 55:97-103, 1994.
5. Bishara, S.E.; Kommer, D.D.; McNeil, M.H.; Montagano, L.N.; Oesterle, L.J.; and Youngquist, H.W.: Management of impacted canines, Am. J. Orthod. 69:371-387, 1976.
6. Moyers, R.E.: *Handbook of Orthodontics*, 2nd ed., Year Book Medical Publishers, Chicago, 1963, pp. 83-88.
7. Thomas, K.H.: *Oral Pathology*, 2nd ed., C.V. Mosby Co., St. Louis, 1944, p. 415.
8. Platzer, K.M.: Mandibular incisor-canine transposition, J. Am. Dent. Assoc. 76:778-784, 1968.
9. Shapira, Y.: Bilateral transposition of mandibular canines and lateral incisors: Orthodontic management of a case, Br. J. Orthod. 5:207-209, 1978.
10. Shapira, Y. and Kuftinec, M.M.: Orthodontic management of mandibular canine-incisor transposition, Am. J. Orthod. 83:271-276, 1983.
11. Joshi, M.R. and Bhatt, N.A.: Canine transposition, Oral Surg. Oral Med. Oral Pathol. 31:49-54, 1971.
12. Caplan, D.: Transposition of the maxillary canine and the lateral incisor, Dent. Pract. Dent. Rec. 22:307, 1972.
13. Jackson, M.: Upper canine in position of upper central incisor, Br. Dent. J. 90:243, 1951.
14. Joshi, M.R. and Gaitonde, S.S.: Canine transposition of extensive degree: A case report, Br. Dent. J. 121:221-222, 1966.
15. Shapira, Y.: Transposition of canines, J. Am. Dent. Assoc. 100:710-712, 1980.
16. Jarvinen, S.: Mandibular incisor-cuspid transposition: A survey, J. Pedod. 6:159-163, 1982.
17. Laptook, T. and Silling, G.: Canine transposition: Approaches to treatment, J. Am. Dent. Assoc. 107:746-748, 1983.
18. Mader, C. and Konzelman, J.L.: Transposition of teeth, J. Am. Dent. Assoc. 98:412-413, 1979.
19. Dayal, P.K.; Shodhan, K.H.; and Dave, C.J.: Transposition of canine with traumatic etiology, J. Ind. Dent. Assoc. 55:283-285, 1983.
20. Payne, G.S.: Bilateral transposition of maxillary canines and premolars: Report of two cases, Am. J. Orthod. 56:45-52, 1969.
21. Hitchin, A.D.: The impacted maxillary canine, Br. Dent. J. 100:1-12, 1956.