A New Supraconstruction for Palatal Orthodontic Implants

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When osseointegrated implants were developed for prosthetic dentistry, orthodontists began to explore the possibilities of using them as anchorage devices.[1-14] The idea of an implant in the median maxillary suture, originally proposed by Triaca and colleagues,[15] seems to have prompted investigators to explore other anchorage sites, such as the trigonum retromolare[16,17] and the alveolar bone.

Most orthodontic patients are too young to have fully developed alveolar bones. This problem can be circumvented by inserting a miniature implant buccolingually into the alveolar bone, between the roots of the adjacent teeth,[18] or by affixing "onplant" plates to the bone surface.[19]

The maxillary suture would seem to be a more reliable location for anchorage in adolescent orthodontic patients. Unfortunately, research data on the effectiveness of implants used for orthodontic anchorage are available only from animal studies,[20-30] and only one of these used implants in the median maxillary sutures.[30]

Furthermore, the fabrication of a supraconstruction—the palatal arch attached to the implant—has been a longstanding problem, especially if active movement of the anchor teeth is desired.[31,32] The ideal supraconstruction should be easy to fabricate by an orthodontic technician, should be simple to use and adjust, and should allow stabilization and active movement of the attached teeth in all three dimensions, without refabricating the appliance. This article describes a new supraconstruction that meets these requirements.

Design and Fabrication

The basic principle of the appliance is to provide a rigid platform that is not attached primarily to any single tooth. A yoke-shaped palatal bar made of .036" × .072" heat-treatable Remaloy* stainless steel wire has 4.5mm .022" × .028" rectangular tubes** attached on each end (Fig. 1). Sectional wires connect these tubes to .022" Damon SL*** brackets welded to the palatal sides of the molar bands. The sectional wires are used to stabilize, move, or rotate the molars in any plane of space, depending on the clinical situation.

The working cast is constructed as follows:

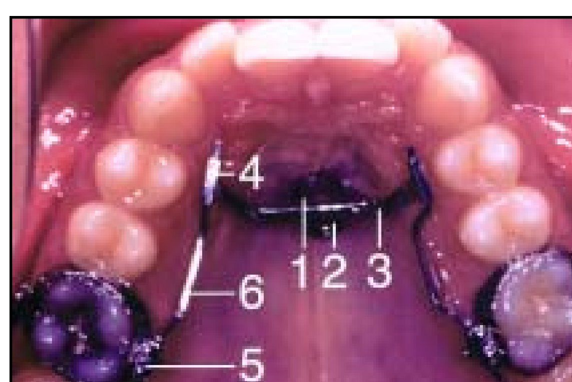

Fig. 1 New supraconstruction, showing remodeled impression coping (1), gold fixation screw (2), yoke-shaped palatal bar (3), rectangular tubes (4), Damon SL molar brackets (5), and sectional wires (6).

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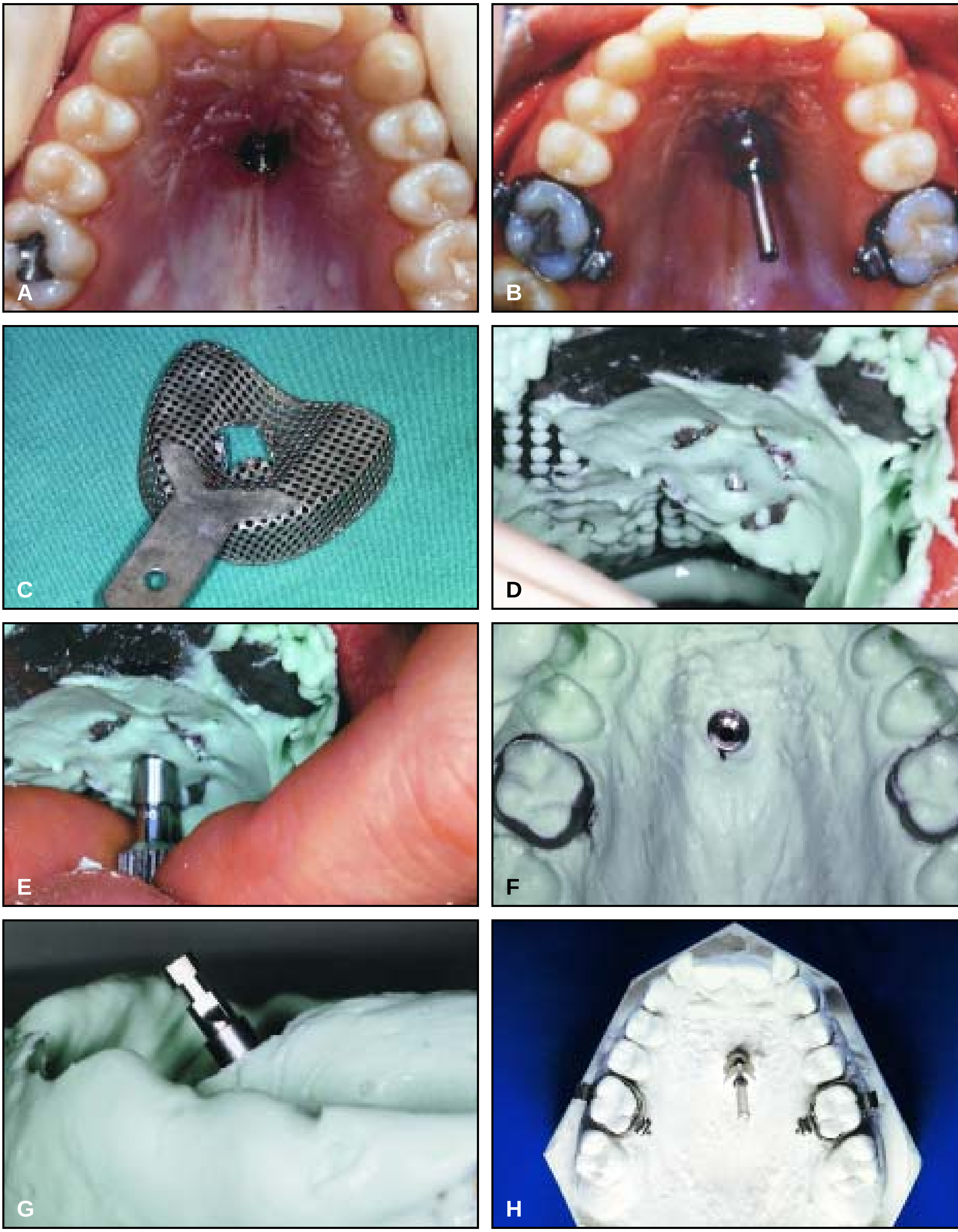

Fig. 2 A. Implant after connection of abutment. B. Impression coping fixed with guide pin and molar bands seated. C. Hole cut in impression tray for coping and guide pin. D. Excess alginate removed from top of guide pin. E. Guide pin unscrewed after alginate has set. F. Molar bands positioned in alginate. G. Replica of abutment attached to impression coping with guide pin. H. Finished cast with molar bands and impression coping in place.

1. After surgical placement of the implant and connection of the abutment (Fig. 2A), the impression coping is inserted and fixed with a guide pin (a long-headed screw, Fig. 2B). In the clinical trials pictured here, two weeks elapsed between these steps; the same procedure can be accomplished in one appointment.
2. The molar bands are seated.
3. An x-shaped slot is cut into the impression tray at the implant site. The triangles thus created are bent lingually, and the edges are curled to prevent injury to the tongue (Fig. 2C).
4. Since the model does not need the high degree of accuracy required for crowns and bridges, an alginate impression is sufficient. The tray is inserted, and the excess alginate covering the guide pin is removed (Fig. 2D).
5. After the alginate has set, the guide pin is unscrewed with the tray still in place (Fig. 2E). The tray is then removed.
6. The molar bands are positioned in the alginate (Fig. 2F) and waxed.
7. A technician's replica of the abutment is attached to the impression coping with the guide pin, taking care not to move the impression coping (Fig. 2G).
8. The impression is poured in plaster (Fig. 2H).

The supraconstruction is then constructed as follows:

1. The guide pin is replaced by a gold fixation screw. The impression coping is cut to the height of this screw, and its square edges are milled into a round shape (Fig. 3A).
2. The coping is further milled with an .036" × .072" slot to accommodate the palatal bar (Fig. 3B).
3. The Remaloy palatal bar is heat-treated so it can be manually bent and stiffened into the prop-

Fig. 3 A. Impression coping (left) cut to height of gold fixation screw and milled into round shape (right). B. Impression coping (left) milled with slot for palatal bar and ready to accommodate gold screw (right). C. Palatal bar trimmed back to allow space for gold screw. D. Palatal bar laser-welded to impression coping (continued on next page).

er yoke shape. The wire is shaved back in the center, where it meets the impression coping, to allow enough space for the gold screw (Fig. 3C).

4. The palatal bar is laser-welded to the impression coping (Fig. 3D). (All laser-welded parts can be soldered if desired.)

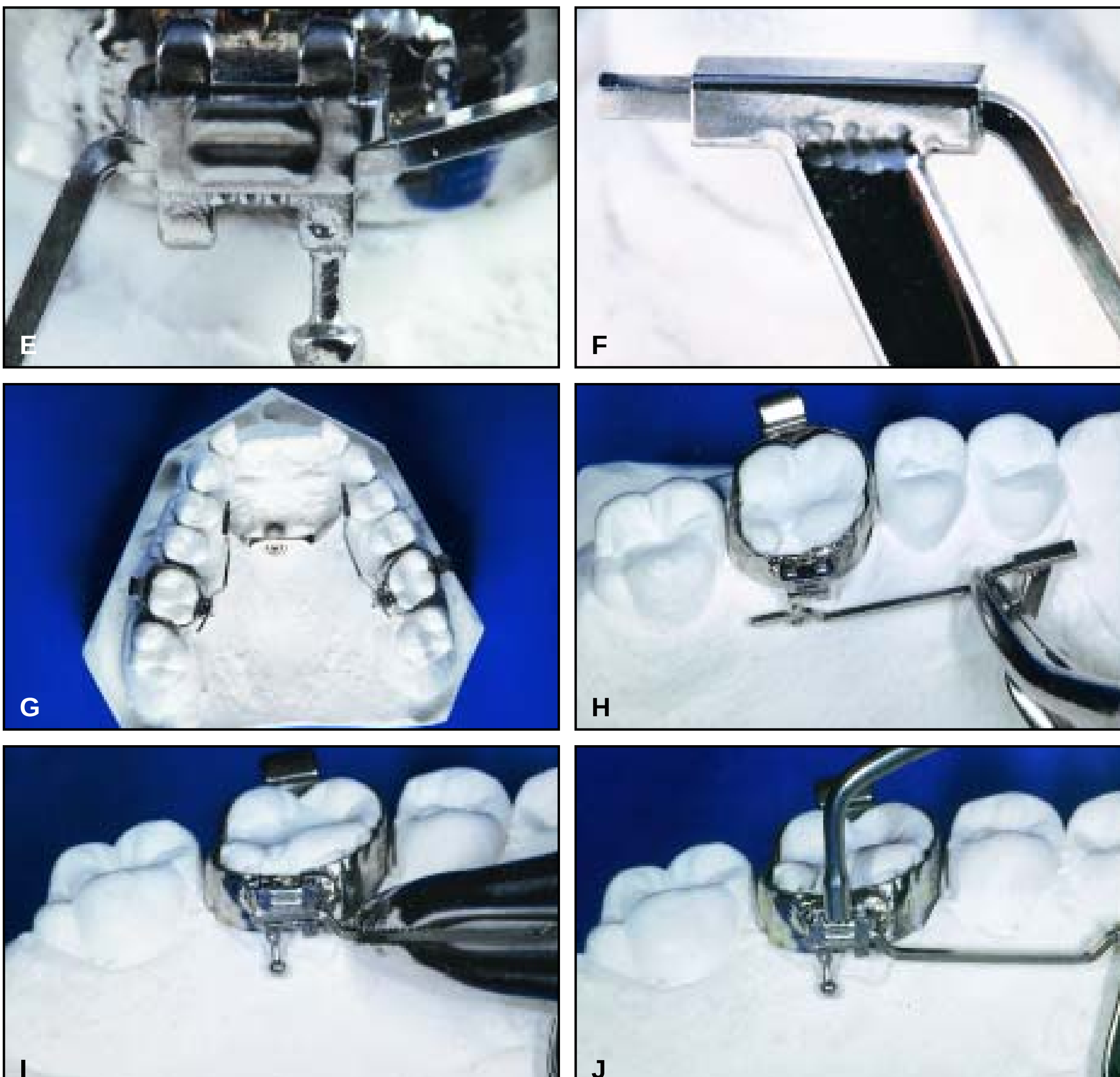

Fig. 3 (cont.) E. Damon SL bracket welded to palatal side of molar band, showing sectional wire in closed bracket. F. Rectangular tube welded to palatal bar, with sectional wire in place. G. Completed supraconstruction on cast. H. Mesial end of sectional wire inserted into distal end of rectangular tube. I. Distal end of sectional wire inserted into palatal side of Damon SL bracket. J. Bracket closed into tube with band-seating instrument.

5. Damon SL .022" brackets (Roth prescription, maxillary first premolar of opposite side) are welded to the palatal sides of the molar bands (Fig. 3E).
6. The .022" × .028" rectangular tubes are welded to the ends of the palatal bar (Fig. 3F), with a straight .0215" × .028" wire inserted in each tube to stabilize it during welding. Care must be taken to ensure identical torque in the tubes and the molar brackets.
7. Sectional wires can also be prefabricated by the technician (Fig. 3G) and later adjusted in the mouth by the orthodontist. The mesial ends of the sectional wires can be filed down to facilitate insertion into the distal ends of the rectangular tubes (Fig. 3H). The Damon bracket slots are opened to allow insertion of the distal ends of the sectional wires from the palatal side (Fig. 3I). The slots are then closed into tubes, using the special Damon tool or a band-seating plier (Fig. 3J).

Clinical Applications

The palatal implant provides absolute anchorage of the molars in a passive setup using .021" × .025" stainless steel sectional wires (Fig. 4A). The vertical legs of the sectional wires should be as short as possible, serving only as sagittal stops.

Either distal or mesial movement of the molars is possible, although the former is usually desired. Distalization can be accomplished either with sagittally preactivated delta loops and long vertical legs (Fig. 4B) or with straight sectional wires and push-coil springs (Fig. 4C). If straight wires are used, stops should be crimped or welded distal to the rectangular tubes to pre-

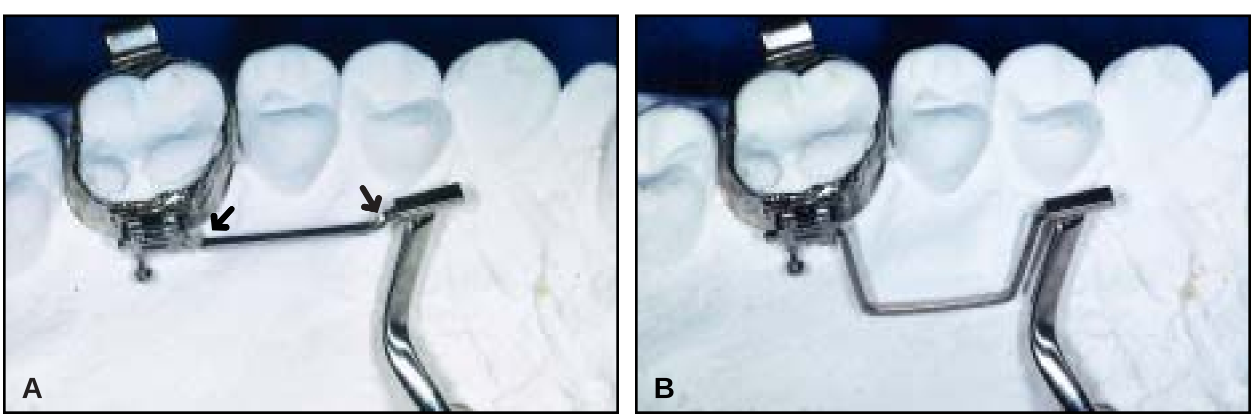

Fig. 4 A. Passive .021" × .025" sectional wire for molar stabilization; note short vertical legs (arrows). B. Active .018" × .025" sectional wire for molar distalization, with preactivated delta loop. C. Molar distalization with straight sectional wire and push-coil spring, with welded or crimpable stop distal to rectangular tube.

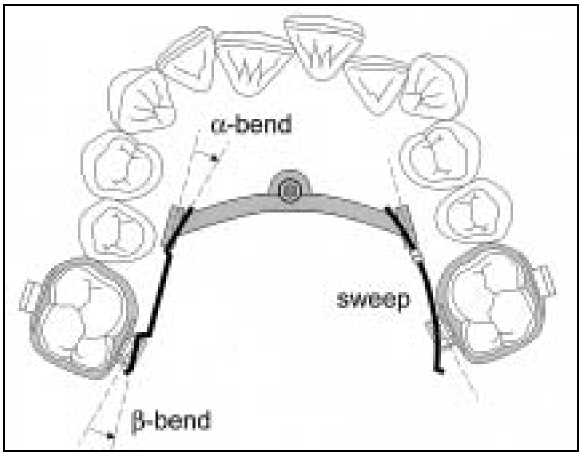

Fig. 5 1st-order compensations needed for molar distalization. With delta-loop sectional wire (patient's right side), β-bend at molar bracket prevents mesial molar rotation, and opposite α-bend at rectangular tube prevents undesirable transverse side effects. With straight sectional wire (patient's left), bends are made in continuous "sweep" (coil spring is omitted from drawing for clarity).

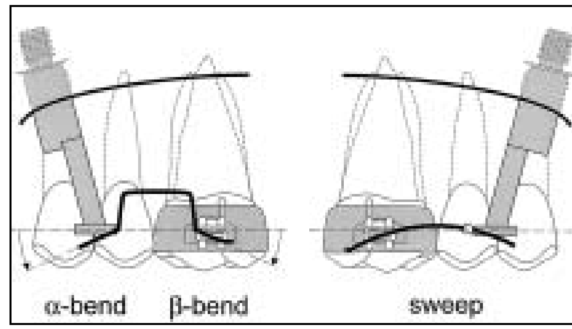

Fig. 6 2nd-order compensations needed for molar distalization. With delta-loop sectional wire (patient's right side), β-bend at molar bracket prevents distal tipping, and opposite α-bend at rectangular tube avoids molar intrusion. With straight sectional wire (patient's left), bends are made in continuous "sweep" (coil spring is omitted from drawing for clarity).

vent free sagittal sliding. In either case, .018" × .025" stainless steel sectional wires seem to be ideal.

Because the applied force is palatal to the center of resistance, the distal movement will tend to rotate the molars mesial-in and tip them distally. Therefore, compensatory 1st- and 2nd-order bends are needed.

When delta-loop sectional wires are used, antirotation (toe-in) β-bends are made at the molar brackets (Fig. 5). Equilibrium then requires a couple in the opposite direction—a buccal force at the molars and a palatal force at the implant. Since the implant will not move, the molars will move buccally. To avoid this undesirable side effect, α-bends of the same angle should be placed in the opposite direction at the rectangular tubes.

Second-order compensation involves crown-tip-forward β-bends at the molars, with α-bends at the rectangular tubes to prevent intrusion of the molars, if that is not desired (Fig. 6).

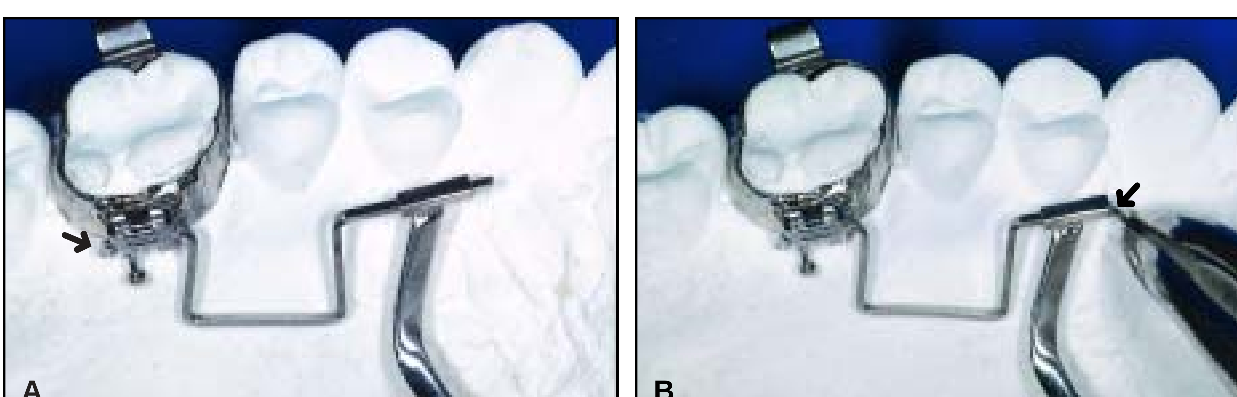

Fig. 7 A. Sectional wire for mesial molar movement prior to activation; note bend distal to molar bracket (arrow). B. Sectional wire activated by pulling mesial end through rectangular tube and tying it back (arrow).

When straight sectional wires are used for distalization, the bends described above are replaced by "sweeps" or continuous curvatures in the appropriate directions. These curves allow free movement of the coil springs.

Mesial molar movement can be produced with the same type of delta loop, preactivated in the opposite direction. The sectional wire must be bent down distal to the molar bracket (Fig. 7A). The loop is then activated by pulling the wire mesially through the rectangular tube and tying it back (Fig. 7B). Compensatory bends are applied in the opposite directions as those for distal molar movement.

Case 1

A 12-year-old male presented with a full Class II molar relationship on the right and a one-and-a-half-step Class II on the left (Fig. 8A). Even with extraction of the maxillary first premolars, the maxillary incisors could not be retracted into a normal overjet, nor could the midline be corrected, as long as the left canine was hindered from moving into a Class I relationship.

Therefore, the maxillary left first molar was distalized with a palatal implant and a straight sectional wire and push-coil spring as described above (Fig. 8B). The required distal movement was achieved in two months (Fig. 8C,D).

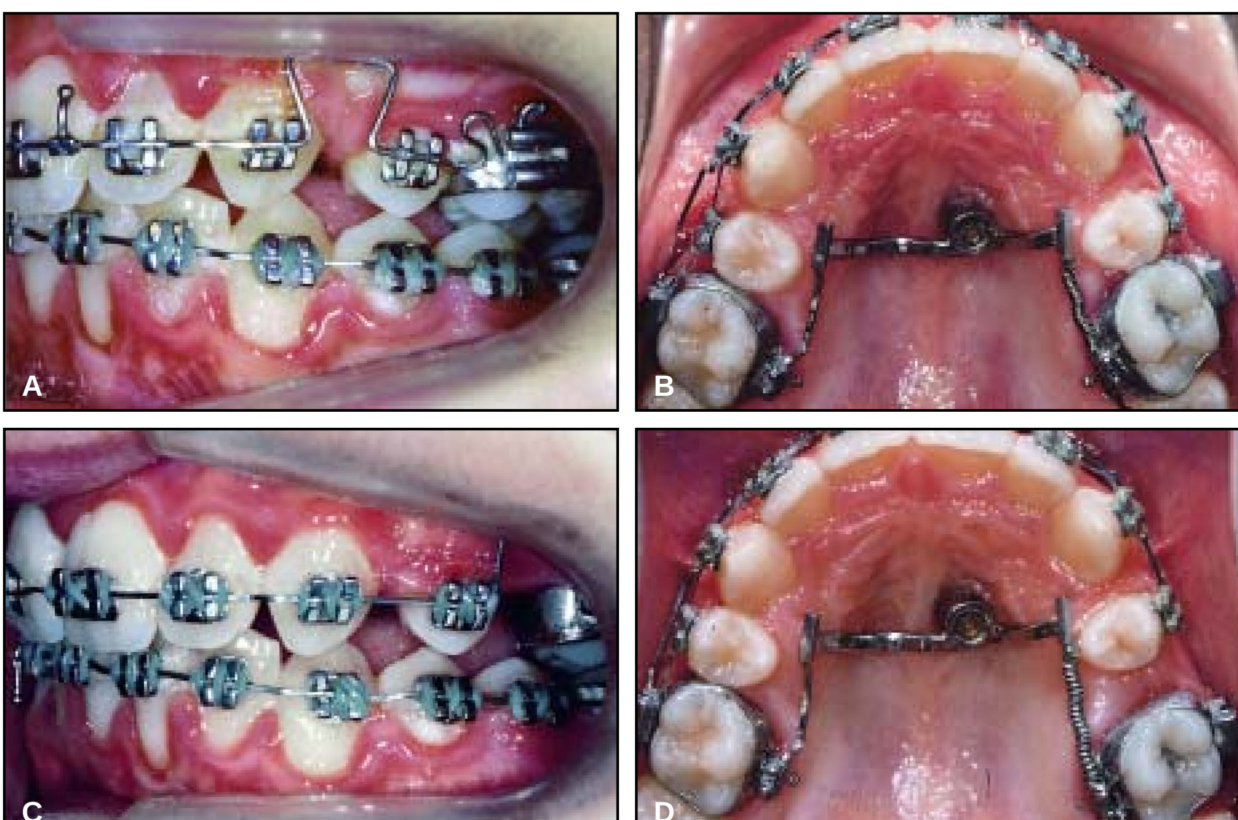

Fig. 8 Case 1. A. 12-year-old male with one-and-a-half-step Class II relationship on left side. B. Supraconstruction with push-coil spring for distalization of left first molar. Molar is not connected to rest of maxillary dentition. Note placement of implant lateral to raphe. C. Molars in Class II relationship after two months. D. Left first molar has been moved 4mm distally, without movement of premolar.

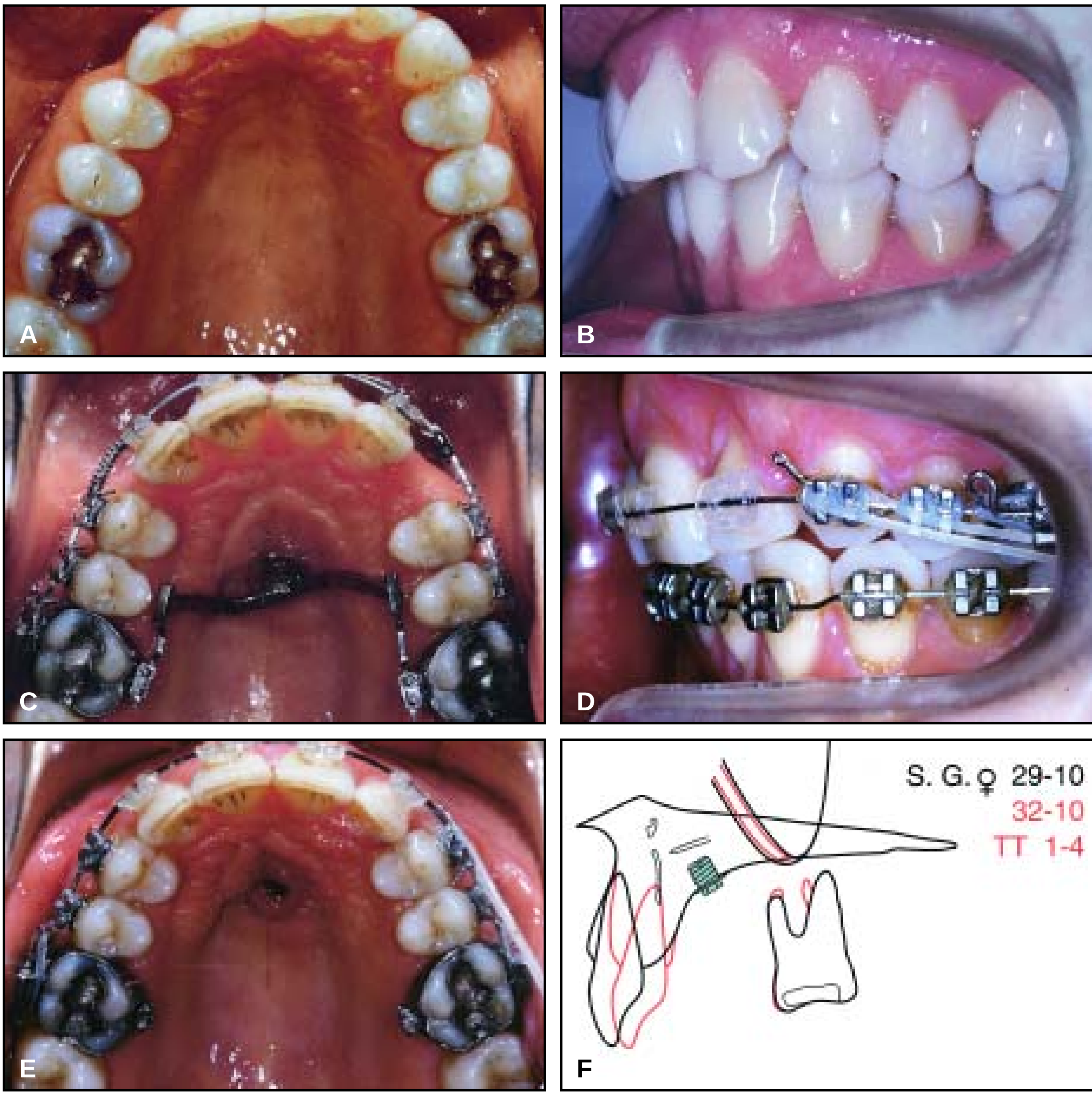

Fig. 9 Case 2. A,B. 29-year-old female with three-quarter-step Class II relationship on each side. Maxillary midline shift to right and retrusive incisors were due to extractions of maxillary right canine and mandibular incisor in previous orthodontic treatment. C. Supraconstruction with .021" × .025" sectional wires for absolute anchorage of molars on both sides. After extraction of maxillary left canine, incisors were shifted to left along archwire, using push-coil spring on right and pull-coil spring on left. D. Class II elastic used for finishing adjustments. E. After removal of implant. F. Structural superimposition of maxilla, showing 7° torquing of incisor and 2.5mm retraction of incisal edge, with no molar movement.

Case 2

A 29-year-old female had a maxillary midline shift to the right and retrusive incisors, due to extractions of the maxillary right canine and a mandibular incisor in previous orthodontic treatment (Fig. 9A). The premolar and molar relationships were three-quarter-step Class II on both sides (Fig. 9B).

The maxillary left canine was extracted because it is larger than the first premolar, and thus would reduce the arch-size discrepancy caused by the extracted mandibular incisor. The maxillary incisors then had to be retracted and shifted to the left, with a substantial amount of palatal root torque.

Although only a little anchorage was needed on the right side, a considerable amount was required on the left. A palatal implant was placed, with a supraconstruction using .021" × .025" sectional wires for molar stabilization (Fig. 9C). The incisors were moved along the archwire with a push-coil spring on the right and a pull-coil spring on the left. After spaces had been closed equally on both sides (Fig. 9D), the implant was removed (Fig. 9E).

Maxillary superimposition showed that the incisors were torqued 7°, so that the incisal edge was retracted 2.5mm and the apex 5mm (Fig. 9F). Virtually no change in molar position occurred.

Conclusion

The supraconstruction described in this article can be adapted to numerous clinical situations simply by adjusting its sectional wires. The overall design can be adapted to any implant system in which the supraconstruction is protected against rotation. The appliance is easy to fabricate and install.

Clinical observation thus far has shown favorable stability, effectiveness, and patient comfort. The long-term reliability of implants in the median palatal suture still needs to be confirmed by further investigation.

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