Multifunctional Use of Palatal Mini-Implants

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Mini-implants have become increasingly popular as a source of stable anchorage in recent years because of their versatility, minimal invasiveness, and low cost.[1-5] A major problem with orthodontic mini-implants, however, is their high failure rate, reportedly ranging from 10% to 30%.[6-10] This might be a reason why such implants are generally regarded as suitable only for single treatment tasks.

For primary stability, the best implant site is a region with high bone quality,[11] covered with thin attached mucosa to allow adequate insertion depth.[12] The median part of the anterior palate fulfills both of these requirements.[13] High bone density, sufficient bone height,[14,15] and a soft-tissue thickness of less than 1mm[14] are generally available posterior to the incisive papilla. Another advantage of this region is that interference with the dental roots is unlikely.[16,17]

Miniscrews with diameters of 2-2.3mm and lengths of 9-11mm have been associated with higher survival rates and stability.[18-23] Success rates can be further increased by coupling two mini-implants with a plate along the line of force.[24]

The improved stability and reliability of today's mini-implants allow more complex treatment planning, in which skeletal anchorage can be used to accomplish multiple treatment goals either simultaneously or sequentially. This article illustrates various combinations of tooth movements that can be achieved using skeletal anchorage from multifunctional mini-implants with exchangeable abutments[23] and plates[24]* inserted in the anterior palate.

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Simple Mechanics with Sequential Tooth Movement

The design of the Benefit* mini-implant permits the use of different abutments or plates screwed to the implant head, so that one implant-borne appliance can be replaced by another after a treatment goal is reached. The sequential use of simple mechanics allows the construction of relatively comfortable, compact appliances.

For simple mechanics, appliances can be easily manufactured from the prefabricated components of the Benefit-Beneplate* system (Fig. 1). For example, a single mini-implant can be used for both extrusion and subsequent alignment of a displaced canine with direct anchorage. Sequential sectional wires can be attached to the bracket abutment, as shown in a 12-year-old male patient with an impacted upper left canine and congenitally missing lateral incisors (Fig. 2).

Upper-molar distalization can be carried out using mini-implant anchorage after Class III treatment with rapid maxillary expansion and protraction, as illustrated in a 9-year-old male patient who presented with mesially migrated upper molars (Fig. 3). Here, a Hybrid Hyrax[25] was connected to two mini-implants in the anterior palate and to the upper first molar bands for maxillary expansion. This appliance can significantly reduce lateral tipping of the molars while providing skeletal anchorage during maxillary protraction with a facemask[25]—in contrast to toothborne expansion devices, which cannot prevent mesial movement of the dentition during orthopedic maxillary protraction.[26] After removal of the Hybrid Hyrax expander, the mini-implants were used to anchor a Beneslider* on a Beneplate, with an incorporated .045" stainless steel wire for molar distalization.[27]

One problem associated with the sequential use of mini-implants is the risk of loosening during removal of the first appliance. A special counter clamp can be used to stabilize the mini-implant at this time (Fig. 4).

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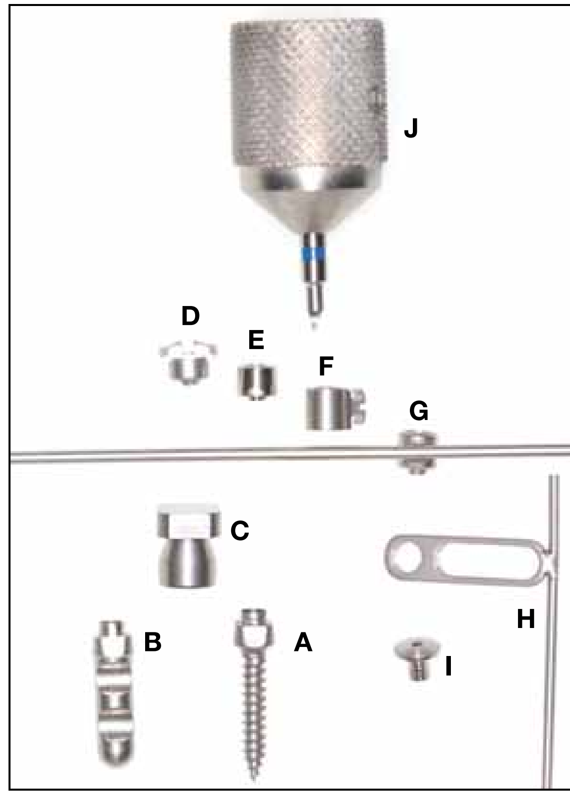

Fig. 1 Benefit* system. A. Mini-implant. B. Laboratory analog. C. Impression cap. D. Slot abutment. E. Standard abutment. F. Bracket abutment. G. Abutment with .045" stainless steel wire. H. Beneplate with .045" stainless steel wire. I. Fixation screw for Beneplate. J. Screwdriver for abutment fixation.

Combination Mechanics with Sequential or Simultaneous Tooth Movement

Combination mechanics can be extremely challenging to the stability of skeletal anchors. We often place an appliance to solve the main treatment goal using prefabricated elements of the Benefit system, then integrate additional elements to achieve further tooth movement without causing patient discomfort.

The patient shown in Figure 5 required simultaneous direct and indirect skeletal anchorage for molar distalization, anterior space opening, and forced eruption of impacted upper central incisors. After direct anchorage from two palatal

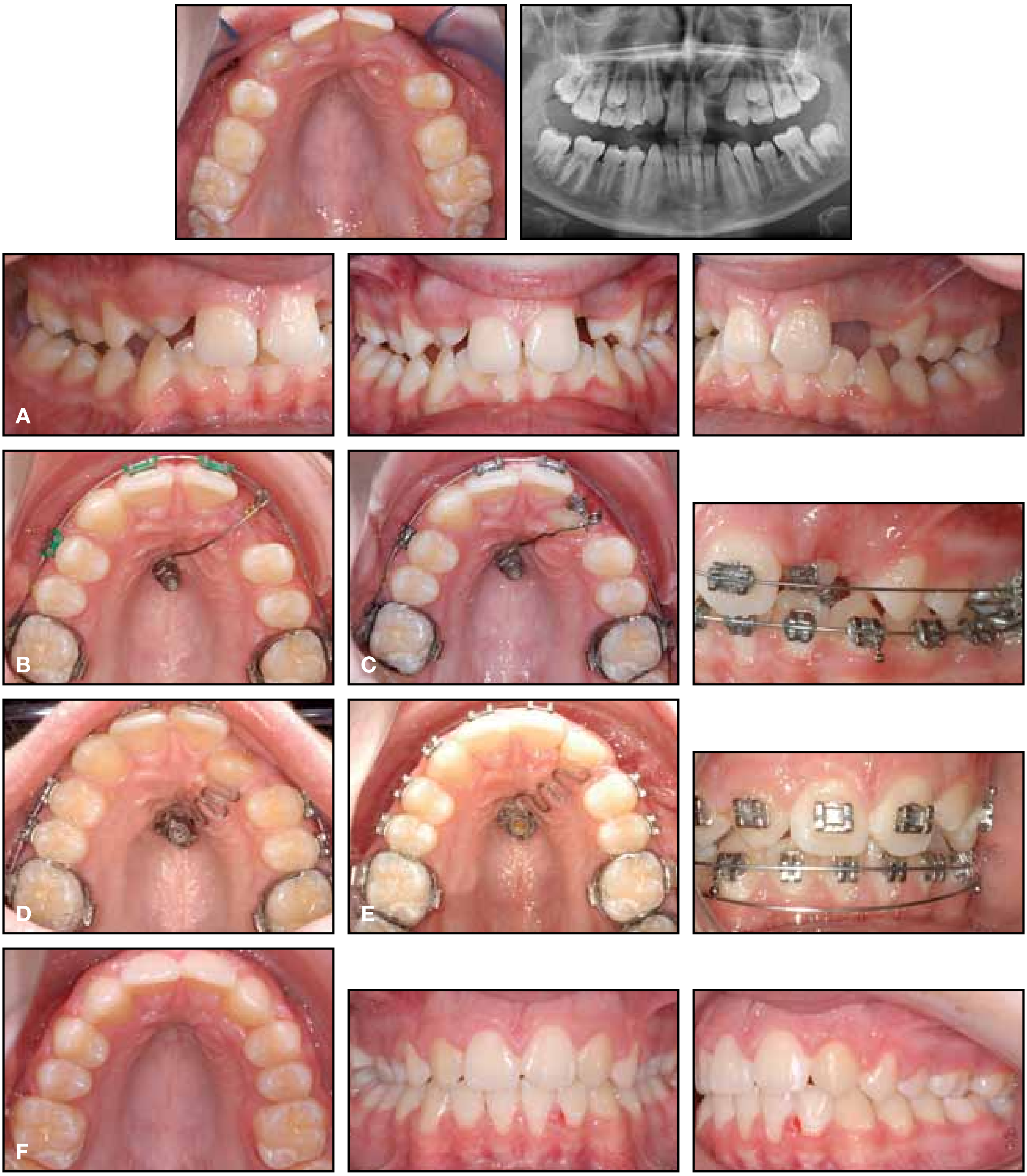

Fig. 2 Sequential use of simple mechanics with single Benefit implant and direct anchorage. A. 12-year-old male patient with impacted upper left canine and agenesis of both upper lateral incisors before treatment. B. Abutment with pre-ligated .016" × .022" TMA sectional wire for extrusion of impacted canine. C. After five months of canine extrusion. D. Application of .016" × .022" TMA spring for alignment of upper left canine. E. After three months of alignment and crossbite correction. F. Patient after debonding.**

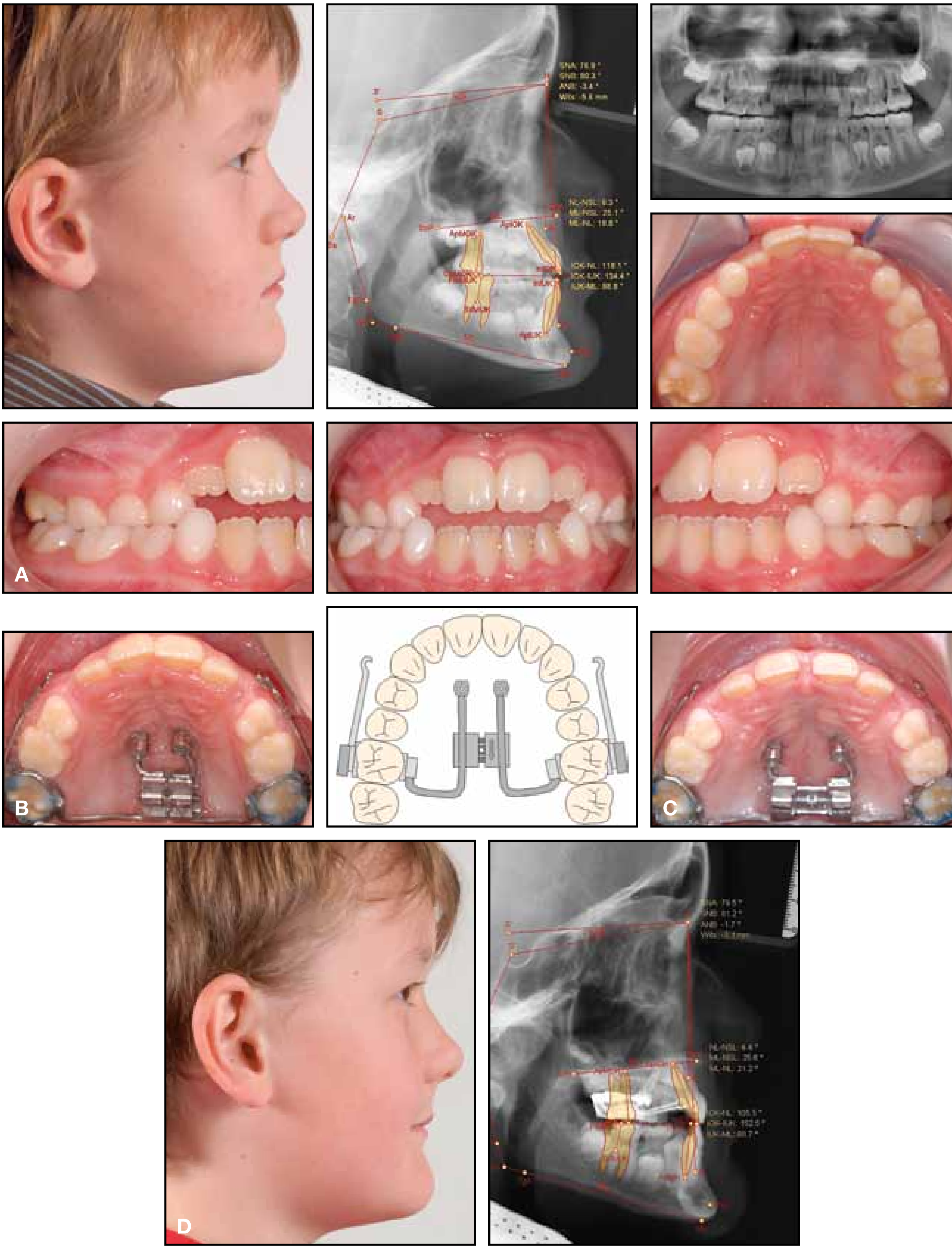

Fig. 3 Sequential use of two mini-implants for direct anchorage. A. 9-year-old male patient with Class III skeletal relationship and mesially migrated upper molars before treatment. B. Skeletally anchored Hybrid Hyrax expansion appliance with hooks for protraction facemask. C. After two weeks of maxillary expansion. D. After six months of maxillary protraction, with 2.5mm improvement in Wits appraisal (continued on next page).

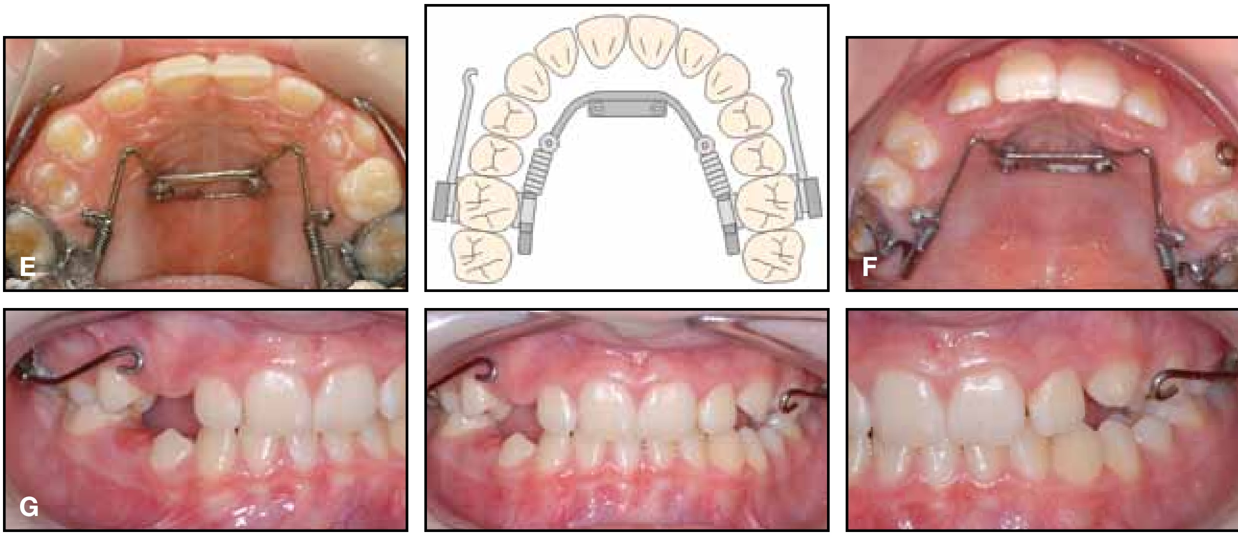

Fig. 3 (cont.) E. Application of Beneslider* for distalization, using same mini-implants. F. After five months of distalization. G. Patient at end of Phase I treatment.

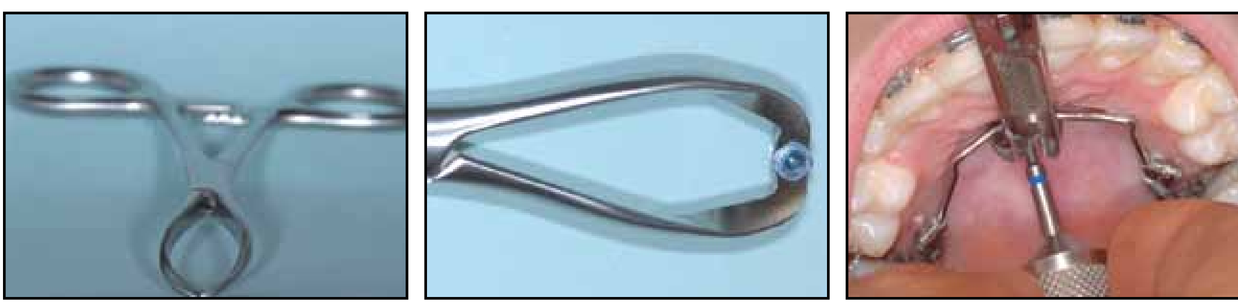

Fig. 4 Counter clamp, similar to surgical clamp, stabilizes mini-implant head to prevent rotation during appliance removal.

mini-implants was applied for molar distalization with a Beneslider appliance, forced eruption of the displaced incisors with an overlay nickel titanium wire was supported by indirect anchorage from two stainless steel sectional wires, extending anteriorly from the Beneslider to stabilize the two lateral incisors.

This technique was also useful in a 7-year-old female treated with rapid maxillary expansion and protraction, followed by distalization of the upper molars, using a single combination appliance (Fig. 6). Since buccal molar movement during expansion produces a cortical anchorage effect, simultaneous expansion and distalization would not have been feasible. Therefore, to achieve distalization after maxillary expansion, the distalizing screws were integrated into a Hybrid Hyrax appliance.[25]

Discussion

Stable anchorage is essential in orthodontic treatment to withstand reactive forces and prevent unwanted side effects. Skeletal anchorage from mini-implants has made treatment plans involving multiple simultaneous or sequential tooth movements much more practical. Clinicians often encounter the need for such combined mechanics; for instance, there is a genetic relationship between impacted upper canines and the agenesis of other maxillary teeth.[28,29] Canine displacement is also commonly accompanied by mesial movement of the molars, resulting in a lack of space for the impacted canines[30-32] or a narrow jaw with displaced teeth.[30]

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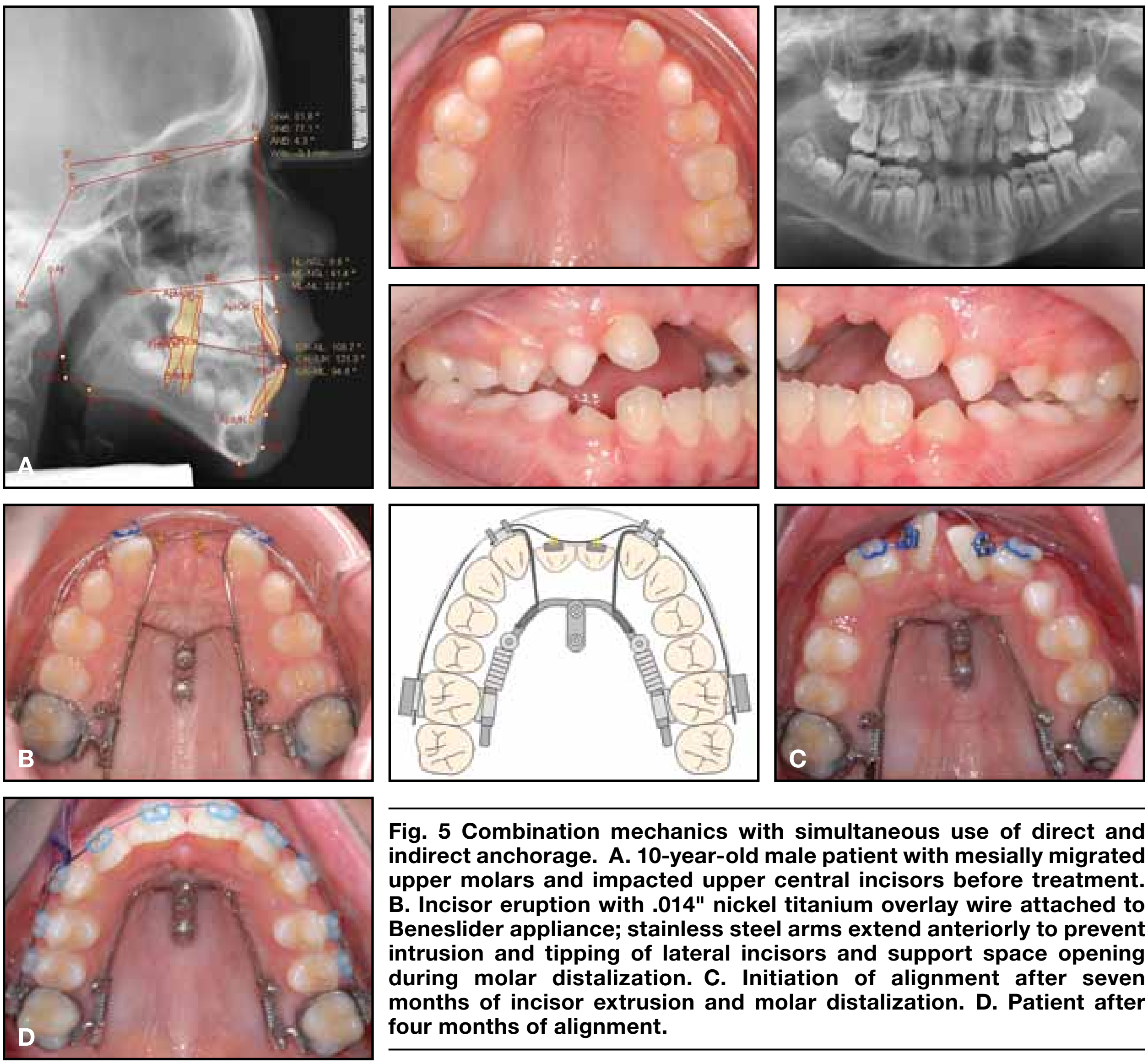

Fig. 5 Combination mechanics with simultaneous use of direct and indirect anchorage. A. 10-year-old male patient with mesially migrated upper molars and impacted upper central incisors before treatment. B. Incisor eruption with .014" nickel titanium overlay wire attached to Beneslider appliance; stainless steel arms extend anteriorly to prevent intrusion and tipping of lateral incisors and support space opening during molar distalization. C. Initiation of alignment after seven months of incisor extrusion and molar distalization. D. Patient after four months of alignment.

Anterior palatal mini-implants offer reliable and stable anchorage in such complex cases, and the versatile Benefit implant system with interchangeable abutments permits the use of multifunctional mechanics. The challenge is to design the appropriate appliance system for each patient.

Although simultaneous tooth movement can shorten treatment time, it is not always feasible, as seen in the expansion-distalization case shown in Figure 6. Because the cortical anchorage effect of buccal molar movement is likely to impede distalization, a consecutive treatment protocol would be preferable in such a patient. Still, the incorporation of sequential active components into a single appliance eliminates the need for intermediate reconstruction.

In some cases, a combined-mechanics appliance may become too complicated, bulky, and

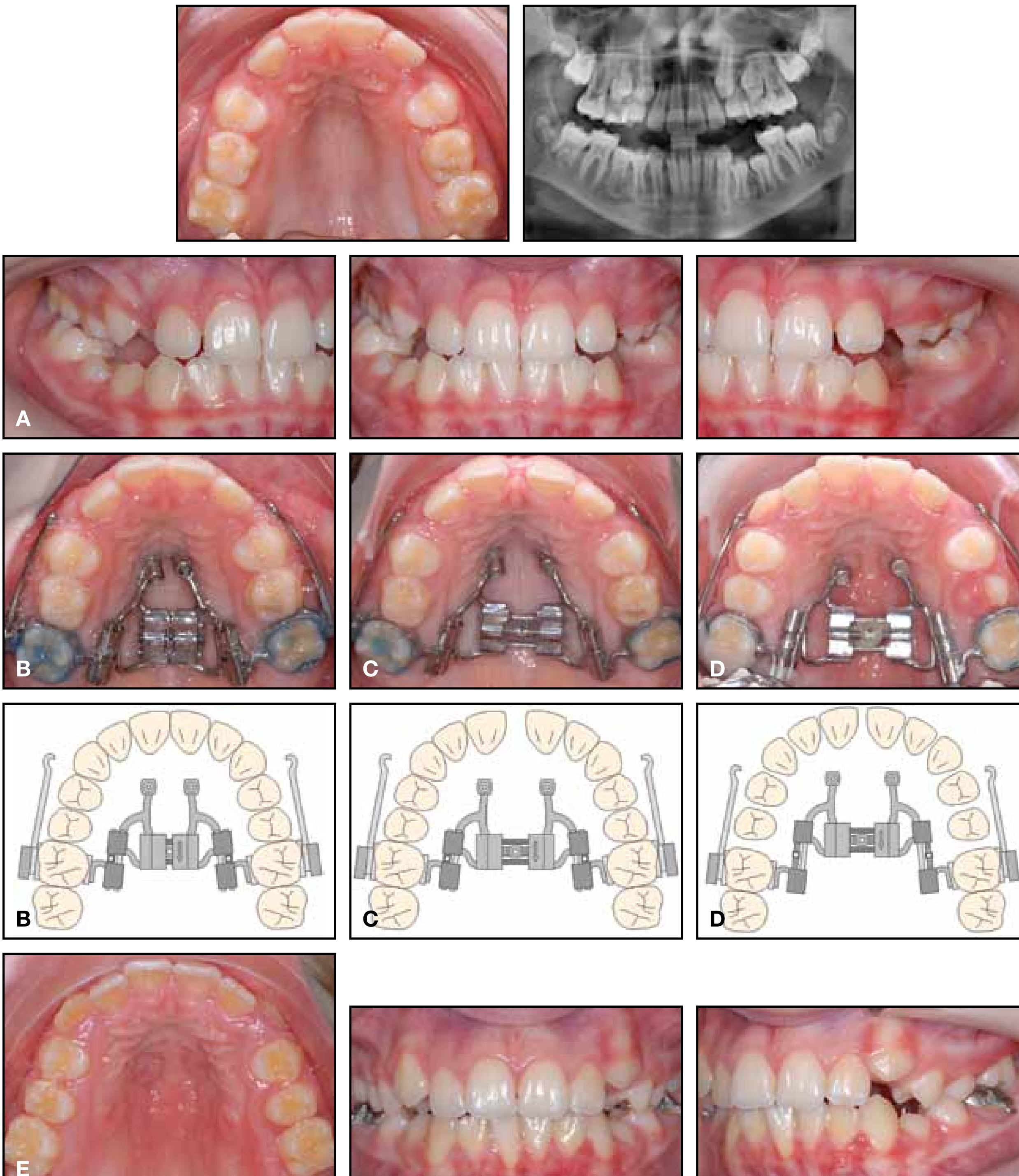

Fig. 6 Combination mechanics with sequential tooth movement. A. 7-year-old female patient with mesially migrated molars and narrow maxilla before treatment. B. After placement of Hybrid Hyrax Distalizer with integrated distalizing screws. C. After two weeks of expansion and crossbite correction. D. After four months of distalization. E. Patient after nine months of Phase I treatment.

uncomfortable for the patient, so that the fabrication of two separate appliances is a better alternative (Fig. 3). Simple appliances can be less expensive than a combination appliance, especially if prefabricated elements can be incorporated and the appliances fitted at the chair. The risk of loosening the mini-implant during removal of the first appliance can be minimized by using a special counter clamp (Fig. 4).

The use of skeletal anchorage reduces the impact of side effects and can shorten or even eliminate the need for treatment with full brackets—which has the added benefit of reducing the likelihood of decalcification.

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