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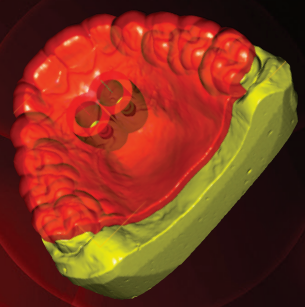
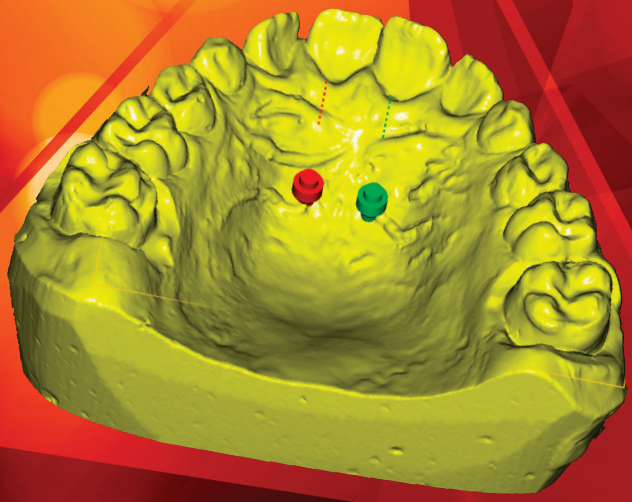
JOURNAL OF CLINICAL ORTHODONTICS
www.jco-online.com
November 2017





The Easy Driver for Placement of Palatal Mini-Implants and a Maxillary Expander in a Single Appointment

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In a preadolescent patient, a Class III malocclusion with maxillary retrognathia is conventionally addressed with a protraction facemask and rapid maxillary expansion. The corollary of this approach, however, is an inevitable mesial migration of the dentition, which results in anterior crowding and may necessitate extraction of the upper first premolars.[1] Mesial molar migration can be mitigated by adding anchorage from intentionally ankylosed teeth,[2] dental implants,[3] or miniplates.[4-6] These methods provide the additional advantage of transferring orthopedic forces directly to the nasomaxillary complex.

Wilmes and colleagues have introduced the Hybrid Hyrax* expansion appliance to avoid anchorage loss in such cases.[7-15] In a minimally invasive procedure, two mini-implants are placed in the paramedian area of the anterior palate to support anchorage in the sagittal and transverse dimensions.[16] The upper permanent or deciduous molars can thus be stabilized in their positions while the maxilla is orthopedically displaced in an anterior direction. The appliance reduces transverse forces on the dentition during maxillary expansion, resulting in less buccal tipping, root damage, and gingival dehiscence.[8-13,15] Because of these perceived advantages, several groups of authors developed a modified concept of hybrid anchorage for expansion, called micro-implant-assisted rapid palatal expansion (MARPE), using four mini-implants and four anchor teeth.[17-19]

Liou and colleagues have described a method to enhance the stimulatory orthopedic effect of

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maxillary expansion by alternating seven-day periods of expansion and constriction, 1mm per day, over seven to nine weeks (Alt-RAMEC).[20-23] To achieve Class III correction, they employed intraoral springs. Franchi and colleagues combined the Alt-RAMEC protocol with a protraction facemask using the deciduous teeth as anchorage.[24,25] These sutural expansion/protraction procedures pose a risk of periodontal damage and mesial migration, however, when the forces are only toothborne. To reduce such risk, the Hybrid Hyrax expander, with mini-implants in the anterior hard palate, can be used in conjunction with the Alt-RAMEC protocol. This approach avoids mesial migration of the upper molars when using a facemask and also prevents any tipping, loosening, or periodontal damage of the premolars or deciduous molars while the maxilla is being expanded.[26]

Orthodontists may not initially feel confident in locating ideal positions for the placement of palatal mini-implants. Additionally, the quantity and quality of available bone in the anterior hard palate varies among patients, especially those with cleft lip or palate. A surgical insertion guide can help overcome these challenges. The present article describes a guide called Easy Driver,** which utilizes digital technology to allow placement of palatal mini-implants and a maxillary expansion appliance during the same appointment.

Easy Driver Protocol

A plaster cast from a silicone impression is laser-scanned to produce a digital stereolithography file, which is superimposed on a cone-beam computed tomography image or a lateral cephalometric radiograph to identify optimal sites for mini-implant placement (Fig. 1). Virtual planning software is used to confirm the precise anatomical positions of the mini-implants in the anterior hard palate (Fig. 2). A rapid-prototyping process produces the Easy

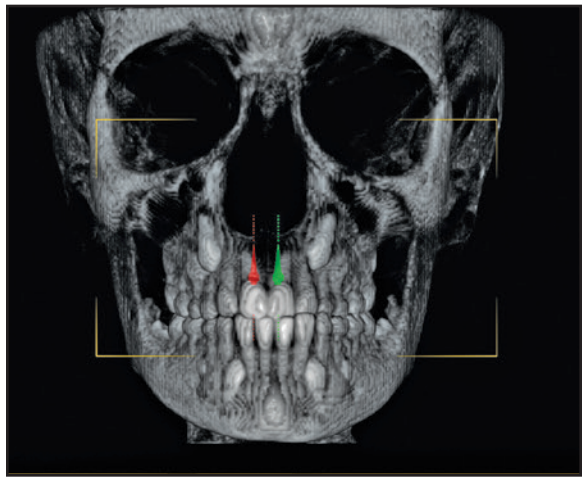

Fig. 1 Palatal mini-implant positions identified using cone-beam computed tomography.

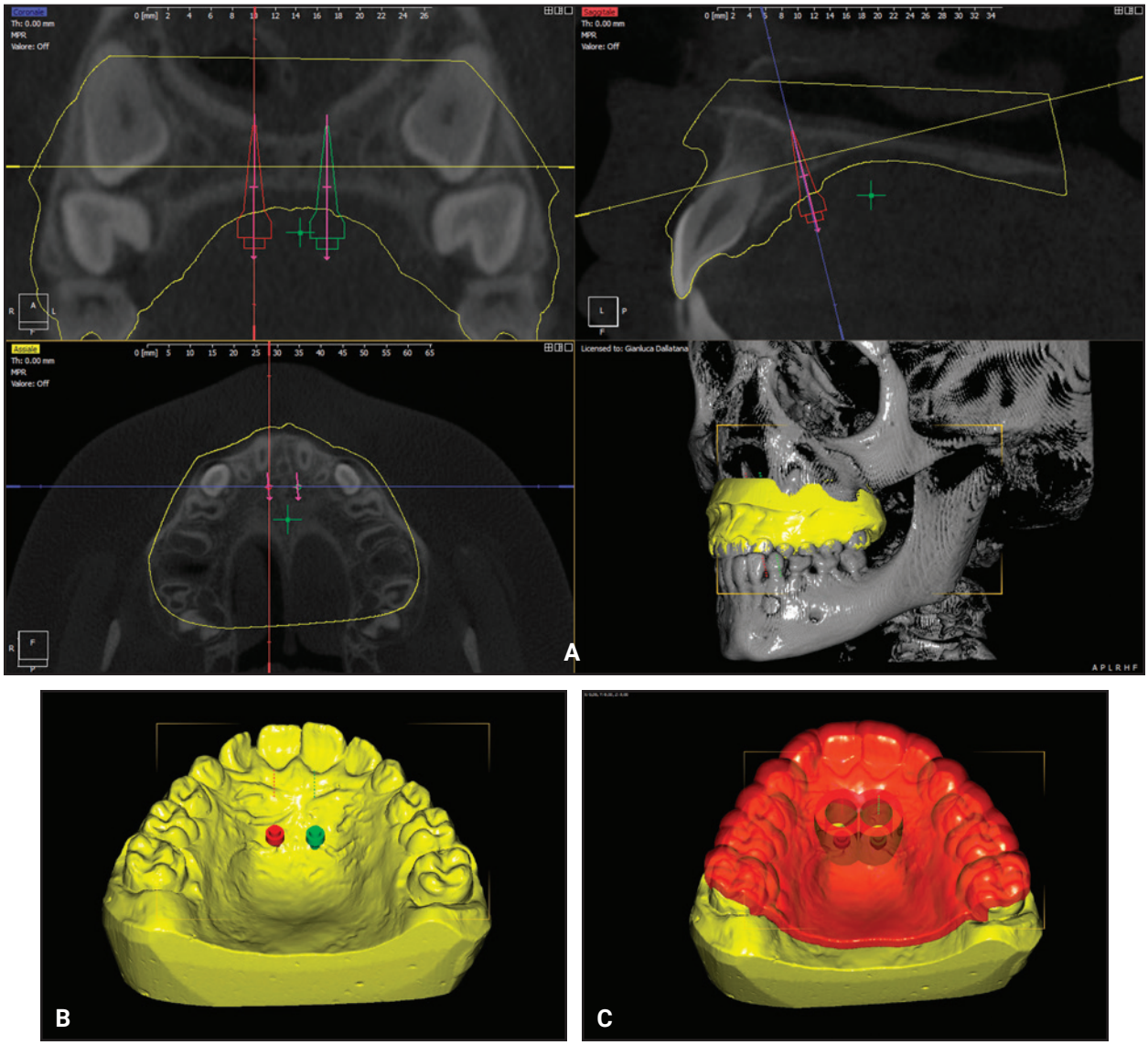

Fig. 2 A. Virtual positioning of mini-implant analogs. B. Digital model with mini-implant analogs. C. Virtual guide used to position mini-implant analogs on plaster cast by dental technician and intraorally by clinician.

Driver surgical insertion guide for precise location of the mini-implants in the mouth (Fig. 3). A Hybrid Hyrax appliance can be fabricated on the same cast. Mini-implants are inserted through the surgical guide using a special contra-angle screwdriver (Fig. 4). This process allows the insertion of both the mini-implants and the Hyrax appliance during the same appointment.

Case Report

An 11-year-old male in the middle mixed dentition presented for treatment of an anterior and left posterior crossbite (Fig. 5). He had a concave facial profile and a retrusive midface. Intraoral examination showed a Class III malocclusion with half-unit mesial molar and canine relation-

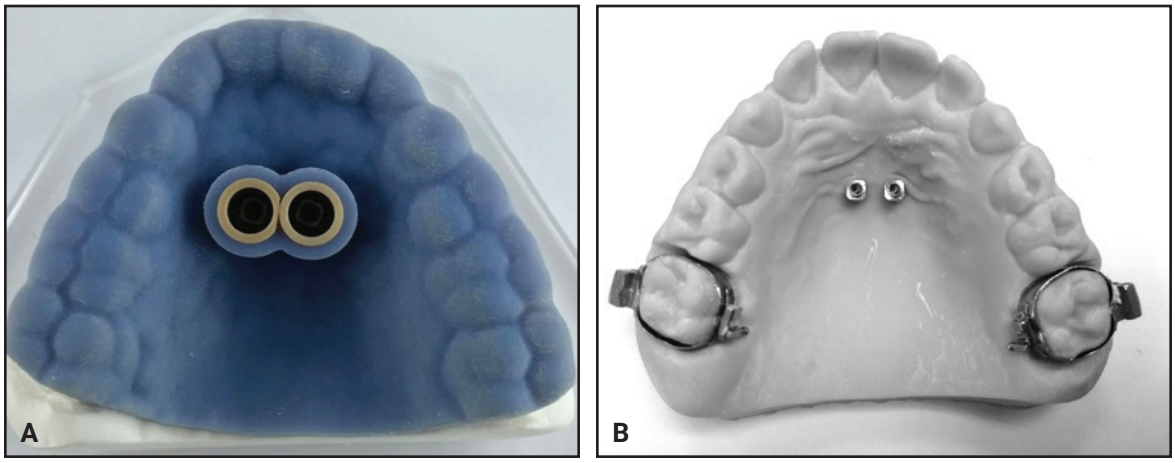

Fig. 3 A. Easy Driver guide on plaster cast. B. Mini-implant analogs on cast.

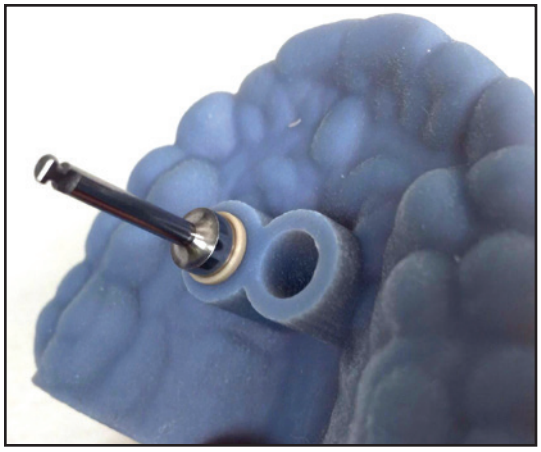

Fig. 4 Contra-angle screwdriver used to insert mini-implants.

ships, a –2mm overjet, a 2mm overbite, and a mandibular midline deviation to the left. A lateral functional shift to the left had been caused by premature occlusal contact, secondary to maxillary transverse constriction. The occlusal trauma had also led to gingival recession on the lower right central incisor.

A panoramic radiograph revealed developing canines, first and second premolars, and second and third molars. Cephalometric analysis (Table 1) indicated a distinct skeletal Class III (Wits appraisal = –5.4mm, ANB = –2°) with a retrognathic maxilla (SNA = 74.9°) and slightly retrognathic mandible (SNB = 77°). Treatment objectives were to correct the skeletal maxillary deficiency by maxillary protraction, using the modified alt-RAMEC protocol, and to correct the anterior crossbite.

The patient and parents elected treatment with a protraction facemask rather than intraoral skeletal anchorage using Bollard plates***[27] or a Mentoplate†[8] because of their concerns about a

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†PSM Medical Solutions, Tuttlingen, Germany; www.psm-na.us. Distributed in the U.S. by Mondeal North America, Inc., Indio, CA; www.mondeal-ortho.com.

TABLE 1
CEPHALOMETRIC ANALYSIS

	Norm	Pretreatment	Post-Treatment	Retention
SNA	82° ± 3.5°	74.9°	79.3°	78.3°
SNB	80.9° ± 3.4°	77.0°	77.4°	78.2°
ANB	1.6° ± 1.5°	−2.0°	1.9°	0.1°
Posterior/anterior facial height (S-Go/N-Me)	65% ± 4.0%	62.4%	63.1%	62.3%
Na-S-Go	67° ± 10.0°	102.5°	102.3°	104.1°
Upper/lower facial height (N-ANS/N-Gn)	45% ± 1.0%	43.3%	44.3%	42.3%
Upper facial height (N-ANS)	50mm ± 2.5mm	47.8mm	49.6mm	49.3mm
Lower anterior facial height (ANS-Me)	66mm ± 6.0mm	60.8mm	60.5mm	65.5mm
Craniomaxillary base/SN-PP	7.3° ± 3.5°	2.1°	4.2°	2.0°
Palatal-mandibular plane (PP-MP)	25° ± 6.0°	33.0°	30.1°	33.4°
SN-GoGn	32.9° ± 5.2°	32.0°	32.7°	32.8°
SN-FOP	19° ± 4.0°	19.5°	18.6°	18.9°
Gonial angle (Ar-Go-Me)	126.4° ± 6.7°	122.4°	125.8°	124.4°
U1-SN	102.3° ± 5.5°	107.1°	104.8°	101.8°
Mandibular unit length (Co-Pog)	105mm ± 8.0mm	97.7mm	106.6mm	106.4mm
IMPA (L1-MP)	95° ± 7.0°	93.3°	85.7°	85.9°
Interincisal angle (U1-L1)	130° ± 6.0°	124.5°	135.2°	137.0°
Upper incisor inclination (U1-APo)	28° ± 4.0°	28.6°	28.8°	23.0°
L1-APo	22° ± 4.0°	27.0°	16.0°	20.0°
Overjet	2.5mm ± 2.5mm	−2.0mm	3.9mm	2.3mm
Overbite	2.5mm ± 2.0mm	2.0mm	1.7mm	0.8mm
Y-axis (SGn-SN)	67° ± 5.5°	69.0°	68.2°	68.7°
Facial axis angle (Ba-Na/Pt-Gn)	0° ± 4.0°	−1.1°	1.7°	−0.1°
SN	75mm ± 3.0mm	66.6mm	67.4mm	67.5mm
FH-SN	6° ± 4.0°	11.8°	10.9°	12.9°
SN-Ba	131° ± 4.5°	131.0°	131.5°	131.2°
Wits appraisal	−1mm ± 1.0mm	−5.4mm	−1.2mm	−3.7mm
Mandibular body length (Go-Me)	75.4mm ± 5.0mm	62.9mm	64.7mm	70.2mm
Mandibular length (Co-Gn)	112.3mm ± 4.0mm	100.5mm	107.9mm	108.3mm
Midfacial length (Co-A)	88.2mm ± 4.0mm	71.5mm	82.8mm	79.8mm
Maxillary/mandibular differential (Co-Gn-Co-A)	20mm ± 4.0mm	29.1mm	25.1mm	28.6mm
Nasolabial angle (Col-Sn-UL)	102° ± 8.0°	113.7°	113.4°	115.5°
Upper lip to S-line	0mm ± 2.0mm	−0.4mm	−1.7mm	−2.3mm
Lower lip to S-line	0mm ± 2.0mm	1.3mm	−1.2mm	−2.3mm
Upper lip thickness	1mm ± 1.0mm	2.4mm	2.8mm	3.9mm
Holdaway ratio (L1-NB/Pg-NB)	2% ± 1.0%	−4.5%	1.7%	2.9%
H-angle (Pg'UL-Pg'Na')	10° ± 4.0°	9.0°	8.5°	7.7°

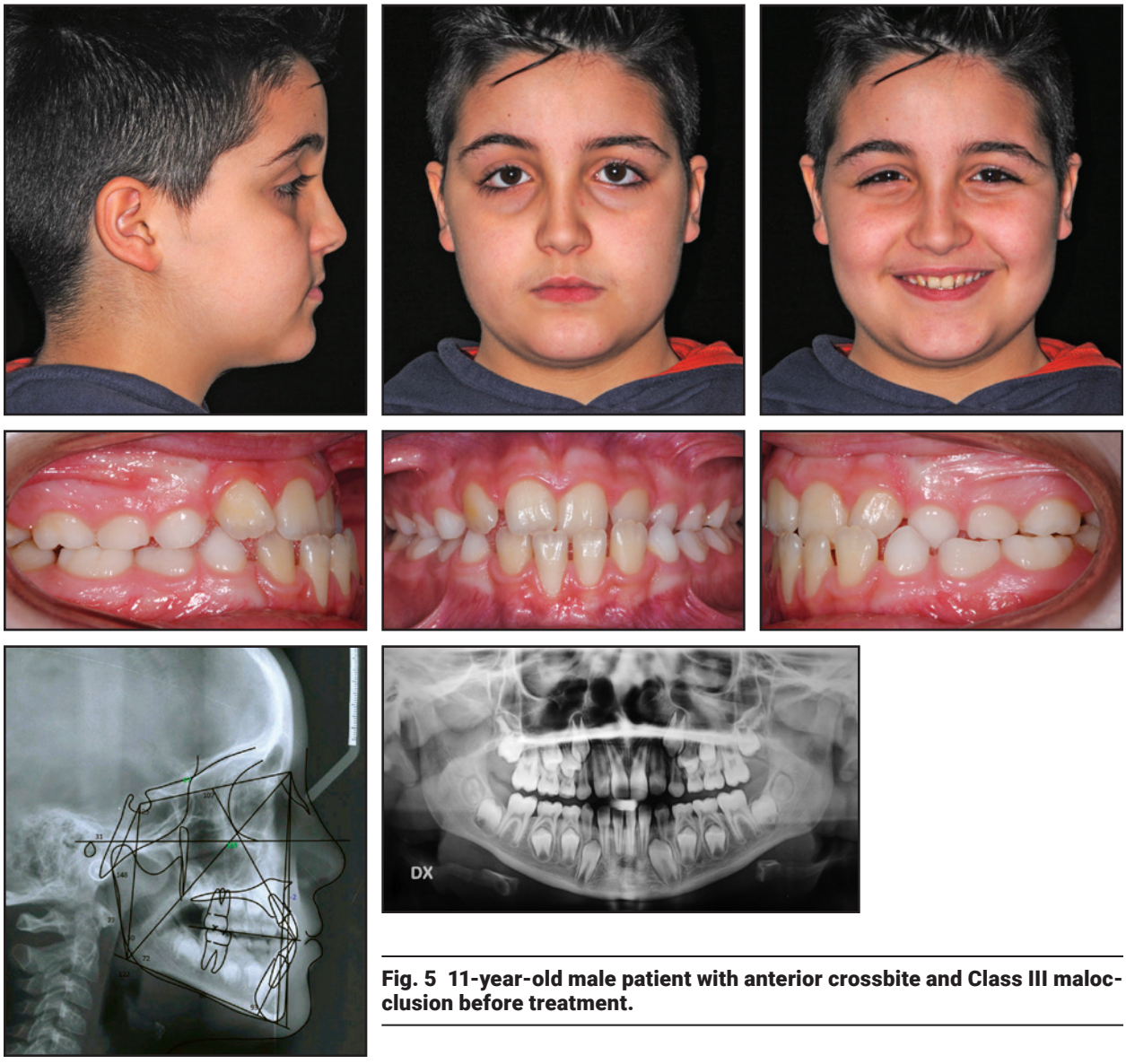

Fig. 5 11-year-old male patient with anterior crossbite and Class III malocclusion before treatment.

surgical insertion procedure. Another alternative would have been a functional appliance such as a Fränkel III, but this type of device may be less effective in correcting a retrognathic maxilla, since it induces downward and backward rotation of the mandible and its treatment effects are mainly dentoalveolar.[28] A Hybrid Hyrax appliance with a .2mm split-screw thread pitch was chosen to maximize the skeletal effect of the protraction facemask while avoiding dental side effects.

Following the Easy Driver protocol, two mini-implants with interchangeable abutments (2mm × 9mm, Benefit system†) were inserted

†PSM Medical Solutions, Tuttlingen, Germany; www.psm-na.us. Distributed in the U.S. by Mondeal North America, Inc., Indio, CA; www.mondeal-ortho.com.

(Fig. 6). The Hybrid Hyrax was securely attached to the mini-implants with the fixation screws (Fig. 7A). The device was then positioned on the molars by applying seating pressure on the bands, which had been lined with cement (Fig. 7B). The mini-implant caps were tightened to complete placement.

After two weeks of acclimatization, expansion was begun with three daily activations, for a total of about .6mm of expansion per day. A week later, according to the Alt-RAMEC protocol, the split screw was activated in reverse for contraction. Expansion and contraction were alternated for seven weeks, ending in expansion. The protraction forces were then initiated, following Liou's procedure.[23]

In conventional orthopedic Class III correction, the protraction forces are applied to rigid sectional wires welded to the buccal side of the molar bands, with hooks in the canine regions. The required wire diameters are .059" on the palatal side (as with a palatal expansion screw) or .039" on the buccal side. This creates extremely stiff mechanical properties and an expansion capacity

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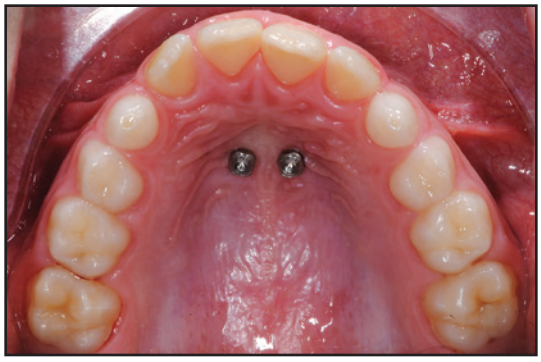


Fig. 6 Palatal mini-implants after insertion.

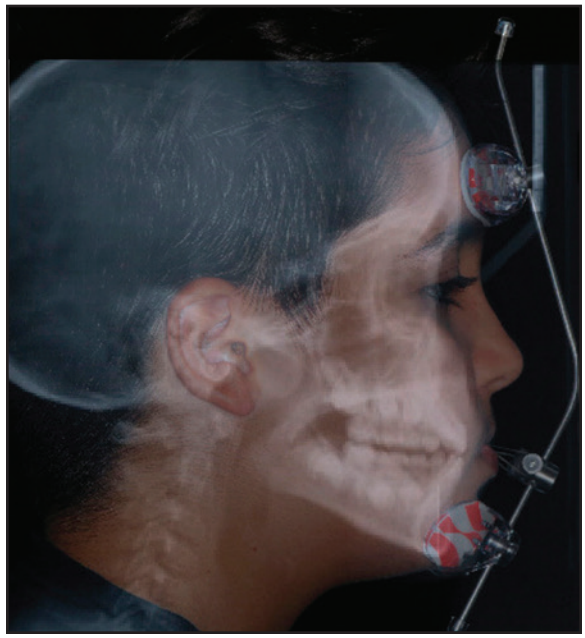
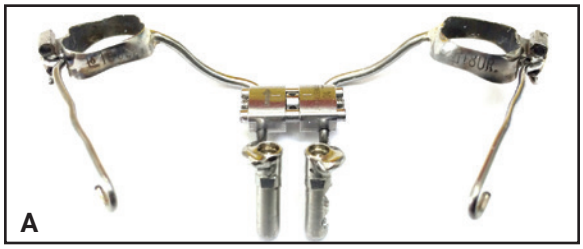


Fig. 8 Superimposition of lateral cephalogram and photograph of patient wearing facemask.



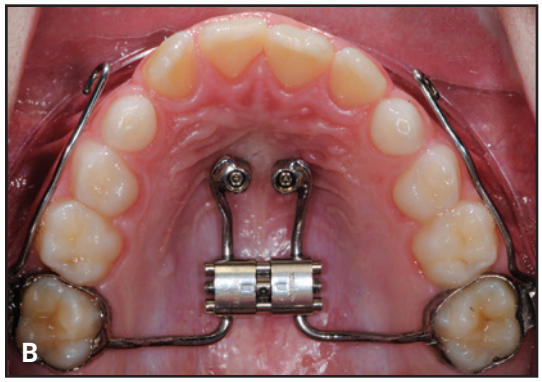


Fig. 7 A. Hybrid Hyrax* on top of mini-implant analogs. B. Appliance in place.

Fig. 9 A. Patient after 10 weeks of maxillary protraction. B. Superimposition of cephalometric tracings before (black) and after (red) treatment and 12 months after treatment (green).

of 10mm. In our case, elastics ($^5/_{16}$", 16oz) were attached from the hooks of the Hybrid Hyrax appliance to the support bar of the protraction facemask in a downward and forward direction, at 30° to the occlusal plane, to avoid anterior rotation of the maxilla.[29] The initial lateral cephalogram was superimposed on a photograph of the patient wearing a facial mask to confirm this angulation (Fig. 8). The elastics applied a force of 400g per side, as measured with a dynamometer.‡ Results of the case confirmed the efficacy of our approach.

The recommended time for wearing the facemask varies from 14 hours per day[30] to full-time,[31] depending on the early Class III treatment protocol. Our patient was instructed to wear the facemask 16 hours per day. His early Class III treatment was finished in 10 weeks (Fig. 9).

Discussion

This patient's overjet increased from –2mm to 3.9mm, a net anterior displacement of 5.9mm (Table 1). SNA increased by 4°, within the range of reported skeletal changes produced by facemask therapy.[32,33] Overcorrection is not advised when treating skeletal Class III malocclusion because the aim is to maintain a deep overbite, which in turn controls maxillary growth through anterior contact and neurosensory signal stimulation.[34] In this case, the combination of facemask therapy and expansion had the added benefit of resolving asymmetry by correcting the mandibular slide to the left, as well as improving the gingival attachment on the lower right central incisor by reducing occlusal trauma on the tooth.

The Easy Driver system facilitates safe and precise insertion of mini-implants in the anterior hard palate, making the Hybrid Hyrax method more accessible for less experienced clinicians. Additionally, the protocol allows the insertion of mini-implants and installation of the appliance in just one appointment.

‡Correx Force Gauge, Haag-Streit Diagnostics, Köniz, Switzerland; www.haag-streit.com.

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