CASE REPORT

Targeted Mechanics for Limited Posterior Treatment with Mini-Implant Anchorage

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The introduction of temporary anchorage devices (TADs) has facilitated orthodontic management of complex dentofacial problems.[1,2] TADs have also elicited the creativity of orthodontists in designing new appliances and approaches for treating different malocclusions.

One such approach involves delivering orthodontic forces directly from mini-implants in the buccal segments without bonding the posterior teeth. Introduced by Chung and colleagues, this "biocreative therapy" obtains skeletal anchorage from sandblasted and acid-etched miniscrews, called C-implants, which are placed interdentally between the first molars and second premolars.[3-5] The archwire is inserted in the anterior brackets and secured posteriorly in the slots of the C-implants to retract the anterior teeth during space closure. Because the implants are partially osseointegrated, they can resist these torsional forces without failing.[4,6,7] Chung and colleagues have indicated that biocreative therapy was especially appropriate for cases of bimaxillary dentoalveolar protrusion and Class II cases with good buccal occlusion.[3,7] Advantages of their method include three-dimensional control of the active units, a minimal need for patient compliance, and significantly re-


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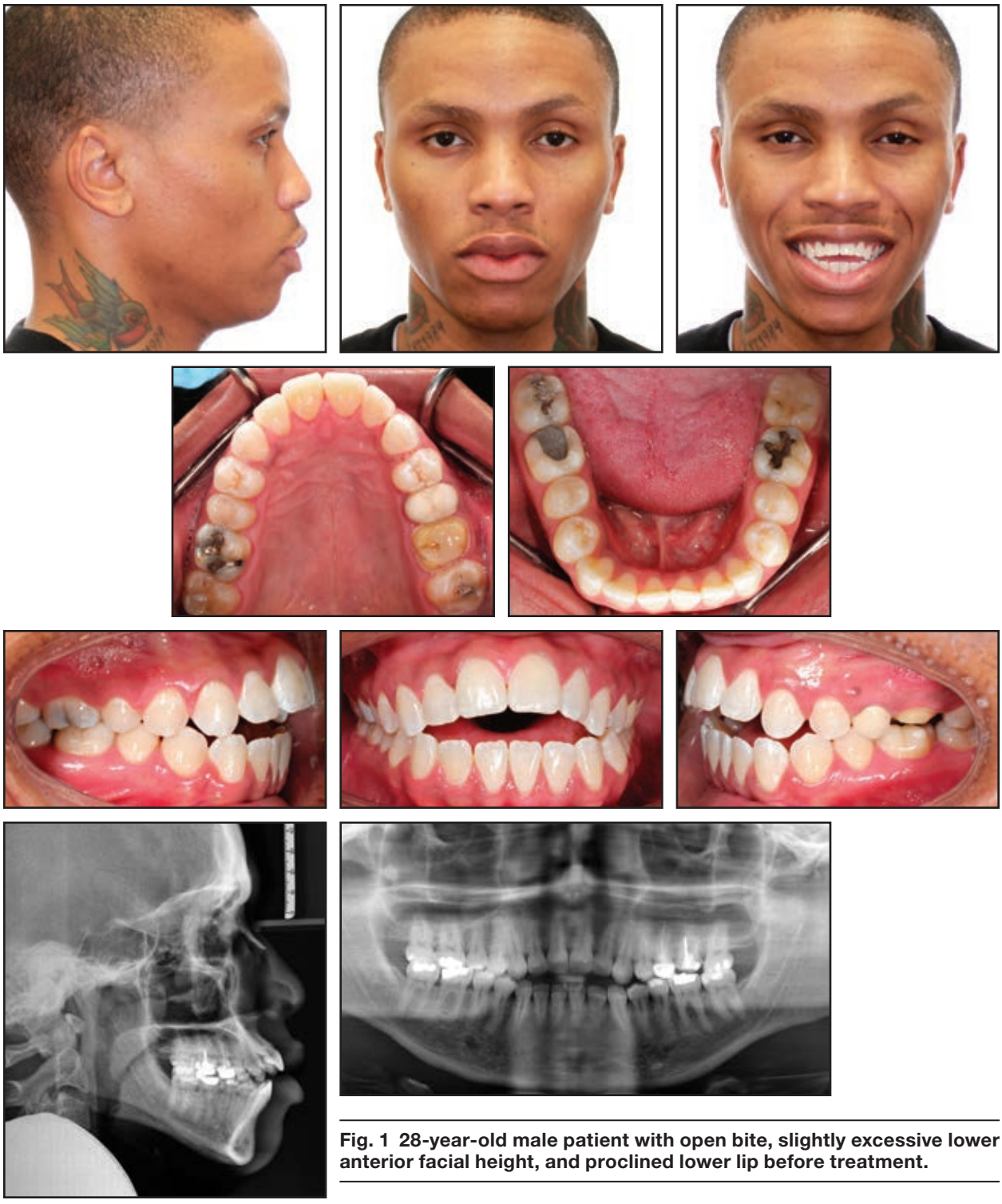

Fig. 1 28-year-old male patient with open bite, slightly excessive lower anterior facial height, and proclined lower lip before treatment.

duced risks of root resorption or white-spot lesions in the posterior segments.[3]

Although biocreative therapy was advocated only for en-masse retraction of anterior teeth,[6] we have recently modified it to manage other types of malocclusion. The rationale for this approach, which we call "targeted mechanics", is to maintain the pretreatment buccal occlusion by bypassing these teeth or indirectly anchoring them from mini-implants while correcting problems in the anterior region. Side effects on the posterior teeth are avoided, potentially reducing overall treatment time.

This article describes the use of targeted mechanics in an open-bite patient.

Diagnosis and Treatment Planning

A 28-year-old male reported to the university clinic with the chief complaint of an open bite. He had received orthodontic treatment as an adolescent and had a history of a thumbsucking habit, which he had ceased one year earlier. Extraoral examination found an orthognathic soft- and hard-tissue profile, slightly excessive lower anterior facial height, and a proclined lower lip in reference to the E-line (Fig. 1). The panoramic radiograph revealed restorations on the posterior teeth, including full-coverage restorations with root-canal therapy on the upper left second premolar and first molar. The patient had recently lost a temporary crown on the first molar. A dental anterior open bite of 7mm was present as a result of the digit-sucking habit, and the upper incisors displayed flaring and intrusion. A 5mm overjet was accompanied by an excellent Class I buccal occlusion and a slightly end-on canine relationship; the maxillary and mandibular arches had different occlusal planes. Smile analysis revealed a reverse smile arc with 80% incisal display on smiling.

The patient was offered two treatment options. The first consisted of placing a tongue crib to prevent a compensatory tongue-thrust habit from the open bite, and, after four to six months, using a statically determinate force system with an extrusion arch to erupt the incisors. The extrusive force on the upper incisors would generate an equal and opposite intrusive force and a tip-forward moment on the posterior anchorage segment (Fig. 2). Seating elastics would be needed to counteract the tip-forward moment, requiring patient compliance. Once the anterior and posterior occlusal planes were leveled, straightwire mechanics would be initiated for final finishing.

The second option, which was recommended and accepted, involved targeted mechanics with the primary goal of maintaining the excellent buccal occlusion. To correct the open bite, a tongue crib would be delivered in conjunction with a one-couple force system from an extrusion arch. An extrusive force of 40g would be exerted on the incisors, generating an intrusive force and a tip-forward moment on the upper and

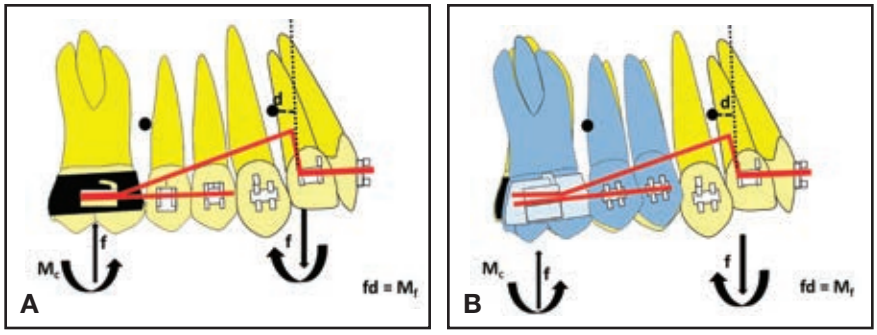

Fig. 2 A. Extrusion arch exerts extrusive force (f) on anterior segment, along with intrusive force and tip-forward moment of couple (Mc) on posterior anchorage unit. Beneficial moment of force (Mf) is generated on upper incisors because extrusive force is anterior to center of resistance. B. Tip-forward moment can tip occlusal plane if patient does not comply with elastic wear.

lower first molars. To counteract this side effect, the molars would be indirectly anchored to mini-implants (Fig. 3). With the extrusive force directed slightly labial to the center of resistance of the incisors, a favorable clockwise moment of force would be generated in the upper incisor segment and a counterclockwise moment of force in the lower anterior arch. This approach would require no premolar brackets or patient compliance with elastic wear.

Treatment Progress

After the temporary crown on the upper left first molar was replaced, a tongue crib was cemented to the upper first molars and the incisors were bonded in both arches. LOMAS* 1.5mm × 9mm mini-implants, which have slots for full-dimensional archwire engagement, were placed interdentally between the first molars and second premolars. The initial setup was a 2 × 4 appliance with .017" × .025" stainless steel

*Mondeal Medical Systems GmbH, Muhlheim a.d. Donau, Germany; www.mondeal.de.

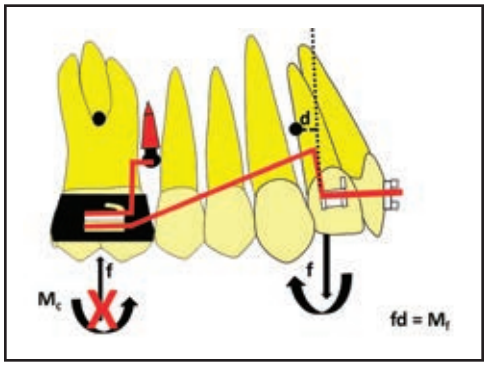

Fig. 3 Statically determinate one-couple force system for correction of anterior open bite with targeted mechanics: extrusion arch inserted in molar tubes and incisor brackets, with indirect anchorage from rigid .019" × .025" stainless steel wire segments between mini-implants and auxiliary molar tubes.

Fig. 4 One-couple force system from extrusion arch and tongue crib, with indirect anchorage from stainless steel wires between mini-implants and upper first molars.

wires in the anterior segments. Indirect anchorage was prepared with rigid .019" × .025" stainless steel wires, passively adapted from the auxiliary tubes of the upper first molars to the mini-implants (Fig. 4), with the lower first molars added at a subsequent appointment. A flowable composite resin was added to stabilize the archwire segments over the screw heads. An .017" × .025" nickel titanium extrusion arch was then secured with a single-point contact over each lateral-incisor bracket and inserted in the main molar tubes.

Due to the synergistic effects of the tongue crib and treatment mechanics, a significant change in overbite was observed in only two months (Fig. 5). After five months of treatment, a positive overbite was achieved, and the anterior and posterior maxillary occlusal planes were leveled (Fig. 6). The mini-implants were then removed, the second molars were bonded, and finishing was performed for two months with continuous .016" × .022" beta titanium archwires. Light seating elastics and anterior box elastics were worn during this period to maintain the corrections achieved with the segmented mechanics. The orthodontic appliances were removed after 10 months of treatment.

Fixed 4-4 lingual retainers were bonded in both arches, and Hawley retainers were delivered.

Treatment Results

Post-treatment photographs demonstrated maintenance of the excellent buccal occlusion, closure of the anterior open bite, and improvement in the smile esthetics (Fig. 7A). Superimposition of the pre- and post-treatment cephalometric tracings confirmed the anchorage control and indicated that the overbite was corrected by extrusion of the incisors (Fig. 7B).

Discussion

The mechanical and surface treatment of the C-implant was designed to provide partial osseointegration to withstand rotational moments from orthodontic mechanics.[4,8] A recent modification involving two splinted mini-implants has also been shown to resist rotational moments while providing greater stability of the machined surfaces.[9] Another alternative is to use indirect anchorage by connecting the anchor teeth to rigid stainless steel wires from the mini-implants, as documented in this article.

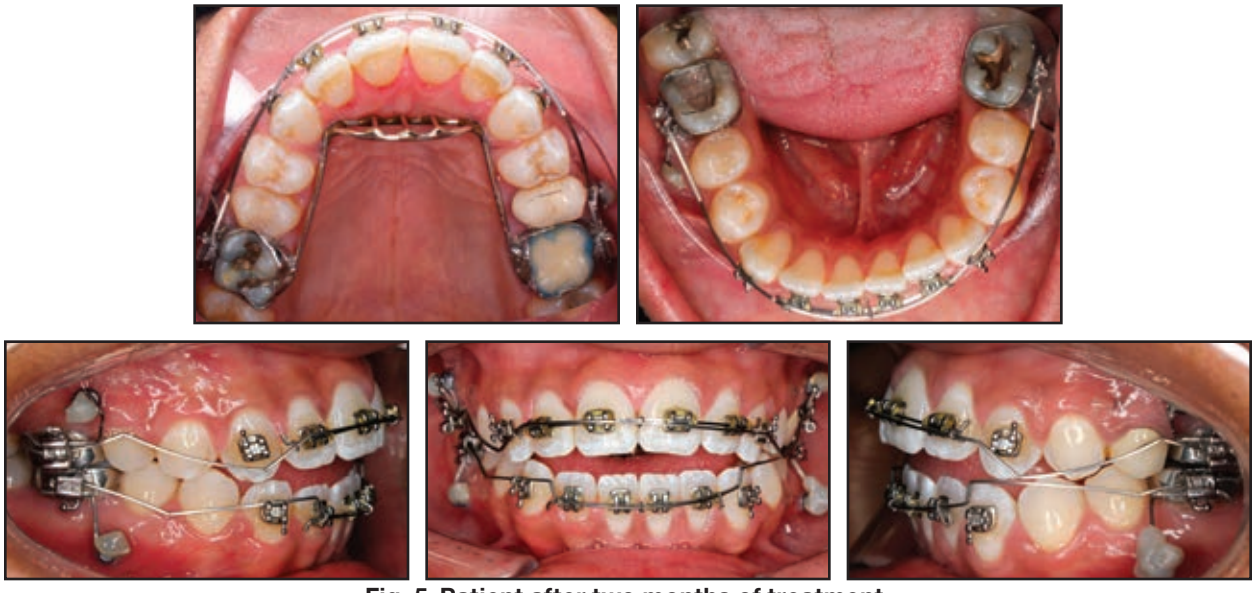

Fig. 5 Patient after two months of treatment.

Fig. 6 Patient after five months of treatment.

Previous reports on biocreative therapy noted the use of direct anchorage from mini-implants for anterior retraction, with no orthodontic attachments on the posterior teeth.[6] To improve the versatility of this technique, we modified it to allow the use of either direct or indirect mini-implant anchorage. In the case shown here, our approach prevented side effects on the posterior dentition while achieving the desired movement of the active units. We did observe minor arch-coordination discrepancies in the premolar region from the use of indirect anchorage, requiring orthodontic attachments to be bonded to the posterior teeth during the finishing phase.

Conclusion

Targeted mechanics is an excellent option in a patient who presents with a good intercuspal posterior occlusion. Understanding the biomechanical principles involved and applying adequate direct or indirect anchorage from mini-implants will allow efficient treatment of various malocclusions.

REFERENCES

1. Poletti, L.; Silvera, A.A.; and Ghislanzoni, L.T.: Dentoalveolar Class III treatment using retromolar miniscrew anchorage, Prog. Orthod. 14:1-6, 2013.
2. Nienkemper, M.; Wilmes, B.; Pauls, A.; and Drescher, D.: Maxillary protraction using a hybrid hyrax-facemask combination, Prog. Orthod. 14:1-8, 2013.
3. Chung, K.R.; Jeong, D.M.; Kim, S.H.; Ko, Y.I.; and Nelson, G.: En-masse retraction dependent on a temporary skeletal anchorage device without posterior bonding or banding in an adult with severe bidentoalveolar protrusion: Seven years posttreatment, Am. J. Orthod. 141:484-494, 2012.
4. Mo, S.S.; Kim, S.H.; Sung, J.; Chung, K.R.; Chun, Y.S.; Kook, Y.A.; and Nelson, G.: Factors controlling anterior torque during C-implant-dependent en-masse retraction without posterior appliances, Am. J. Orthod. 140:72-80, 2011.
5. Mo, S.S.; Kim, S.H.; Sung, S.J.; Chung, K.R.; Chun, Y.S.; Kook, Y.A.; and Nelson, G.: Factors controlling anterior torque with C-implants depend on en-masse retraction without posterior appliances: Biocreative therapy type II technique, Am. J. Orthod. 139:e183-e191, 2011.
6. Kim, S.H.; Hwang, Y.S.; Ferreira, A.; and Chung, K.R.: Analysis of temporary skeletal anchorage devices used for en-masse retraction: A preliminary study, Am. J. Orthod. 136:268-276, 2009.
7. Chung, K.R.; Cho, J.H.; Kim, S.H.; Kook, Y.A.; and Cozzani, M.: Unusual extraction treatment in Class II division 1 using C-orthodontic mini-implants, Angle Orthod. 77:155-166, 2007.
8. Kim, S.H.; Lee, S.J.; Cho, I.S.; Kim, S.K.; and Kim, T.W.: Rotational resistance of surface-treated mini-implants, Angle Orthod. 79:899-907, 2009.
9. Leung, M.T.; Rabie, A.B.; and Wong, R.W.: Stability of connected mini-implants and miniplates for skeletal anchorage in orthodontics, Eur. J. Orthod. 30:483-489, 2008.

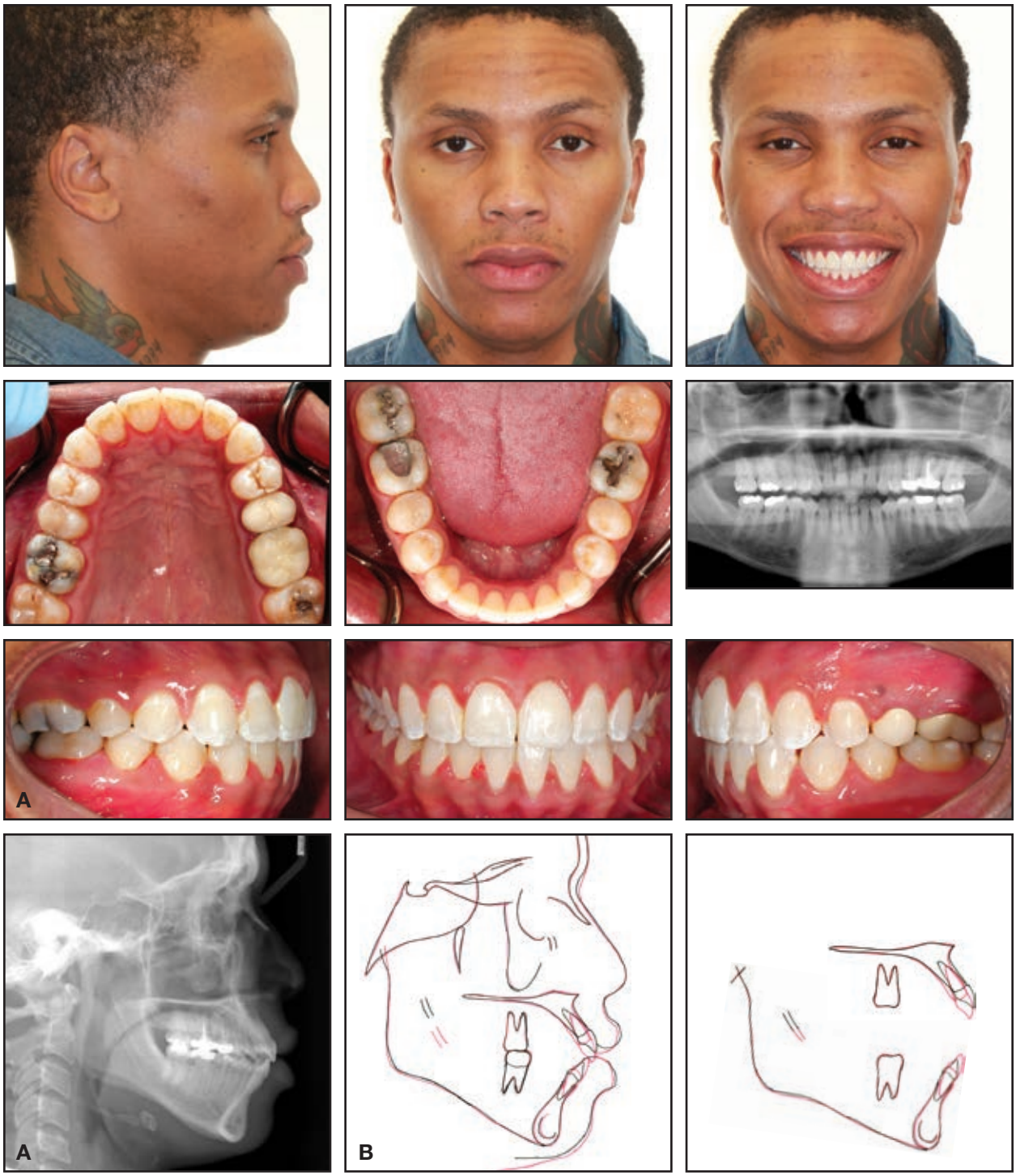

Fig. 7 A. Patient after 10 months of treatment. B. Superimposition of pre- and post-treatment cephalometric tracings.