CASE REPORT

Occlusal-Plane Control in a Hyperdivergent Adult Class II, Division 2 Patient

JOSEPH BOUSERHAL, DDS, MDS, PhD
ISMAEEL HANSA, BDS, MSc
LEA BOUSERHAL, DDS, MS
ELIE JABBOUR, DDS, MS
NIKHILESH R. VAID, BDS, MDS

Conventional camouflage treatment of retrognathic, hyperdivergent Class II patients, involving intermaxillary elastics, usually creates extrusive forces and frequently fails to control the vertical dimension. Hence, it can worsen skeletal problems and soft-tissue esthetics, even if an acceptable occlusal outcome is achieved.[1]

Ideal treatment of the hyperdivergent retrognathic patient hinges on achieving true counterclockwise rotation of the mandible through vertical control of the dentition, thus reducing vertical height and improving chin projection.[2,3] Surgical correction has traditionally been preferred because of its ability to achieve true skeletal changes and improve esthetics.[4,5]

During growth of the hyperdivergent patient, the maxilla moves downward and forward with sutural growth, resulting in a clockwise rotation of the mandible as it supersedes increases in ramal


Dr. J. Bouserhal


Dr. Hansa


Dr. L. Bouserhal


Dr. Jabbour


Dr. Vaid

Dr. J. Bouserhal is Professor and Director, Cranio-Facial Research Laboratory, St. Joseph University of Beirut, Beirut, Lebanon. Dr. Hansa is in the private practice of orthodontics at 30 Northbourne Ave., Westville North, Durban, South Africa 3629; e-mail: drismaeelhansa@gmail.com. Dr. L. Bouserhal is in the private practice of orthodontics in Beirut. Dr. Jabbour is in the private practice of orthodontics in Zahle, Lebanon. Dr. Vaid is an Adjunct Professor, Department of Orthodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Chennai, India.

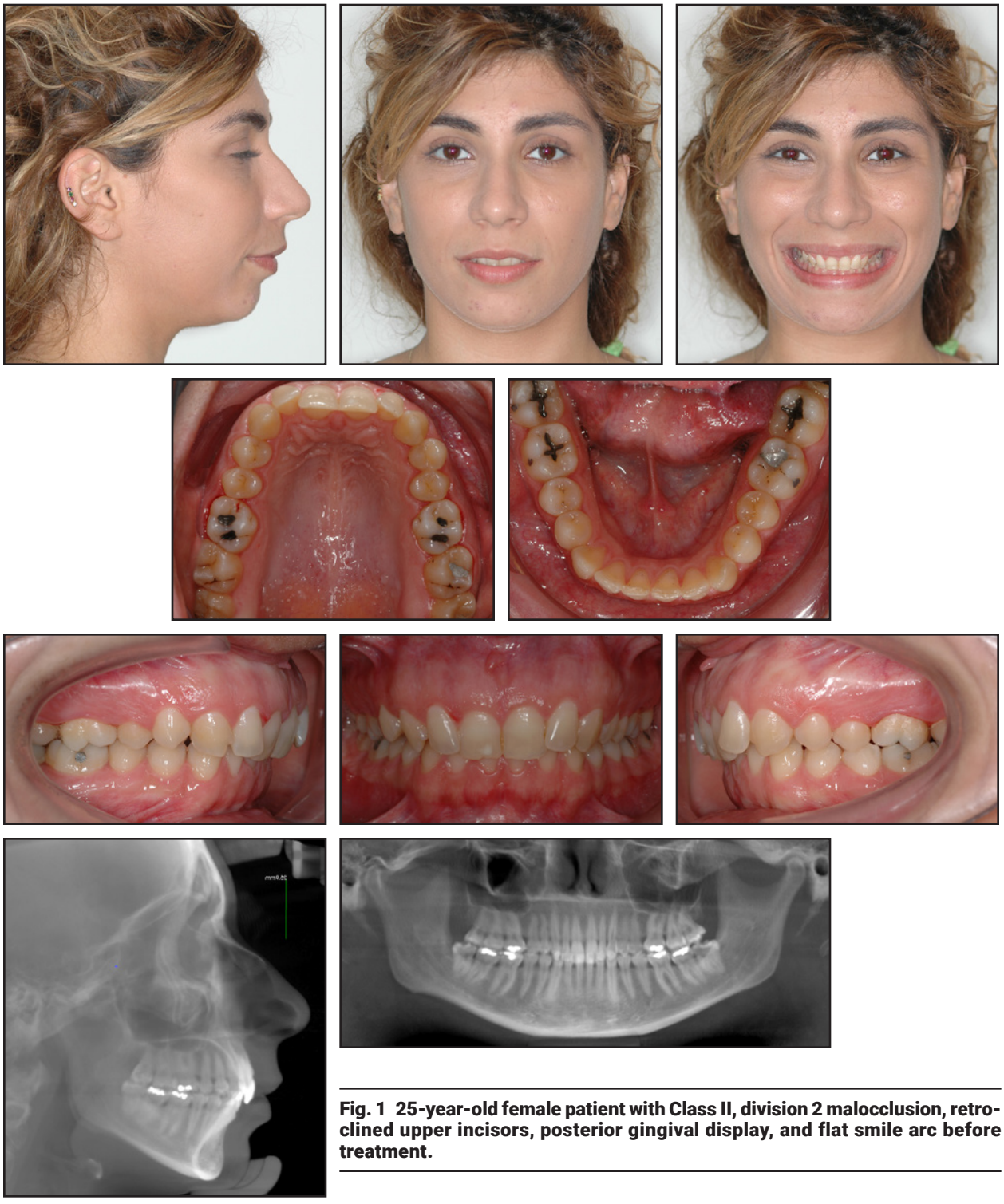

Fig. 1 25-year-old female patient with Class II, division 2 malocclusion, retroclined upper incisors, posterior gingival display, and flat smile arc before treatment.

TABLE 1
CEPHALOMETRIC ANALYSIS

	Norm	Pretreatment	Post-Treatment
FMA	25.0°	33.0°	29.0°
OC-PL/FP	10.0°	13.0°	15.0°
IFPA	107.0°	88.0°	102.0°
IMPA	88.0°	95.0°	99.0°
SNA	82.0°	82.0°	82.0°
SNB	80.0°	72.0°	74.5°
ANB	2.0°	10.0°	7.5°
AO-BO	2.0mm	5.5mm	10.0mm
Z-angle	75.0°	59.0°	69.0°

height and condylar growth.[6] This leads to a compensatory eruptive movement of the upper and lower molars, with the upper molars accounting for 70% and the lower molars 30%.[7] The lower incisors also compensate for the increase in vertical height by overerupting, resulting in an occlusal plane that is rotated counterclockwise relative to the mandibular plane.[7] Braun and Legan calculated a .5mm change in the sagittal molar relationship for each degree of occlusal-plane rotation. In other words, the compensatory counterclockwise rotation of the mandibular dentition results in a more Class II relationship—as opposed to a clockwise rotation, which creates a tendency toward a Class III molar relationship.[8] According to the Wits appraisal, the sagittal interarch relationship is associated with the pitch of the occlusal plane[9,10]; the steeper the occlusal plane, the lower the Wits value. These factors suggest that occlusal-plane rotation can be a viable option for correcting interarch sagittal discrepancies.[8,11]

The following case report shows how vertical control, manipulation, and clockwise rotation of the occlusal plane helped correct a full-step Class II malocclusion.

KRAVITZ KEYS

- The authors performed clockwise rotation of the occlusal plane in an adult hyperdivergent Class II patient using maxillary miniscrews and a Forsus* appliance.
- Occlusal-plane adjustment and Class II correction were achieved by maxillary dental intrusion, mandibular closing rotation, and likely some forward posturing.
- Lower-incisor proclination was controlled with −6° torque prescription brackets and additional lingual crown torque in the archwire.
- Postretention records would be needed to confirm the stability of the Class II correction.

Diagnosis and Treatment Planning

A 25-year-old female presented with the chief complaint of an unesthetic smile (Fig. 1). She was primarily concerned about her retroclined upper incisors, posterior gingival display, and flat smile arc. The patient had a retrognathic profile, increased lower facial height, and mildly excessive

*Forsus: Trademark of 3M, Monrovia, CA; www.3M.com.

gingival display on smiling. Intraoral examination found a full-cusp Class II, division 2 malocclusion, with a slight curve of Spee, a 3mm overjet, and a 5mm overbite. We measured 5mm of crowding in the maxillary arch and 2mm in the mandibular arch.

Cephalometric examination indicated a skeletal Class II relationship with a dolichofacial skeletal pattern (Table 1). The upper incisors were significantly retroclined, while the lower incisors were within normal limits.

Treatment objectives were to obtain Class I molar and canine relationships, reduce vertical facial height, achieve normal overbite and overjet, correct the upper-incisor torque, and reduce the gingival display.

Various treatment options were proposed, including orthognathic surgery and extraction or nonextraction camouflage treatment by means of dentoalveolar compensation. The patient rejected the surgical option, and extractions were contraindicated due to the potential of labial retrusion and an increased nasolabial angle, as well as the difficulty of upper-incisor torque control during space closure. We concluded that a clockwise rotation of the occlusal plane, in conjunction with upper-molar intrusion, would promote a change in the molar relationship from Class II to Class I while reducing lower facial height and gingival display. Hence, a nonextraction camouflage plan was chosen, using a fixed Forsus Class II corrector and three mini-implants—two placed posteriorly between the second premolars and first molars, and one anteriorly between the upper central incisors to control upper-incisor torque during intrusion. The protocol would be similar to surgical-orthodontic treatment in that it would position the maxillary arch ideally within the face, then use it as indirect anchorage for subsequent adaptation of the mandibular arch.

*Forsus: Trademark of 3M, Monrovia, CA; www.3M.com.

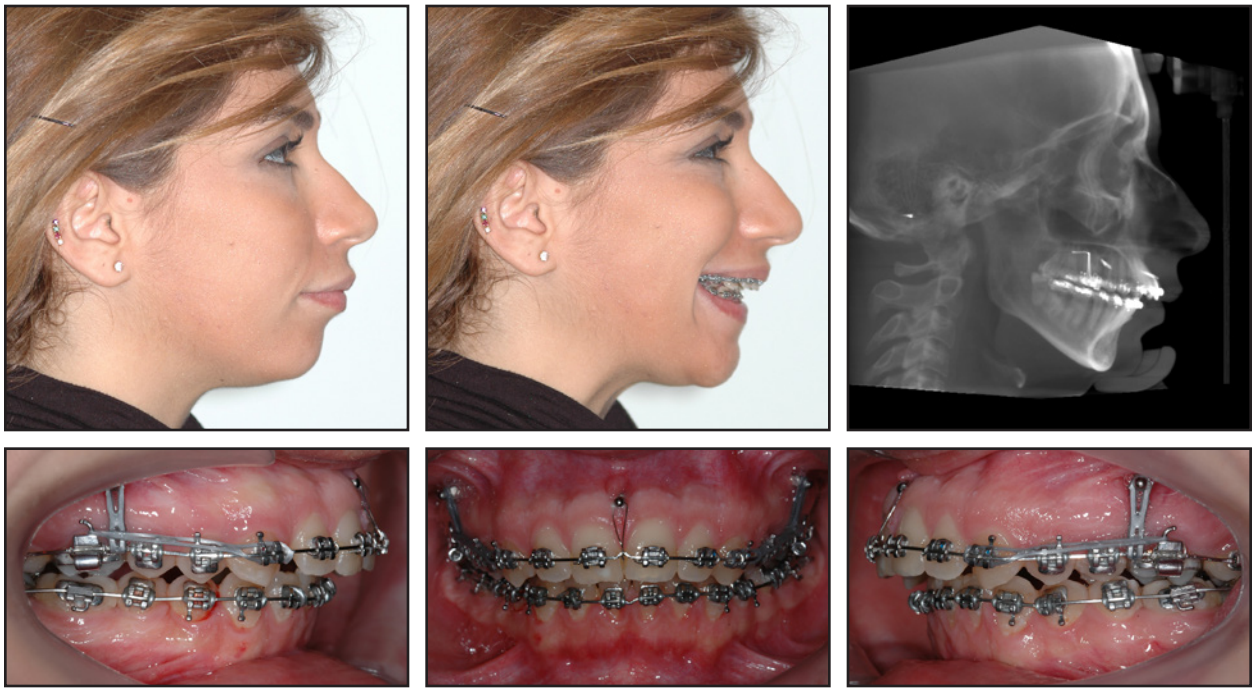

Fig. 2 After nine months of treatment, progression to .020" × .025" stainless steel archwires with omega loops and .012" tiebacks.

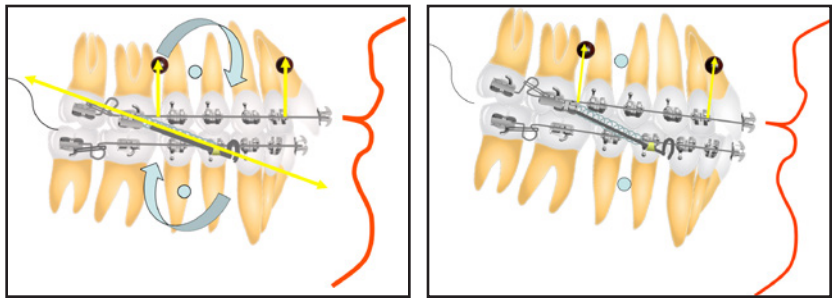

Fig. 3 Forsus* appliance directs forces away from estimated center of resistance of maxillary and mandibular arches, causing clockwise rotation of occlusal plane.

Fig. 4 After eight months of treatment with Forsus appliance.

Treatment Progress

The mini-implants were inserted at the initial bonding appointment, and vertical control began immediately with .012" stainless steel ligature wires tied from the mini-implants to the upper archwire. The advantage of this early vertical control was in preventing unwanted extrusion during the leveling phase. Thereafter, elastomeric chains and stiffer archwires were used to actively intrude the posterior dentition. Treatment proceeded for nine months until the archwire size reached .020" × .025" stainless steel with omega loops and .012" tiebacks (Fig. 2).

The Forsus appliance was then inserted to apply intrusive and distalizing forces to the upper molars and intrusive and mesializing forces to the lower anterior segment. The forces were directed away from the estimated centers of resistance of the maxillary and mandibular arches to cause a clockwise rotation of the occlusal plane (Fig. 3). Mini-implants between the upper first molars and second premolars and between the upper central incisors were used as anchorage to intrude the posterior buccal segments and allow for mandibular autorotation.

After eight months, overcorrection was achieved, and the Forsus appliance was removed (Fig. 4). Treatment was completed in another eight months.

Treatment Results

After 25 months of treatment, all objectives were attained, including a Class I relationship, reduced vertical height, and an improved smile arc (Fig. 5). Cephalometric analysis showed a reduction in lower facial height, a clockwise rotation of the mandible, and an increase in SNB (Table 1). The post-treatment cone-beam computed tomography and reconstructed cephalogram showed only mild incisor proclination despite a full-cusp Class II correction. Maintenance of the lower incisors within the boundaries of the alveolar housing was a challenge due to the thin mandibular symphysis, but was facilitated by the mandibular autorotation and consequent sagittal correction. Lower incisor brackets with a –6° torque prescription, additional lingual crown torque in the archwire, and an almost full-size archwire with tiebacks were also used to prevent

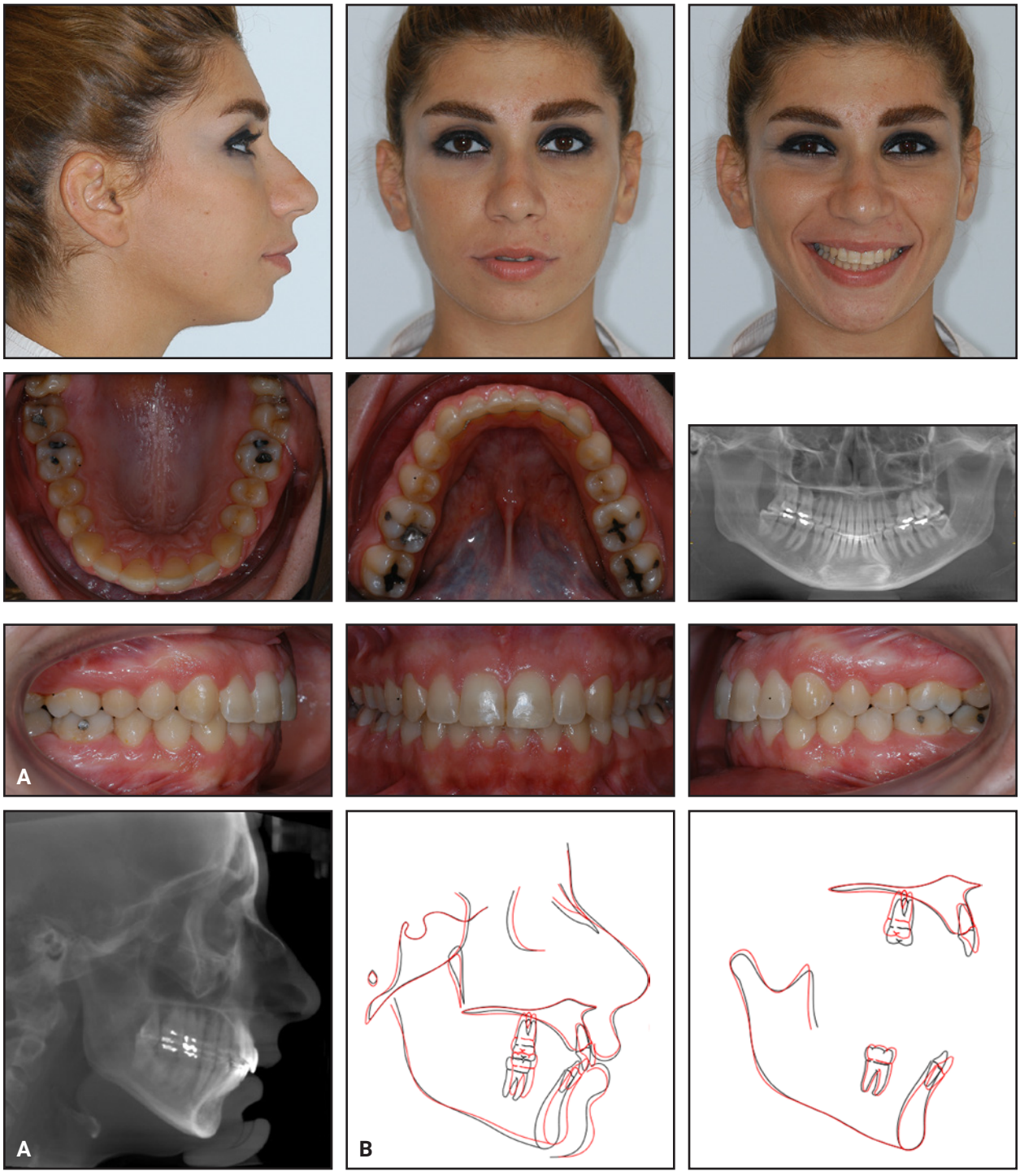

Fig. 5 A. Patient after 25 months of treatment. B. Superimposition of pre- and post-treatment cephalometric tracings.

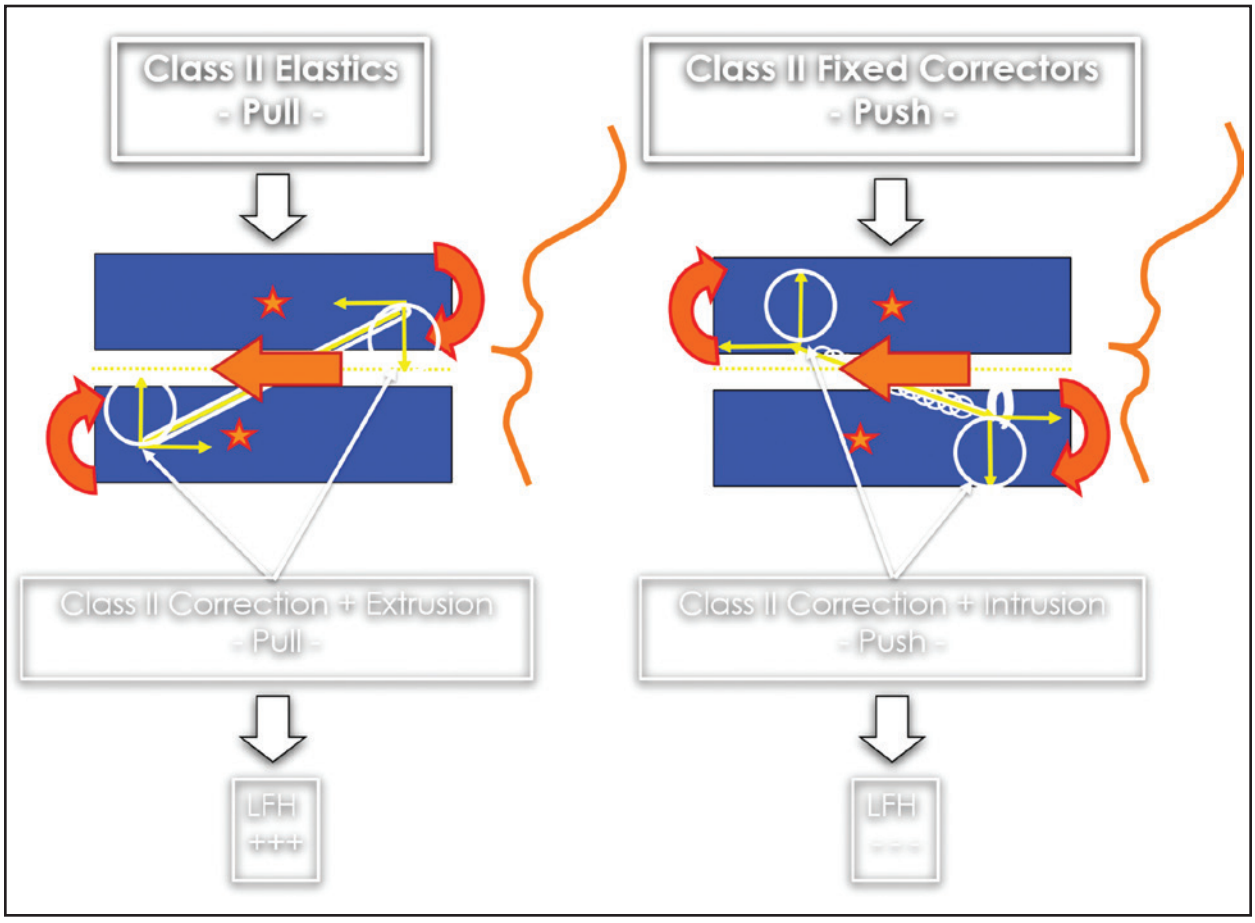

Fig. 6 Difference in Class II correction between Class II elastics and Class II correctors (Forsus).

proclination; this was done judiciously, however, to avoid dehiscence.[12]

Discussion

Our case underscores the importance of controlling the occlusal plane and vertical dimension when treating dolichofacial patients.[13] The rationale was to use the combination of mini-implants and Forsus appliance to rotate the occlusal plane clockwise and allow for mandibular autorotation, resulting in Class II correction. The vertical control was applied independently to the maxillary and mandibular posterior segments, thus compensating for skeletal discrepencies.[11]

The clinician should not confuse clockwise rotation of the occlusal plane with clockwise or backward rotation of the mandible. Conventional clockwise rotation of the occlusal plane would cause the same rotation of the mandible due to the extrusive nature of orthodontic treatment.[14] With the advent of mini-implants,[15] however, these movements can now be performed separately.[16] The Forsus, as a "pushing" appliance, is vital in obtaining the desired rotation of the occlusal plane and controlling the vertical dimension (Fig. 6). Class II elastics, considered a "pulling" device, would also cause a clockwise rotation of the occlusal plane, but would extrude the lower molars, resulting in a clockwise/backward rotation of the

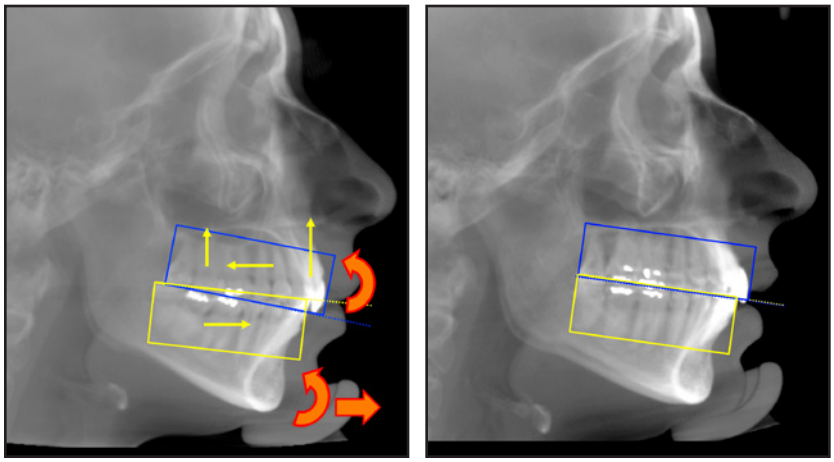

Fig. 7 Occlusal-plane control to compensate for skeletal Class II discrepancy.

mandible, increased lower facial height, and worsened facial esthetics due to a reduced chin projection.[1,8] The primary side effect of the Forsus appliance is labial tipping of the lower incisors, which was limited in our case by the use of brackets with negative torque and the added lingual crown torque in the archwire.[17] An alternative for even better lower-incisor control could be the use of mini-implant anchorage for a force directed inferior to the center of rotation of the mandibular arch. This would both hold the anterior segment and intrude the lower incisors while aiding in the clockwise rotation of the occlusal plane.

The availability of mini-implants to prevent dental extrusion and the use of appropriate appliances and mechanics can increase the scope of camouflage treatment in Class II hyperdivergent patients.[18] Clinicians must consider not only sagittal, but also vertical and transverse compensations—the concept of "rotational compensation of the dentition." The orthodontist needs to analyze the positions of the maxillary and mandibular arches in all three dimensions, control them independently according to the individual treatment plan, and modify the orientation of the occlusal plane to compensate for the skeletal discrepancy and obtain the best possible esthetic result (Fig. 7).

REFERENCES

1. Vaden, J.L.: Alternative nonsurgical strategies to treat complex orthodontic problems, Semin. Orthod. 2:90-113, 1996.
2. LaHaye, M.B.; Buschang, P.H.; Alexander, R.G.W.; and Boley, J.C.: Orthodontic treatment changes of chin position in Class II Division 1 patients, Am. J. Orthod. 130:732-741, 2006.
3. Vaden, J.L.: The Tweed-Merrifield philosophy, Semin. Orthod. 2:237-240, 1996.
4. Raposo, R.; Peleteiro, B.; Paço, M.; and Pinho, T.: Orthodontic camouflage versus orthodontic-orthognathic surgical treatment in Class II malocclusion: A systematic review and meta-analysis, Int. J. Oral Maxillofac. Surg. 47:445-455, 2018.
5. Steinhäuser, S.; Richter, U.; Richter, F.; Bill, J.; and Rudzki-Janson, I.: Profile changes following maxillary impaction and autorotation of the mandible, J. Orofac. Orthop. 69:31-41, 2008.
6. Björk, A.: Prediction of mandibular growth rotation, Am. J. Orthod. 55:585-599, 1969.
7. Schudy, F.F.: The control of vertical overbite in clinical orthodontics, Angle Orthod. 38:19-39, 1968.
8. Braun, S. and Legan, H.L.: Changes in occlusion related to the cant of the occlusal plane, Am. J. Orthod. 111:184-188, 1997.
9. Tanaka, J.L.O.; Ono, E.; Filho Medici, E.; de Moraes, L.C.; de Melo Castilho, J.C.; and de Moraes, M.E.L.: Influence of the facial pattern on ANB, AF-BF, and Wits appraisal, World J. Orthod. 7:369-375, 2006.
10. Jacobson, A.: The "Wits" appraisal of jaw disharmony, Am. J. Orthod. 67:125-138, 1975.
11. Lee, K.J. and Kim, S.J.: Advanced biomechanics for total arch movement and non-surgical treatment for hyperdivergent faces, Semin. Orthod. 24:83-94, 2018.
12. Balut, N.; Hansa, I.; González, E.; and Ferguson, D.J.: Bone regeneration after alveolar dehiscence due to orthodontic tooth movement: A case report, APOS Trends Orthod. 9:117-123, 2019.
13. Fushima, K.; Kitamura, Y.; Mita, H.; Sato, S.; Suzuki, Y.; and Kim, Y.H.: Significance of the cant of the posterior occlusal plane in Class II division 1 malocclusions, Eur. J. Orthod. 18:27-40, 1996.

14. Phan, X.L.; Schneider, B.J.; Sadowsky, C.; and BeGole, E.A.: Effects of orthodontic treatment on mandibular rotation and displacement in Angle Class II division 1 malocclusions, Angle Orthod. 74:174-183, 2004.
15. Gandedkar, N.H.; Koo, C.S.; Sharan, J.; Chng, C.K.; and Vaid, N.: The temporary anchorage devices research terrain: Current perspectives and future forecasts! Semin. Orthod. 24:191-206, 2018.
16. Buschang, P.H.; Carrillo, R.; and Rossouw, P.E.: Orthopedic correction of growing hyperdivergent, retrognathic patients with miniscrew implants, J. Oral Maxillofac. Surg. 69:754-762, 2011.
17. Elkordy, S.A.; Abouelezz, A.M.; Fayed, M.M.S.; Attia, K.H.; Ishaq, R.A.R.; and Mostafa, Y.A.: Three-dimensional effects of the mini-implant-anchored Forsus Fatigue Resistant Device: A randomized controlled trial, Angle Orthod. 86:292-305, 2016.
18. Lamarque, S.: The importance of occlusal plane control during orthodontic mechanotherapy, Am. J. Orthod. 107:548-558, 1995.