Case Report

Nonsurgical orthodontic correction of facial asymmetry by condylar remodeling and mandibular repositioning following occlusal cant correction with microimplants: a case report

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ABSTRACT

Recently, the demand for correcting facial asymmetry has been increasing, even when the extent of asymmetry is small. This case report describes nonsurgical orthodontic treatment for facial asymmetry in a 13-year-old female patient, facilitated by moving the deviant mandible to the nondeviated side after correcting for relevant dental compensation using microimplants. Mandibular repositioning was attempted using intermaxillary elastics between the microimplants placed into each jaw and guided by resin that was bonded on the maxillary first molar of the deviated side. To enhance mandibular movement, correction of the transverse occlusal cant and buccolingual inclination of the teeth were also performed. After 65 months of gradual treatment, facial symmetry, with favorable occlusion and jaw function, was achieved. These satisfactory results, including a well-balanced face and good occlusal interdigitation, were well maintained at the 53-month follow-up. Direct and functional forces applied against deviant functional forces can reduce facial asymmetry by differential growth or modeling of the condyle. (*Angle Orthod.* 2022;93:111–125.)

KEY WORDS: Facial asymmetry; Nonsurgical orthodontic treatment; Mandibular repositioning; Microimplant

INTRODUCTION

Facial asymmetry is defined as a status of unequal facial features between the left and right sides relative to the mid-sagittal plane.[1] A previous study[2] reported that the perception of facial asymmetry is mainly affected by the extent of chin deviation, and with regard to this issue, orthodontists were most sensitive to the asymmetry, followed by general dentists and laypersons. However, recently, patients have become highly interested in correcting facial asymmetry for esthetics, even when the extent of asymmetry is small.[3,4] For adult patients with moderate to severe facial asymmetry, improving facial asymmetry usually requires orthognathic surgery.[5,6] In the case of mild asymmetry, surgery is typically not accepted by patients; hence, an orthodontic approach should be sought.

The conventional approach for reducing chin deviation in facial asymmetry treatment involved the facilitation of mandibular position changes after the intrusion of the maxillary teeth on the nondeviated side.[7] The force applied directly from the maxillary to the mandibular bone might offer another approach. Park[8] reflected that mandibular position can be successfully adjusted using intermaxillary elastics between microimplants that are placed in each jaw. If this is accompanied by appropriate bone remodeling of the condyle, as previously reported,[9–11] long-term stability of the adjusted mandibular position may be achieved.

Compensatory tooth movement occurs when the mandible has deviated. A previous study[12] on patterns of dental compensation in patients with facial asymmetry demonstrated transverse occlusal canting due to extruded maxillary molars on the nondeviated side, buccal tipping of the maxillary molars on the deviated side, and lingual tipping of the mandibular molars on the deviated side. Dental compensation occurs even in patients with mild facial asymmetry and should be

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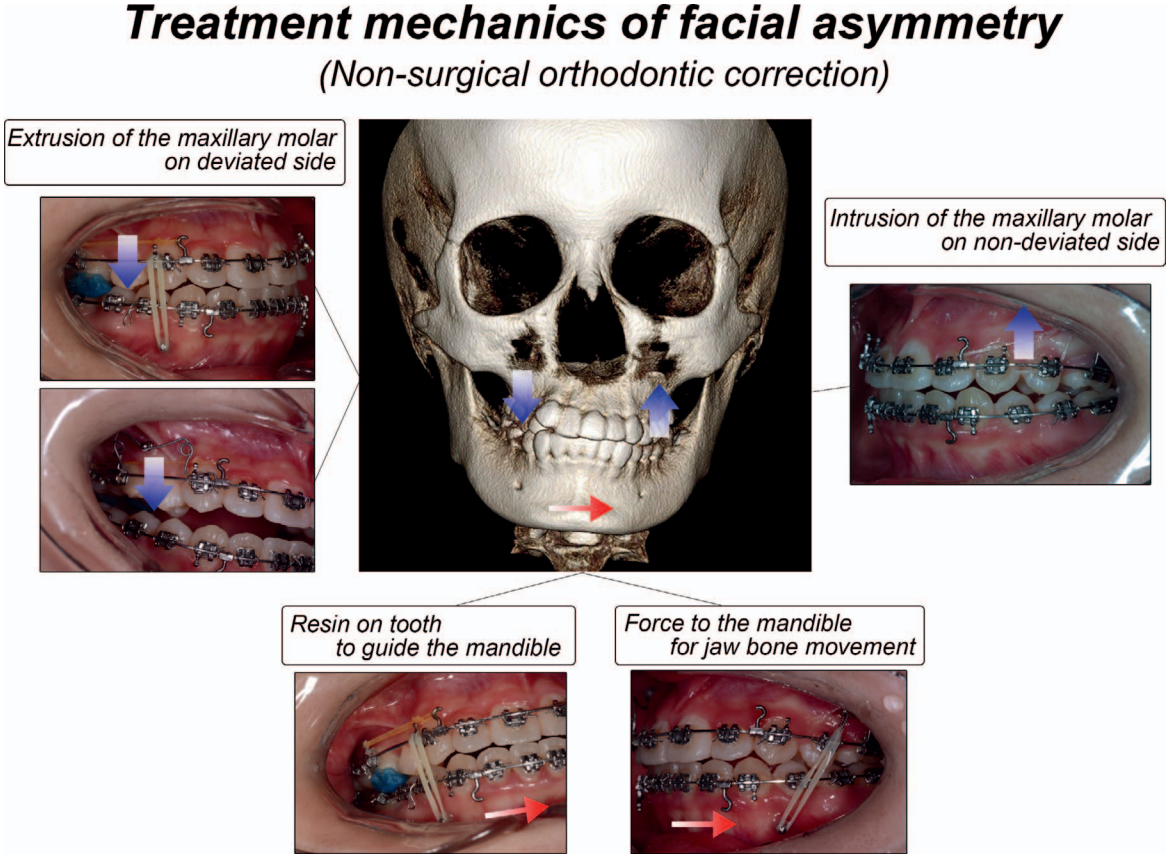

Figure 1. A brief summary of the nonsurgical orthodontic treatment mechanics in a patient with facial asymmetry.

resolved when treating facial asymmetries. This is significant work to accomplish better symmetry of the face when correcting the deviant mandible by moving it to the nondeviated side.

Nonsurgical Orthodontic Treatment Mechanics in Patients with Facial Asymmetry

As shown in Figure 1, successful orthodontic intervention to correct facial asymmetry without a surgical approach should include moving the deviant mandible steadily to the nondeviated side by applying intermaxillary elastics between the microimplants in each jaw[8] and by producing lateral functional force, properly guided by a resin that is bonded on the tooth of the deviated side. Concurrently, to enhance the mandibular movement and stabilize the acquired mandibular position after treatment, accurate dental decompensation, including correction of the transverse occlusal cant and inclination of the posterior teeth, is mandatory.[4,7] Importantly, the movements should be implemented slowly and cautiously, taking jaw function and condylar position into consideration. Using this approach, patients with facial asymmetry can achieve a better-balanced face and improved esthetics. By applying direct forces between microimplants in the maxillary and mandibular bones and inducing lateral functional forces opposite to deviant forces from the asymmetric mandible from the resin guide on the maxillary first molar of the deviated side, along with selective intrusion or extrusion of teeth, the deviant mandible can be moved to the nondeviated side by differential growth or remodeling of the condyles.

This article presents a case of facial asymmetry management using a nonsurgical orthodontic treatment approach that involved moving the mandible to the nondeviated side and resolving dental compensation. The critical factors related to the treatment mechanics and long-term stability in this patient will also be discussed.

Diagnosis and Etiology

A 13-year-old female was concerned about maxillary dental crowding and visited the Department of Orthodontics at the Kyungpook National University Dental Hospital in Daegu, Republic of Korea (Figure 2). The patient presented with a 2-mm overbite and overjet, Class II molar relationship on the right side, and Class I canine and molar relationships on the left side. The maxillary and mandibular arch length discrepancies were −11.5 mm and −3 mm, respectively. In the facial

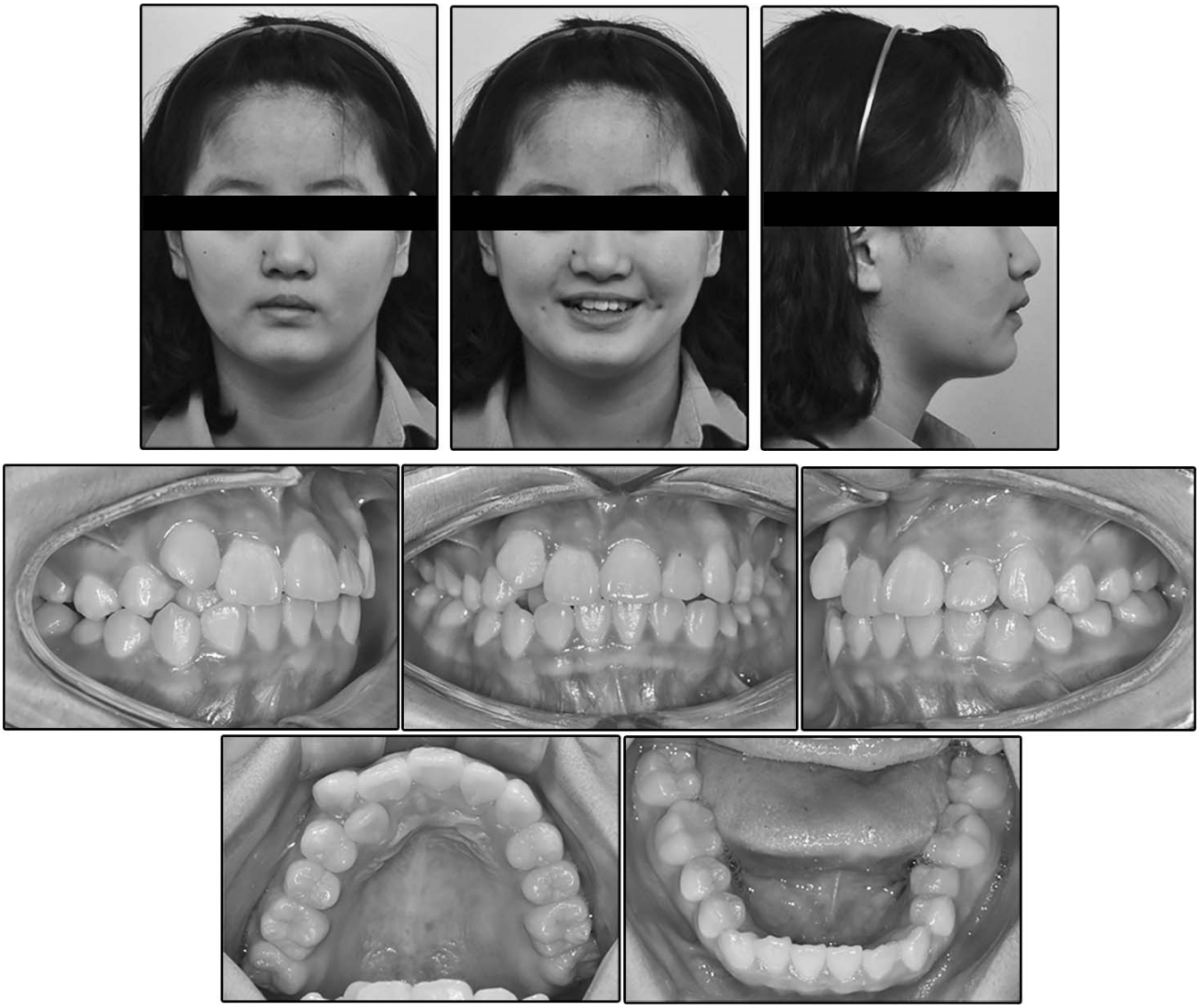

Figure 2. Pretreatment facial and intraoral photographs.

photographs, the facial asymmetry, with a deviated chin to the right and a lip canted-down toward the deviated side, was observed.

As presented in Figure 3 and Table 1, the patient had a skeletal Class I relationship (SNA, 82.8°; SNB, 80.1°; ANB, 2.7°) and a hypodivergent skeletal pattern (FMA, 21.6°). The maxillary incisors were inclined labially (U1 to FH, 121.9°).

Three-dimensional analysis of the images using cone-beam computed tomography (CBCT) revealed a mandibular asymmetry, with a right-sided deviation of the menton of 5.0 mm (Figure 4). The ramus height and body length on the left side were longer than those on the right side by 4.1 mm and 1.3 mm, respectively. The etiology of the asymmetry might have been asymmetric mandibular growth. Dentally, the left maxillary first molar was extruded by 3.0 mm compared with that of the right, leading to a transverse occlusal cant.

Treatment Objectives

The treatment objectives were to accomplish appropriate tooth alignment with well-interdigitated occlusion and to improve the degree of facial asymmetry by correcting the transverse cant of the teeth and moving the mandible to the nondeviated side.

Treatment Alternatives

Considering that the facial asymmetry was accompanied by a deviant mandible and transversely canted maxilla, orthognathic surgery, including Le Fort I osteotomy to correct the transverse cant of the maxilla and bilateral sagittal split ramus osteotomy to obtain

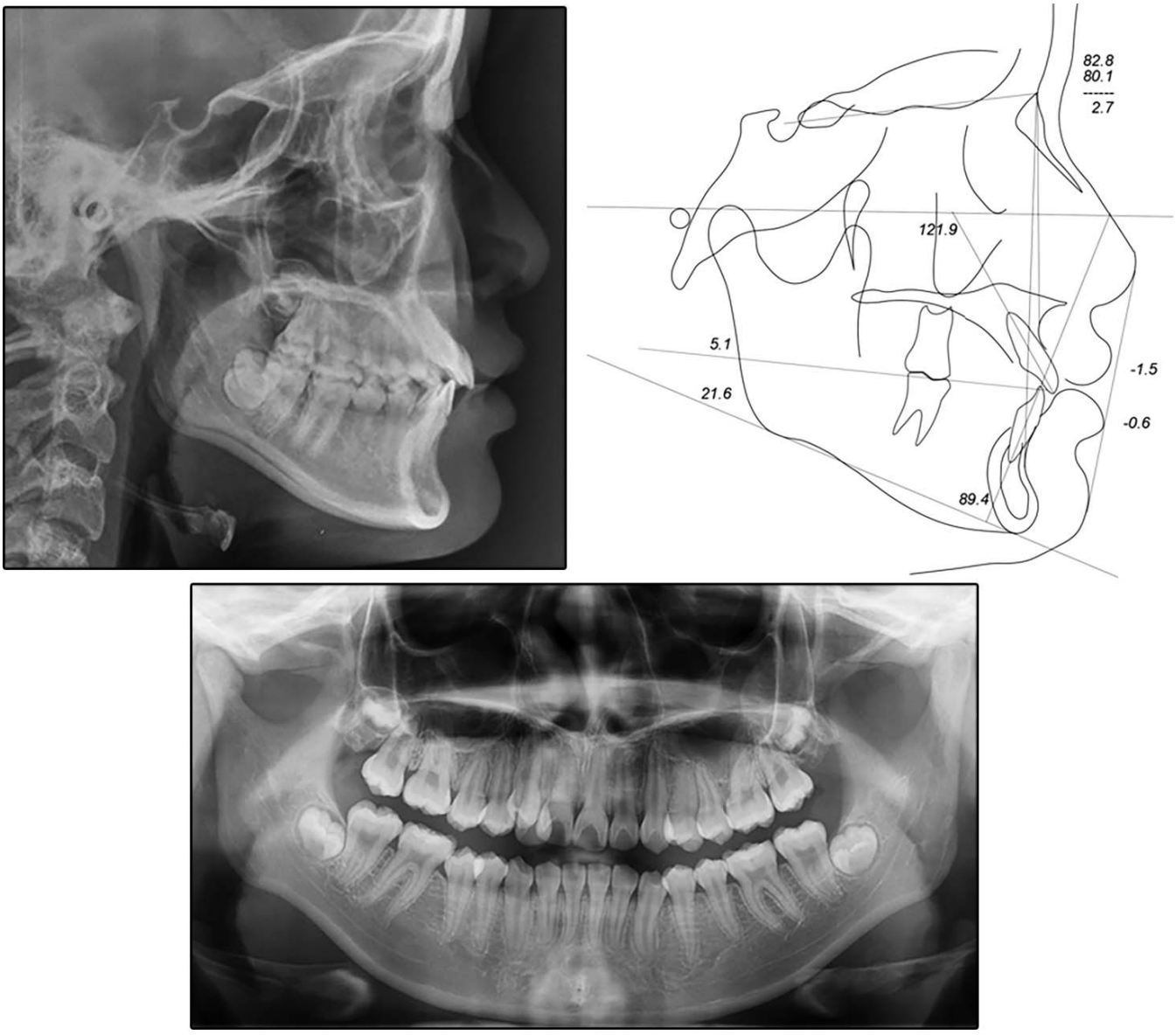

Figure 3. Pretreatment cephalometric and panoramic radiographs and cephalometric tracing.

Table 1. Cephalometric Measurements

Measurements	Pretreatment	Posttreatment (65 mo)	Retention (53 mo)
Skeletal			
SNA, °	82.8	81.9	81.8
SNB, °	80.1	77.9	78.0
ANB, °	2.7	4.0	3.9
FMA, °	21.6	25.1	24.5
Dental			
U1 to FH, °	121.9	113.8	116.4
IMPA, °	89.4	96.6	98.4
FH to occlusal plane, °	5.1	10.7	7.9
Soft tissue			
Upper lip to E-line, mm	−1.5	−2.2	−2.5
Lower lip to E-line, mm	−0.6	−1.1	−1.3

mandibular symmetry, was indicated. Another option might have been correction of the occlusal cant using microimplants, followed by sliding genioplasty for the correction of the chin asymmetry.[13] However, the patient and her parents refused surgical intervention and consented only to align the teeth with orthodontic treatment.

Therefore, an alternative intervention without orthognathic surgery was identified. To relieve dental crowding, which was the patient's main concern, extraction of the maxillary first premolars was planned. In addition, to improve the deviant mandible, moving the mandible to the nondeviated side along with correction of the transverse occlusal cant was planned using microimplants.

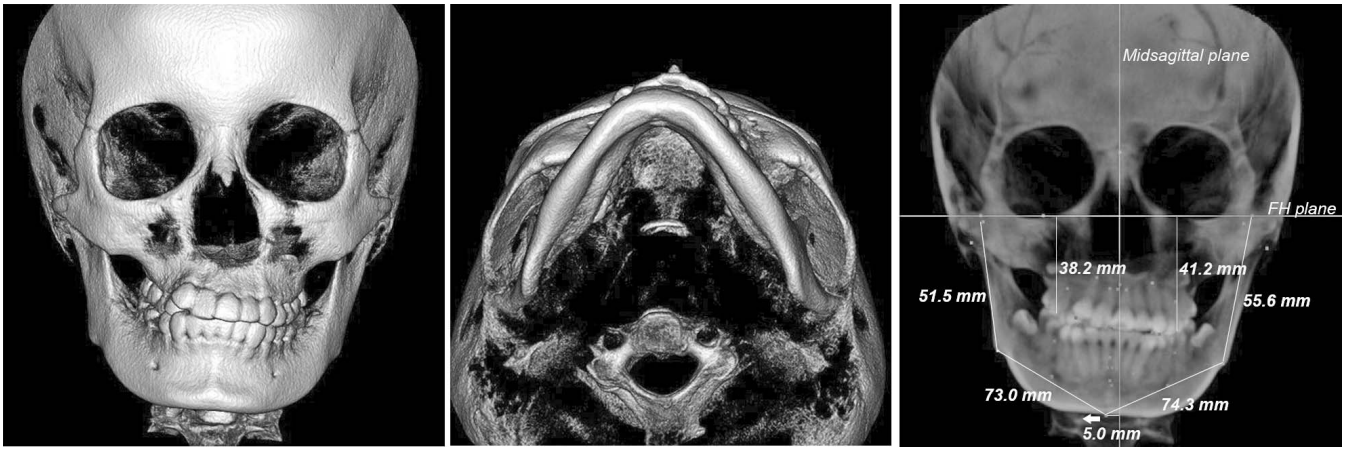

Figure 4. Pretreatment three-dimensional images of cone-beam computed tomography and the skeletal and dental measurements. FH, Frankfort horizontal.

Treatment Progress

Both maxillary first premolars were extracted, and pre-adjusted brackets (0.022 × 0.025-inch slot) were bonded to both dental arches. After tooth alignment, a 0.017 × 0.025-inch stainless-steel archwire was placed in the maxilla at 9 months into treatment (Figure 5A). A maxillary microimplant (Absoanchor, SH1312-07, Dentos Co, Ltd, Daegu, Korea) was placed between the second premolar and first molar on the left side, and an intrusive force was immediately applied with an elastomeric thread (Square thread®, ST-045, Dentos Co, Ltd) from the microimplant to the maxillary canine and second premolar on the same side. Resin was bonded to the lingual surface of the right maxillary canine to guide the mandible to the left side. The guide resin was added to gradually move the mandible to the contralateral side, as required. At 10 months of treatment, a mandibular microimplant (Absoanchor, SH1413-06, Dentos Co, Ltd) was placed between the right canine and first premolar, and extrusive force was applied to the maxillary dentition from the microimplants with elastics (Figure 5B,C). To enhance the mandibular movement to the nondeviated side, a microimplant (Absoanchor, SH1413-06, Dentos Co, Ltd) was also placed between the mandibular canine and first premolar on the left side, and a Class III elastic (one-quarter inch, 5 ounce) force was applied between the microimplants of both jaws on the left side (Figure 5C). Additionally, guide resin was bonded to the lingual slope of the buccal cusp of the right maxillary first molar. Subsequently, to enhance extrusion of the right maxillary dentition, an extrusion spring (made of a 0.016 × 0.022-inch beta-titanium wire) was applied that was reinforced by a microimplant (Absoanchor, SH1312-07, Dentos Co, Ltd) placed between the second premolar and first molar on the right side (Figure 5D). All treatment procedures were performed gradually and cautiously, with periodic reviews to evaluate the mandibular movement and temporomandibular joint functions and to address any discomfort.

At 65 months, treatment was completed after achievement of a symmetrical face with well-interdigitated occlusion (Figure 6). For retention, anterior lingual bonded retainers and wraparound retainers on both arches were provided. To stabilize the shifted mandibular position, a Class III elastic was used between the microimplants of both jaws on the left side for 19 months. After observing stable retention, the use of Class III elastics was stopped, and the microimplants were removed.

Treatment Results

After completing the comprehensive treatment, the facial asymmetry of the patient significantly improved. A well-balanced chin was visible, and the resting lip cant relative to the interpupillary line was alleviated (Figure 6). Additionally, proper occlusal interdigitation with Class I canine and Class II molar relationships was observed, and the dental midline matched the facial midline.

As shown in Figure 7 and Table 1, extrusion of the right maxillary teeth during the treatment led to a clockwise rotation of the mandible. As a result, the FMA and ANB angles were increased.

Three-dimensional analysis of the CBCT images indicated resolution of the chin deviation by a 5.7-mm movement of the menton to the left side (Figures 8 and 9A). The difference between the right and left ramus heights was reduced after treatment, with a decrease in the left ramus height of 4 mm. Regarding the vertical distance of the maxillary first molars relative to the Frankfort horizontal plane, the initial

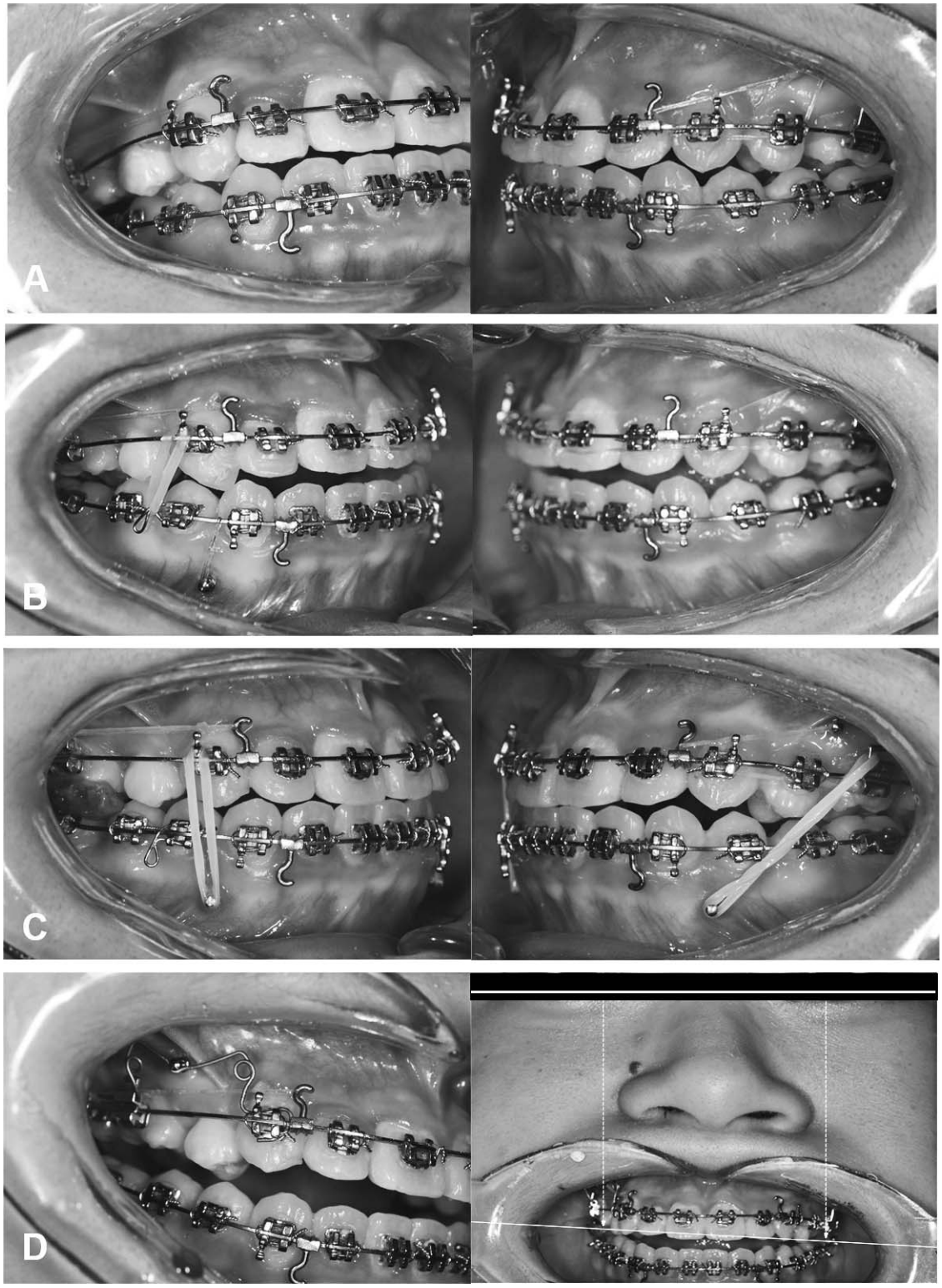

Figure 5. Treatment progress. (A) At 9 months of treatment, a resin guide was bonded to the maxillary right canine to guide the mandible to the left side, and intrusive force to the left maxillary canine and second premolar was applied from the microimplant. (B) At 10 months of treatment, extrusion of the right maxillary teeth was accomplished using elastics from the mandibular teeth supported by the mandibular microimplant. (C) At 23 months of treatment, continued extrusive forces on the right maxillary teeth, a resin guide on the right maxillary first molar, and skeletal Class III elastics between the microimplants of both jaws were used to facilitate mandibular movement to the nondeviated side. (D) Application of the extrusive spring from the microimplant for more extrusion of the right maxillary teeth and correction of the remaining transverse occlusal cant.

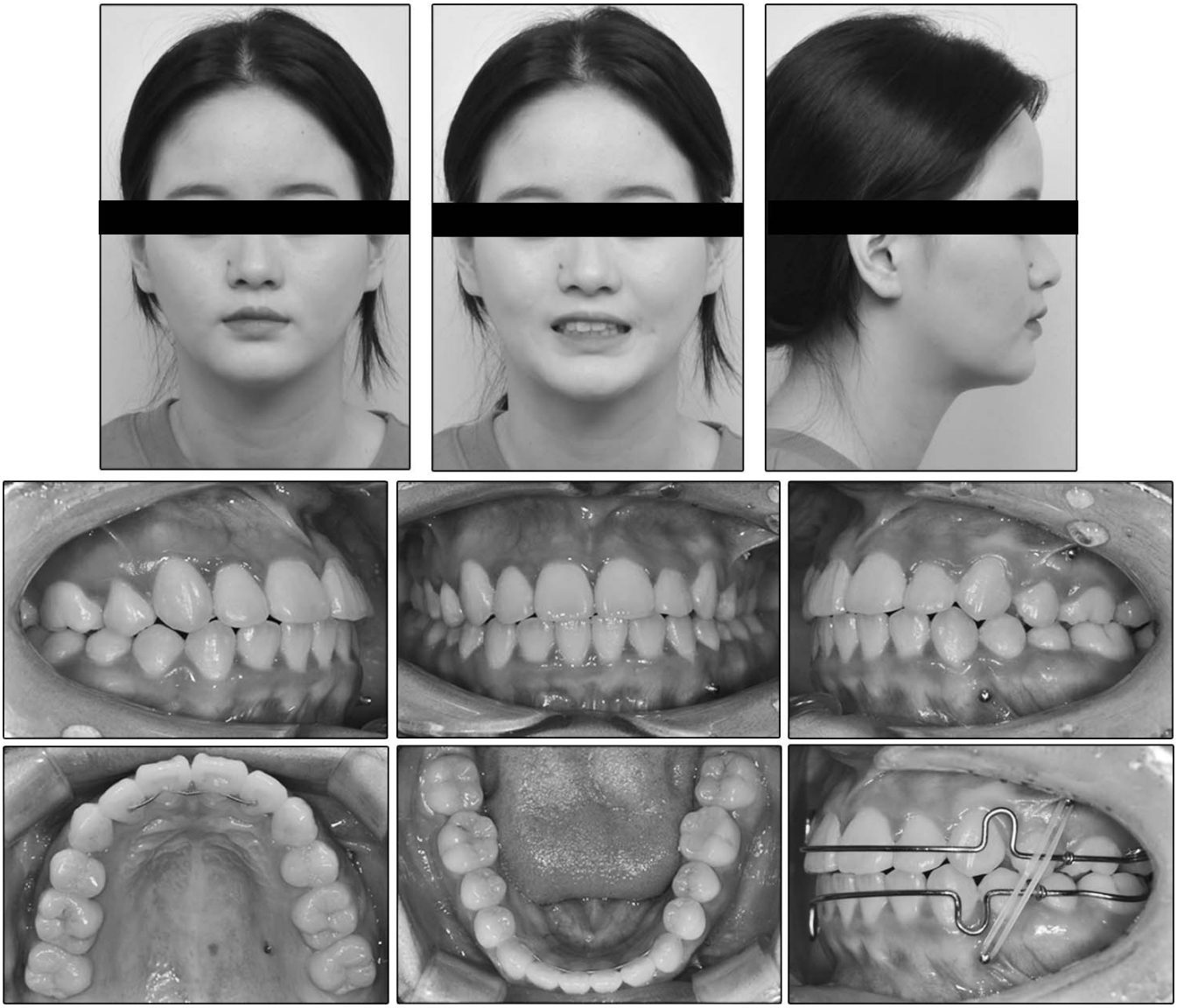

Figure 6. Posttreatment facial and intraoral photographs.

transverse cant of the maxillary molar was corrected after treatment as a result of 1.0 mm of intrusion on the left side and 2.5 mm of extrusion on the right side (Figure 9B). Bone remodeling of the condyle occurred favorably as the mandible moved laterally (Figure 9C–G).

After 53 months of retention, the facial symmetry and tooth position were well maintained, with favorable occlusal interdigitation (Figures 10 through 12). During the maintenance check-up, the patient showed good functional movements of the jaw, without any adverse signs or symptoms. The three-dimensional evaluation indicated a certain degree of relapse in menton position; however, the jaw position was generally stable, along with good condylar integrity (Figures 9H and 13).

DISCUSSION

Recently, patient interest in obtaining treatment to improve facial symmetry is becoming more prevalent than ever before. Orthognathic surgery is considered a suitable option for the treatment of facial asymmetry. However, an additional surgical cost, in addition to the cost of orthodontic treatment, along with consideration of the possible complications from surgery might be considered as contraindications to surgery. In cases involving mild facial asymmetry with a small menton deviation of <2 mm, the amount of surgical error, ranging from 0.4 to 3 mm,[14] can be similar to or greater than the initial deviation. Thus, orthognathic surgery is not indicated for mild facial asymmetries. Instead, orthodontic correction may be required for correcting such asymmetry.

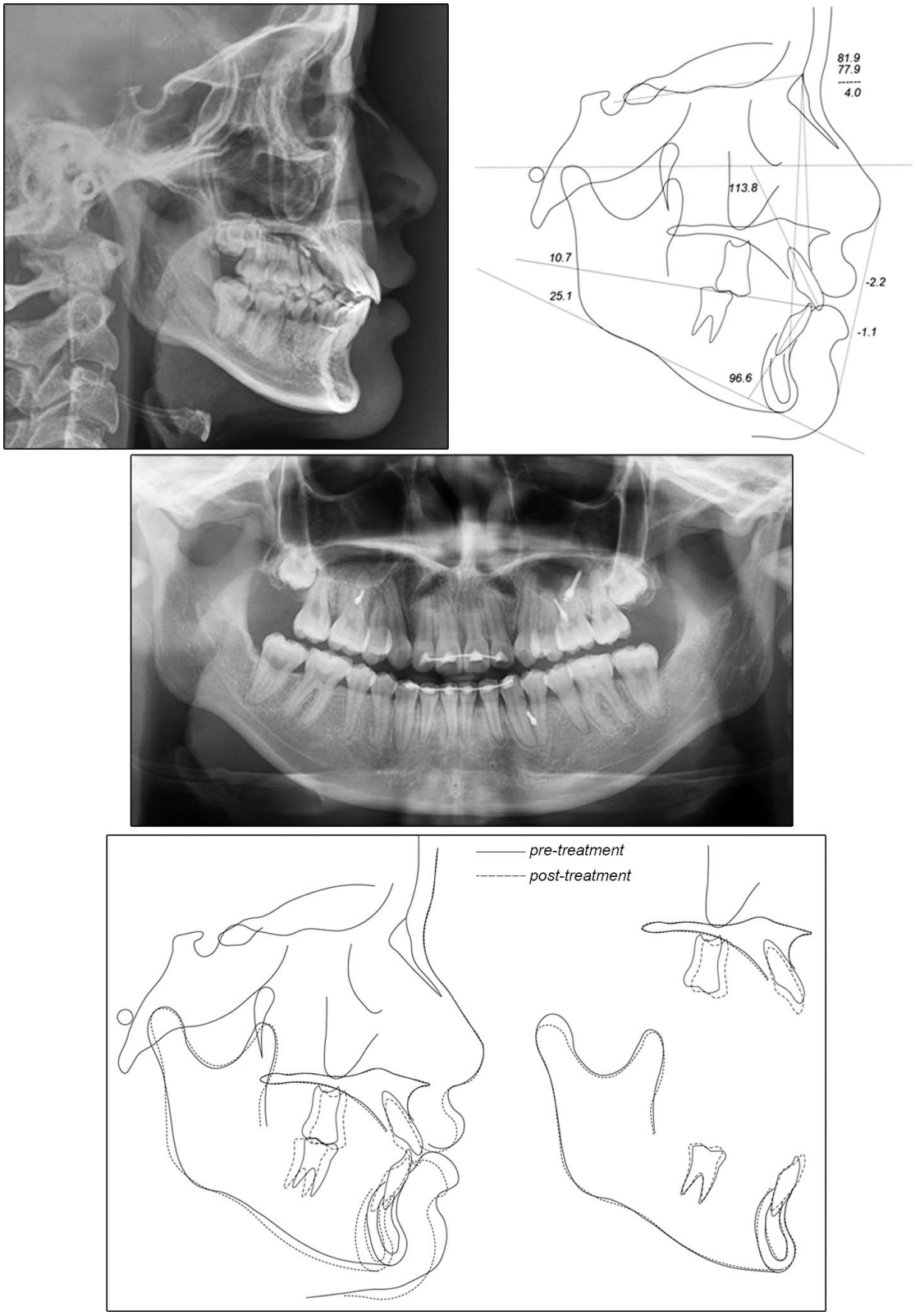

Figure 7. Posttreatment cephalometric and panoramic radiographs, cephalometric tracing, and superimposition of pretreatment (solid line) and posttreatment (dashed line) images.

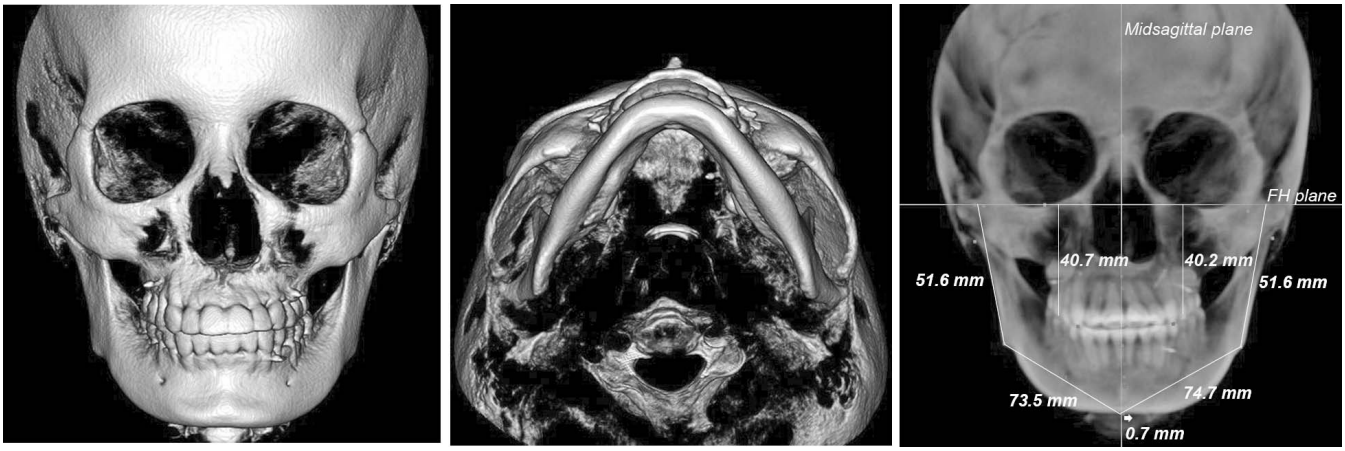

Figure 8. Posttreatment three-dimensional images of cone-beam computed tomography and the skeletal and dental measurements. FH, Frankfort horizontal.

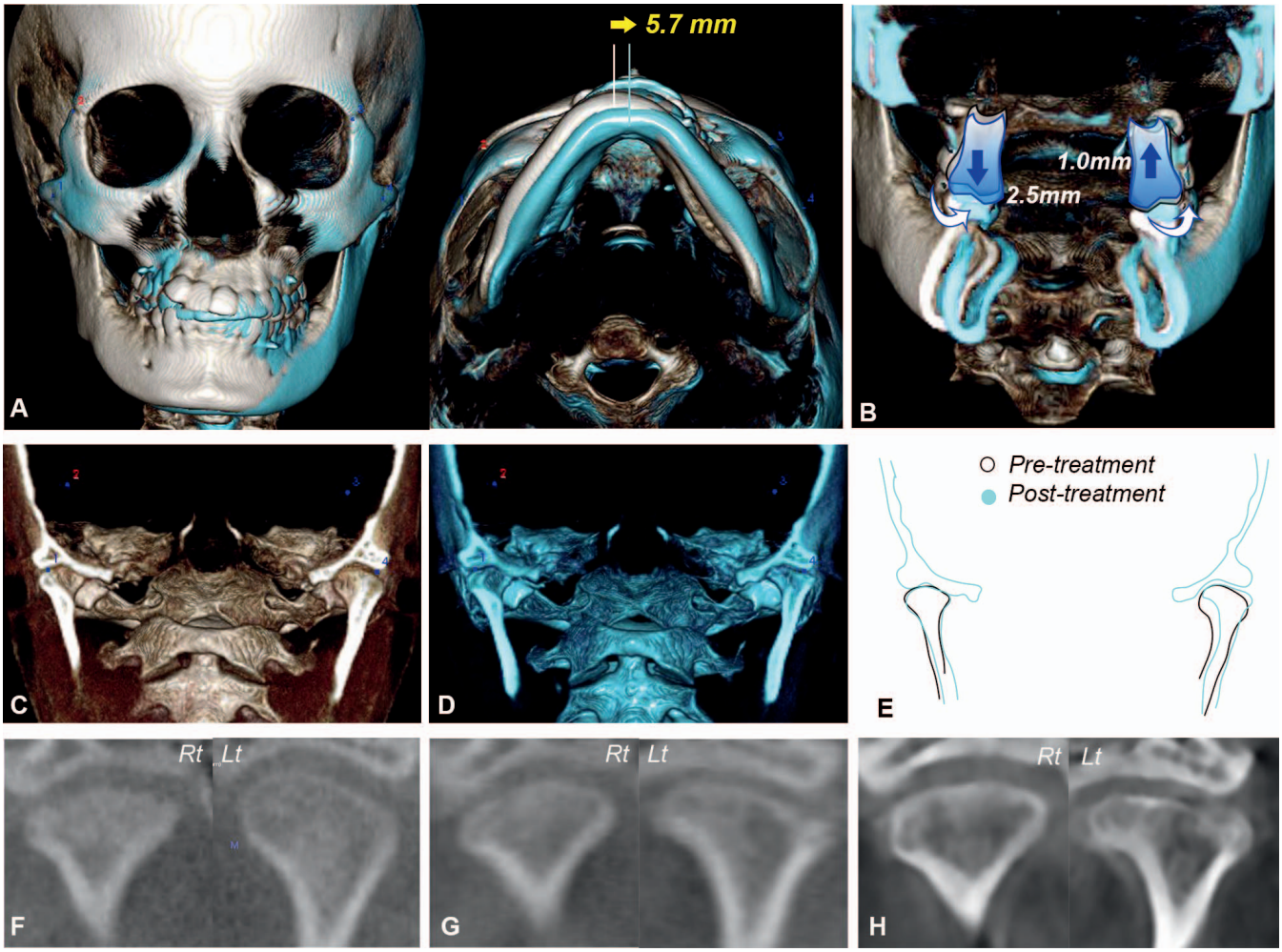

Figure 9. Reconstructed cone-beam computed tomography images. (A and B). Three-dimensional superimposition of the pre-treatment (white) and posttreatment (blue) images (A, frontal and submentovertex views; B, posterior half of coronal section). (C and D) Frontal views of the three-dimensional condylar image (posterior half of the coronal section; C, pretreatment; D, posttreatment). E, Superimposed condylar images of pre-treatment (black) and posttreatment (blue). F–G, Coronal-sectioned views of the condyle (F, pretreatment; G, posttreatment; H, 53 months after treatment).

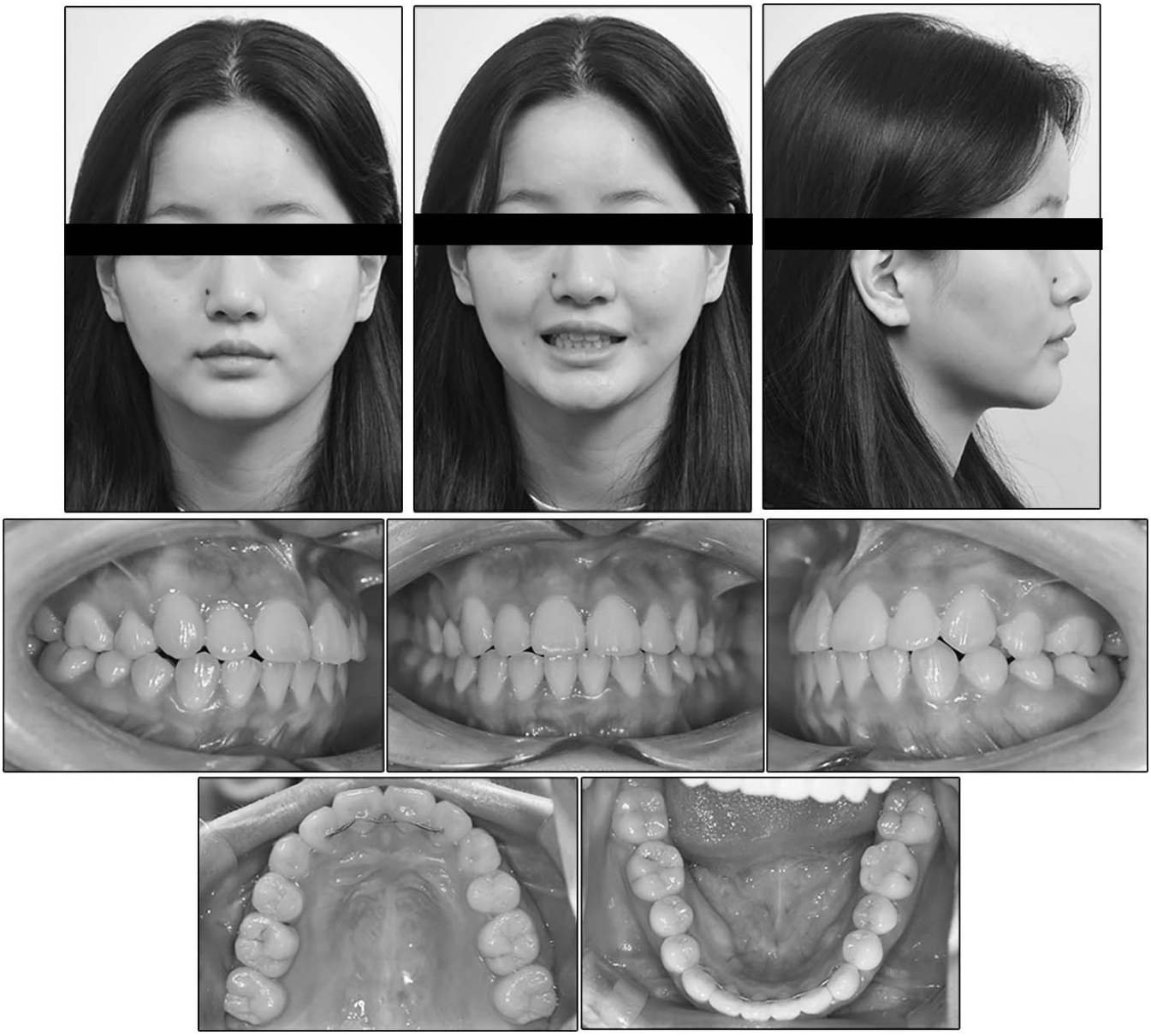

Figure 10. Retention (53 months after treatment) facial and intraoral photographs.

In this case, the patient's facial asymmetry improved markedly by moving the mandible to the nondeviated side using intermaxillary elastics between microimplants placed in both jaws.[8] In addition, the resin guide that was bonded to the maxillary posterior tooth on the deviated side was very effective in shifting the mandible to the nondeviated side. Along with the role of guiding the mandible, the resin guide might produce nonuniform contacts of occlusion and less occlusal contacts on the nondeviated side. This might act as a lateral functional force to shift the mandible toward the nondeviated side. In other words, intentional functional force could be applied to the mandible toward the end of correcting mandibular asymmetry as a mechanism opposite to that for the development of facial asymmetry from a posterior crossbite.[15,16] Hence, the condyle on the nondeviated side might experience heavier loading, while the teeth previously had no or fewer occlusal contacts on that side. Consequently, bone resorption on the condyle of the nondeviated side might occur, resulting in improvement of the facial asymmetry. This finding was similar to that of a previous study[17] that demonstrated adaptive condylar resorption following functional loading force. The procedures for mandibular repositioning were performed gradually and cautiously over a long-term treatment period to provide sufficient time for bone remodeling and muscular adaptation.

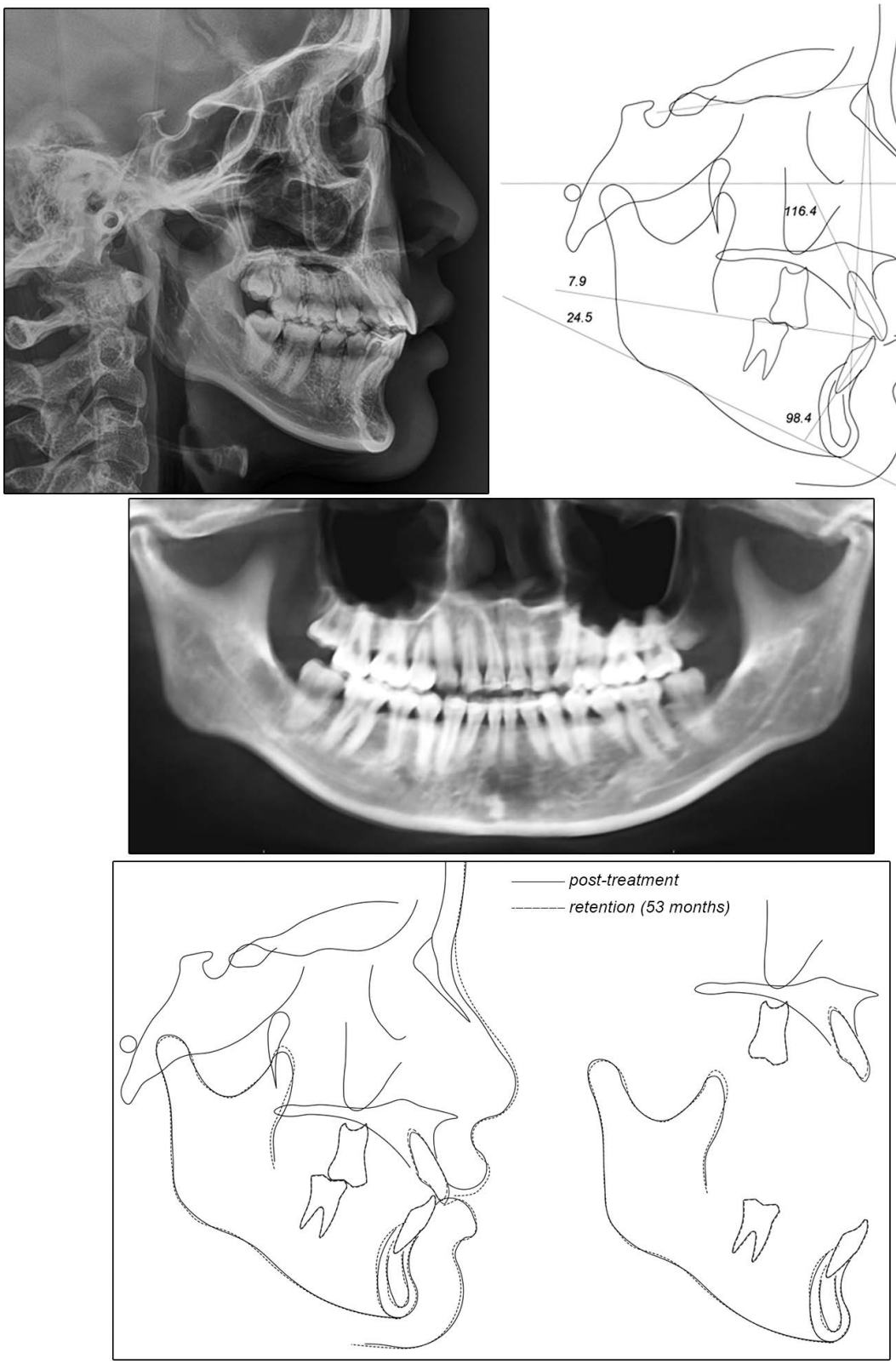

Figure 11. Retention (53 months after treatment) cephalometric and panoramic radiographs, cephalometric tracing, and superimposition of posttreatment (solid line) and retention (dashed line) images.

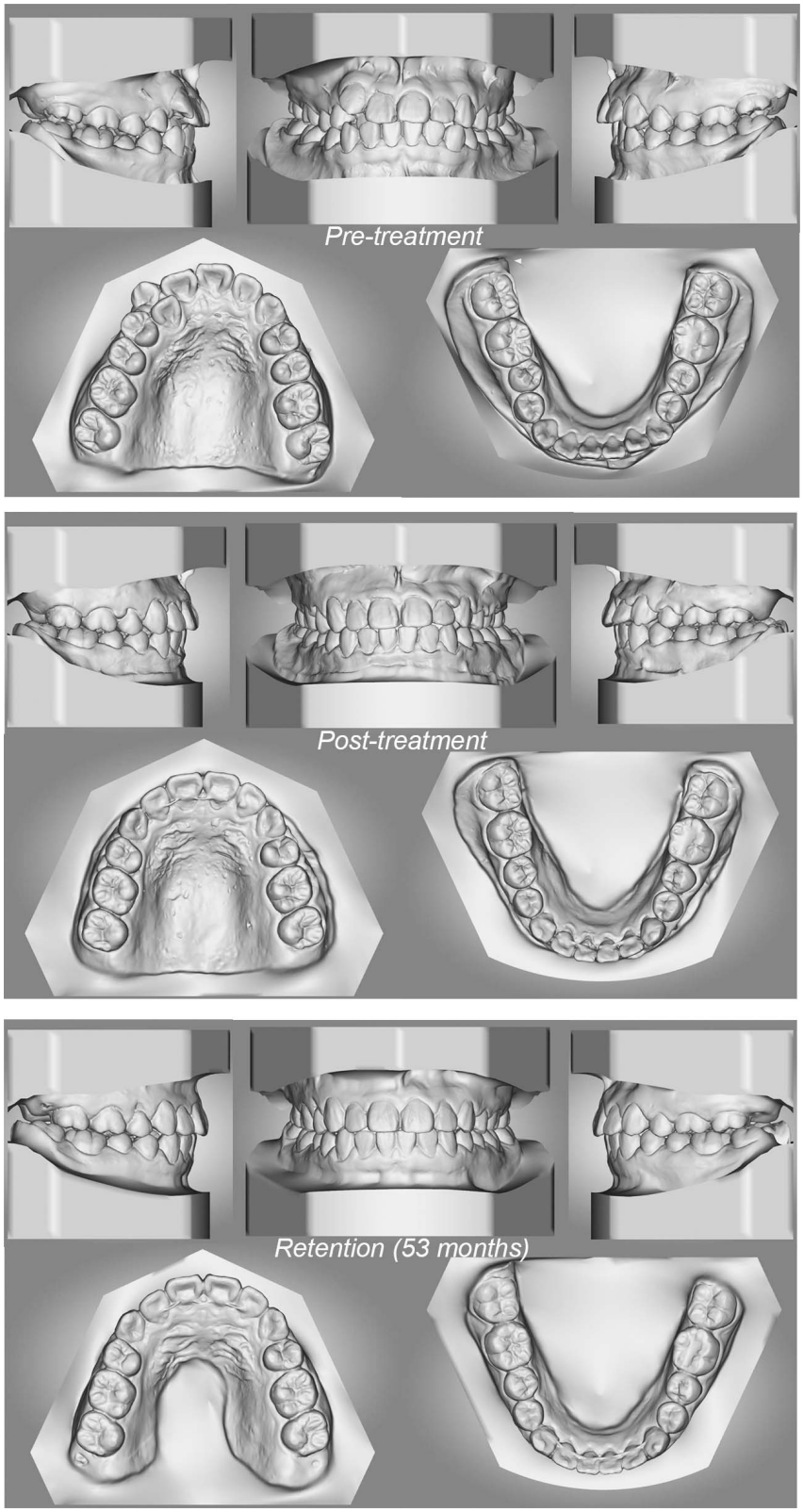

Figure 12. Digital dental models (upper, pretreatment; middle, posttreatment; lower, after 53 months of retention).

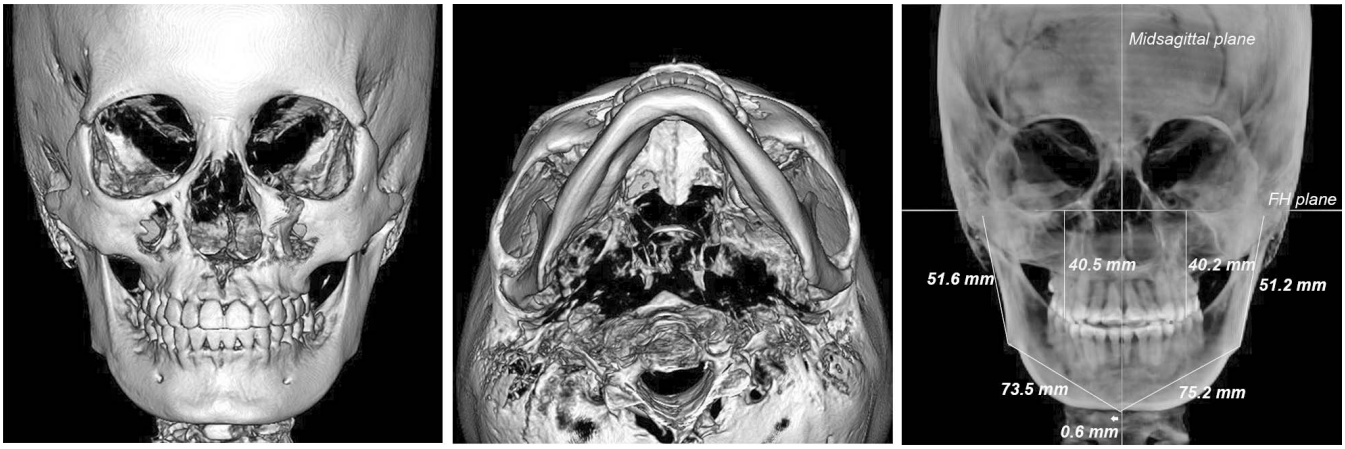

Figure 13. Retention (53 months after treatment) three-dimensional cone-beam computed tomography images and skeletal and dental measurements. FH, Frankfort horizontal.

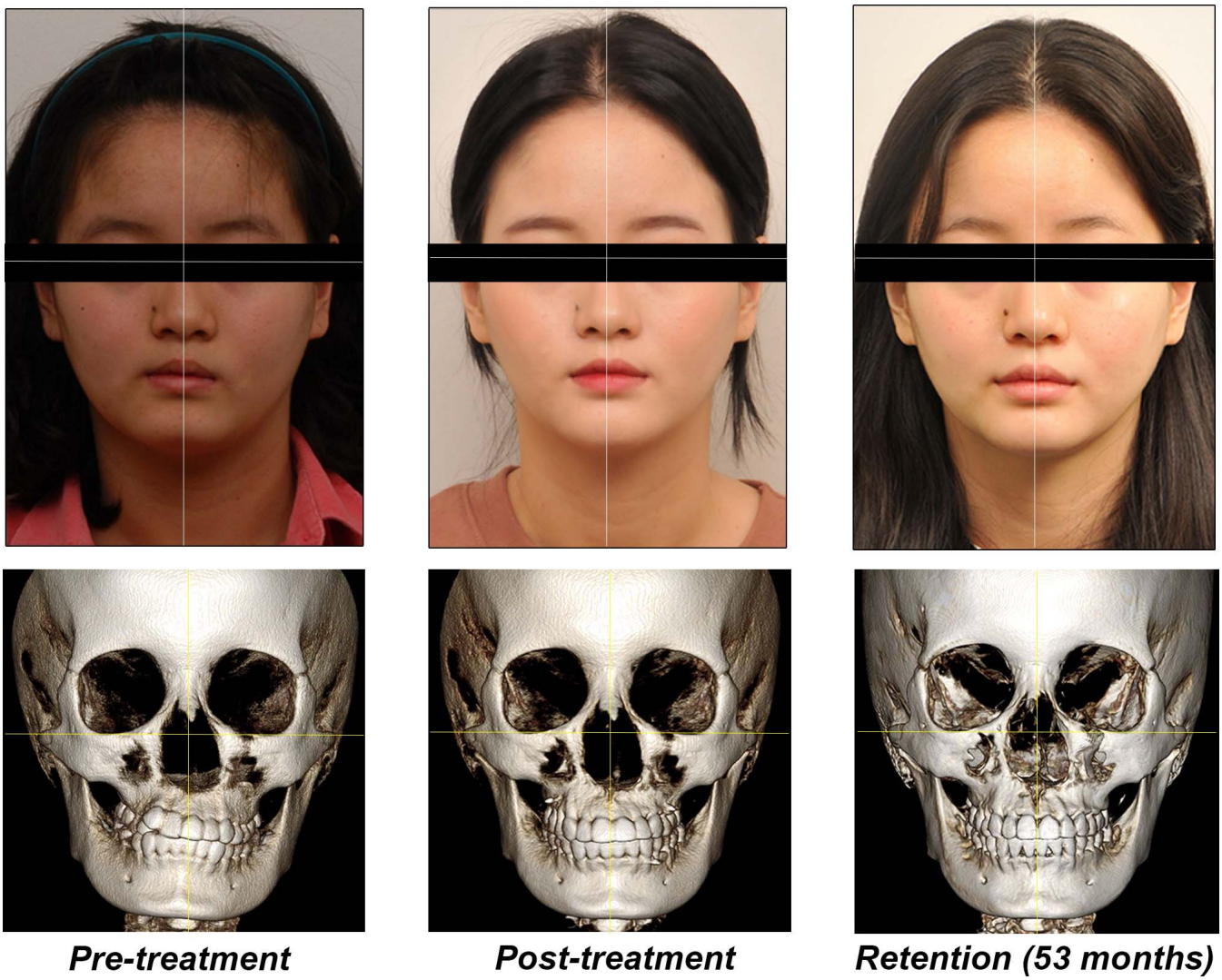

Figure 14. Serial comparison of the facial photographs and three-dimensional skeletal images.

The transverse cant of the maxillary dentition should be corrected during facial asymmetry treatment. Correction of the transverse occlusal cant can be obtained in two ways with microimplants, including extrusion of the side canted up or intrusion of the side canted down. This approach can be modified based on the skeletal pattern of patients. In hyperdivergent patients, the intrusion of the teeth on side canted down can be chosen, while extrusion of the teeth on the side canted up should be performed in hypodivergent patients. Additionally, the two movements can be combined in patients with normodivergent skeletons. The present patient had a hypodivergent skeletal pattern, and the transverse cant was corrected with more extrusion on the side canted up than intrusion on the side canted down. Once extruded, this might also lead to intrusion of the mandibular dentition on the corresponding side to some extent as a result of heavy occlusal contacts. Thus, the correction of the mandibular occlusal cant was achieved after treatment. Consequently, no obvious increase in the ramus height on the deviated side occurred.

The microimplant should hold the vertically extruded tooth positions during mandibular repositioning and mandibular dental movement. If the mandibular dentition has no transverse cant, the vertical position of the mandibular teeth could have been held with the microimplants to maximize mandibular bone repositioning.

Simultaneously, during the intrusive and extrusive tooth movements, buccal and lingual tipping of the nondeviated and deviated sides occurred, respectively (Figure 9B). On the nondeviated side, the intruded maxillary teeth with increased buccal overjet accommodated mandibular movement to that side. On the deviated side, the extruded maxillary teeth with decreased buccal overjet confined the mandible to the nondeviated side. Consequently, as shown in Figure 14, long-term treatment, with deliberate movements of the mandible and teeth, noticeably improved the patient's facial asymmetry. The prolonged progressive intervention also facilitated long-term stability after treatment. The mandible was shifted gently and gradually at a slow rate, with regular review to evaluate jaw function and discomfort. Thus, consistent with previous studies,[10,11,18] the condyle was favorably remodeled, and jaw function remained stable even 53 months after treatment. As shown in Figure 12, a well-established occlusion that maintained the mandible in a steady position may also be crucial for long-term stability.

CONCLUSIONS

- This case report illustrates a noteworthy treatment modality using microimplants, without surgical intervention, in a patient with facial asymmetry.
- Gradual and cautious mandibular repositioning using functional force, selective intrusion of the teeth, a resin guide, and direct force applied from microimplants placed in the upper and lower jaws could ensure not only satisfactory facial symmetry but also long-term stability, thereby optimizing the esthetic outcome.

ACKNOWLEDGMENTS

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