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Total Maxillary Arch Distalization by Using Headgear in an Adult Patient: Reconsidering the Traditional Strategy in Modern Orthodontics

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Abstract

Although headgear is rarely used in adult patients, its use in adults is mainly for anchorage control. In the current case report, a 24-year-old patient had a skeletal Class I relationship with a Class II tendency, brachyfacial pattern, significant facial asymmetry, and dental 3/4 cusp Class II molar and canine relationships on both sides. The patient declined surgery, and facial asymmetry was not his concern. The final treatment goal was to achieve a stable Class I dental relationship and normal occlusion without significantly compromising the patient's profile. The patient was compliant with the use of cervical-pull headgear after he refused the options of orthodontic-orthognathic combined treatment, maxillary premolar extraction, or temporary skeletal anchorage mini-implants. A 5-mm maxillary arch distal movement was accomplished without significant distal tipping of the molar crowns. The active treatment duration was 31 months. Proper overbite and overjet, balanced occlusion, and an acceptable facial profile were achieved. The treatment results inspire reconsideration of the possibility of using headgear in dental Class II correction in adult patients. (Angle Orthod. 2021;91:267-278).

Keywords

Adult, Distalization, Headgear, Adult, Cephalometry, Humans, Male, Malocclusion, Angle Class II, Maxilla, Orthodontic Anchorage Procedures, Tooth Movement Techniques, Young Adult, adult, case report, cephalometry, diagnostic imaging, human, male, malocclusion, maxilla, orthodontic anchorage, orthodontic tooth movement, surgery, young adult

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Case Report

Total maxillary arch distalization by using headgear in an adult patient: *Reconsidering the traditional strategy in modern orthodontics*

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ABSTRACT

Although headgear is rarely used in adult patients, its use in adults is mainly for anchorage control. In the current case report, a 24-year-old patient had a skeletal Class I relationship with a Class II tendency, brachyfacial pattern, significant facial asymmetry, and dental 3/4 cusp Class II molar and canine relationships on both sides. The patient declined surgery, and facial asymmetry was not his concern. The final treatment goal was to achieve a stable Class I dental relationship and normal occlusion without significantly compromising the patient's profile. The patient was compliant with the use of cervical-pull headgear after he refused the options of orthodontic-orthognathic combined treatment, maxillary premolar extraction, or temporary skeletal anchorage mini-implants. A 5-mm maxillary arch distal movement was accomplished without significant distal tipping of the molar crowns. The active treatment duration was 31 months. Proper overbite and overjet, balanced occlusion, and an acceptable facial profile were achieved. The treatment results inspire reconsideration of the possibility of using headgear in dental Class II correction in adult patients. (*Angle Orthod.* 2021;91:267–278)

KEY WORDS: Headgear; Distalization; Adult

INTRODUCTION

Among all patients in permanent dentition, 19.63% have Class II malocclusion,[1] with the underdevelopment of the mandible being more frequent than maxillary prognathism.[2–5] In adult patients, orthognathic surgery is considered in cases with a large mandibular discrepancy. For moderate to mild mandibular deficiency, dental compensation could be considered by leaving either the large overjet uncorrected to benefit the profile or maxillary anterior tooth retraction to achieve a Class I canine relationship with a slightly flattened profile.[6,7]

Maxillary molar distalization in adult patients could be achieved by skeletal anchorage devices (TADs) without the critical problem of patient compliance.[8] However, because TADs are invasive intervention procedures, not all patients accept them.[9,10] Meanwhile, slippage and migration of TADs, root damage, and soft-tissue embedding are common complications that challenge the success of TADs.[9] Thus, for patients suffering from skeletal anchorage device failure[11] or refusing TADs,[12] traditional appliances could be alternative maxillary molar distalization strategies.

Particularly, headgear is a common appliance for treating adolescents with Class II malocclusion.[13,14] Although cervical-pull headgear (CPHG) is mainly

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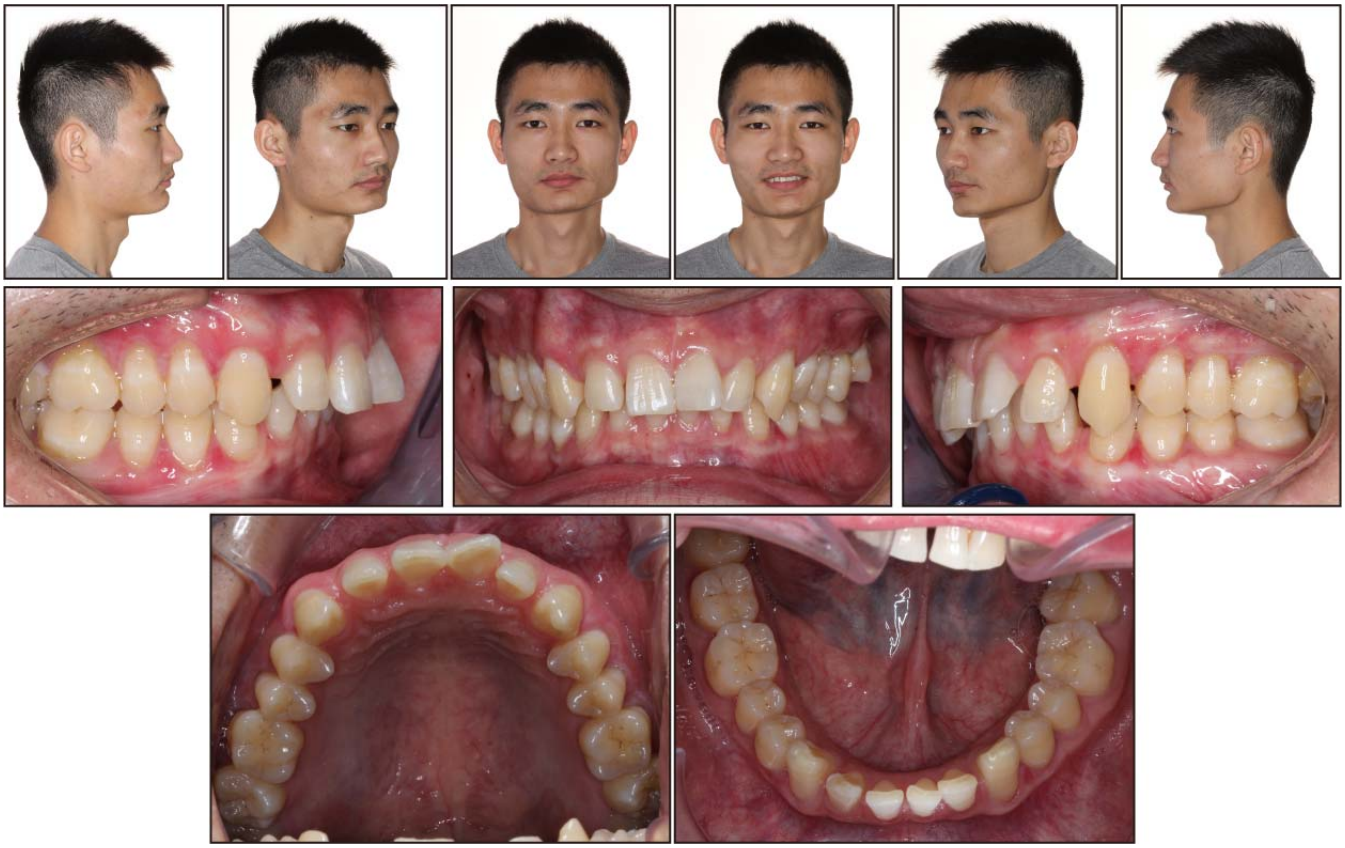

Figure 1. Pretreatment extraoral and intraoral photographs.

used to modify the sagittal growth of the maxilla, it can also be used for maxillary molar distalization.[15] To date, headgear is not popular for adult usage, and if used, it is mainly considered as an anchorage device.[8,16–18] This case report aims to explore the potential use of headgear in distalizing the entire maxillary arch in adult patients, which would extend the current application of headgear.

Diagnosis and Etiology

A 24-year-old Asian man presented with a chief complaint of a "rotated" upper left front tooth. The patient had an alimentary tract hemorrhage 1 year before the orthodontic consultation and had been hospitalized for 5 days. The patient was otherwise healthy, was not taking any medication, or did not have any known drug allergies. At age 14, the patient had a removable orthodontic appliance, which was applied to correct the rotated upper left central incisor (UL1). He had no regular visits to a general dentist, and he reported pain on the UL1 upon heat stimulation over the past 4 years.

Extraoral examination (Figure 1; Table 1) showed the following: anterior-posteriorly, the patient had a convex profile with a normal upper lip position (upper lip to E-plane, –2.2 mm), retrusive and everted lower lip (lower lip to E-plane, –5.4 mm), and a strong chin point; transversely, significant facial asymmetry was noticed with a shorter lower facial height on the left side than that on the right side; and vertically, the patient presented a brachyfacial pattern with short lower facial height. No mentalis strain or lip incompetence at rest was noted. He also exhibited 70% incisor display with no gingival display on the smile.

Intraoral examination (Figures 1–3; Table 1) showed, anterior-posteriorly, 3/4 cusp Class II molar and canine relationships on both sides, with an overjet of 8.1 mm. The upper incisors were proclined and protrusive (U1-NA 7.2 mm, 37.0°). The lower incisors were proclined and normotrusive (L1-NB 3.0 mm, IMPA 106.0°). Transversely, the occlusal plane canted up on the left. The upper midline was 2 mm to the left; the lower midline was 1 mm to the left. Buccal crossbite was present on UL7-8, and there was a deep curve of Wilson with LL7-8. Vertically, impinging overbite was present (5.0 mm). The curve of Spee was severe (4 mm on the right, 3 mm on the left). There were arch length excesses of 3.4 mm and 3.2 mm in the maxillary and mandibular arches, respectively. A total Bolton discrepancy of 1.6 mm mandibular excess was also observed. The patient's oral hygiene was fair. Calculus

Table 1. Cephalometric Comparisons

Parameter	Asian Norm[a] Mean	Asian Norm[a] SD	Pretreatment	Posttreatment	Change
Skeletal					
SNA, °	85.1	3.3	79.7	79.1	−0.6
SNB, °	81.6	3.5	76.4	76.5	0.1
ANB °	3.5	1.4	3.3	2.6	−0.7
Occlusal plane to SN, °	14.4	2.5	6.6	18.5	11.9
Pog-NB, mm	3.0	1.7	6.4	5.8	−0.6
SN-MP, °	32.9	5.2	19.0	20.1	1.1
FMA (MP-FH), °	28.2	6.6	11.2	12.4	1.2
Convexity (A-NPo), mm	0.1	2.0	−0.2	−0.6	−0.4
Wits appraisal (using functional occlusal plane), mm	−0.6	2.6	3.4	−0.9	−4.3
Dental					
Maxillary dentition					
U1-SN, °	114.6	6.3	116.7	95.9	−20.8
U1-NA, mm	4.3	2.7	7.2	−0.2	−7.4
U1-NA, °	22.8	5.7	37.0	16.9	−20.1
U1-APo, mm	3.5	2.3	7.0	−0.7	−7.7
U1-APo, °	28.0	4.0	36.5	15.5	21.0
Mandibular dentition					
FMIA (L1-FH), °	65.7	8.5	61.6	62.4	0.8
IMPA (L1-MP), °	94.4	5.4	106.0	108.4	2.4
L1-NB, mm	4.0	1.8	3.0	1.4	−1.6
L1-NB, °	25.3	6.0	24.1	23.2	−0.9
L1-APo, mm	2.0	2.3	−1.4	−2.6	−1.2
L1-APo, °	22.0	4.0	27.9	27.2	−0.7
Maxillary/mandibular dentition					
Interincisal angle (U1-L1), °	130.0	6.0	115.6	137.3	21.7
Molar relation, mm	−3.0	1.0	4.1	−1.2	−5.3
Overjet, mm	2.5	2.5	8.1	2.2	−5.9
Overbite, mm	2.5	2.0	5.0	1.4	−3.6
Soft tissue					
Upper lip to E-plane, mm	−0.3	2.2	−2.2	−4.5	−2.3
Lower lip to E-plane, mm	1.7	2.2	−5.4	−6.2	−0.8
Soft-tissue convexity, °	130.0	4.0	133.3	135.0	1.7

[a] Refer to Gu Y, McNamara JA Jr, Sigler LM, Baccetti T. Comparison of craniofacial characteristics of typical Chinese and Caucasian young adults. *Eur J Orthod*. 2011;33:205–211.

on the lingual surface and generalized gingival recession of the full dentition were noted. The full-mouth series X-rays (Figure 3) revealed periapical radiolucency at UL1 and mild generalized horizontal alveolar bone loss. A Class IV lesion was seen on LR2.

The lateral cephalometric X-ray (Figure 3; Table 1) displayed that the patient was skeletal Class I with a Class II tendency, whereas both the maxilla and mandible were retrognathic (SNA 79.7°, SNB 76.4°, ANB 3.3°, Wits appraisal 3.4 mm referencing the functional occlusal plane). The patient had a brachyfacial pattern (SN-MP 19.0°, FMA 11.2°) with a prominent chin (A-NPo -0.2 mm). Cervical vertebral maturation stage (CVMS) V indicated that the patient was at least 2 years after the mandibular growth peak.

Treatment Objectives

The treatment objectives were to achieve (1) ideal overjet and overbite, (2) normal occlusion with Class I canine relationships on both sides, (3) stable and functional occlusion, and (4) minimize the facial profile flattening as the patient refused orthognathic surgery.

Treatment Alternatives

The proposed option for this patient was combined orthodontic-orthognathic treatment due to severe skeletal asymmetry and retrognathic maxilla and mandible. After presurgical orthodontic setup, Le Fort I osteotomy and mandibular BSSO advancement would be performed to correct the skeletal Class II, roll movement of the maxillomandibular complex with impaction on the right side would address the occlusal cant and mandibular asymmetry, and clockwise rotation of the maxillomandibular complex would increase the lower facial height and improve the smile arc. Genioreduction would help to improve the profile.

For nonsurgical options, bilateral U4 extraction and whole maxillary arch distalization were offered. Facial asymmetry and skeletal Class II tendency would be

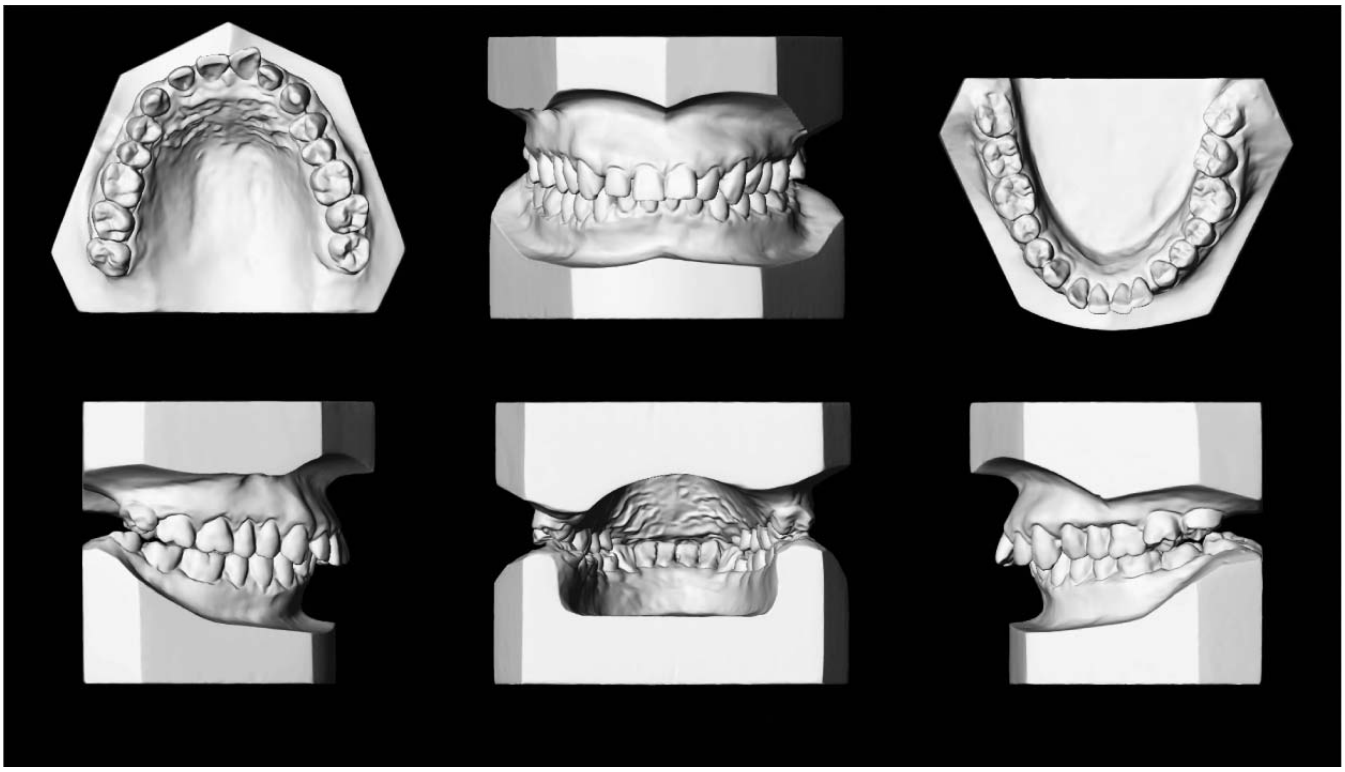

Figure 2. Pretreatment dental casts.

maintained. The profile would be flattened by upper lip retraction.

The patient denied orthognathic surgery because facial asymmetry was not his concern. He also rejected premolar extraction and TAD placement. Therefore, after a detailed discussion of the pros and cons of each option, a treatment plan involving headgear to distalize the maxillary arch was selected and well-accepted by the patient. A possibly prolonged treatment time and the critical role of his compliance were emphasized.

Treatment Progress

Medical, periodontic, and endodontic clearances were obtained before starting orthodontic treatment. After extraction of the third molars, the upper and lower 3-7 were bonded and banded with 0.022 MBT brackets/bands and leveled and aligned with NiTi archwires (0.016 inches, 0.016 $\times$ 0.022 inches, 0.017 $\times$ 0.025 inches, and 0.019 $\times$ 0.025 inches). The buccal crossbite on UL7 was corrected with cross elastics (3/16 inches, 6 oz). After 3-7 generalized space closure with power chains, L2-2 were bonded and consolidated. All the spaces in the lower arch were then closed with closing loops, and the lower arch was stabilized with 0.021 $\times$ 0.025-inch stainless steel wire (Figure 4).

After 8 months of treatment, U3-7 were lace-tied together. CPHG with Series 5 facebow (size 5, 3M Oral Care, St Paul, Minn; catalog No. 328-251) was delivered to initiate U3-7 distalization. The intraoral bow was adjusted to be passively inserted in the headgear tubes of the U6 bands and to be parallel to the occlusal plane (Figure 5). There was at least 4 mm of clearance between the facebow and the maxillary incisors. Extraorally, the outer bow was angled superiorly to be at the same level as the center of resistance of the U6s (Figure 5) and connected to Traction Release Cervical Headgear Release Modules (3M Oral Care, catalog No. 415-009) at the distal side of U6s. A heavy force (26 oz) was selected because 10 teeth (U3-7 on both sides) were distalized at the same time. Thus, the magnitude of the force that each tooth received was within the orthodontic force range. The patient was directed to wear the headgear at least 12 hours per day. For each appointment, the headgear was adjusted to maintain the consistency of the force level, force direction, and the clearance between the facebow and maxillary incisors. In addition, the patient was asked to demonstrate the headgear delivery and removal in front of the orthodontist. Whether the patient's operation was proficient or not was used to justify the patient's compliance with wearing the headgear.

After 12 months of headgear wear, bilateral Class I molar relationships were achieved. U2-2 were then bonded and consolidated (Figure 6). The patient was instructed to continue wearing headgear at nighttime

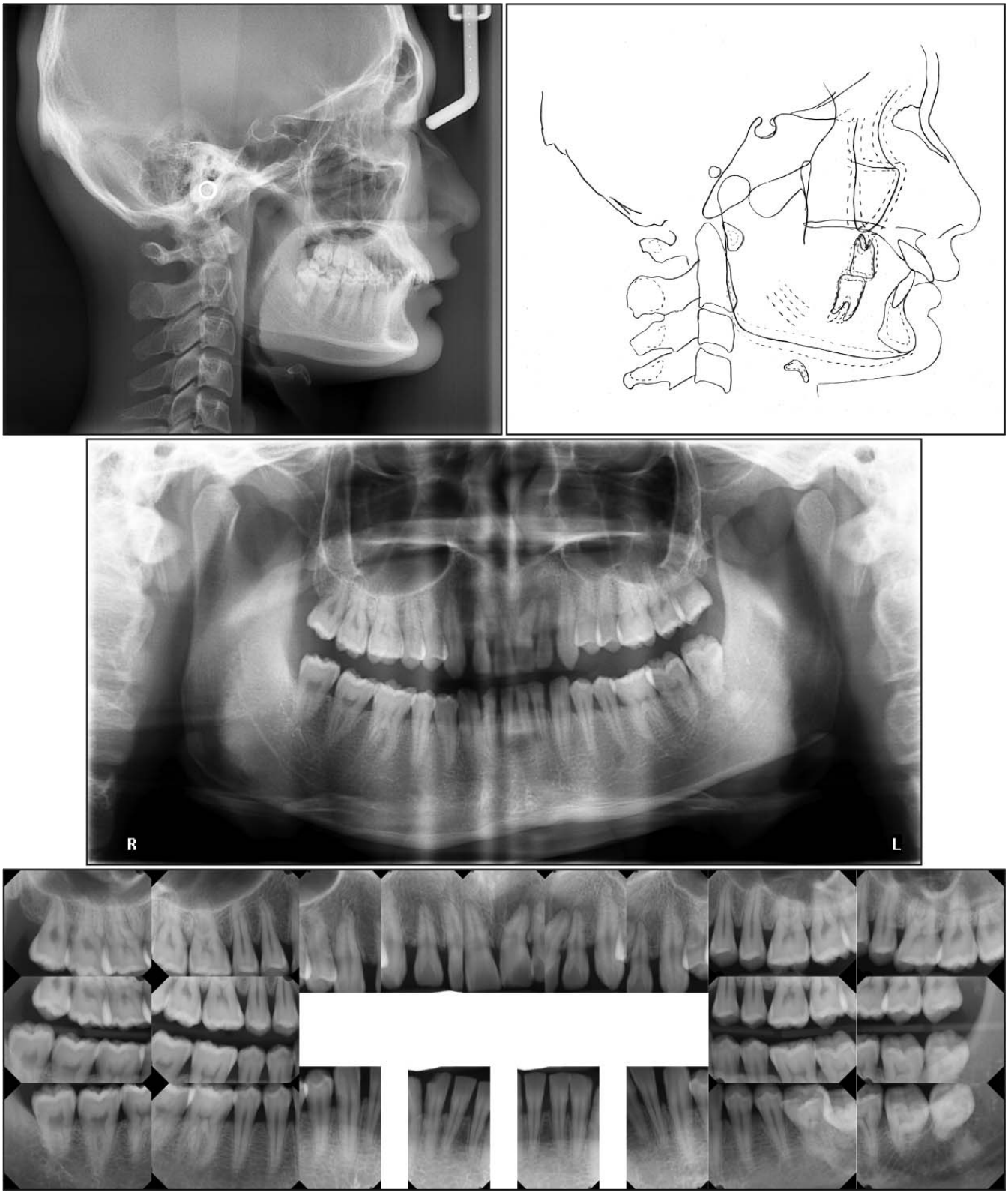

Figure 3. Pretreatment lateral cephalometric radiograph, cephalometric tracing, panoramic radiograph, and full-mouth series x-rays.

Figure 4. Treatment progress photographs: initial leveling and aligning (8 months in active treatment).

only for anchorage maintenance during U2-2 retraction. Once the orthodontic objectives had been achieved, the fixed appliances were removed, and circumferential retainers were delivered. The patient was instructed to wear the retainers 22 hours per day for 6 months and then gradually reduce the wear time.

Treatment Results

The patient reported about 16 hours per day headgear wear during the U3-7 distalization period and 10 hours per day headgear wear during the U2-2 retraction period. The intraoral photographs and dental casts (Figures 7 and 8) showed satisfactory dental alignment, bilateral Class I canine and molar relationships, and ideal overjet and overbite. Good buccal interdigitation was achieved. Dental midlines were coincident with the facial midline, and protrusive and canine guidance was obtained. The radiographic examination (Figure 9) showed satisfactory root parallelism and preserved alveolar ridge heights.

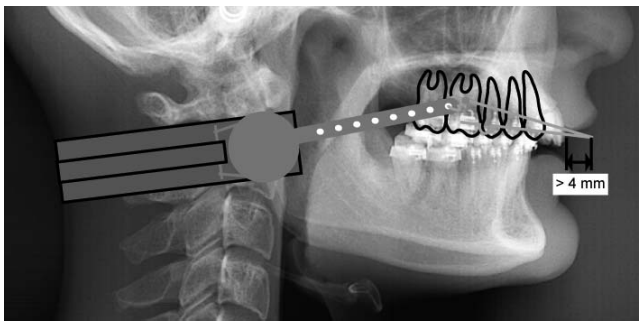

Figure 5. Diagram of the cervical pull headgear. Lateral cephalometric x-ray of the patient right before the delivery of the headgear was used. The dot indicates the center of resistance of the maxillary first molar.

The cephalometric superimposition (Figure 10; Table 1) demonstrated that the skeletal Class II tendency had been reduced due to slight retraction of A point (SNA decreased from 79.7° to 79.1°; ANB from 3.3° to 2.6°). The maxillary incisors were retracted 7.4 mm (U1-NA diminished from 37.0°/7.2 mm to 16.9°/–0.2 mm), while the mandibular incisors were slightly retracted (L1-NB reduced from 24.1°/3.0 mm to 13.2°/1.4 mm). Following the incisor retraction, the lips flattened as anticipated (upper lip to E-plane changed from –2.2 mm to –4.5 mm, lower lip to E-plane from –5.4 mm to –6.2 mm). U6s had been efficiently distalized by 5 mm and extruded by 2 mm. A total of 4.5 mm intrusion of mandibular incisors and 0.5 mm extrusion of L6s contributed to the correction of the deep curve of Spee.

The dental cast comparison based on the anterior-posterior position of 6s (Figure 11; Table 2) demonstrated that the intermolar width was maintained and the intercanine width was slightly decreased for both maxillary and mandibular arches.

DISCUSSION

There are few reports of the use of headgear to distalize the entire maxillary arch in adult patients. Previously, a 44.3-year-old male patient was treated with a Jones jig and bite plate to distalize the maxillary molars, followed by straight-pull headgear to assist the retraction of premolars and canines.[19] The pre- and posttreatment superimposition showed that the Class II

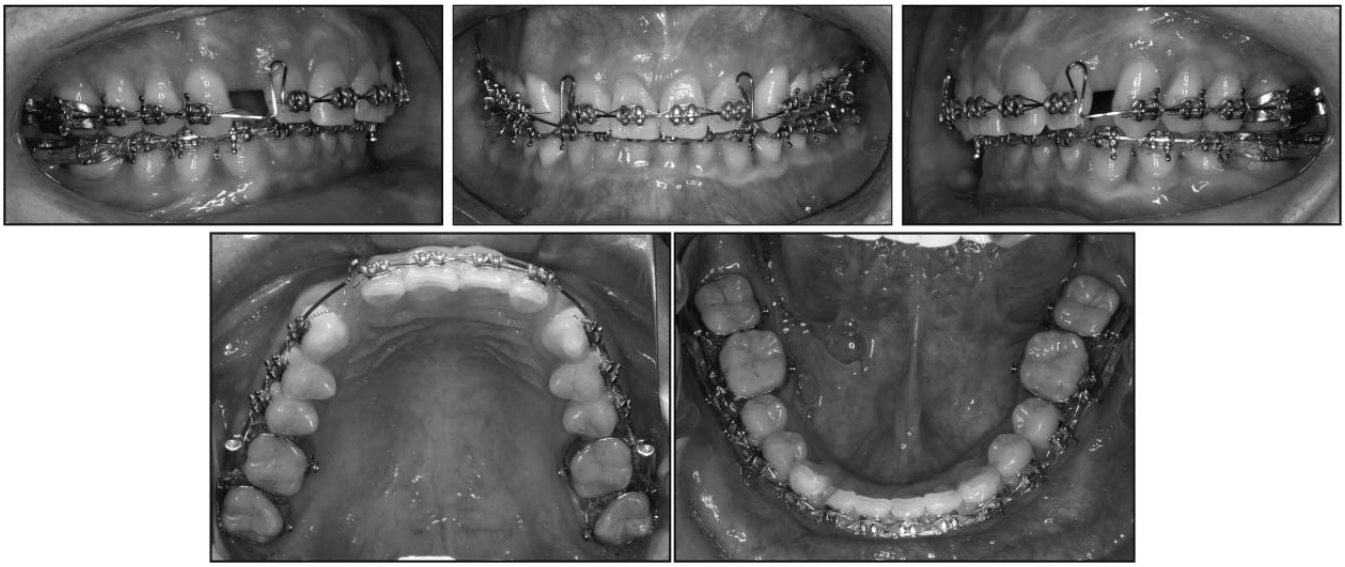

Figure 6. Treatment progress photographs: 1-year cervical-pull headgear wear (20 months in active treatment).

correction was accomplished by ~1-mm maxillary molar distalization and ~2-mm mandibular molar mesialization.[19] In addition, a 20-year, 3-month-old female patient had superelastic nickel-titanium alloy wire and J-hook headgear.[20] A significant amount of sagittal correction was obtained by ~2-mm maxillary molar distalization and 6.5-mm gain of maxillary intercanine width.[20] In addition, in a study of 22 patients (age 23.0 ± 7.7 years) who received treatment with CPHG for total arch distalization showed that the

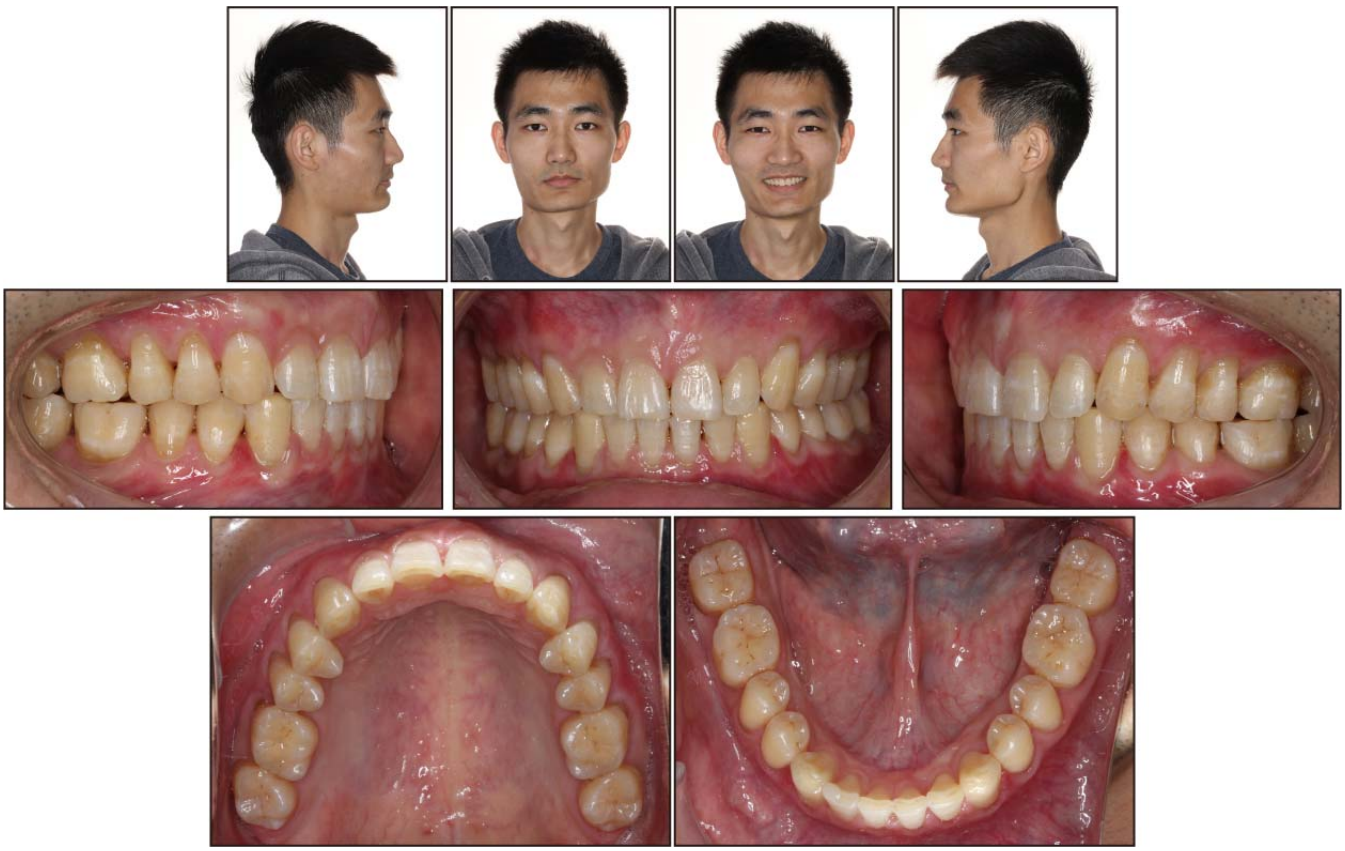

Figure 7. Posttreatment extraoral and intraoral photographs.

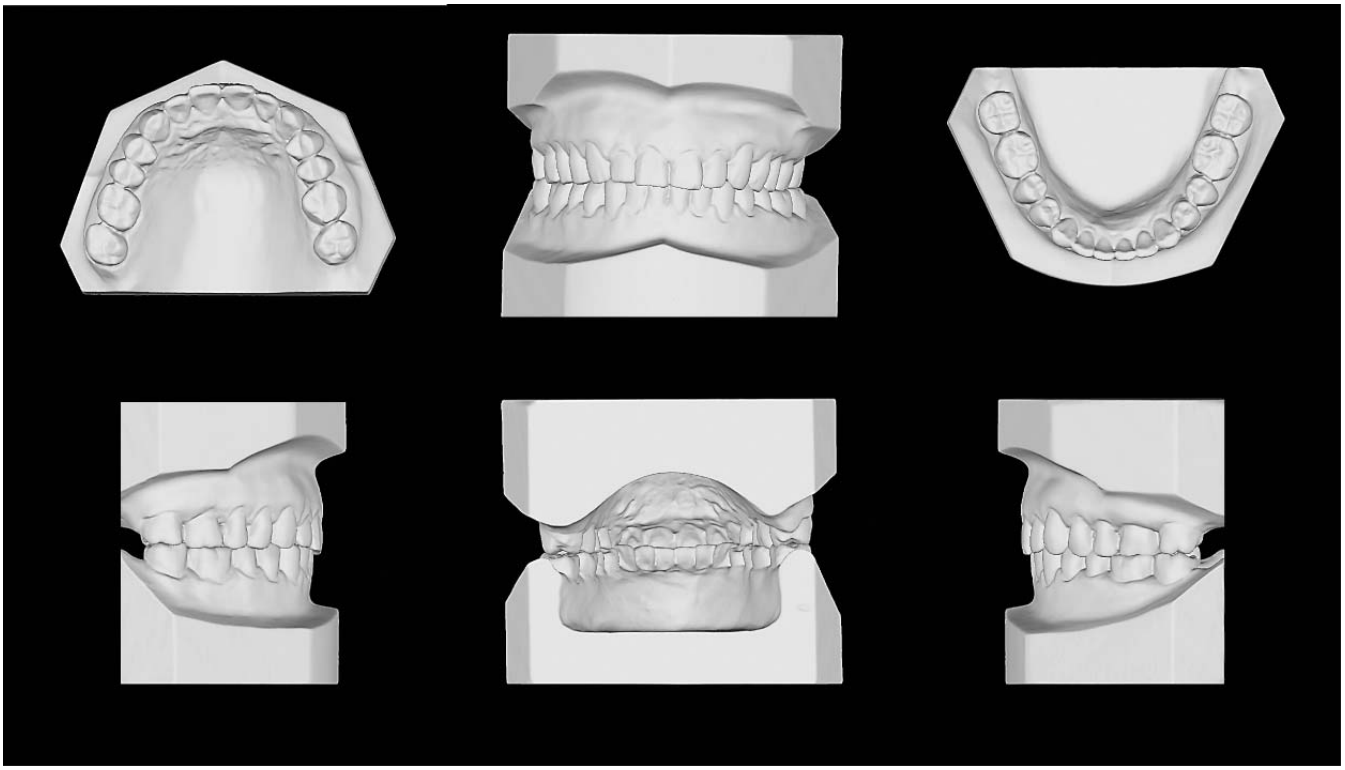

Figure 8. Posttreatment dental casts.

amount of distalization of the maxillary first molar was 2.28 ± 0.65 mm at the crown level but only 0.61 ± 0.71 mm at the root level.[21]

In the current case report, 7.4 mm of maxillary anterior tooth retraction was evidenced by the measurement of U1-NA distance without the extraction of premolars. Unlike a previously reported case,[20] the enormous amount of anterior tooth retraction was not attributed to the space gained from arch expansion, as the dental cast overlay showed no significant arch width difference. According to the lateral cephalometric superimposition, bodily distalization of U6s was noted without significant distal crown tipping, as the amount of distalization at the crown and root levels of U6s was 5 mm and 4.5 mm, respectively, which was more significant than in previous reports.[19,21] Thus, the considerable retraction of the maxillary central incisors in the current case was achieved by the combination of space closure, tooth rotation correction, and entire maxillary arch distalization.

Since the patient had an inferiorly positioned and flat occlusal plane, as demonstrated by increased posterior facial height (Go-CF 74.9 mm), increased maxillary height (N-CF-A 59.8°), and decreased occlusal plane angle (Occ Plane to SN 6.6°), CPHG could generate a more horizontal force in this patient as compared with other patients (Figure 5). Thus, cervical-pull instead of combined-pull headgear was selected. To avoid crown-distal tipping and ensure bodily movement, the outer bow was adjusted to the same level as the center of resistance of U6s (Figure 5). We decided not to have the outer bow more superiorly to the center of resistance of U6s, as greater extrusion force and worsening of the Class II malocclusion would be introduced by doing so.

To achieve posttreatment stability, the treatment objectives for the mandibular dentition were to (1) prevent further proclination of the mandibular incisors, (2) maintain the vertical position of the posterior teeth to avoid increasing the skeletal Class II deficiency, and (3) intrude the mandibular anterior teeth to correct the impinging bite. Thus, during treatment, interarch Class II mechanics were avoided, and the lower incisors were bonded after stabilization of the mandibular posterior segments. In the pre- and posttreatment mandibular superimposition (Figure 10), no significant mandibular molar protraction or extrusion was noted, and the mandibular incisors were only slightly proclined after a considerable amount of intrusion. The interproximal contacts of the mandibular arch were tested at each retention appointment to check for the potential for relapse. In the 6-month observation period, no increase in the tightness of any interproximal contact was noted (Figure 12). Thus, at least in the short term, posttreatment stability was

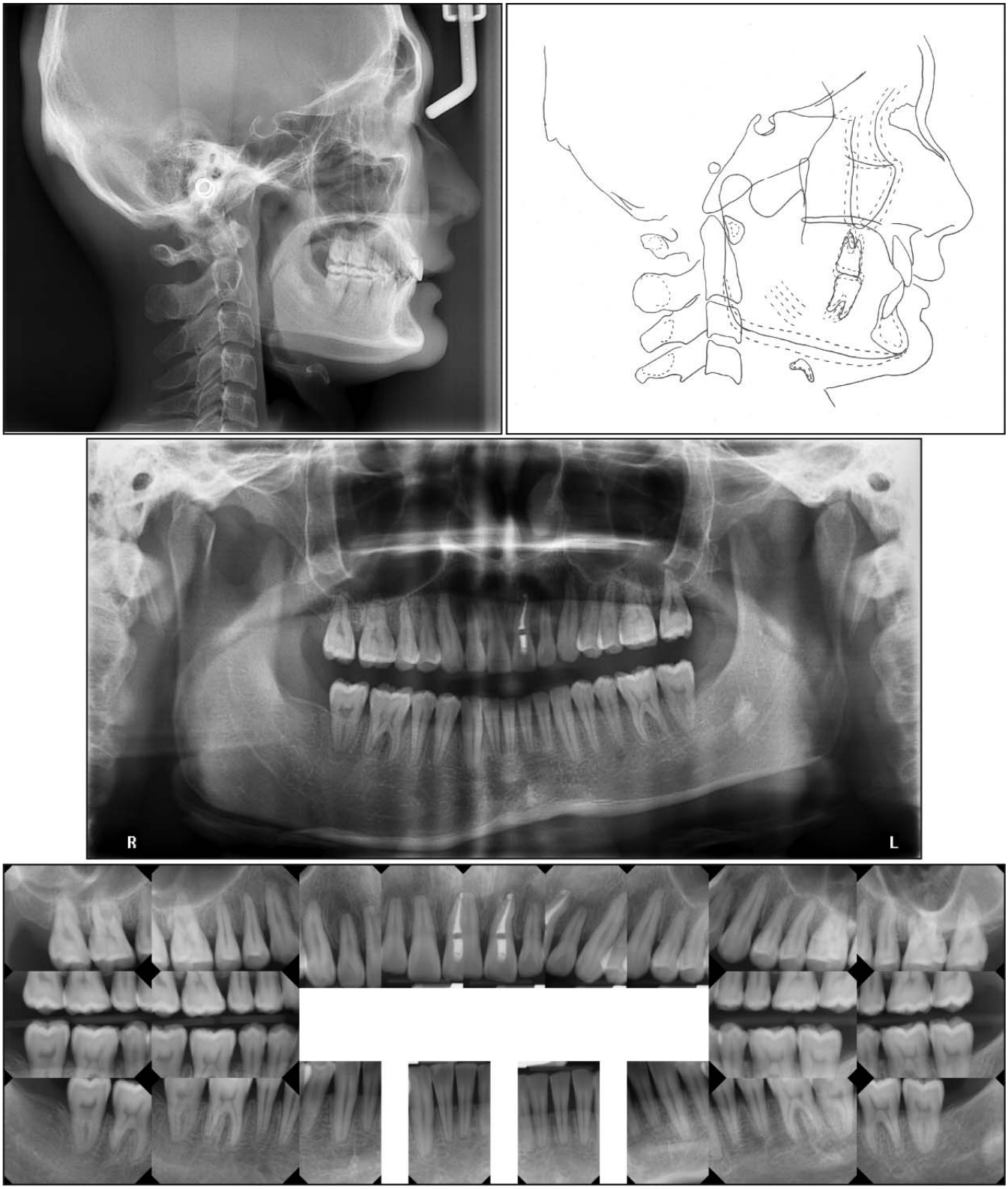

Figure 9. Posttreatment lateral cephalometric radiograph, cephalometric tracing, panoramic radiograph, and full-mouth series x-rays.

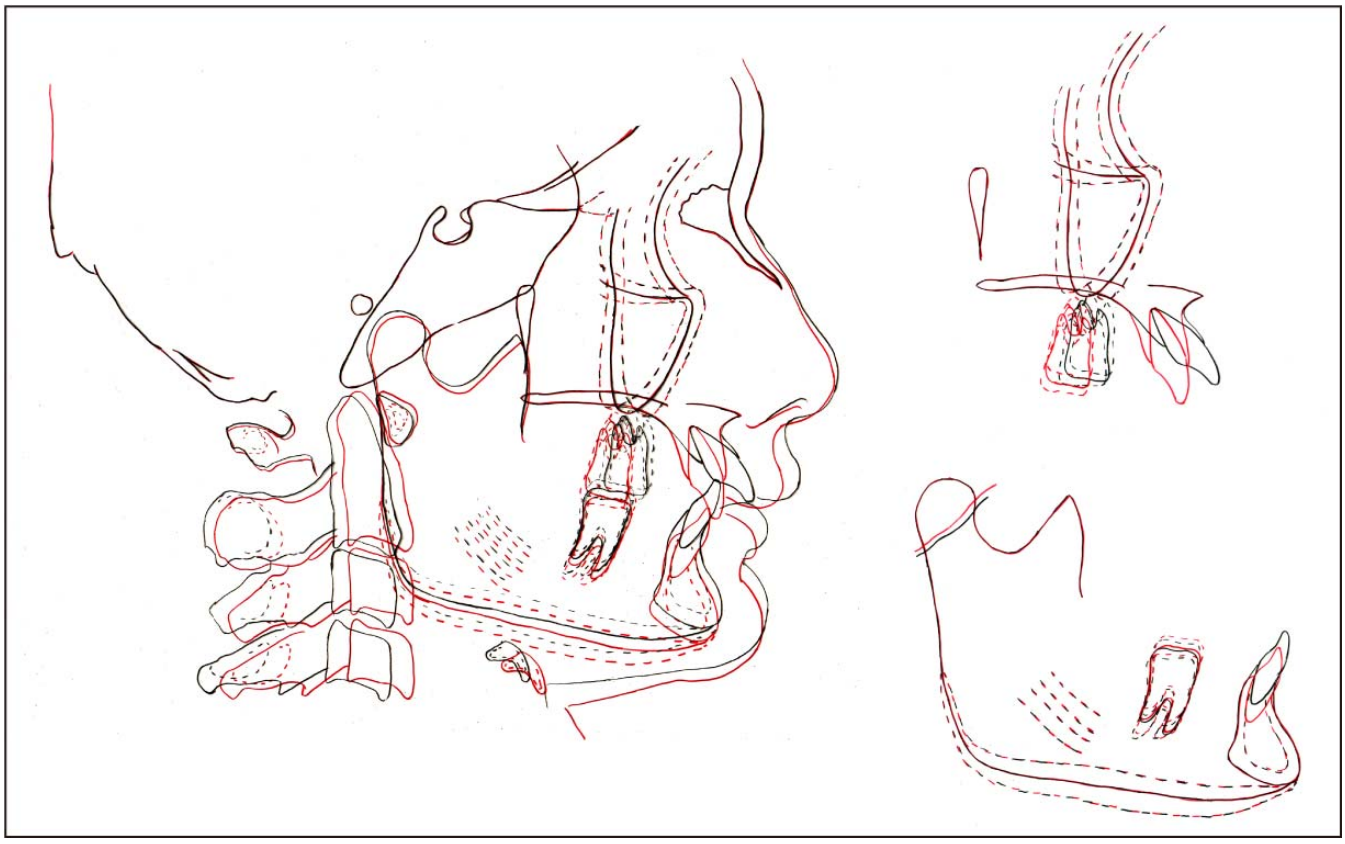

Figure 10. Superimposition of pretreatment (black) and posttreatment (grey) cephalometric radiographs.

achieved by maintaining the dental arch over the basal bone.[22] However, long-term follow-up is needed to evaluate treatment stability after finishing the retention protocol.

For Class II malocclusions, maxillary first molar extraction could have been considered for orthodontic treatment to achieve ideal Class I occlusion by avoiding molar distalization and using the maxillary second molars as substitutes for the maxillary first molars.[23] Maxillary second molar extraction was an alternative strategy[24] as headgear therapy is more effective without the presence of the maxillary second molar.[25] It is worth noting that, for these options, the maxillary third molars with proper morphology are crucial for substituting for the maxillary second molars. However, in the current case, the patient's U8s had relatively poor crown morphology, which significantly reduced the chance of achieving ideal posterior occlusal contact by using them to substitute for U7s. In addition, the cone-shaped, fused roots of the patient's U8s markedly reduced their stability.[26] Therefore, we chose not to extract the maxillary first or second molars.

Overall, the malocclusion was corrected, and an acceptable facial profile was achieved using a traditional treatment strategy, demonstrating that with good

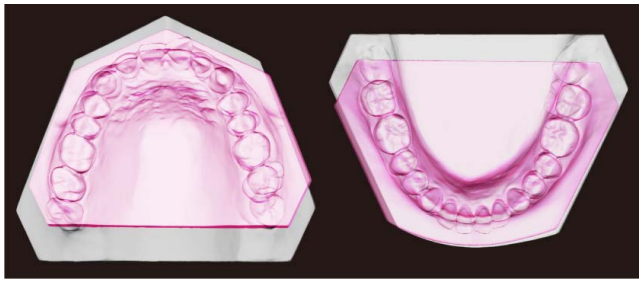

Figure 11. Superimposition of the initial and final dental casts based on the first molars.

Table 2. Dental Cast Measurements

Parameter	Pretreatment	Posttreatment	Change
Maxillary			
Canine to canine width, mm	30.8	30.2	−0.6
First molar to first molar width (central groove), mm	45.6	45.4	−0.2
Mandibular			
Canine to canine width, mm	29.2	29.9	0.7
First molar to first molar width (buccal cusp), mm	45.3	45.4	0.1

Figure 12. Six-month retention extraoral and intraoral photographs.

patient compliance, headgear may be an excellent and effective option for molar distalization in adult patients. It is suggested that orthodontists should never underestimate the compliance of patients. Of course, adequate and efficient communication between orthodontists and patients is crucial to make patients fully understand the treatment objectives and to maintain their motivation throughout treatment.

CONCLUSIONS

- Headgear could be a feasible option for entire maxillary arch distalization, not only in adolescents but also in adult patients.
- A thorough evaluation of the patients' conditions and expectations, as well as adequate and efficient communication between orthodontists and patients, is crucial to ensure a balanced and harmonious treatment outcome.

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