Case Report

Class III correction and enhanced periodontal health with aligner treatment in a 53-year-old patient

Ibtehal Almagrami[a]; Maryam Almaqrami[b]; LingSu Zhu[c]; Yiqiang Qiao[d]

ABSTRACT

In this case report, we describe the successful camouflage treatment of a 53-year-old female with dental and skeletal Class III malocclusion combined with anterior crossbite, gingival recession, and mobility of the lower incisors, using clear aligners. The treatment involved periodontal debridement followed by orthodontic treatment. The mandibular posterior teeth were distalized to correct the anterior crossbite and to establish Class I molar relationships. During treatment, the mandibular incisors were intruded, and the mandibular occlusal plane underwent a clockwise rotation due to slight extrusion of the maxillary buccal segments and distalization of the mandibular posterior teeth. Following treatment, all objectives were achieved, including resolution of the anterior crossbite, significant reduction of gingival recession and tooth mobility, and improved functional occlusion. The dental and skeletal Class III malocclusion was corrected, and the marginal alveolar bone dehiscence was significantly reduced. The results remained stable over a 3-year retention period, with enhanced molar intercuspation and gingival growth progression. This case adds to the evidence supporting the adaptability and effectiveness of clear aligners in treating orthodontic patients with compromised periodontium. The treatment outcomes support that orthodontic treatment using clear aligners, combined with periodontal monitoring, can assist in managing alveolar bone defects, gingival recession, and tooth mobility. (*Angle Orthod*. 2025;95:452–463.)

KEY WORDS: Class III malocclusion; Crossbite; Gingival recession; Bone resorption; Clear aligners

INTRODUCTION

Class III malocclusion is a challenging dentoalveolar growth deformity characterized by a concave profile, which results from maxillary retrusion (25%), mandibular protrusion (18.7%), or a combination of both (22.2%).[1] The prevalence of Class III malocclusion in Western populations ranges from 3% to 5%, whereas it increases to 10% in the Japanese population. The highest prevalence is recorded in China, reaching 25%.[2] Three main treatment protocols for correcting skeletal Class III malocclusion have been identified: (1) growth modification, which uses differential growth of the maxilla in relation to the mandible; (2) camouflage, by which the skeletal discrepancy is masked by orthodontic treatment to correct dental occlusion while maintaining the skeletal discrepancy; and (3) orthognathic surgery, which combines orthodontic and surgical treatments for patients with severe skeletal jaw discrepancies that may or may not be accompanied by facial asymmetry. The choice of treatment protocol should be based on several factors, including the patient's age, skeletal pattern, facial profile, and the severity of the malocclusion.[3]

Treating Class III malocclusion in skeletally mature patients presents a significant challenge for orthodontists, especially when accompanied by additional complications such as age, anterior crossbite, periodontitis, and tooth mobility. Periodontitis, an inflammatory condition of bacterial origin, is characterized by the formation of periodontal pockets and loss of periodontal attachment accompanied by gingival recession and bone destruction.[4]

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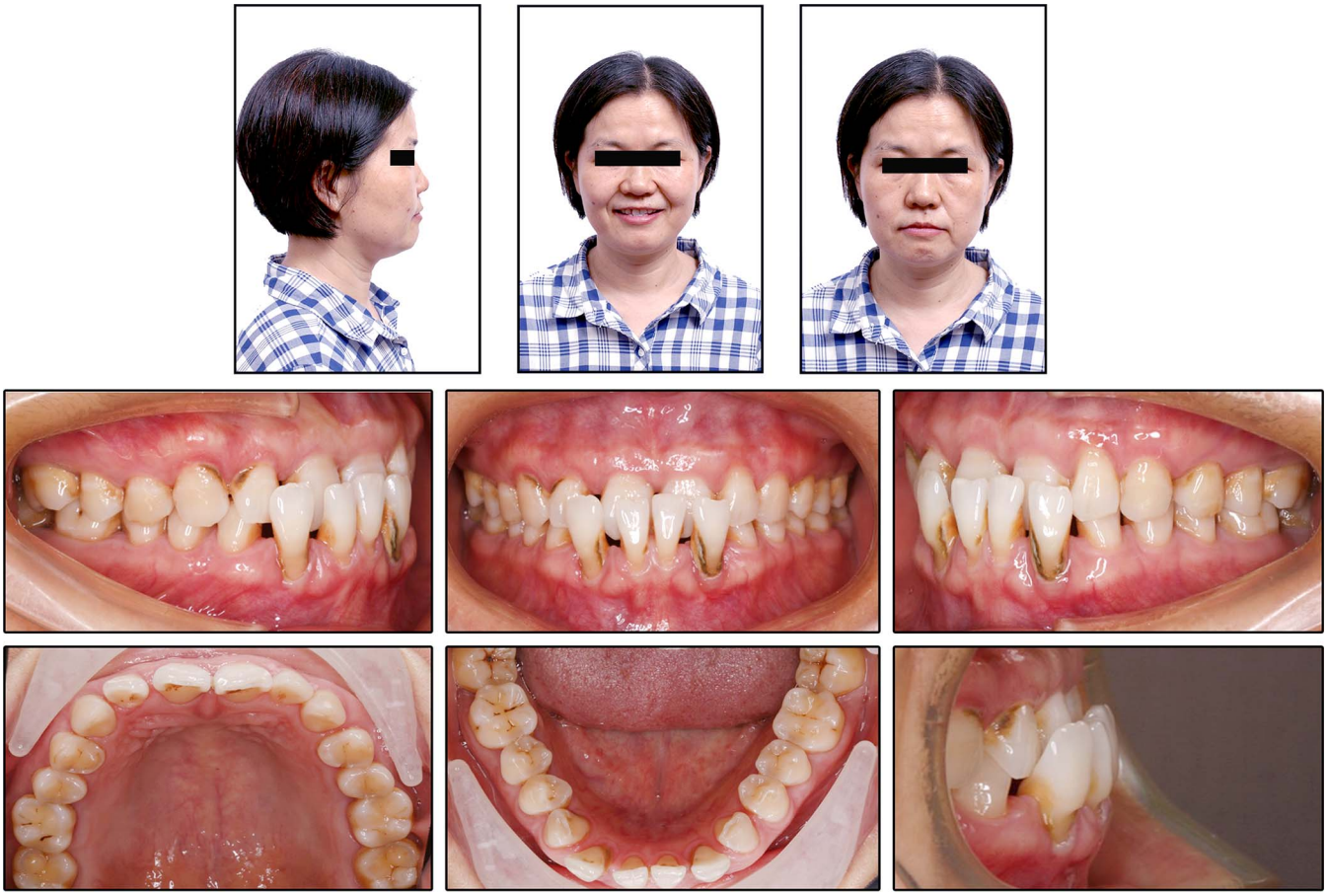

Figure 1. Pretreatment facial and intraoral photographs.

The treatment of malocclusion in the presence of periodontitis requires a multidisciplinary approach. This begins with periodontal therapy to control the progression of periodontal disease, followed by orthodontic treatment to realign teeth, thereby restoring esthetics and function.[5] Properly managed oral hygiene enhances periodontal health, which is crucial during the active phase of orthodontic treatment.[6]

In adults with periodontal complications and tooth mobility, orthodontic treatment is important, not only for improving dental alignment and occlusal function, but also for addressing underlying periodontal concerns. Orthodontic intervention plays a crucial role in stabilizing mobile teeth by repositioning them within the alveolar bone and redistributing occlusal forces more evenly.[7] In addition, proper tooth alignment through orthodontic treatment facilitates improved oral hygiene practices, which are essential for managing periodontal disease and preventing its progression. By enhancing dental alignment and occlusal stability, orthodontic treatment not only aids in preserving the natural dentition but also contributes to long-term periodontal health and overall oral well-being in adult patients with periodontal complications.[8]

In this case report, we highlight the effectiveness of clear aligners in treating an adult patient who had skeletal and dental Class III malocclusion accompanied by an anterior crossbite, gingival recession, tooth mobility, and diminished lower anterior alveolar bone.

CASE REPORT

Diagnosis and Etiology

A 53-year-old female patient consulted the Orthodontic Department at the First Affiliated Hospital of Zhengzhou University regarding an anterior crossbite and mobility of lower anterior teeth. The patient had no major family or medical history relating to her chief complaints.

Pretreatment facial photographs showed a symmetrical, concave profile with a protruded chin and normal lower facial height (Figure 1). During smiling, insufficient incisor exposure was present, and the maxillary dental midline was shifted 2 mm to the left. Intraoral photographs showed a Class III molar relationship and anterior crossbite, accompanied by gingival inflammation and recession. Supragingival calculus was present, and no caries were detected. The diagnostic model casts demonstrated a greater-than-half-unit Class III molar

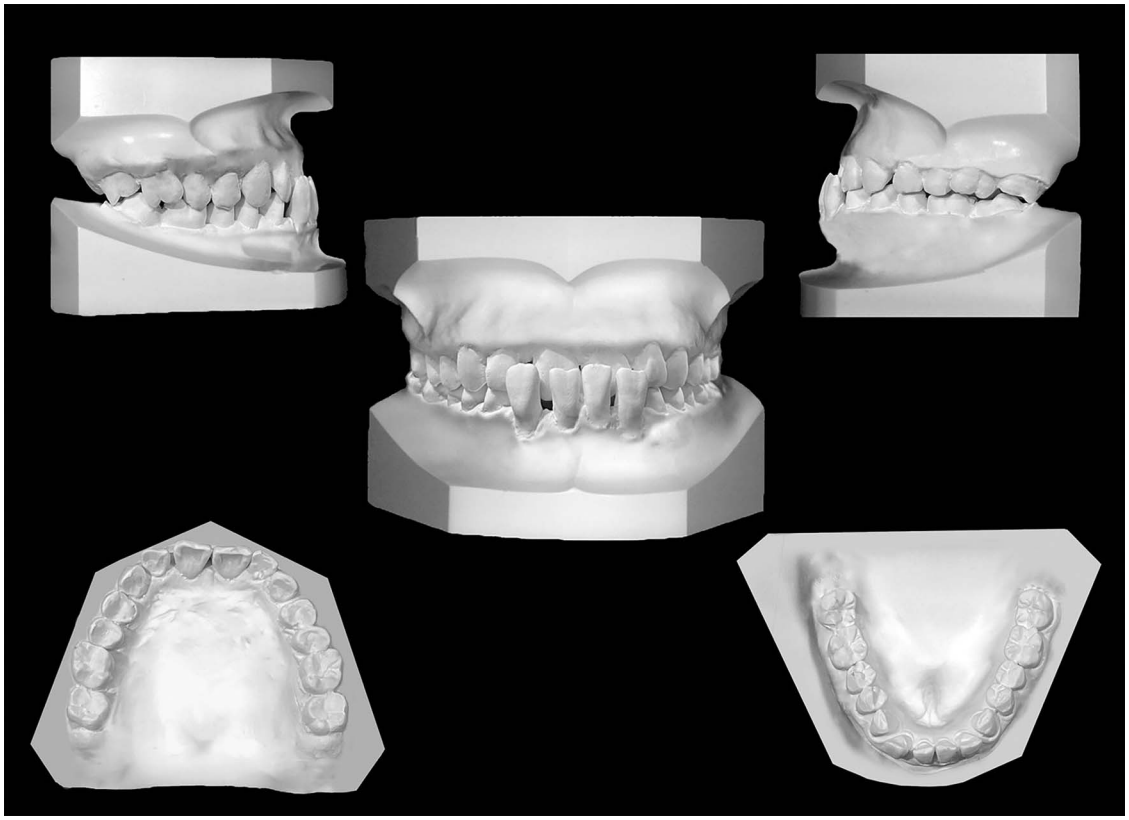

Figure 2. Pretreatment dental casts.

relationship (−3.5 mm and −4.5 mm from the Class I position on the right and left sides, respectively; Figure 2). Negative overjet and overbite were 3.0 mm and 7.0 mm, respectively. A moderate curve of Spee, measuring 3.9 mm in depth, was noted. All teeth, except for the third molars, were present.

Pretreatment panoramic radiograph showed generalized horizontal alveolar bone loss with the highest vertical bone loss on the lower incisors (Figure 3). Cephalometric analysis indicated a skeletal Class III pattern characterized by mandibular prognathism, normal maxillary incisor inclination, proclined lower incisors, and an increased interincisal angle (Figure 4). No centric relation (CR)-centric occlusion (Co) discrepancies were identified. The American Board of Orthodontics Discrepancy Index score for the malocclusion was 22 (Supplemental Worksheet 1).

Treatment Objectives

The treatment objectives outlined during the planning phase were to enhance periodontal health, minimize tooth mobility, prevent the progression of gingival recession and alveolar bone loss by correcting the anterior crossbite, eliminate traumatic occlusion, and obtain an ideal positive overjet (about 2.5 mm) and overbite (about 2 mm). Additionally, the goals included compensating for the mandibular prognathism, achieving a Class I molar and canine relationship, and correcting the midline deviation.

Treatment Alternatives

Skeletal Class III malocclusion in adult patients can be treated using two primary treatment modalities. The first modality involves orthognathic surgery to reposition the mandible and enhance the facial profile. However, it is essential to note that this treatment approach is complex, and given the patient's age, a less invasive alternative was deemed preferable.

Figure 3. Pretreatment panoramic radiograph.

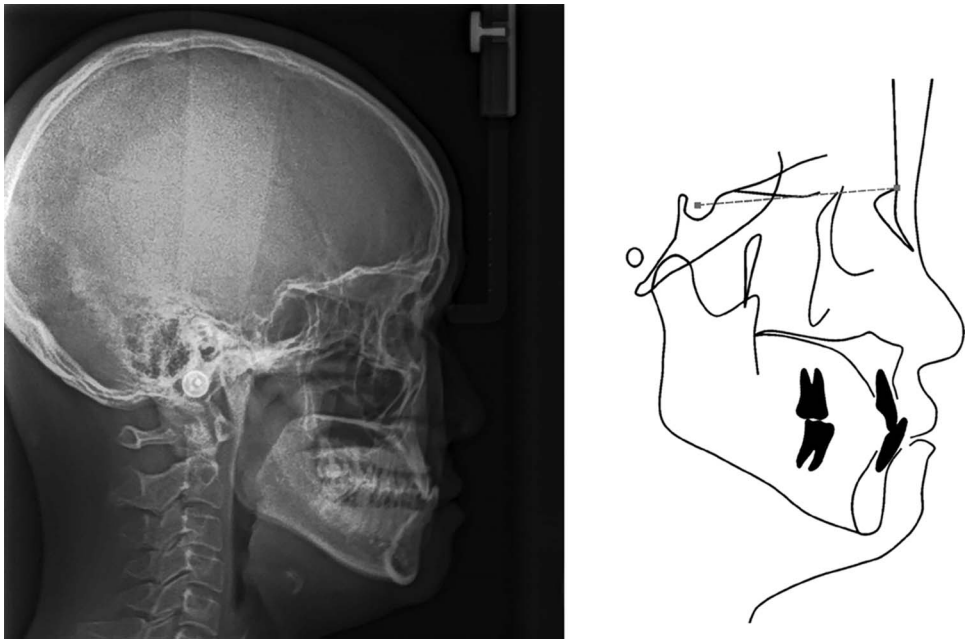

Figure 4. Pretreatment lateral cephalometric radiograph.

The second treatment modality is orthodontic camouflage treatment, which aims to correct the anterior crossbite, close spacing, and adjust the inclination of the incisors. This treatment modality can be achieved using either fixed appliance or clear aligner treatment.

Orthodontic camouflage treatment, either with a fixed appliance or clear aligners, was suggested to the patient. During the discussion of treatment options, factors such as esthetics, oral hygiene maintenance, and the time commitment associated with each treatment modality were thoroughly discussed. The decision to proceed with clear aligners was reached collaboratively between the patient and clinician, weighing the advantages and drawbacks of each treatment option and considering patient preferences and the clinician's recommendation for the best treatment given the periodontal situation. The Invisalign system (Align Technology, Zhengzhou City, Henan Province, China) was selected for her treatment.

Treatment Progress

Before initiating orthodontic treatment, the patient was referred for periodontal care. She underwent two sessions of periodontal treatment, including mechanical and ultrasonic scaling, root planing, and subgingival debridement. The patient was also instructed on enhancing and maintaining proper oral hygiene. One month later, a periodontal re-evaluation was performed.

During orthodontic treatment, a total of 56 active aligners were used for the maxillary arch and 88 for the mandibular arch. Each aligner was worn for 7 days, with the first aligner not being activated. The bonding of all attachments was postponed until the next stage. The patient was instructed to wear the aligners for no less than 22 hours daily and undergo periodontal debridement scaling every 3 months. Throughout treatment, the maxillary and mandibular incisors were subjected to torque applied by Power Ridges. To establish Class I molar relationships and create space for mandibular incisor alignment, mandibular posterior teeth were distalized along with intrusion of the mandibular incisors.

By the third aligner, Class III intermaxillary elastics (size 3/16 inch) were used to assist in correcting the anterior crossbite. Cutouts were made in the aligners to accommodate orthodontic metal buttons on the mesial-gingival surface of the upper first molars (U6s). By the 24th aligner, the anterior crossbite was corrected. Interproximal reduction of 0.2 mm was performed on the lower incisors and upper central incisors for esthetic purposes (resolving black triangles) in the anterior segment. After the active phase of treatment, the attachments were removed. Both maxillary and mandibular clear retainers were delivered to the patient to begin the retention phase. The entire treatment sequence is documented in Figure 5.

Treatment Results

Posttreatment records indicated that all treatment objectives were achieved. The anterior crossbite was successfully resolved (Figure 6). Gingival recession of the mandibular incisors was significantly decreased, along with resolved tooth mobility. Marginal alveolar bone dehiscence was notably reduced (Figure 7). The dental and skeletal Class III malocclusion was nearly ideally

Figure 5. Frontal views of the treatment sequence before treatment (0M). Progress is shown at treatment times in months: 6M, 8M, 10M, 14M, 16M, 18M, and 22M.

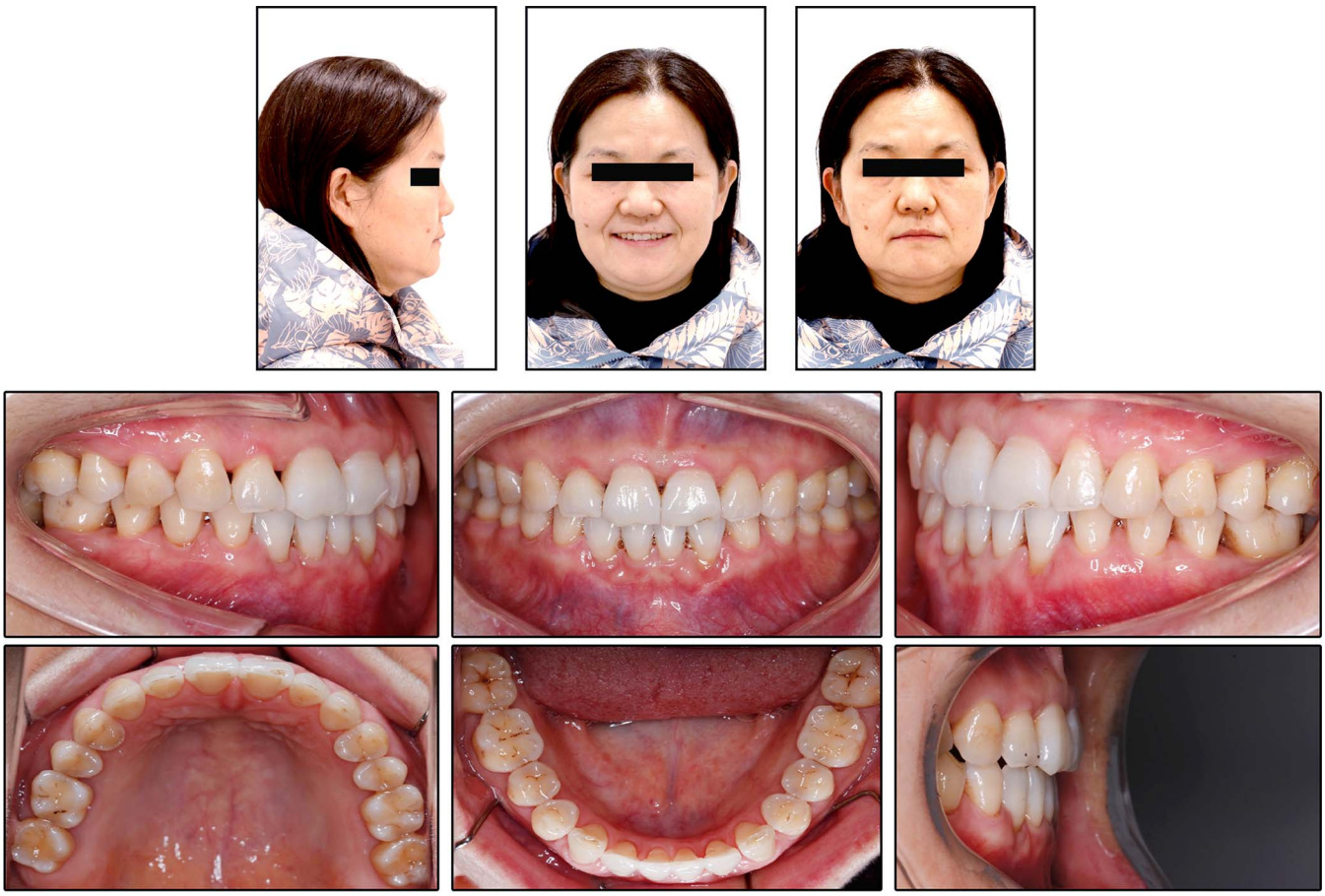

Figure 6. Posttreatment facial and intraoral photographs.

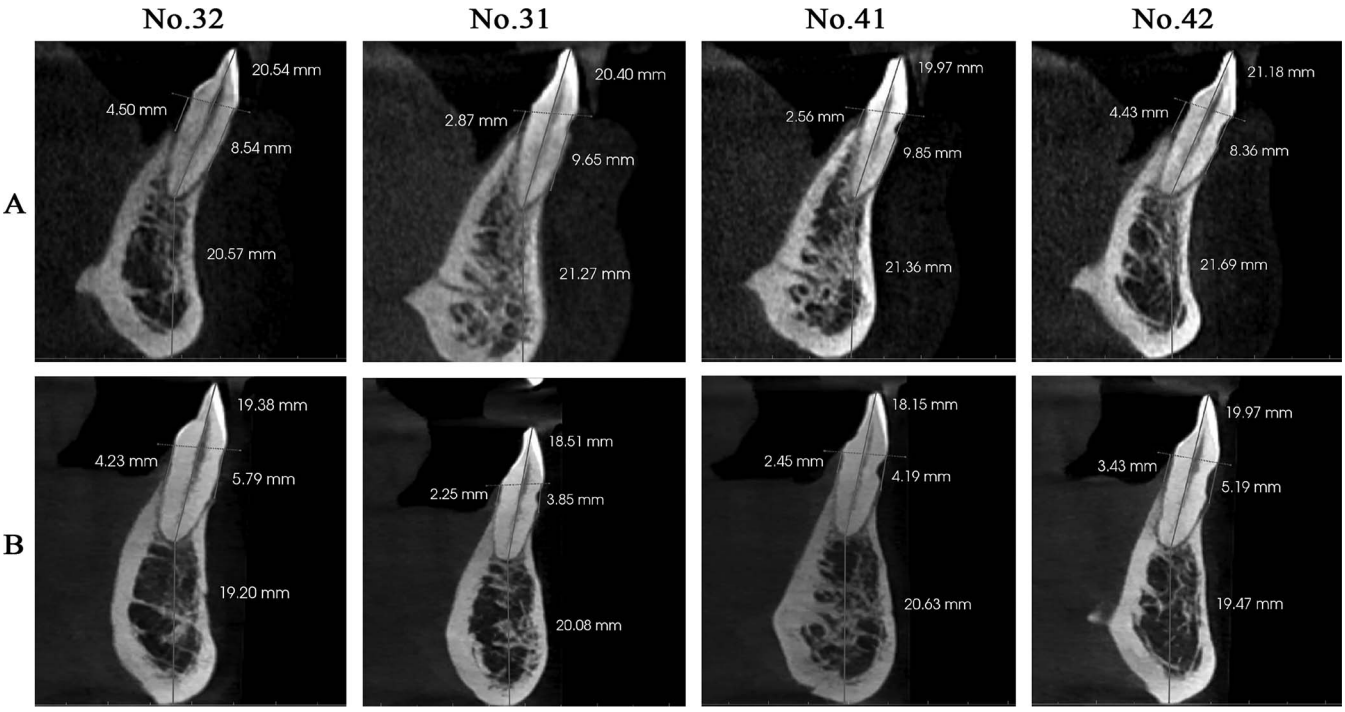

Figure 7. Bone height, root length, and distance from the tooth apex to the posterior limit of the symphysis.

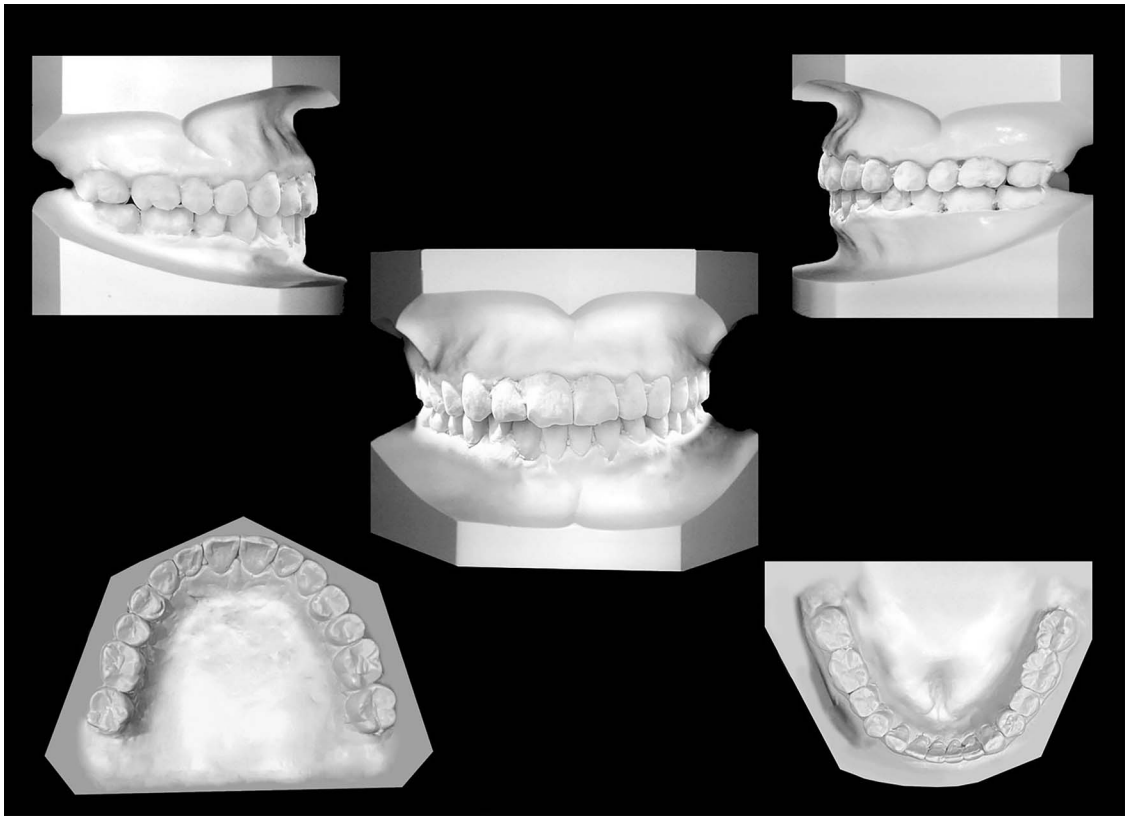

Figure 8. Posttreatment dental casts.

corrected, resulting in good functional occlusion overall (Figures 8 and 9). The American Board of Orthodontics Cast-Radiograph Evaluation score was 23 points (Supplemental Worksheet 2).

The posttreatment cone-beam computed tomography (CBCT) film showed that the average labial and lingual alveolar bone dehiscence of the mandibular incisors was reduced by 4.35 ± 1.61 mm and 0.55 ± 0.40 mm,

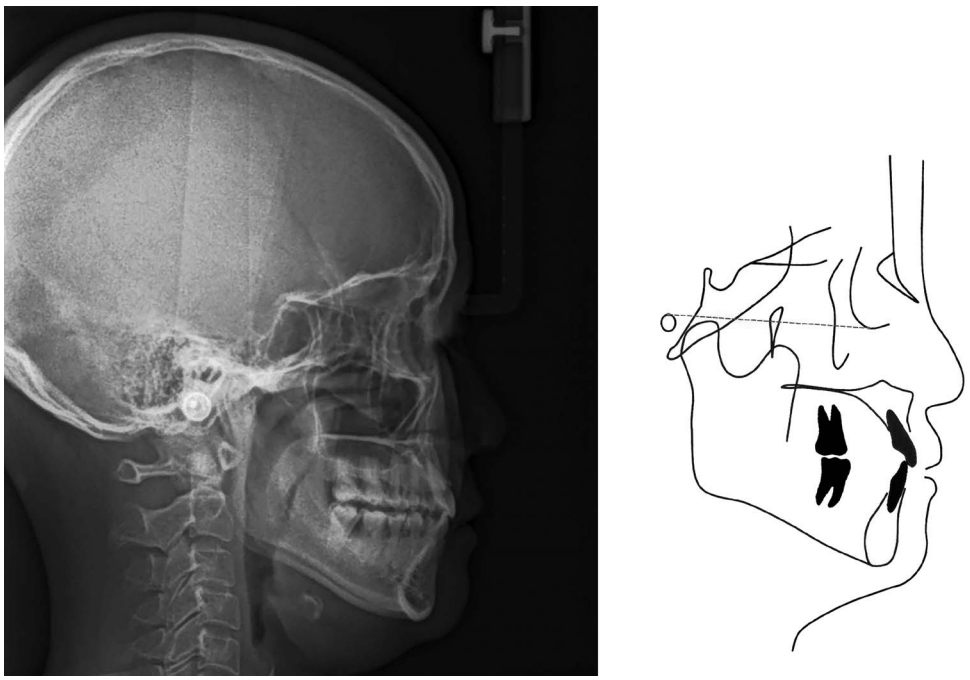

Figure 9. Posttreatment lateral cephalometric radiograph.

Table 1. Posttreatment Changes in Bone Height, Root Length, and Root Apex to the Symphysis Base[a]

Tooth	BBH T0–T1	LBH T0–T1	Root Length T0–T1	Root Apex (90°) to Symphysis Base T0–T1
32	2.75	0.27	1.16	1.37
31	5.8	0.62	1.89	1.19
41	5.66	0.11	1.82	0.73
42	3.19	1.2	1.32	2.2
Mean ± SD	4.35 ± 1.61	0.50 ± 0.40	1.56 ± 0.35	1.37 ± 0.62

[a] BBH indicates buccal bone height; LBH, lingual bone height; T0, pretreatment; T1, posttreatment.

Table 2. Cephalometric Measurements

Measurements	Norm	Pretreatment	Posttreatment
SNA	82°	85.43°	85.68°
SNB	80°	86.57°	84.06°
ANB	2°	−1.14°	1.62°
Wits appraisal	0 mm	−5.72 mm	−1.18 mm
SN-MP	32°	28.2°	35.5°
FMA	25°	19.2°	24°
U1-NA mm	4 mm	3.2 mm	3.26 mm
U1-SN	104°	102.21°	105.65°
L1-NB	4 mm	5.17 mm	3.24 mm
L1-MP	90°	94.2°	85.6°
E-Line UL	−1 mm	−2.25 mm	−3 mm

respectively, and the incisors were intruded by 2.94 ± 0.51 mm (Table 1). According to Sharpe's method, the severity of root resorption was classified as slight, grade 1° (1.56 ± 0.35 mm).[9]

The posttreatment panoramic radiograph showed good root parallelism, except for UL3 and UL4 (Figure 10). Cephalometric measurements showed a slight increase in SNA (from 85.43° to 85.68°) and a decrease in SNB angle (from 86.57° to 84.06°). This resulted in an increased ANB angle and improvement in the Wits appraisal (from −1.14 mm to 1.62 mm and from −5.72 mm to −1.18 mm, respectively; Table 2). The maxillary incisors were proclined from 102.21° to 105.65° relative to SN (U1 to SN), and the mandibular incisors were retroclined from 94.90° to 88.33° (IMPA). The SN-MP and FMA angles were increased (7.3 and 4.8, respectively).

The superimposed cephalometric tracings demonstrated a clockwise rotation of the mandible and slight extrusion of the maxillary buccal segments. Backward movement of the mandible and the lower lip occurred, resulting in a decreased mentolabial angle (Figure 11A). Three-dimensional (3D) superimposition of the pretreatment and posttreatment CBCT shows the dental changes (Figure 11B).

After 3 years of retention, the occlusion was stable, and the health of the teeth was improved with regenerated gingival tissue. The overjet and overbite were maintained, and molar intercuspation was improved (Figure 12). The cephalometric radiograph showed further extrusion of the posterior teeth with better intercuspation (Figure 13).

Figure 10. Posttreatment panoramic radiograph.

DISCUSSION

The primary treatment objectives were to correct the anterior crossbite and resolve the gingival recession and mobility of the mandibular incisors. Both surgical and orthodontic camouflage using conventional fixed appliances have been successfully employed for many years to correct mild to moderate skeletal Class III cases with anterior crossbite.[10] Recently, clear aligners have also been used to correct similar cases. However, in this report, we are the first to document their use in a middle-aged patient with skeletal and dental Class III malocclusion, localized Stage III grade B periodontitis,[11] mandibular gingival recession, and grade II tooth mobility (Miller Index).[12] Orthodontic camouflage treatment was suggested, and preference by the patient for clear aligners over fixed appliances was influenced by multiple factors. First, clear aligners offer greater esthetics, which may be particularly appealing to adult patients concerned about the appearance of traditional braces. Additionally, clear aligners allow for greater treatment flexibility and comfort than fixed appliances.[13] The ability to remove aligners during meals and oral hygiene routines facilitates easier maintenance of oral hygiene, reducing the risk of plaque accumulation and periodontal complications, which may be particularly advantageous in patients with underlying periodontal concerns, as was the case in this patient.

Gingival recession is multifactorial and may develop due to exacerbated periodontal disease, thin gingival biotype, traumatic occlusion, mechanical trauma (eg, tooth brushing), smoking, and aging.[7] In this case, traumatic occlusion, age, and poor oral hygiene were the main factors leading to a compromised periodontium. Therefore, prior to orthodontic treatment, the patient was referred to the Periodontal Department for comprehensive management of periodontal disease and instruction in proper oral hygiene. Before orthodontic treatment

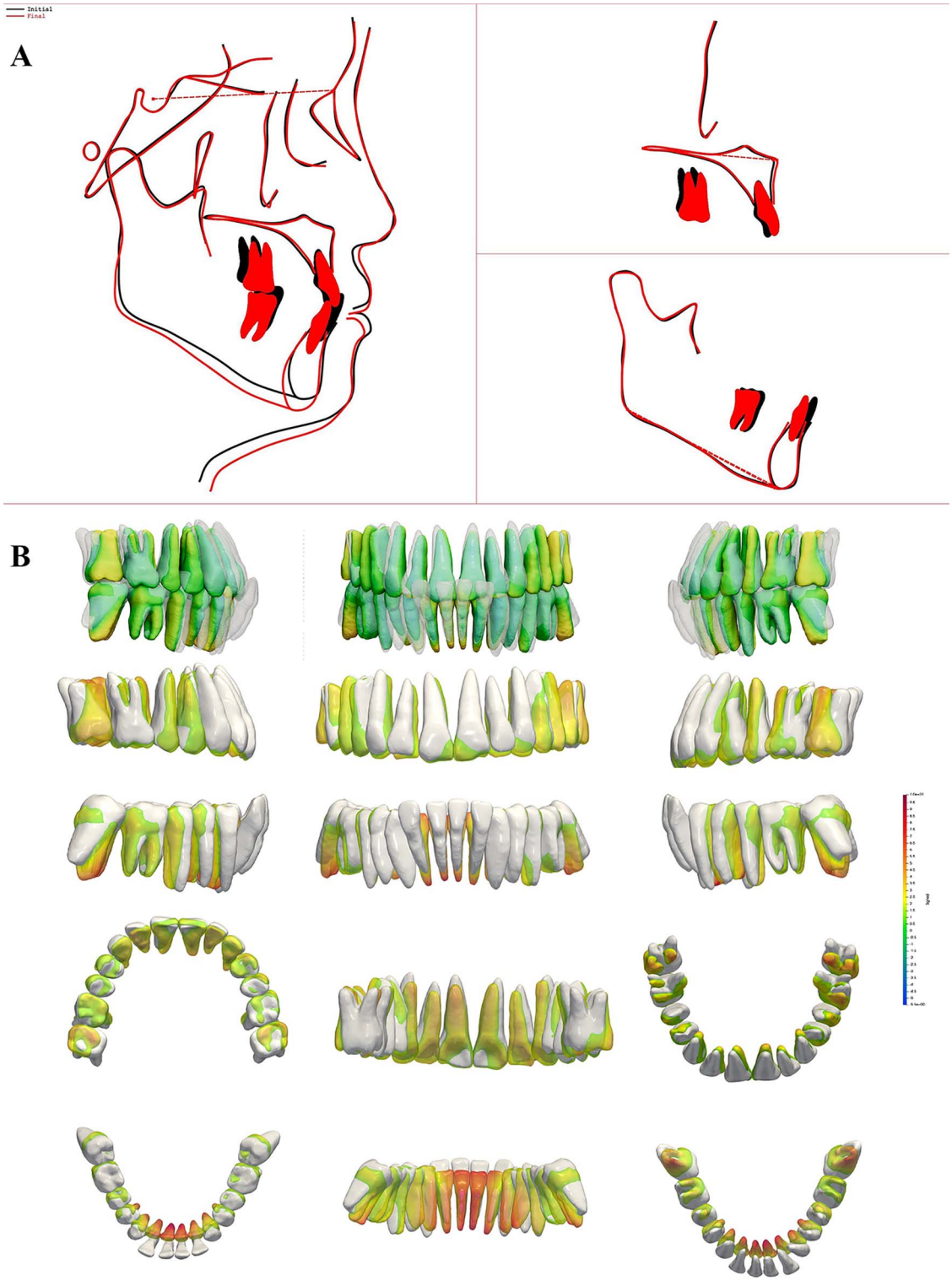

Figure 11. (A) Pretreatment (black) and posttreatment (red) lateral cephalogram and superimposition tracings. (B) Three-dimensional (3D) superimposition of pretreatment (white) and posttreatment (colored) cone-beam computed tomography (CBCT) showing dental tissue changes.

commenced, gingival inflammation and bleeding were significantly decreased.

The orthodontic treatment aimed to address the patient's chief complaint by correcting the traumatic occlusion and repositioning the lower incisors within the alveolus. Authors of previous studies have reported significant improvements in the affected periodontium following proper tooth repositioning.[7,14] Orthodontic forces

Figure 12. Facial and intraoral photographs at 36-month follow-up.

applied by clear aligners create areas of pressure and tension in the periodontal ligament, resulting in resorption and apposition of the bone facilitating tooth movement. It applies controlled, intermittent forces, which help minimize trauma and promote healthy bone formation.[15] Power Ridges were designed on both the upper and lower incisors throughout treatment to control positive root torque.[16] The intrusive movement designed for the lower incisors was an average of 4 mm. In comparison, the achieved intrusive movement averaged 2.94 mm, with the greatest being 3.60 mm in the lower right lateral incisor (Table 1). These findings agreed with those in previous studies, which suggested the need for additional overcorrection in planned intrusive movement.[17,18] Posttreatment, the average lingual and labial alveolar bone dehiscence decreased by 4.35 mm and 0.50 mm, respectively. Gingival recession notably decreased, and tooth mobility was resolved. Since external root resorption is a common iatrogenic result of orthodontic treatment,[19] the root length of the lower incisors was measured pretreatment and posttreatment, revealing a slight root length reduction of 1.56 ± 0.35 mm. The mandibular central incisors exhibited more root resorption, measuring 1.82 mm and 1.89 mm (Table 1). This was consistent with findings from previous studies.[15,20]

Correcting anterior crossbite can be achieved using various methods, such as fixed appliances with Class III elastics, bondable bite raisers for disocclusion, fixed acrylic planes, reversed stainless steel crowns, removable acrylic appliances with finger springs, and bonded resin-composite slopes.[21] Despite the variety of treatment modalities, correcting anterior crossbite typically requires unfavorable bite opening. However, clear aligners offer the advantage of achieving an occlusion opening of up to 1.5 mm (created by 0.75 mm thickness of each aligner) and applying sequential intrusion to the anterior teeth, providing the necessary vertical clearance to help open the bite. Additionally, clear aligners allow for better sagittal control by managing anterior anchorage loss using intermaxillary elastics to counteract the distalization force on mandibular teeth.[22] Therefore, correcting anterior crossbite with aligners is often preferable. In this case, the anterior crossbite was corrected within 6 months.

Invisalign has been reported in several case studies to achieve sequential molar distalization for borderline Class III cases effectively. Simon et al.[18] reported high predictability of molar distalization of 2.6 mm with aligners. Another report on two cases demonstrated molar

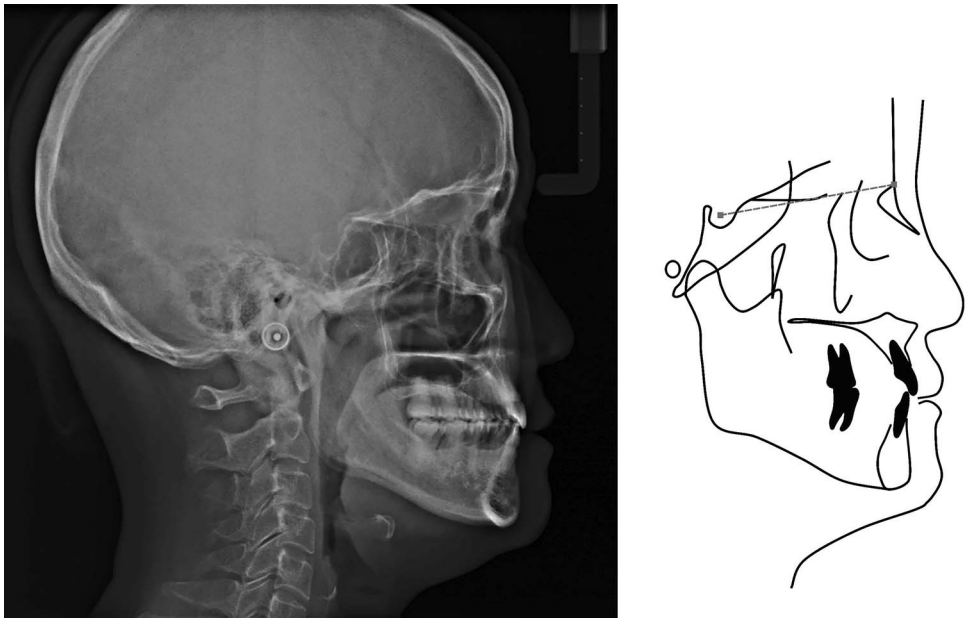

Figure 13. Lateral cephalogram at 36-month follow-up.

distalization predictability of 2.5 mm and 3 mm, respectively.[22] Similarly, in the current case report, we demonstrated sequential distalization of the mandibular molars by 2 mm. According to previous studies, clear aligners effectively prevent distal tipping and unwanted molar extrusion during distalization.[23] Class III intermaxillary elastics were used to control the proclination of the lower anterior teeth. The Invisalign software inserted button cutouts on the aligners to allow the direct bonding of buttons on the upper first molars for direct application of the intermaxillary elastics. The patient was educated on how to wear the elastics (3/16 in, 3.5 oz; Ormco) and was instructed to wear them full time.

At the end of the treatment, the patient was pleased and satisfied as the anterior crossbite was corrected, and the gingival recession and tooth mobility were resolved, potentially preventing early permanent tooth loss and preserving the teeth for a longer period. After a retention period of 3 years, the treatment results were stable, with further gingival growth and improved molar intercuspation.

Due to the recognized shortcomings of alternative treatment modalities, orthodontic aligners for correcting anterior crossbite in patients with compromised periodontium should be considered a comfortable and well-tolerated approach. It helps minimize the deterioration of periodontal conditions and dental decalcifications that may occur during orthodontic treatment.[13] It is important to note that the success of clear aligner treatment depends on the practitioner's clinical skills and the patient's compliance with wearing the aligners and intermaxillary elastics for no less than 22 hours per day.

CONCLUSIONS

- The combined orthodontic and periodontal approach significantly enhanced dental alignment, occlusion, and periodontal health.
- The success of this treatment, evident in the stability of results over 3 years, emphasizes the potential of clear aligners as a viable option for complex orthodontic cases in adult patients, balancing esthetic, and functional outcomes.

SUPPLEMENTAL DATA

Supplemental Worksheets 1 and 2 are available online.

DISCLOSURES

The authors declare no conflict of interest. No funding. Data used and/or analyzed during the current case reported are available from the corresponding author upon reasonable request.

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