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ALIGNER CORNER

This JCO column is compiled by Contributing Editor William V. Gierie, DDS, MS. Every few months, Dr. Gierie will introduce a pertinent article related to clear aligner therapy. Your suggestions for future topics or authors are welcome.

Anterior open bite remains one of the most challenging malocclusions to correct and maintain. Although clear aligner therapy has dramatically expanded our ability to treat these patients, successful outcomes still depend on controlling the posterior vertical dimension and understanding the biomechanics that drive mandibular autorotation—not simply programming tooth movements in treatment-planning software.

Many of the concepts presented in this Aligner Corner will be familiar to clinicians who routinely treat open bites with aligners, including sequential posterior intrusion, intentional overcorrection, and the strategic use of elastics. What makes this contribution unique is the authors' reinterpretation of those mechanics through the biomechanical philosophy of the multiloop edgewise archwire (MEAW) technique.

Although MEAW has long been recognized as an effective approach for open-bite correction, it is also technically demanding and time-consuming, and it requires a level of wirebending expertise that limits its widespread use. Drs. Moshiri, Mourgues, and Huanca Ghislanzoni demonstrate how many of these same biomechanical principles can be incorporated into a clear aligner workflow, making sophisticated vertical control accessible to a much broader group of clinicians.

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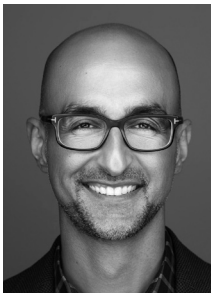

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Integrating MEAW Principles into Clear Aligner Therapy for Open-Bite Management

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Anterior open bite represents a significant challenge in orthodontics—particularly in adult patients, owing to its multifactorial etiology and high potential for relapse.[1] Traditional approaches to open-bite correction include the use of fixed appliances combined with vertical elastics for dental-origin cases, or orthognathic surgery in severe skeletal presentations.[2]

In this context, it is worthwhile to consider other orthodontic modalities that have been developed to control the vertical dimension. The multiloop edgewise archwire (MEAW) technique pioneered by Dr. Sadao Sato[3] and inspired by the original work of Dr. Young-Ho Kim[4,5] stands out as an effective method for compensatory treatment of anterior open bite.

MEAW biomechanics center on strategic modification of the occlusal plane by shifting the occlusal fulcrum from the molar region to the premolar area. This adjustment promotes favorable mandibular rotation and enables nonsurgical correction of complex malocclusions. The technique employs a system of horizontal L-loops in conjunction with full-time vertical elastics, facilitating controlled molar intrusion, as well as distal tipping, incisor extrusion, and stable intercuspation in the premolar and canine regions.[6,7]

In recent years, clear aligner therapy has broadened its range of indications and emerged as a promising option for managing vertical discrepancies, including anterior open bite. Aligners can facilitate open-bite closure by means of incisor extrusion and molar intrusion, ultimately leading to counterclockwise mandibular autorotation.[8,9] Compared to conventional brackets, which often produce undesirable posterior extrusion, aligners afford better control of the vertical dimension, largely because of the "occlusal splint effect" created by the aligner material encasing the posterior teeth.

This article proposes a clinical protocol that translates the biomechanical principles of the MEAW technique into clear aligner therapy. By leveraging aligner-specific mechanics such as programmed tooth movements, occlusal coverage, and the strategic use of vertical elastics, we aim to achieve similar vertical control and occlusal plane modulation as with MEAW, but with the esthetic and hygienic advantages of clear aligner systems.

Treatment Protocol

Like the MEAW technique, our treatment protocol primarily targets vertical control. The use of clear aligners allows us to rely on the controlled intrusion of posterior teeth. Three complementary mechanisms are employed to achieve this goal.

1. Digital Planning of Molar Intrusion with Anterior Anchorage

Optimized classic or horizontal attachments (fully beveled toward the gingiva) should be placed on all upper incisors and canines to provide effective retention and/or extrusion for these cases. Additional retention attachments on the premolars further enhance aligner stability, enabling efficient transmission of intrusive forces to the posterior segments. In the absence of these anterior attachments, partial dislodgement of the aligner tray is frequently observed, compromising the accuracy of tooth movement. We also recommend placing attachments on the posterior teeth targeted for intrusion to avoid unwanted side effects, such as torque variation during expansion or expression of buccal root torque when intruding palatal molar cusps.[10]

The choice of intruding the upper or lower posterior teeth, or both, should be customized based on the etiology of the open bite and the patient's specific occlusal features. Each posterior tooth is intruded individually, starting with the second molars and going forward as far as the first premolars, until all initial posterior centric contacts have been eliminated.

In some cases, the third molars may be used as passive anchorage points to facilitate initial intrusion of the first and second molars. The technician should be asked to plan a slight virtual extrusion of the third molars, creating a temporary increase in the anterior open bite. Once molar intrusion is achieved, we recommend extracting the third molars to eliminate the intentional premature contact.

All molar intrusion should be intentionally overcorrected or exaggerated in the digital treatment plan to create a deliberate posterior open bite. This overcorrection acts as a clinical marker: once the posterior open bite becomes apparent, no additional aligners should be delivered. A refinement scan must then be performed to assess the occlusion and adjust the treatment plan accordingly.

During this refinement phase, any remaining occlusal interferences—due to a residual curve of Wilson or autorotation effects—should be eliminated through further intrusion. The final series of aligners can be used to precisely detail the occlusion, ensuring stable posterior settling and completion of the vertical correction.

2. Posterior Bite Blocks

The technician should be requested to integrate occlusal bite blocks into the aligners on the occlusal surfaces of the appropriate posterior teeth.[11] Their thickness is calibrated to interfere with the patient's freeway space, thereby generating intrusive forces on the posterior teeth during functional mandibular closure. Recent evidence shows that such occlusal interference increases masticatory muscle contraction episodes by as much as 55% over the first week, which may contribute to molar intrusion through sustained functional loading. It should be noted, however, that significant intrusion has not been consistently demonstrated in short-term studies.[12] This effect must be enhanced by the continuous use of vertical elastics in the premolar and/or canine area.

The bite blocks are created by placing three layers of rectangular attachments, each measuring 5mm, parallel to one another to form a cube-like structure on the occlusal surfaces of the molars. We have developed a specific instruction for this protocol: "Place triple rectangular 5mm attachments on three superimposed layers simulating a high square pad on the occlusal surface of the lower first and second molars to help with intrusion."

TABLE 1
CASE 1 CEPHALOMETRIC DATA

	Norm	Pretreatment	Post-Treatment
SNA	82.0° ± 3.0°	80.9°	80.8°
SNB	80.0° ± 3.0°	75.1°	75.5°
ANB	2.0° ± 2.0°	5.7°	5.3°
SN-GoMe	32.0° ± 5.0°	31.6°	30.6°
U1 to horizontal reference line	110.0° ± 5.0°	98.6°	103.5°
IMPA	95.0° ± 5.0°	96.6°	93.6°
Overjet	2.5mm ± 1.0mm	2.5mm	3.3mm
Overbite	2.5mm ± 1.0mm	−1.9mm	3.6mm

Fig. 1 Case 1. 38-year-old female patient with Class II malocclusion, anterior open bite, retrognathic profile, transverse maxillary constriction, and delayed eruption of upper left first molar before treatment.

The attachments should be stacked vertically to create a greater volume. It is important to note that they should not actually be bonded; their sole purpose is to generate a virtual occlusal thickness within the tray, thereby simulating a bite block. This allows the practitioner to benefit from a posterior intrusive effect, even when the aligner software does not inherently support that feature.

Some aligner systems do not support the direct integration of bite blocks into the tray design. To overcome this limitation, the technician can be asked to place three rectangular attachments close to each other on the occlusal surfaces of the molars. Each aligner tray will then be fabricated with a negative imprint of the occlusal attachments, enabling them to act as raised bite pads during aligner wear.

3. Short Anterior Elastics

These elastics (⅛", 4.5oz) serve a dual purpose: they increase vertical pressure on the posterior bite blocks, enhancing the intrusive effect, and they help promote the convergence of occlusal planes in the premolar and canine areas. The elastics are adapted according to the planned occlusal goals, taking into account any anticipated anteroposterior movements.

Case 1

A 38-year-old female presented with a dentoalveolar malocclusion characterized by an anterior open bite and moderate Class II relationships (Fig. 1). The overbite was negative (–1.9mm), and the overjet indicated insufficient vertical overlap. The patient exhibited well-formed, U-shaped arches with a slight maxillary transverse constriction and minimal crowding. Periodontal health appeared intact, with no gingival recession or notable inflammation, although mild staining was observed on the posterior teeth.

Cephalometric evaluation indicated a skeletal Class II profile, predominantly due to mandibular retrognathia (Table 1). In the sagittal plane, the SNA angle suggested mild maxillary retropositioning, while the SNB angle confirmed a pronounced mandibular retrusion, resulting in a convex skeletal pattern. Vertically, the dimensions appeared balanced, with no significant hyper- or hypodivergence (SN-GoMe = 31.6°). The absence of significant vertical cephalometric discrepancies was notable, along with the presence of a double occlusal plane (a posterior plane at the molar level and an anterior plane at the canine-incisor level). Dentally, the maxillary incisors showed retroclination

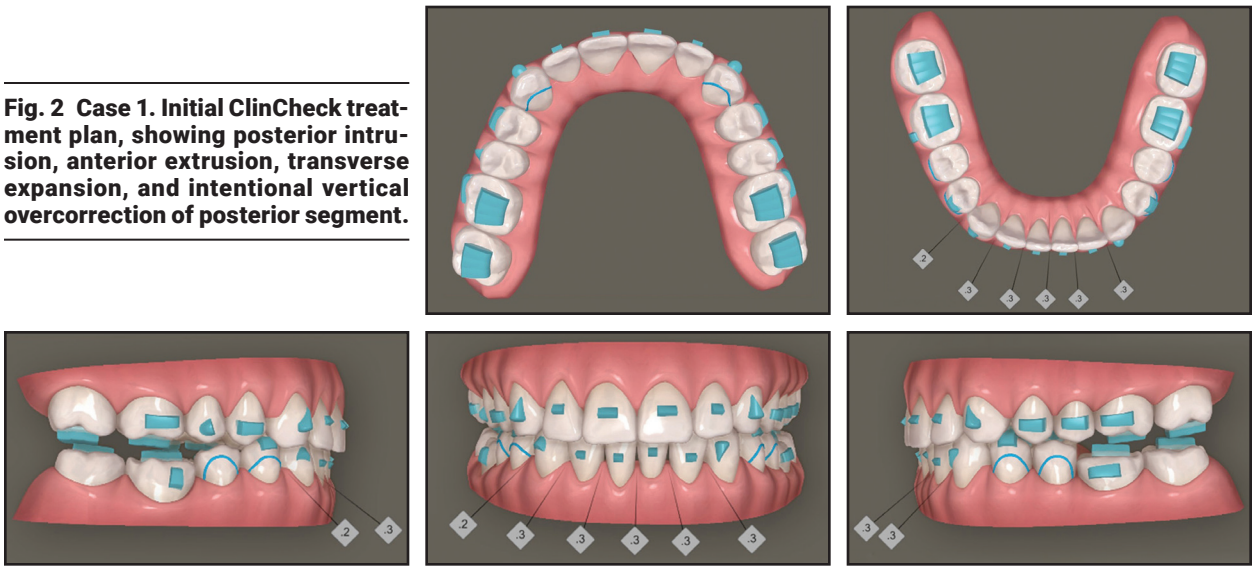

Fig. 2 Case 1. Initial ClinCheck treatment plan, showing posterior intrusion, anterior extrusion, transverse expansion, and intentional vertical overcorrection of posterior segment.

relative to the horizontal reference line, likely compensating for the underlying sagittal skeletal discrepancy. The mandibular incisors showed slight proclination, approaching the upper limit of normal (IMPA = 96.6°).

The previously described protocol was applied. Posterior intrusion and anterior extrusion were planned on the ClinCheck, using an initial 55 stage treatment of Invisalign* clear aligners, changed weekly (Fig. 2). Vertical elastics were prescribed to reach the occlusal plane tipping point (Fig. 3).

In a second aligner phase (25 stages), the upper molars were settled with controlled relapse (Fig. 4). A slight transverse expansion was performed to improve contacts and optimize vertical control. The placement of lingual buttons on the

*Align Technology, Inc., San Jose, CA; www.aligntech.com.

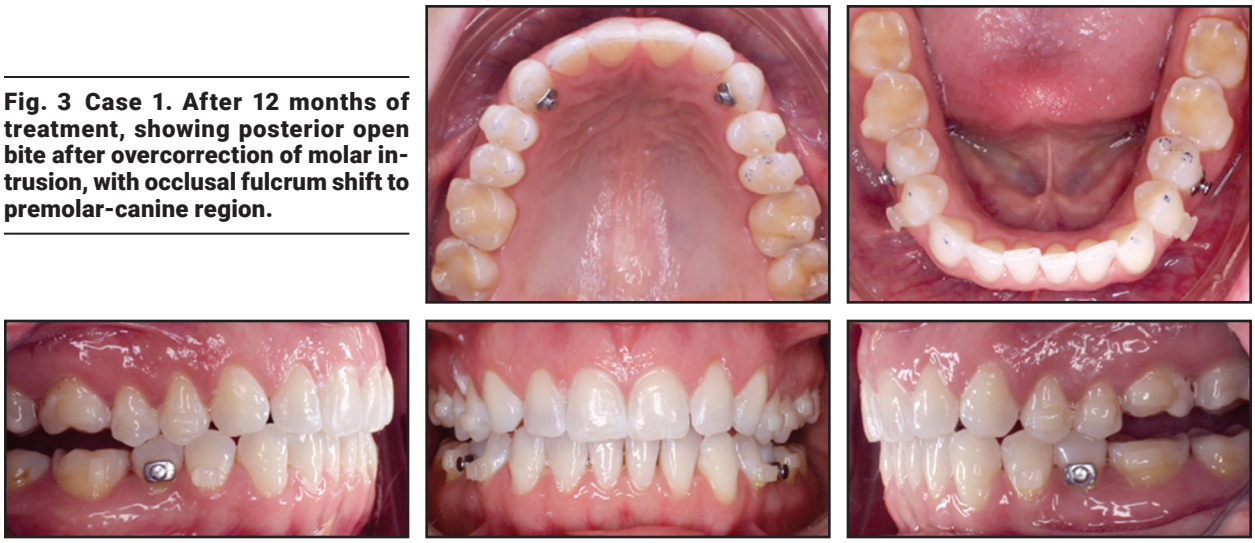

Fig. 3 Case 1. After 12 months of treatment, showing posterior open bite after overcorrection of molar intrusion, with occlusal fulcrum shift to premolar-canine region.

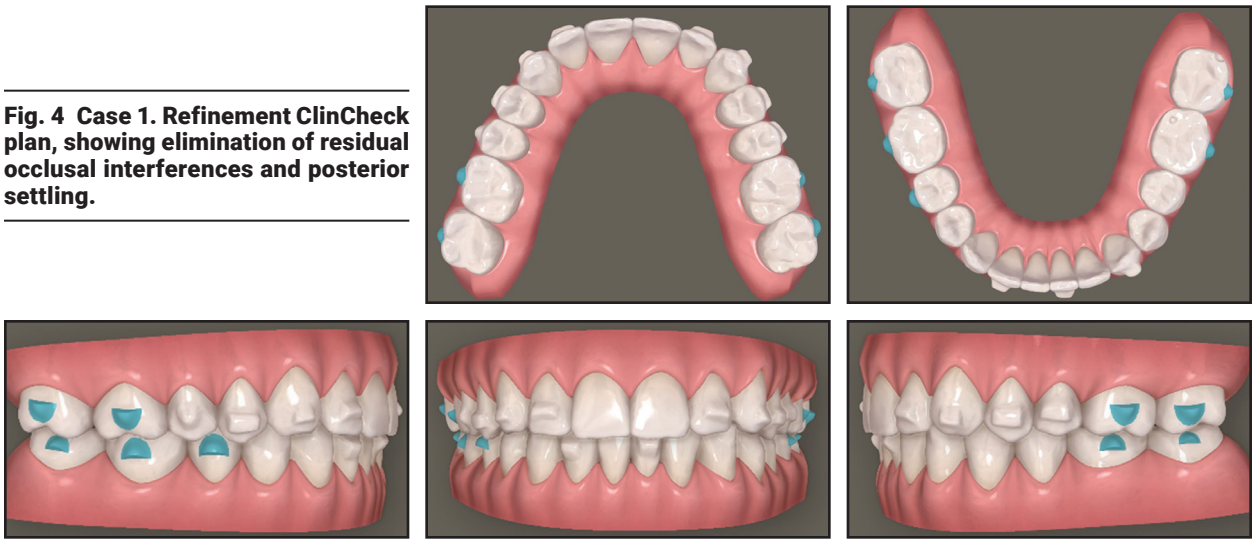

Fig. 4 Case 1. Refinement ClinCheck plan, showing elimination of residual occlusal interferences and posterior settling.

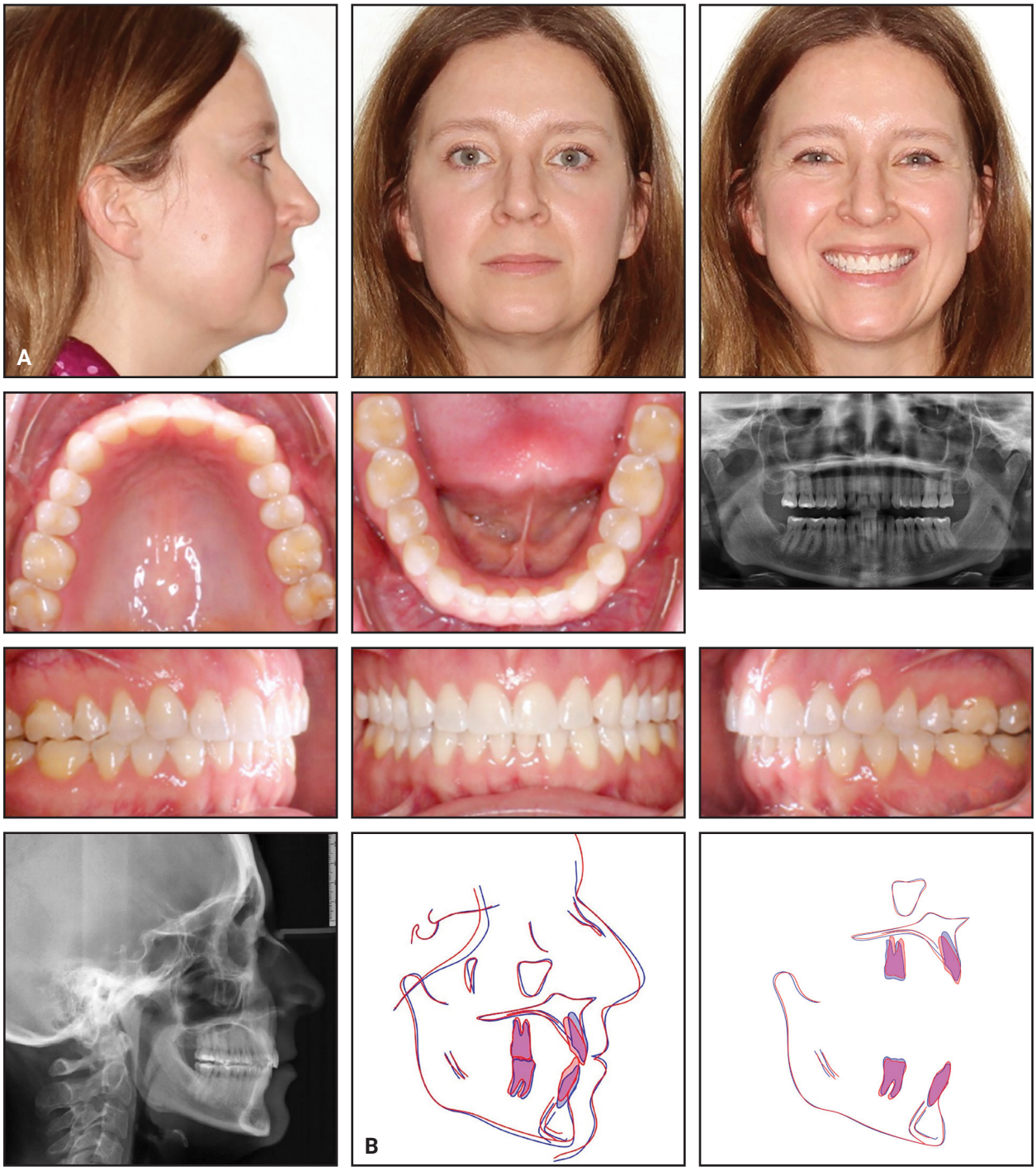

Fig. 5 Case 1. A. Patient after 22 months of treatment, showing closure of anterior open bite, solid premolar-canine intercuspation, overbite correction, and counterclockwise mandibular autorotation. B. Superimposition of pre-treatment (blue) and post-treatment (red) cephalometric tracings.

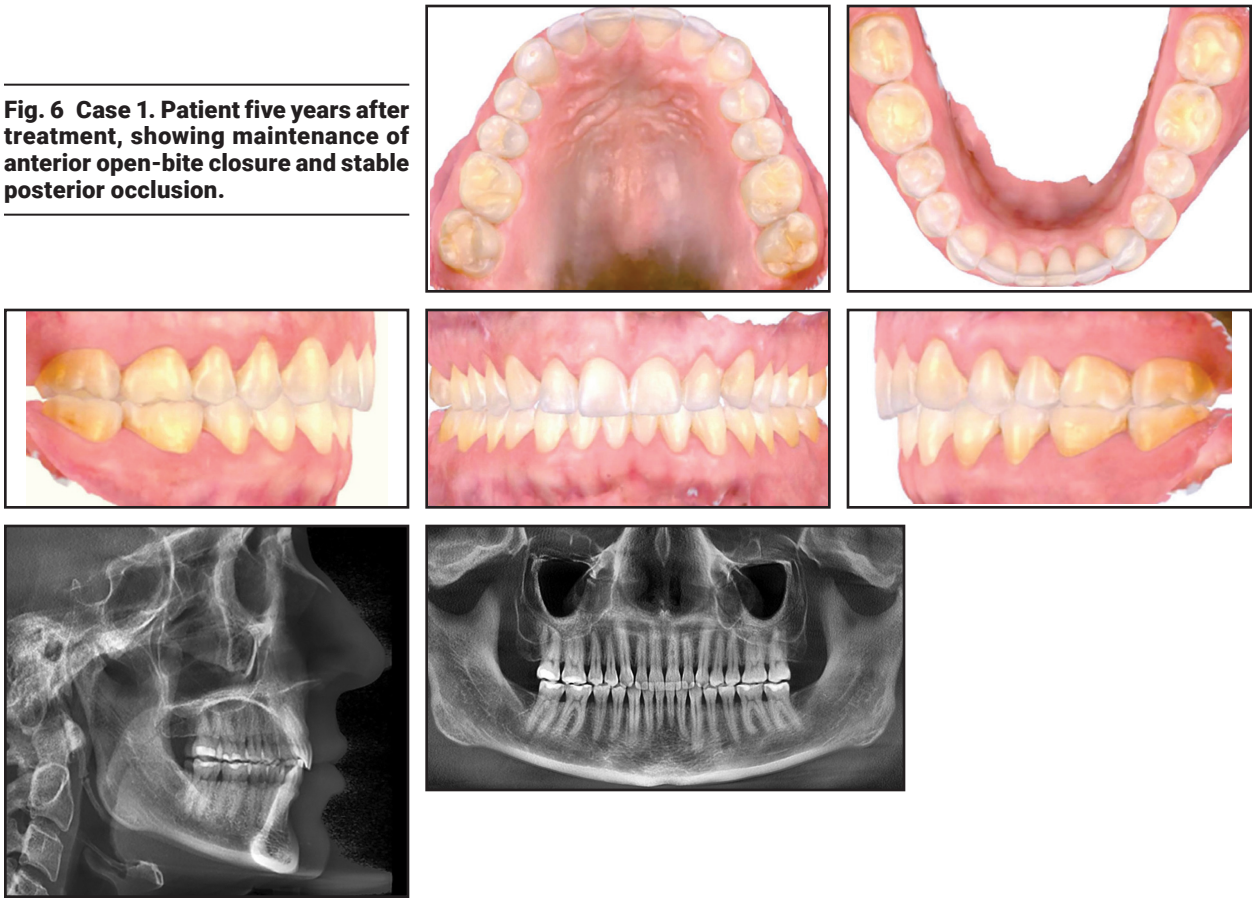

Fig. 6 Case 1. Patient five years after treatment, showing maintenance of anterior open-bite closure and stable posterior occlusion.

canines promoted expansion while applying a sagittal vector contributing to correction of the Class II malocclusion.

Overall, the treatment lasted 22 months (Fig. 5). In the sagittal plane, the ANB angle remained stable; a net improvement of 5.5mm was seen at the incisor level, since the initial negative overbite of –1.9mm was corrected to a positive overbite of 3.6mm (Table 1). The closure of the anterior open bite was likely supported by the intrusion of both maxillary and mandibular molars, with an intentional vertical overcorrection. This approach shifted a posterior precontact in the molar region to a solid intercuspation in the premolar and canine area, allowing harmonization of the occlusal planes. The upper molars were settled with controlled relapse over two refinement sets of 25 and 20 stages, respectively, reaching light occlusion with their antagonists.

Vivera* retainers were prescribed for six months full-time, then at night only for life. The patient was referred to a myofunctional therapist, considering that control of lingual function would be essential to maintaining the achieved results. Records taken five years after treatment demonstrated long-term stability (Fig. 6).

Case 2

A 16-year-old female presented with a Class II, division 1 malocclusion marked by a severe overjet (11.1mm) and an anterior open bite (Fig. 7).

*Align Technology, Inc., San Jose, CA; www.aligntech.com.

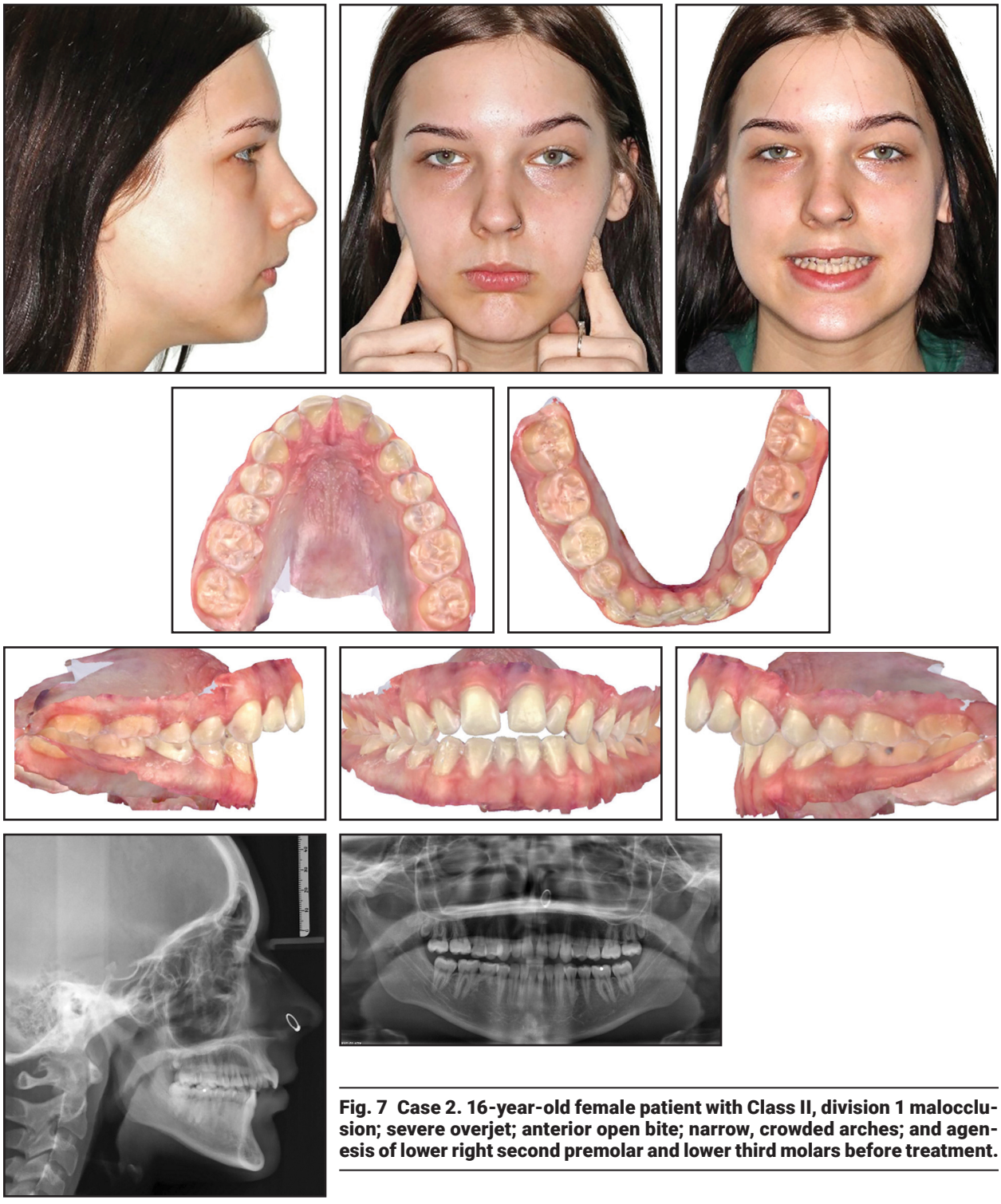

Fig. 7 Case 2. 16-year-old female patient with Class II, division 1 malocclusion; severe overjet; anterior open bite; narrow, crowded arches; and agenesis of lower right second premolar and lower third molars before treatment.

The arches were narrow and crowded, with proclined upper incisors and retroclined lower incisors suggesting a labial interposition parafunction. Agenesis of the lower right second premolar and the lower third molars was noted, while the upper third molars were present but microdontic. The periodontal status appeared healthy, though mild plaque accumulation was observed in the posterior region.

Cephalometric evaluation (Table 2) confirmed a severe skeletal Class II profile (ANB of 7.3°), primarily due to mandibular retrognathia (SNB = 73.8°). The profile was convex. Vertically, a mild hyperdivergence was observed, as in-

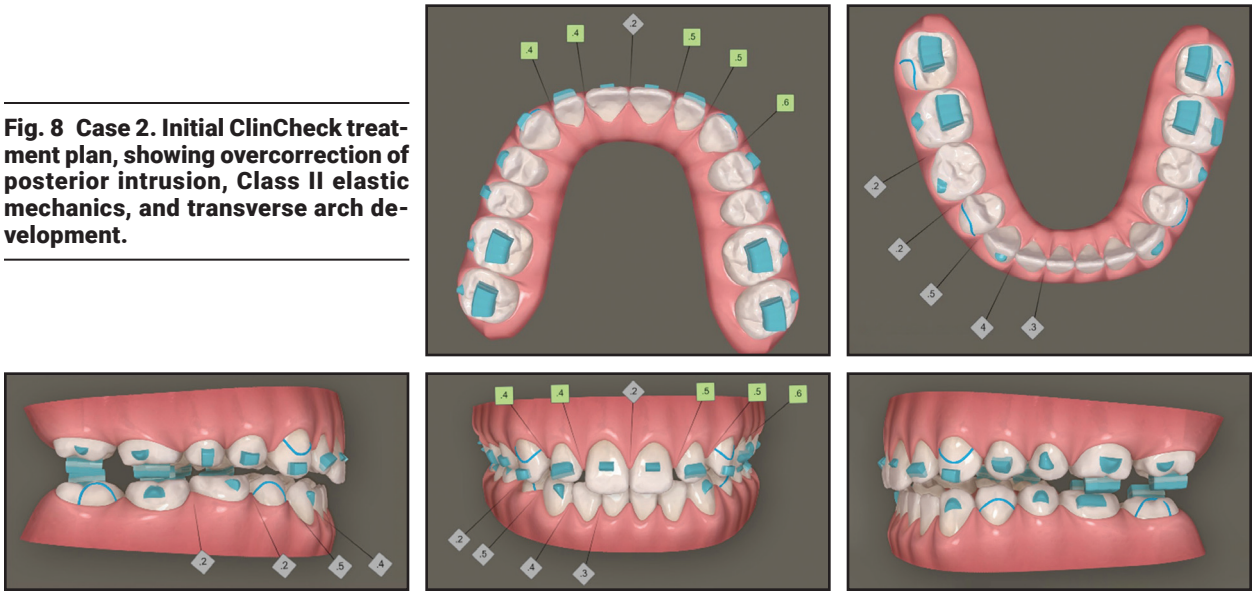

Fig. 8 Case 2. Initial ClinCheck treatment plan, showing overcorrection of posterior intrusion, Class II elastic mechanics, and transverse arch development.

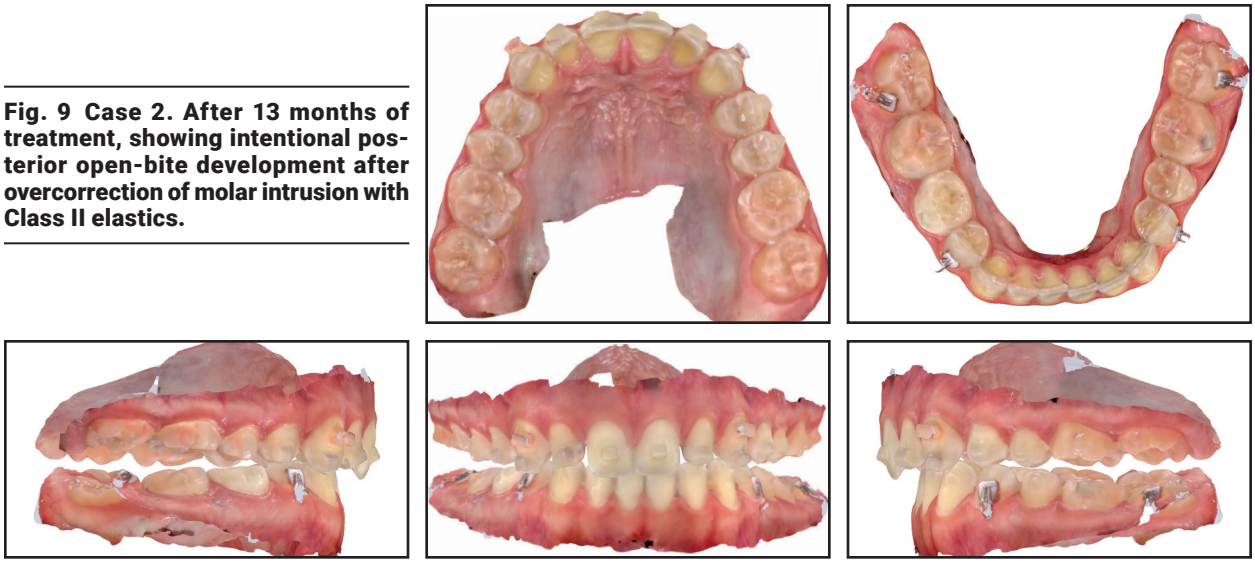

Fig. 9 Case 2. After 13 months of treatment, showing intentional posterior open-bite development after overcorrection of molar intrusion with Class II elastics.

dicated by a mandibular plane angle (SN-GoMe) of 34.8°, with balanced anterior and posterior facial heights but a pronounced occlusal plane inclination.

We decided to extract the microdontic third molars and retain the lower right deciduous second molar, whose well-developed roots would contribute to long-term stability. In the vertical plane, the intrusion protocol was implemented with one modification: a more pronounced sagittal component of elastic force was incorporated due to the severity of the Class II relationship. To enhance the projection of the mandibular dentition, distal buttons were bonded to the lower first molars. As in the previous case, overcorrection of the posterior occlusion was planned in a first set of 56 aligners

TABLE 2
CASE 2 CEPHALOMETRIC DATA

	Norm	Pretreatment	Post-Treatment
SNA	82.0° ± 3.0°	81.0°	79.6°
SNB	80.0° ± 3.0°	73.8°	74.0°
ANB	2.0° ± 2.0°	7.3°	5.6°
SN-GoMe	32.0° ± 5.0°	34.8°	33.9°
U1 to horizontal reference line	110.0° ± 5.0°	113.7°	103.7°
IMPA	95.0° ± 5.0°	83.7°	91.5°
Overjet	2.5mm ± 1.0mm	11.1mm	3.8mm
Overbite	2.5mm ± 1.0mm	0.0mm	3.0mm

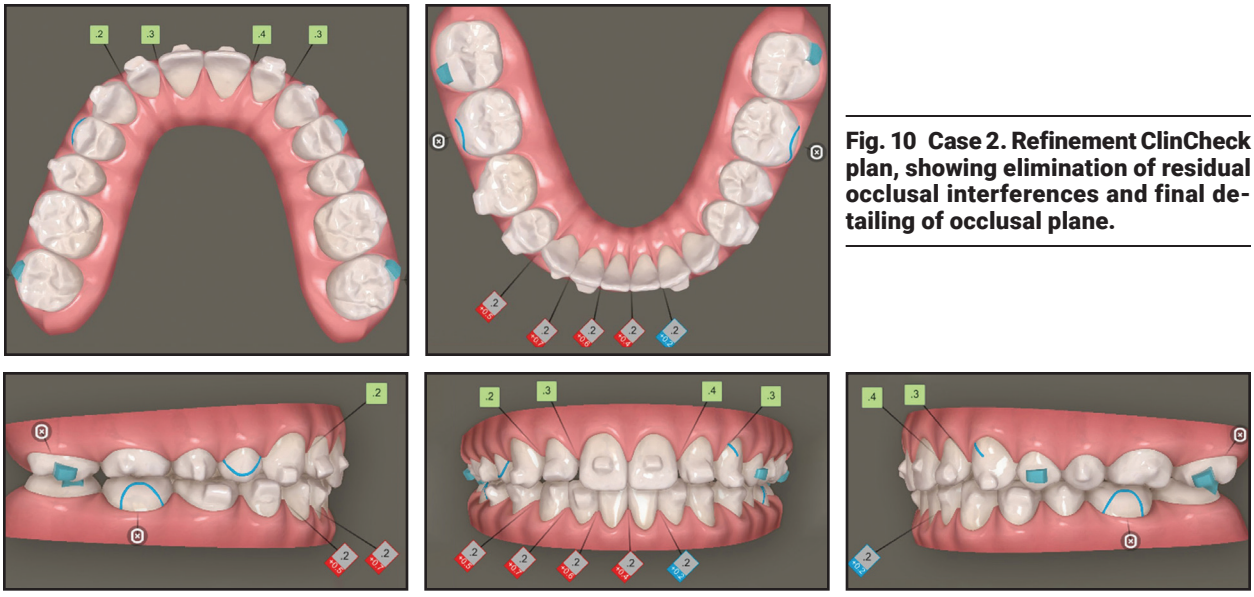

Fig. 10 Case 2. Refinement ClinCheck plan, showing elimination of residual occlusal interferences and final detailing of occlusal plane.

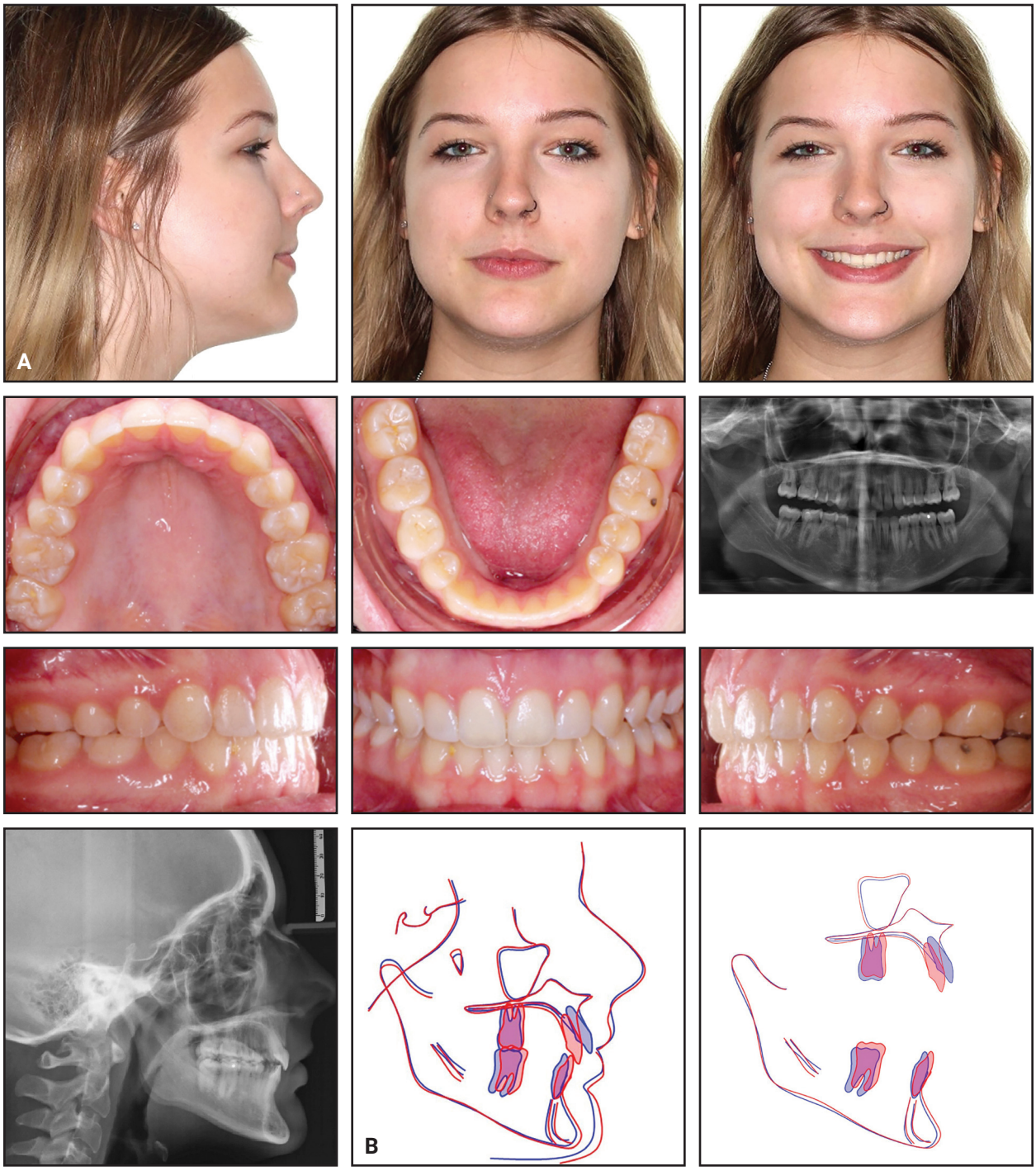

Fig. 11 Case 2. A. Patient after 30 months of treatment, showing reduced overjet, positive overbite, reduced mandibular plane angle, and upper first molar intrusion. B. Superimposition of pretreatment (blue) and post-treatment (red) cephalometric tracings.

(Fig. 8). Class II mechanics were applied with elastics (Fig. 9); the extrusive forces linked to Class II correction would be partially dissipated by the intrusive overcorrection planned for the lower molars. Transverse arch development was also carried out to improve interdigitation and facilitate autorotation of the mandible.

The treatment, lasting 30 months, included a second refinement of 40 stages (Fig. 10) and a third refinement of 18 stages. A satisfactory functional and esthetic outcome was achieved (Fig. 11). In the sagittal plane, the ANB angle decreased from 7.3° to 5.6°—an improvement that could be attributed to residual mandibular growth and a slight counterclockwise rotation, as indicated by the reduced mandibular plane angle (Table 2). This rotation also resulted in a more esthetic profile. Vertically, the overbite improved from 0mm to 3mm, and the overjet was significantly reduced, from 11.1mm to 3.8mm, restoring a functional occlusion. The upper first molars were intruded by 1.2mm as a consequence of the planned intrusion, although no equivalent intrusion was observed in the lower molars. Dentally, a mild Class II relationship was achieved on the left, while a full Class I relationship was achieved on the right.

Vivera retainers were delivered to be worn for six months full-time, then at night only for life. Eighteen months after treatment, the results were maintained (Fig. 12).

Discussion

Open-bite correction with clear aligners is achieved primarily through incisor extrusion. Active extrusion is planned when improved smile-arch esthetics are part of the treatment goals; it can also be expected as a result of clockwise rotation of the occlusal plane due to the continuous nature of the mechanics, since the anterior dentition serves as anchorage while the posterior teeth are intruded. To promote autorotation of the mandible, the posterior intrusion must be significantly greater than would normally be planned. The occlusion can then be settled down to light contact in the new vertical dimension.

Posterior intrusion can be enhanced by the use of bite blocks on the mandibular molars. Finkleman and colleagues reported an average intrusion of 1.2mm with bite blocks versus .4mm without, although no vertical elastics were used in their study.[11] The generally lower bone density in the maxilla, as compared to the mandible, may facilitate this intrusive movement. Nevertheless, the proximity and cortical density of the maxillary sinus floor can limit intrusion and increase the risk

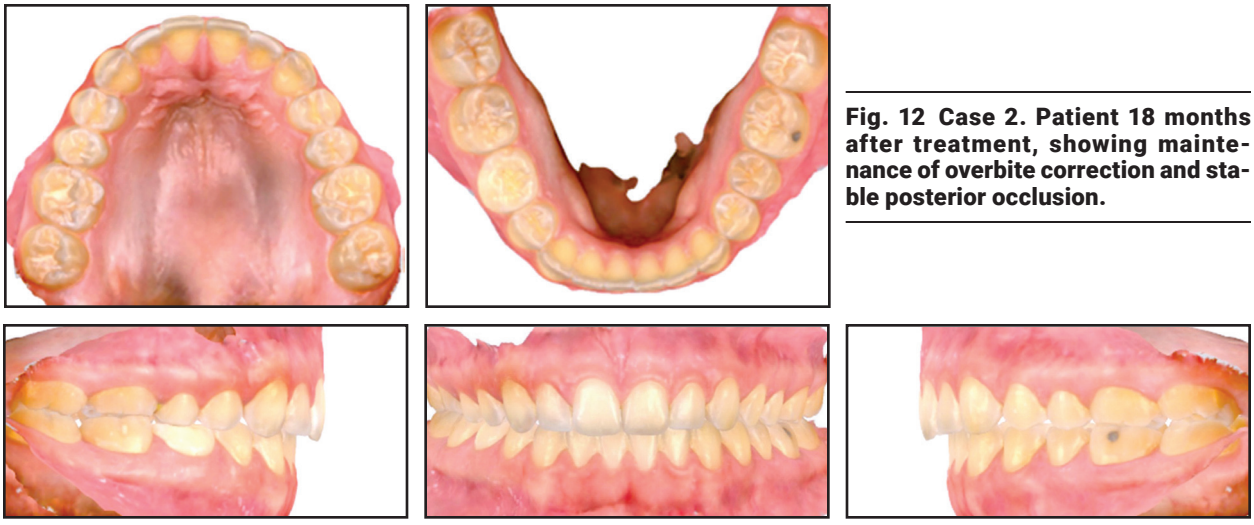

Fig. 12 Case 2. Patient 18 months after treatment, showing maintenance of overbite correction and stable posterior occlusion.

of root resorption.[13] Our findings are limited to the two cases presented and require further investigation with a larger sample.

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