

Conservative Treatment of a Skeletal Class II Malocclusion with Overjet Using Clear Aligners

**Nawal J. Almutawa, Vicky T. Huang, Chris H. Chang & W. Eugene Roberts**

Management of Anterior Deep Bite and Posterior Crossbite with a Reengineered Self-Ligating Bracket System: A Four-Premolar Extraction Case

**Lily Y. Chen, Joshua S. Lin, Chris H. Chang & W. Eugene Roberts**

A Two-Phased Clear Aligner Therapy for Bimaxillary Protrusion with Severe Rotation of Lower Left Second Molar

**Joy Cheng, Chris H. Chang & W. Eugene Roberts**



*Class II L-shaped elastics (orange lines) with Z-shaped elastics (green lines) were coordinated to correct a malocclusion with anterior deep bite. The Class II L-shaped elastics guided the mandibular dentition to establish ideal overjet and overbite, while the Z-shaped elastics facilitated midline correction. The pre- (upper right) and posttreatment (lower right) record show satisfactory treatment outcomes.*



# 2026 熱愛學矯正

全新的貝多芬高效 Damon 矯正大師系列課程是由國際知名講師張慧男醫師親自規劃及授課，課程特色強調由臨床病例帶動診斷、分析、治療計畫擬定與執行技巧。此外，透過數位影片反覆觀看，課堂助教協助操作，以及診間臨床見習，讓學員在短時間能快速上手，感染「熱愛矯正學，熱愛學矯正」的熱情。

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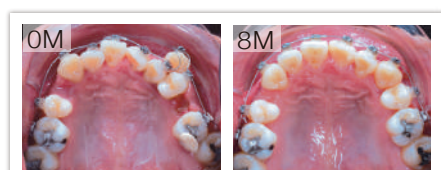
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Module 3 - 4/23	Module 9 - 8/27
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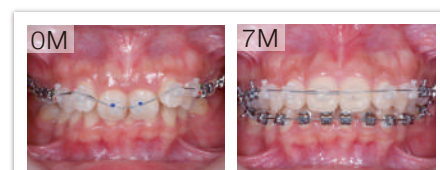
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Module 1 - 1/13	Module 7 - 7/7
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Module 3 - 3/10	Module 9 - 9/8
Module 4 - 4/21	Module 10 - 10/20
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Module 6 - 6/2	Module 12 - 12/15



Damon Clear

## Screws & Aligners

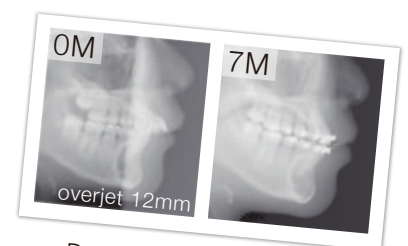
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## Mission Impossible

Steve Jobs once said, “You did the impossible because you didn’t know it was impossible.” Had you known it was impossible, you might never have dared to try.

When my young colleague, Dr. Lee, proposed a study investigating the effect of buccal shelf bone screws on distalization of the lower dentition, I immediately recognized the value of the project. The challenge, however, was clear: the number of variables involved would make meaningful analysis difficult. Dr. Lee addressed this problem with an elegant solution. By dividing the patients into several groups, he substantially reduced the confounding variables—an approach reminiscent of the Roman strategy: divide and conquer.

One year later, he presented highly convincing data. After completing the manuscript, he decided to submit it to *The Angle Orthodontist*, one of the most prestigious journals in orthodontics. I remember smiling, thinking that publication there would be nearly impossible. After six months of revisions and refinement, the paper was accepted and published. Later, I learned that in the 95-year history of the journal, Dr. Lee is the youngest author ever to publish a research article. No other author has come close to his age, and the record may stand for many years to come.

Twenty-six years old—how could that be possible? Perhaps this reflects the strength of the younger generation: the courage to challenge the status quo and the audacity to aim extraordinarily high. When goals are set that high, even reaching halfway can still represent a remarkable achievement.

I hope Dr. Lee’s story will inspire young clinicians and researchers to set their life goals—especially their academic goals—as high as possible.

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# Conservative Treatment of a Skeletal Class II Malocclusion and Overjet Using Clear Aligners

## Abstract

**History:** A 42-year-old female presented for orthodontic consultation with a severe skeletal Class II malocclusion, anterior crowding, overjet of 7 mm, dental Class II molar and canine relationships on both sides. The chief complaints were poor esthetics and an uneven smile.

**Diagnosis and Etiology:** The patient presented with a narrow upper arch, constricted 1<sup>st</sup> molars and premolar area, retroclined upper incisors, and crowding, with overjet of 7 mm. On the lower arch, there was mild crowding. Molar and Canine relationships were full-cusp Angle Class II malocclusion on both sides. However, cephalometric analysis showed a skeletal Class II relationship with a straight profile. The increased overjet is probably due to external factors, including childhood thumb-sucking and ongoing habits such as mouth breathing and tongue thrusting. These behaviors contribute to the narrowing of the upper arch. A skeletal retrognathic mandible was noted. A high mandibular angle (FMA, 37°) led to a hyperdivergent facial pattern, increased overjet, and Class II malocclusion.

**Treatment:** A non-surgical orthodontic treatment plan utilizing clear aligners and elastics has been created. A thorough pre-treatment evaluation was conducted, including digital impressions taken with the iTero Element II scanner. All necessary records and the prescription form were submitted for the comprehensive Invisalign clear aligners. Extraction of upper third molars on both sides were performed prior to arrival of the aligners. A set of 61 aligners was prescribed. After one week, at the second visit, attachments were bonded, and early Class II elastics were used. The patient was appointed every 4 weeks, with 7-day intervals between aligner changes. Upon finishing the aligner treatment, we observed substantial improvements in the overjet and overbite, as well as achieving Class I molar and canine relationships on both sides. Retention was maintained using clear retainers. (*J Digital Orthod* 2026;78:4-23)

**Outcomes:** Treatment goals were achieved after 18 months of treatment with clear aligners.

**Key words:**

Class III malocclusion, Class III molar relationship, open bite, crossbite, Class III elastics, overjet, overbite

## Introduction

A 42-year-old female presented with chief complaints of uneven smile and crowding with increased overjet. She was previously seen by other orthodontists and was given the options of premolars extraction or surgery to solve her problem. Oral soft tissues, periodontium, frena, and gingival health were all examined and were within normal limits. Oral hygiene was very good. No significant medical or dental histories were noted.

## Diagnosis and Etiology

Pre-treatment facial and intraoral photographs (Fig. 1) showed a hyperdivergent facial pattern with a straight profile, competent lips, and retrusive lower chin. The pre-treatment close-up photographs (Fig. 1) showed a high lip line smile and 7-mm overjet, a moderate crowding of upper anteriors as well as retroclined upper incisors, and mild crowding in lower anterior teeth. Canine and molar Class II malocclusion of full unit of 7 mm was observed on both sides. A constricted upper arch at premolars

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■ Fig. 1: Pre-treatment facial and intraoral photograph

and molars area with palatal crown tipping was noted. Two wisdom teeth in the upper arch were fully erupted, whereas the two lower wisdom teeth were congenitally missing (Fig. 1). The patient reported no significant pain or discomfort in the temporo-mandibular joints (TMJs). Patient reported

history of mouth breathing habit as a child because of an allergic blocked nose and allergic pharyngitis. Pre-treatment panoramic and cephalometric radiographs are shown in Figs. 3 and 4, respectively. Cephalometric analysis showed a hyperdivergent skeletal Class II pattern with a retrusive mandible



■ Fig. 2: Pre-treatment intraoral digital scans



■ Fig. 3: Pre-treatment panoramic radiograph



■ Fig. 4: Pre-treatment cephalometric radiograph

and severe Class II dental relationships, as seen clearly in the pre-treatment intraoral digital scans (Fig. 2). The panoramic radiograph obtained prior to treatment indicated that there were no significant pathological lesions in the hard tissues (Fig. 3). From the pretreatment cephalometric radiograph (Fig. 4), and the pretreatment analysis data showed the ANB angle was  $9^\circ$ , the FMA angle was  $37^\circ$ , the upper incisors were retroclined  $92^\circ$ , and the lower incisors were inclined  $98^\circ$  to the mandibular plane. The cephalometric values are summarized in Table 1. The American Board of Orthodontics (ABO) Discrepancy Index (DI) was 45, as documented in Worksheet 1. The patient was successfully treated with a conservative non-surgical protocol with extraction of the upper 3<sup>rd</sup> molars only and Class II elastics. Upper molars retraction protocol and the use of early Class II elastics for anchorage were prescribed. A beautiful and satisfying smile was achieved by the end of the treatment. The IBOI Pink and white score as documented in Worksheet 3.

## Objectives

To enhance the esthetics of the patient's smile, the treatment objectives were to (1) sequentially retract

the upper posterior teeth to produce a Class I molar and canine relations on both sides, (2) expand the the upper arch around the 1<sup>st</sup> molars and premolars area to correct the upper narrow arch and to eliminate black corridors, and (3) intrude and retract the anterior teeth with lingual root torque to overcome the tendency of deep bite. Extrusion of the upper and lower molars and premolars and intrusion of the lower anterior teeth were also planned to level the curve of Spee and to control the vertical dimension of anterior occlusion (VDO) and minimize the tendency of gummy smile which could worsen during retraction. Selective retroclination and rotation of upper anterior teeth was planned to correct the moderate crowding and overlapping. The patient's chief concerns were esthetics as well as difficulty in closing the lips and incising food (Fig. 1). A conservative treatment plan with extraction of the upper third molars only was carried out despite the orthognathic surgical option or 1<sup>st</sup> upper premolars extraction option as were previously suggested by other orthodontists, which the patient declined because they were too aggressive. Therefore, extraction of upper 3<sup>rd</sup> molars on both sides were requested virtually to provide space for retraction after oral scanning. An orthodontic treatment of light force with clear aligner system (Invisalign, Align Tech Inc., San Jose, CA) was recommended to meet the patient's needs:

### Treatment Objectives

1. Correct the skeletal Class II discrepancy:  
Achieve a more harmonious sagittal skeletal relationship by utilizing dento-alveolar compensation techniques appropriate for non-surgical adult treatment.
2. Reduce the severe overjet: Retract maxillary anterior teeth to decrease the excessive overjet and establish proper anterior guidance and incisal coupling.
3. Improve molar and canine relationships : Achieve bilateral Class I molar and canine relationships through upper arch retraction and Class II elastics.
4. Address upper arch crowding and proclination: Create space by extracting upper third molars and allowing posterior segmental retraction, improving incisor angulation and arch form.
5. Control the vertical dimension and deep bite : Prevent deepening of the bite during retraction using a combination of true and relative anterior intrusion, posterior extrusion, and leveling of the curve of Spee.
6. Enhance facial esthetics and soft tissue profile: Improve the convex profile and reduce lip protrusion while maintaining smile esthetics and avoiding a gummy smile, especially considering the patient's high smile line.
7. Maintain periodontal health and root positioning: Utilize controlled tooth movements with torque expression (e.g., power ridges) to maintain root parallelism and prevent flaring or root resorption.

8. Establish stable occlusion and long-term retention: Ensure proper occlusal contacts and stability after treatment using customized clear removable retainers.

### Treatment Strategies

1. Non-extraction approach in the anterior region: Maintain all anterior teeth and avoid premolar extractions to preserve facial esthetics and reduce the risk of excessive flattening of the profile.
2. Extraction of upper third molars: Remove upper wisdom teeth to facilitate posterior segmental retraction without compromising anchorage or treatment efficiency.
3. Segmental retraction of the upper arch: Implement sequential retraction of posterior teeth using clear aligners, beginning with second molars and progressing anteriorly, to correct the Class II molar and canine relationships.
4. Use of Class II elastics: Employ early light Class II elastics during retraction to reinforce anchorage and enhance mandibular advancement, improving sagittal correction.
5. Expansion of the maxillary arch: Apply programmed transverse expansion through the aligner system to broaden the upper arch, facilitate molar rotation, and support Class I molar interdigitation.
6. Molar disto-buccal rotation: Correct the mesio-palatal rotation of upper molars to gain effective distal space and optimize occlusal intercuspation.
7. Retraction of maxillary anterior teeth: Retract protrusive upper incisors to reduce overjet while using power ridges and optimized attachments to maintain root torque and upright incisor positioning.
8. Vertical control through curve of Spee leveling: Control bite deepening by combining relative and true anterior intrusion with posterior extrusion, addressing both overbite and smile esthetics.
9. Root torque and anchorage control: Use clear aligner features such as power ridges and optimized attachments to ensure proper root control and minimize anchorage loss during retraction.
10. Retention with clear removable retainers: Deliver upper and lower clear retainers posttreatment to maintain results, stabilize occlusion, and preserve rotational and expansion correction.

### Treatment Progress

The total treatment period lasted 15 months, and the final results are documented in the finish records (Figs. 5-7). A dental scan was performed using the iTero Element II (Align Tech Inc., San Jose, CA), and all necessary records were submitted to initiate the analysis and treatment planning for the case. The following instructions were provided to the CAD designer: Virtual extraction of upper third molars. The upper posterior teeth were planned to move in three dimensions: 1. sequential retraction, 2. expansion with buccal root torque and disto-buccal rotation, and 3. extrusion. For Class II elastics, placements of hooks at



■ Fig. 5: Posttreatment facial and intraoral photographs



■ Fig. 6: Posttreatment panoramic radiograph

upper canines and button cut-outs on the lower first molars were requested. The initial ClinCheck treatment simulation using the Invisalign System (Align Tech Inc., San Jose, CA) was satisfactory, and minor modifications were made using 3D control and was approved after reviewing the desired biomechanics design and treatment outcome.

A total of 61 aligners were used: 61 active aligners in the upper arch and 14 active aligners in the lower arc. The treatment interval for changing aligners



■ Fig. 7: Posttreatment cephalometric radiograph

was set at every 7 days. The process began with the delivery of the first aligners, but no attachments were placed for the first week. This allowed the patient to adjust to speaking with the aligners in place and ensured greater comfort and ease of use. The patient was instructed to wear the aligners full-time, for 22 hours each day, and was advised to remove them only when eating and brushing their teeth. After one week, the patient returned for a follow-up appointment. During this visit, their teeth were polished and prepared for the adhesion of attachments using an attachment template. The composite resin used for this was Bulk Fill, a flowable composite (SDR Flow, Dentsply Sirona, Germany).

Upper arch :

1. Optimized expansion support attachments on UR4-7 and UL4-7
2. Optimized root control attachments on UR3, UR2, UL2, and UL3

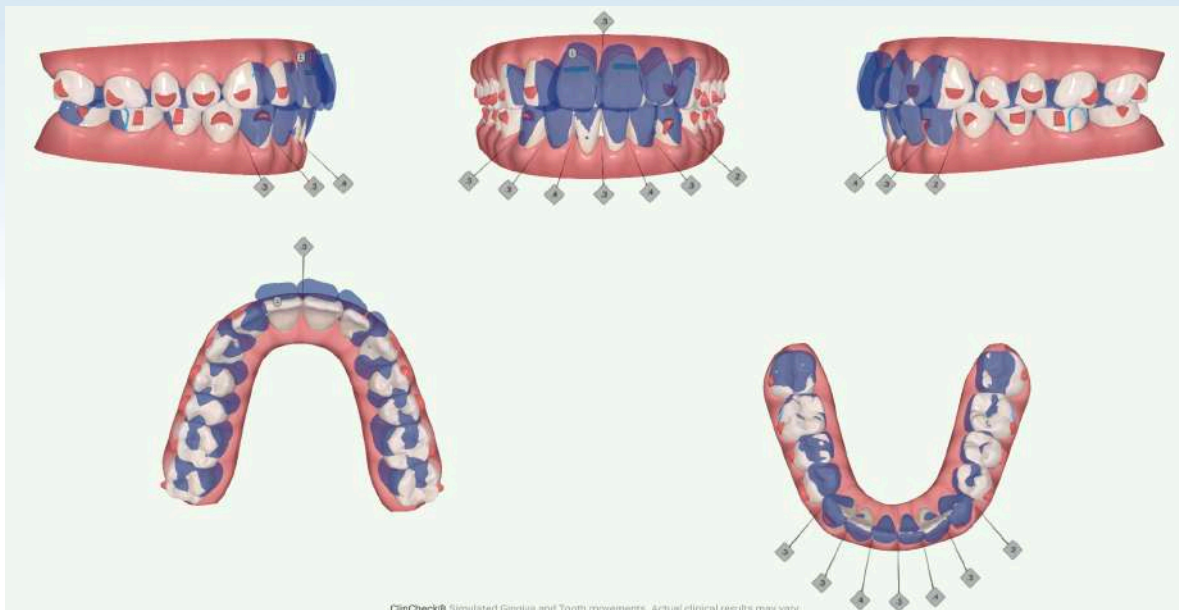
Lower Arch:

1. Conventional rectangular attachments on LR6, LR5, LL5, and LL6
2. Optimized expansion support and root control attachments on LR7, LR4, LR3, LL3, LL4, and LL7

The digital simulation of the treatment outcome was designed to meet the treatment goals (Fig. 8).

At aligners #5, metal lingual buttons were bonded at the corresponding cut-out on the buccal surfaces of teeth LL6 and LR6. The patient was requested to hook elastics in Class II pattern (Fox, 1/4 -in, 3 oz,Ormco, CA) on both sides while wearing the aligners (Figs. 9a and 9b). The patient received instructions on how to attach the elastics and was advised to keep them hooked at all times while wearing the aligners. They should be removed every 8 hours for changes and taken off during meals or when brushing teeth.

After aligners #61, a new scan was performed. The patient was instructed to continue wearing the last set of aligners and to keep the Class II elastics on at night only until the new additional aligners arrive. A new ClinCheck was created and modified to meet the following instructions:



■ Fig. 8: The Initial ClinCheck views show initial teeth position (blue) and simulated final position (white).



■ Fig. 9a: Class II elastics from right buccal view



■ Fig. 9b: Class II elastics from the left buccal view

1. Removal of all old attachments and button cutout and hooks
2. Extra intrusion of upper central incisors with palatal root torque
3. IPR in the upper anteriors

Modifications in the attachments were as follows :

1. All the existing attachments were removed.
2. New optimized retention deep bite attachments on UR4, UR3, UL4 and UL3

3. New optimized root control attachments on UL1 and UL2, and LL4
4. Power ridge on UL1 for palatal root torque
5. IPR of 0.4 mm between upper central incisors to reduce the black triangle effect
6. No button cut-outs or hooks

The additional aligners is consisted of 8 active aligners. Digital simulation outcome as shown in (Fig. 16). All the old attachments were replaced by

new attachments as needed. The new attachments were placed with the use of a new template. After aligner #8, all the planned goals were achieved with satisfying results. All attachments were removed, and final records of photos, X-ray, and digital scans for clear retainers were taken. The patient was advised to wear aligner #8 for full time to hold the teeth in place waiting for the retainers.

### Retention

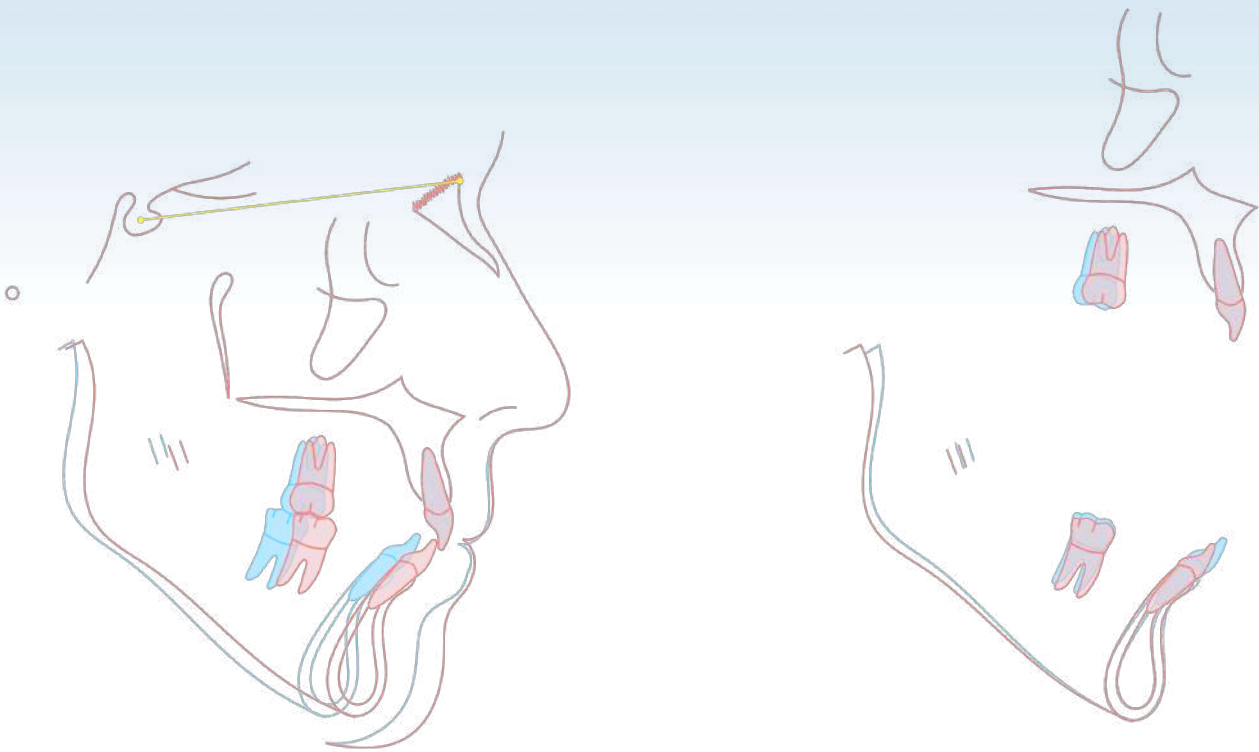
Digital scans for clear removable retainers were taken using the iTero scanner. The clear retainers (Vivera, Align Tech., CA) were delivered after two weeks and it was advised to wear them full time for six months. No Class II elastics were used (Fig. 11).

### Treatment Results

Posttreatment documentation included photographs (Fig. 5), radiographs (Figs. 6 and 7), cephalometric measurements (Table 1), and superimposed tracings (Fig. 10). The analysis indicated that both the overbite and overjet were within normal ranges. Additionally, a Class I molar and Class I canine relationship were achieved on both sides. Alignment and retraction of upper anteriors was achieved, and crowding was eliminated. Intrusion of upper anteriors, correction of overjet and overbite by leveling of the curve of Spee were achieved. Two sets, a total of 69 aligners for both arches, over 15 months produced the final results. The treatment goals were achieved as planned and closely matched the original 3D ClinCheck projection. The results were stable as shown in two years follow up photos (Fig. 12).

CEPHALOMETRIC SUMMARY			
	PRE-TX	POST-TX	DIFF.
<b>SKELETAL ANALYSIS</b>			
SNA° (82°)	78°	78°	0°
SNB° (80°)	69°	72°	3°
ANB° (2°)	9°	6°	3°
SN-MP° (32°)	44°	45°	1°
FMA° (25°)	37°	36°	1°
<b>DENTAL ANALYSIS</b>			
U1 TO NA mm (4 mm)	2	1	1
U1 TO SN° (104°)	92°	92°	0°
L1 TO NB mm (4 mm)	9	9	0
L1 TO MP° (90°)	98°	99°	1°
<b>FACIAL ANALYSIS</b>			
E-LINE UL (-1 mm)	3	5	2
E-LINE LL (0 mm)	2	4	2
%FH: Na-ANS-Gn (53%)	54%	55%	1%
Convexity:G-Sn-Pg' (13°)	25°	17°	8°

■ Table 1: Cephalometric summary



**Fig. 10:** Superimposed cephalometric tracings show the dentofacial changes after 18 months of treatment (red) compared to the pre-treatment position (blue).



**Fig. 11:** Clear retainers with buttons and elastics

## Discussion

This case demonstrates the effectiveness of the clear aligner system in addressing a challenging skeletal Class II malocclusion in an adult without the need for orthognathic surgery or premolar extractions. Maxillary third molar extractions allowed for retraction of the upper arch, an approach supported by multiple studies.<sup>1</sup> Class II elastics provided additional anchorage control and sagittal correction.<sup>2</sup> Patient compliance was critical to success, as was careful planning of attachment design, elastic placement, and staging of movements. While not all Class II cases are amenable to conservative management, this case supports the use of clear aligners as a viable treatment modality when



■ *Fig. 12: Two years follow up intra-oral photos*

patients present with mild to moderate skeletal discrepancies and high motivation.<sup>3</sup>

In adult patients, achieving true bodily retraction of maxillary molars using clear aligners is biomechanically challenging. While clear aligners can deliver controlled forces to induce tooth movement, the predominant effect observed is often distal tipping of the crown with some degree of root uprighting rather than complete bodily movement.<sup>4</sup> The following outlines the biomechanical principles behind Class II correction with clear aligners in adults:

1. True Bodily Retraction vs. Tipping: True bodily movement requires both the crown and root to move in tandem, which demands significant anchorage and precise force vectors. In

contrast, distal tipping is more easily achieved with clear aligners due to their force application characteristics.<sup>5</sup> Aligners primarily apply force at the crown level unless modified with attachments and torque elements.

2. Challenges in Adults: Due to higher bone density and decreased biological responsiveness, adult patients present with slower and more resistant tooth movement.<sup>6</sup> This makes controlled bodily retraction more difficult. Furthermore, anchorage demands are higher, and relapse risk may be elevated without adequate control.
3. Molar Retraction Protocol: In this case, sequential molar retraction was employed. The process typically involves retracting the second



■ Fig. 13: Occlusal view shows the progress of sequential retraction and alignment of the lower arch in weeks (W).



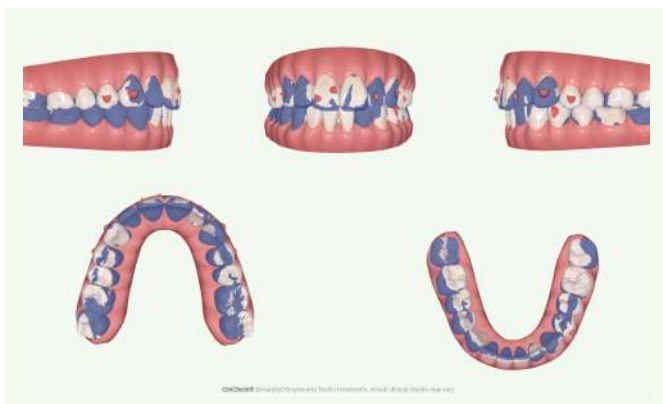
■ Fig. 14: Lateral right view shows the progress of sequential retraction and correction of open bite in weeks (W).



■ Fig. 15: Lateral left view shows the progress of sequential retraction and correction of open bite in weeks (W).

molars first, followed by the first molars and premolars, and finally retracting the anterior teeth.<sup>7</sup> Optimized attachments, such as horizontal rectangular and torque control designs, were essential to reduce tipping and promote root control (Figs. 13-15).

4. Use of Class II Elastics: Class II elastics were used in conjunction with clear aligners to reinforce anchorage and promote sagittal correction. Elastics provided a distal vector on the maxillary arch while supporting anterior anchorage. However, care was taken to monitor vertical side effects, such as bite opening. The early use of Class II elastics during clear aligner therapy serves a strategic biomechanical role in enhancing the predictability and effectiveness of Class II correction. In adult orthodontic cases where anchorage demands are high and distalization is complex, elastics provide critical support during early treatment phases (Figs. 9a and 9b).



■ Fig. 16: The ClinCheck of additional aligners  
Blue shows the teeth position after the end of first set of aligners, and white shows the simulated teeth position after refinement treatment.

## Retraction of Anterior Teeth: Torque Control and Bite Management

Retraction of anterior teeth was a central component of the Class II correction in this adult case, with the goal of resolving severe overjet and achieving optimal incisor angulation and smile esthetics. Clear aligners, supplemented by biomechanical features such as power ridges and staged intrusion, played a crucial role in this process.

1. **Power Ridges and Palatal Root Torque:** Power ridges are specifically designed features within clear aligner systems that help deliver torque to the roots of incisors. In this case, power ridges were used to exert palatal root torque during retraction of the upper incisors. This was essential for maintaining proper incisor inclination and avoiding excessive lingual crown tipping. The application of palatal root torque helped achieve more upright upper incisors, enhancing both esthetic and functional outcomes.
2. **Control of Incisor Position:** The initial presentation involved significant proclination of the upper incisors, contributing to a large overjet. Retraction with torque control not only reduced the overjet but also re-established proper incisor angulation, which was critical in achieving a harmonious smile arc and incisal display.
3. **True and Relative Intrusion for Bite Control:** To manage the deep overbite and prevent bite deepening during retraction, both true and relative intrusion strategies were employed. True intrusion was achieved through carefully

programmed vertical movements in the aligners, primarily affecting the anterior segment. Relative intrusion occurred as a result of posterior extrusion and vertical control in the molars, assisting in the leveling of the curve of Spee.

4. **Preventing Gummy Smile in a High Lip Line Patient:** Given the patient's high smile line, controlling vertical movements during anterior retraction was paramount. Over-retraction or incisor extrusion could exacerbate a gummy smile. By combining anterior intrusion with torque control, the treatment maintained an appropriate gingival display while retracting the teeth into a more esthetic and functional position.
5. **Combined Outcome:** Through a combination of torque application via power ridges, incisor retraction, and vertical control, the treatment successfully reduced overjet, improved incisor angulation, prevented deepening of the bite, and maintained a pleasing smile line despite the initial high lip position.

## Correction of Deep Bite Tendency During Anterior Retraction

In adult Class II cases, retraction of the anterior teeth can often deepens the bite due to the clockwise rotational effect it exerts on the occlusal plane. To counteract this tendency, a deliberate biomechanical approach was taken to level the curve of Spee through a combination of true and relative intrusion of anterior teeth, as well as true and relative extrusion of posterior teeth, as follows:

1. **Intrusion of Anterior Teeth (True and Relative):** True intrusion was programmed into the aligner staging to apply vertical intrusive forces on the upper incisors. This was facilitated by the use of optimized attachments and aligner design that directed forces apically along the long axis of the anterior teeth. Relative intrusion occurred as a result of posterior extrusion and molar uprighting, which effectively reduced the incisor overbite without increasing incisal display.<sup>8</sup>
2. **Extrusion of Posterior Teeth (True and Relative):** True extrusion of the upper and lower molars was programmed in selected stages to support bite opening. This helped counteract the deepening effect of incisor retraction. Relative extrusion took place as the occlusal plane was altered through sagittal correction and retraction mechanics, particularly as posterior teeth uprighted into a more vertical orientation.<sup>9</sup>
3. **Coordinated Vertical and Sagittal Control:** By synchronizing posterior extrusion and anterior intrusion, the occlusal plane was leveled without increasing gingival display, which was especially critical in this patient with a high lip line. This vertical control maintained a balanced smile line and ensured that the deep bite was addressed while retracting the anteriors.<sup>10</sup>
4. **Functional and Esthetic Outcome:** This vertical biomechanical strategy prevented the retraction-induced deepening of the

bite and promoted a more stable occlusion. It also helped avoid excessive gingival display or gummy smile, ensuring both esthetic and functional harmony at the conclusion of treatment.

### Biomechanics of Upper Molars Disto-Buccal Rotation in Class II Correction and Expansion

In Class II malocclusion cases, particularly those treated with clear aligners, disto-buccal rotation of the upper molars is a critical movement that contributes significantly to both Class II correction and transverse arch development (expansion).<sup>11</sup> This rotation, when strategically incorporated, serves both sagittal and transverse treatment objectives:

1. **Nature of Upper Molar Rotation in Class II Malocclusion.** In many Class II cases, the upper first molars are mesio-palated rotated—that is, their mesiobuccal cusp is positioned more anteriorly and medially than ideal.<sup>12</sup> This rotation makes the tooth occupy more arch space mesiodistally, limiting the available space for distalization and contributing to the Class II molar relationship.
2. **Biomechanical Benefits of Disto-Buccal Rotation:**
  - **Sagittal Space Gain (Effective Retraction):** Disto-buccal rotation repositions the mesiobuccal cusp distally and laterally, effectively shortening the mesiodistal width of the molar in the arch. This movement creates additional space that mimics

retraction, helping to transition the molars from a Class II to a Class I relationship—even before true bodily retraction occurs.

- Improved Arch Coordination: Rotated molars disrupt occlusal interdigitation with lower molars. Correcting the rotation aligns the buccal cusps of the upper molars more appropriately over the buccal grooves of the lower molars, improving Class I molar intercuspation.
- Contribution to Expansion: The buccal component of the rotation moves the distobuccal cusp laterally, aiding in the transverse development of the arch. This is particularly beneficial in adults with constricted maxillary arches, as it increases buccal overjet, enhances smile width, and facilitates crossbite correction when present.<sup>13</sup>
- Better Root Alignment and Anchorage Control: Rotational correction aligns the long axis of the molar more favorably, improving load distribution and anchorage control. It also creates a more stable platform for retracting forces or Class II elastics by orienting the molar's root complex properly within the alveolus.

### 3. Clear Aligner Mechanics for Rotation:

- Optimized Attachments: Aligner systems often employ buccal attachments (rectangular or optimized rotation attachments) on the mesiobuccal and distobuccal line angles to generate rotational couples that apply torquing forces on the crown.

- Sequential Staging and Pressure Points: Aligners deliver rotational force through programmed pressure points that cusp the tooth and deliver precise force couples. Disto-buccal rotation is often staged early in treatment to maximize space gain before bodily retraction or Class II elastic mechanics.

- Stability Considerations: Achieving and maintaining molar rotation is crucial for occlusal stability. Without proper retention, upper molars tend to relapse into their pre-treatment rotational positions. Therefore, retainers must encompass the molars fully to preserve their rotational correction.

### 4. Clinical Relevance in Class II Clear Aligner Therapy:

In this case, upper molar disto-buccal rotation was an essential first step that enabled smoother posterior retraction, reduced anterior anchorage demand, and contributed to a broader arch form. When combined with expansion and sagittal mechanics (e.g., Class II elastics), this rotation supported both functional occlusion and facial esthetics.

## Conclusion

This case demonstrates the successful conservative orthodontic management of a skeletal Class II malocclusion with a severe overjet in a 42-year-old female patient using a clear aligner system. Through a carefully planned biomechanical approach featuring upper third molar extractions,

sequential retraction, early Class II elastics, controlled anterior retraction with torque expression, and strategic leveling of the Curve of Spee, functional and esthetic objectives were achieved without the need for orthognathic surgery. The treatment maintained vertical control, preserved soft tissue harmony, and improved both occlusal function and facial profile. Cephalometric and photographic records confirmed the effectiveness and predictability of aligner therapy in addressing complex adult malocclusions when combined with sound biomechanical principles. The use of clear removable retainers ensured post-treatment stability and patient compliance. This case highlights how clear aligner systems, when applied with precision and supplemented by appropriate auxiliaries, can serve as a viable and esthetically pleasing option for managing even challenging skeletal Class II discrepancies in adult patients.

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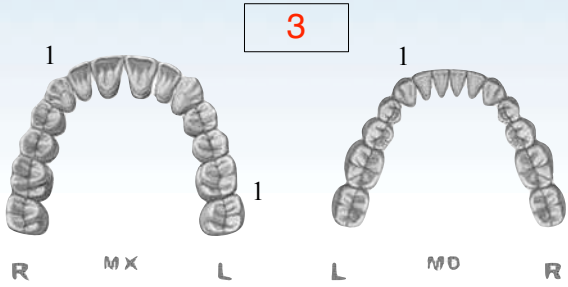
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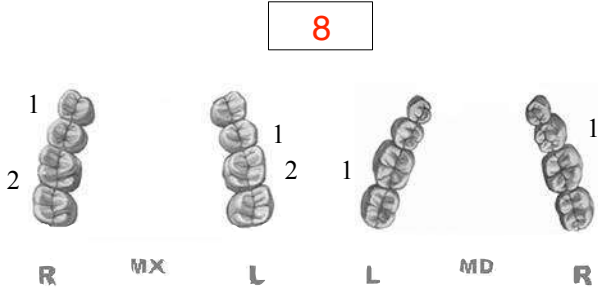
# Cast-Radiograph Evaluation

Total Score: 23

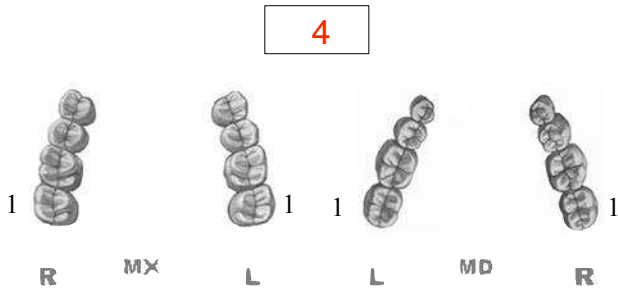
## Alignment/Rotations



## Marginal Ridges



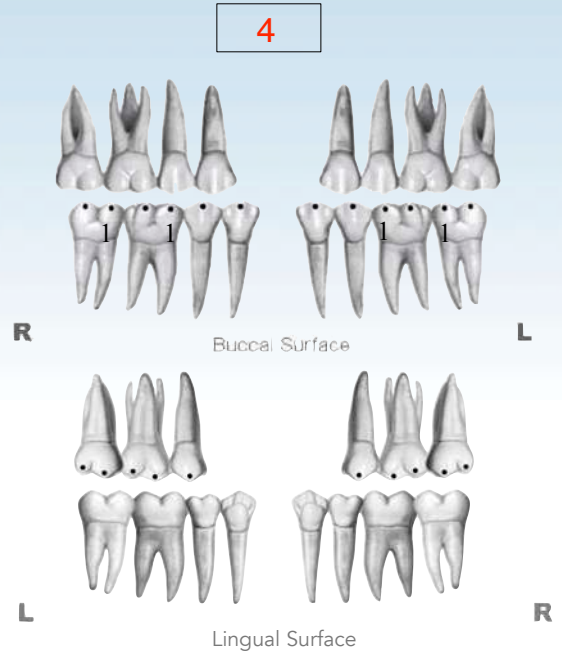
## Buccolingual Inclination



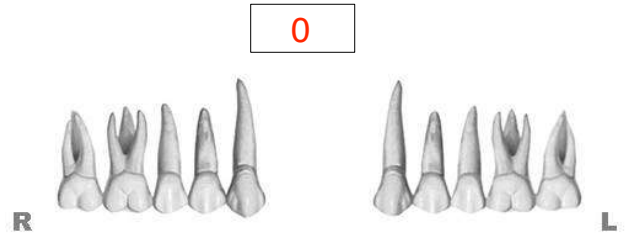
## Overjet



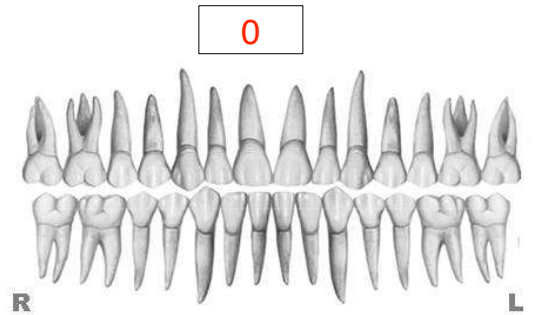
## Occlusal Contacts



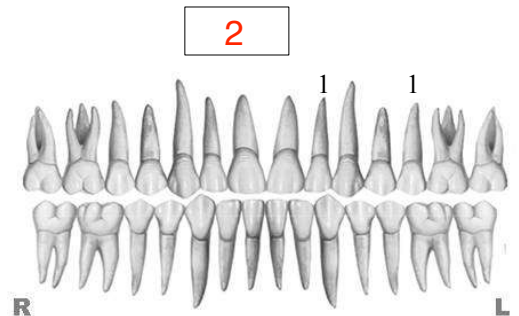
## Occlusal Relationships



## Interproximal Contacts



## Root Angulation



**INSTRUCTIONS:** Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

## IBOI Pink & White Esthetic Score

Total Score = 3

### 1. Pink Esthetic Score

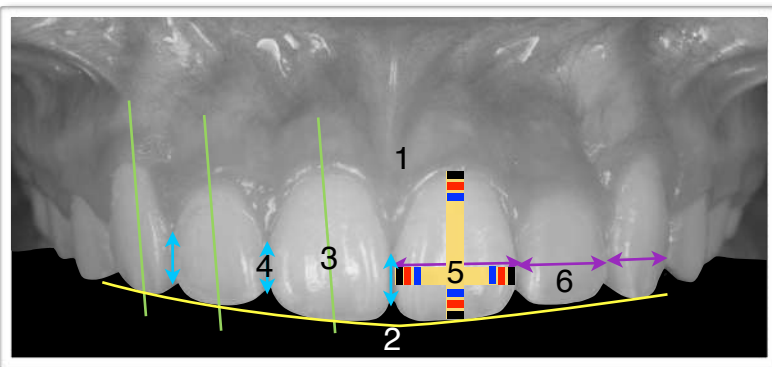


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity ( Torque )	0	1	2
6. Scar Formation	0	1	2

Total = 1

1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity ( Torque )	0	1	2
6. Scar Formation	0	1	2

### 2. White Esthetic Score (for Micro-esthetic)



1. Midline	0	1	2
2. Incisor Curve	0	1	2
3. Axial Inclination (5°, 8°, 10°)	0	1	2
4. Contact Area (50%, 40%, 30%)	0	1	2
5. Tooth Proportion	0	1	2
6. Tooth to Tooth Proportion	0	1	2

Total = 2

1. Midline	0	1	2
2. Incisor Curve	0	1	2
3. Axial Inclination (5°, 8°, 10°)	0	1	2
4. Contact Area (50%, 40%, 30%)	0	1	2
5. Tooth Proportion	0	1	2
6. Tooth to Tooth Proportion	0	1	2



# Screws & Aligners

# International Workshop

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Hsinchu, Taiwan



**Screws & Aligners**

**Keynote**  
(optional)

**2026**

Dec 01-03

Dec 04



**Dr. Chris Chang**

DDS, PhD. ABO certified, Angle Midwest member, director of Beethoven Orthodontic Center, Taiwan

*“Dr. Angle would be glad to know that contemporary orthodontics has a professional as Chris Chang!”*



Prof. Dr. Paulo Fernandes Retto, Portugal

Dr. Chang received his PhD in bone physiology and Certificate in Orthodontics from Indiana University in 1996. As publisher of Journal of Digital Orthodontics—a journal for interdisciplinary dental treatment, he has been actively involved in the design and application of orthodontic bone screws.



## Course Schedule

D  
A  
Y

1

**Chair-side observation**

D  
A  
Y

2

**Lecture, chair-side observation**

Lecture topic: **Screws & Aligners**

D  
A  
Y

3

**VISTA & 4 other minor surgeries for orthodontic practice**

Hands-on workshop

D  
A  
Y

4

**Keynote workshop**

(optional) conducted by Newton's A team



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**Stainless Steel\*\***

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\* TADs made of Ti alloy have a lower failure rate compared to SS when placed in thin cortical bone. These results are consistent with a biocompatibility-related tendency for less bone resorption at the bone screw interface. Reference: Failure Rates for SS and Ti-Alloy Incisal Anchorage Screws: Single-Center, Double Blind, Randomized Clinical Trial (J Digital Orthod 2018;52:70-79)

\*\* The overall success rate of 93.7% indicates that both SS and TiA are clinically acceptable for IZC BSs.

Reference: Failure rates for stainless steel versus titanium alloy infrazygomatic crest bone screws: A single-center, randomized double-blind clinical trial (Angle Orthod 2019;89(1):40-46)

# NEW DESIGN Stainless Steel Mirror 2.0

全新不鏽鋼口鏡曲線設計更舒適亦方便握持，一支即可拍攝全口照片，提供照相最廣可視範圍。

專利設計

咬合面拍攝



鏡面改良

側面拍攝



成像清晰

加倍舒適

無鍍膜的**不鏽鋼拋光鏡面**，可增加影像清晰度、色澤穩定度。**多道修邊工序**，可適應不同大小的口腔環境，增加患者口腔舒適感。

圓滑邊角



這個鏡子最厲害的是頰側鏡的長度，拍頰側面不會因為鏡面長度不夠，切到前牙的影像（坊間其他這種一邊頰側鏡一邊咬合鏡的拍照鏡大多都有這個問題）。



桃園 宗醫師



它牌口鏡



不鏽鋼口鏡2.0



# Management of Anterior Deep Bite and Posterior Crossbite with a Reengineered Self-Ligating Bracket System: A Four-Premolar Extraction Case

## Abstract

A 24yr-5m-old male presented with skeletal Class II relationships ( $ANB = 6^\circ$ ), severe crowding, deep overbite, posterior crossbite, and mandibular midline deviation. After 26 months of active treatment, the deep bite was significantly improved with leveling of curve of Spee. Treatment involved extraction of four premolars, combined with staged bite-opening strategies, including the use of posterior and anterior bite turbos (BTs), along with elastics to facilitate posterior occlusal settling and to achieve ideal overjet and overbite. A four-wall rigid orthodontic bracket system based on a reengineered self-ligating design was utilized to enhance torque control of anterior teeth and improve the efficiency of space closure. This case with a Discrepancy Index (DI) of 17 points was finished with a Cast-Radiograph Evaluation (CRE) score of 10 points and a Pink and White esthetic score of 3 points. (*J Digital Orthod* 2026;78:28-46)

### Key words:

Skeletal Class II, severe crowding, deep bite, posterior crossbite, midline deviation, anterior bite turbo, posterior bite turbo, four premolars extraction, Damon Ultima™

## Introduction

Correction of deep overbite is a key objective in orthodontic treatment because of its impact on occlusal function and stability. It may be achieved through anterior intrusion, posterior extrusion, or both, depending on skeletal pattern, vertical dimension, and interocclusal space.<sup>1-3</sup> Anterior intrusion requires precise control of force magnitude and direction, which can be achieved with intrusion arch mechanics or temporary anchorage devices.<sup>1,4,5</sup> Posterior extrusion is less force-sensitive but must be controlled to avoid occlusal plane canting, and may be accomplished with continuous arches, tip-back mechanics, or anterior bite turbos with Class II elastics.<sup>1,6,7</sup>

Management is more complex when deep overbite is associated with severe crowding, midline discrepancy, deep curve of Spee, and transverse disharmony, particularly in adults with a balanced facial profile.<sup>3</sup> Although extraction is often required to relieve crowding, it may lead to deepen the curve of Spee and overbite, loss of anterior torque control, and incisor retroclination. Careful control of incisor inclination and vertical dimension is therefore essential.

This case report describes a 24-year-old male with a skeletal Class II pattern ( $ANB = 6^\circ$ ), severe crowding, deep overbite, posterior crossbite, and mandibular midline deviation with bilateral Class I canine and molar relationships. Treatment included extraction of four first premolars and third molars, combined with staged bite-opening strategies, including the

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**Chris H. Chang,**

*Founder, Beethoven Orthodontic Center*

*Publisher, Journal of Digital Orthodontics (Center)*

**W. Eugene Roberts,**

*Editor-in-Chief, Journal of Digital Orthodontics (Right)*



■ Fig. 1: Pre-treatment facial and intraoral photographs

use of posterior and anterior bite turbos, along with elastics to facilitate posterior occlusal settling and to achieve ideal overjet and overbite.

A reengineered passive self-ligating system (Damon Ultima™, Ormco, Glendora, CA) was used in this case. It features a novel bracket-archwire interface,

consisting of a parallelogram-shaped slot and a round-sided rectangular archwire that combines the characteristics of round and rectangular wires. This configuration permits up to four points of contact between the archwire and bracket slot in cross-sectional view, enabling earlier control of rotation and angulation while maintaining effective torque expression.

The dental nomenclature for this report follows a modified Palmer notation. Four quadrants are defined as upper right (UR), upper left (UL), lower right (LR), and lower left (LL). Permanent teeth are numbered 1-8 from the midlines, and deciduous teeth are designated a-e.

### Diagnosis and Etiology

A 24-year-5-month-old male presented with chief complaints of crowding, deep bite, posterior crossbite, and dental midline discrepancy.

Facial examination and intraoral findings revealed a straight facial profile with a 6-mm deep overbite (Fig. 1). The mandibular dental midline was deviated 2 mm to the left relative to the maxillary midline. A blocked-out upper right canine (UR3), a buccal crossbite involving the upper left second molar (UL7), and a deep curve of Spee were noted. The molar and canine relationships were Class I bilaterally. The overjet was 3 mm, and the overbite was 6 mm, consistent with a deep bite. Severe crowding was present in the mandibular arch, measuring approximately 9 mm.

Radiographic evaluation, including panoramic radiography (Fig. 2) and cephalometric analysis (Fig.

3; Table 1), revealed impacted third molars in the upper left (UL8) and lower left (LL8) regions. A skeletal Class II relationship ( $ANB = 6^\circ$ ) with proclined mandibular incisors (L1-NB, 7.5 mm; L1-MP,  $100^\circ$ ) and a straight facial profile was noted.



■ Fig. 2: Pre-treatment panoramic radiograph



■ Fig. 3: Pre-treatment cephalometric radiograph

CEPHALOMETRIC SUMMARY			
	PRE-TX	POST-TX	DIFF.
<b>SKELETAL ANALYSIS</b>			
SNA° (82°)	84°	84°	0
SNB° (80°)	78°	78°	0
ANB° (2°)	6°	6°	0
SN-MP° (32°)	34°	34°	0
FMA° (25°)	27°	27°	0
<b>DENTAL ANALYSIS</b>			
U1 TO NA mm (4mm)	3	-1	4
U1 TO SN° (104°)	103°	93°	10°
L1 TO NB mm (4mm)	7.5	4	2.5
L1 TO MP° (90°)	100°	94°	6°
<b>FACIAL ANALYSIS</b>			
E-LINE UL (-1mm)	0.5	0	0.5
E-LINE LL (0mm)	1.5	0.5	1
%FH: Na-ANS-Gn (53%)	56.5%	57%	0.5%
Convexity:G-Sn-Pg' (13°)	13°	12°	1°

■ **Table 1:** Cephalometric summary

Pretreatment dental 3D models are shown in figure 4. The American Board of Orthodontic Discrepancy Index score for this malocclusion was 17 points (Worksheet 1). There was no contributing medical or dental history, and no temporomandibular disorders were identified.

## Treatment Objectives

The treatment objectives were to maintain the existing straight facial profile while addressing the dental and occlusal discrepancies. In the maxillary dentition, the goals were to relieve crowding,

achieve proper alignment, and correct the posterior crossbite. In the mandibular dentition, the objectives included relieving severe crowding, aligning the dentition, leveling the deep curve of Spee, and intruding the anterior teeth to correct the deep overbite while maintaining appropriate torque of the anterior teeth. The occlusal objectives were to establish ideal overjet and overbite, achieve and maintain Class I canine and molar relationships, and correct the dental midline discrepancy. Preservation of a balanced facial profile was also an essential treatment goal.

## Treatment Alternatives

Two treatment alternatives were considered. The first option was a non-extraction approach, except for removal of the impacted third molars (UL8 and LL8). This approach is less invasive and may shorten treatment time; however, alignment of severe crowding could result in anterior proclination and a more convex facial profile. Additional anchorage, such as temporary skeletal anchorage devices (TSADs), and interproximal reduction (IPR) may be required to control incisor position and facial esthetics.

The second option involved extraction of four first premolars in addition to the impacted third molars. This approach facilitates relief of severe crowding and helps prevent flaring of the anterior teeth, thereby maintaining a more favorable facial profile. However, it may prolong treatment time and presents greater challenges in anterior torque control, with a risk of retroclination, deepening of the overbite, and accentuation of the curve of Spee.

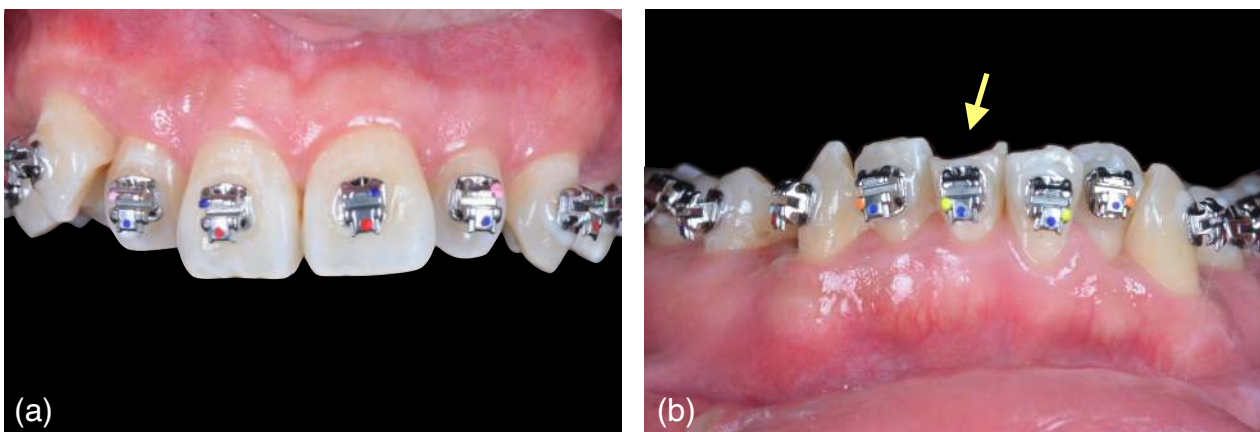
Additional anchorage or auxiliaries may be required to manage these effects.

After a thorough discussion of the advantages and disadvantages of the two treatment options with the patient, he elected to proceed with the extraction treatment plan.

### Treatment Progress

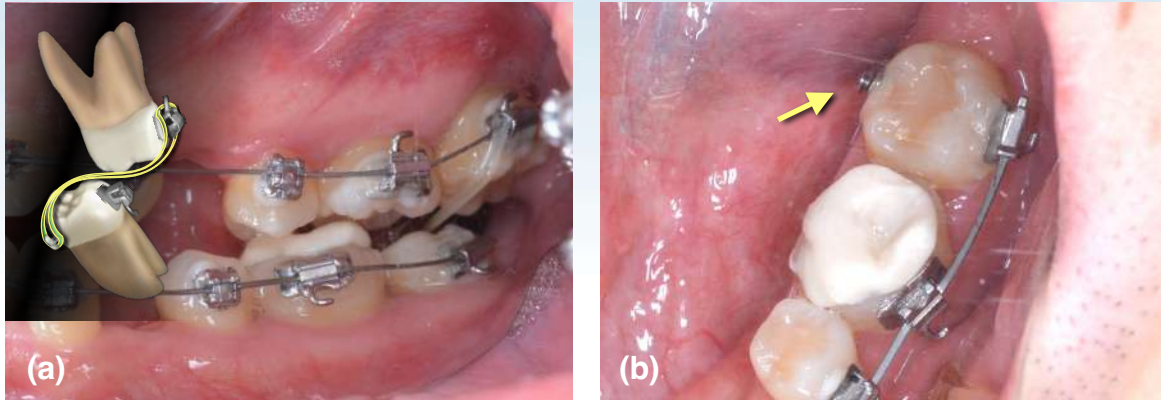
Following extraction of the four first premolars, the patient was scheduled for fixed appliance therapy. A reengineered passive self-ligating (PSL) bracket system (Damon Ultima™, Ormco, Glendora, CA) was initially bonded to the maxillary dentition only. Procline (high-torque) brackets were selected for the maxillary central incisors and canines to facilitate root control and minimize risk of cortical plate encroachment during space closure, whereas neutral (standard-torque) brackets were used for the maxillary lateral incisors, and a 0.014-in CuNiTi

archwire was inserted. One month later, the mandibular dentition was bonded with the same bracket system and a 0.014-in CuNiTi archwire was placed. Bracket torque selection was procline (high-torque) for canines and neutral (standard-torque) for mandibular incisors. Note the bonding position of LR1, which was placed approximately 2 mm more incisally to compensate for occlusal wear associated with the deep bite and to facilitate relative intrusion in preparation for future restorative treatment. This offset was estimated based on the extent of exposed dentin, suggesting approximately 2 mm of tooth structure loss (Fig. 4).<sup>8</sup> A button was bonded to the lingual surface of the lower left second molar (LL7), and bite turbos were placed on the mandibular first molars to disclude the posterior teeth. Cross elastics (Kangaroo, 3/16-in, 4.5 oz; Ormco, Glendora, CA) were applied from UL7 buccal to LL7 lingual and were subsequently progressed to (Chipmunk, 1/8-in, 3.5 oz; Ormco, Glendora, CA) to enhance crossbite correction (Fig. 5).



■ Fig. 4:

*Torque selection and bonding position for maxillary and mandibular anteriors. (a) Procline (high-torque) brackets were selected for the maxillary central incisors and canines, whereas neutral (standard-torque) brackets were used for the maxillary lateral incisors. (b) Neutral brackets were used on mandibular incisors, and procline brackets on canines. Note the bonding position of LR1, due to the tooth wear (yellow arrow), bracket was bonded more incisally.*



■ **Fig. 5:** Cross-elastic configuration and bite turbo application.

(a) Intraoral lateral view showing a bite turbo placed on LL6. A cross elastic was applied from the buccal side of the maxillary left second molar (UL7) to the lingual side of the mandibular left second molar (LL7). A schematic illustration in the upper left corner demonstrates the direction of the cross-elastic traction.

(b) Intraoral occlusal view showing a bite turbo placed on LL6 and a lingual button bonded on the lingual side (yellow arrow) of LL7 to facilitate cross-elastic application.

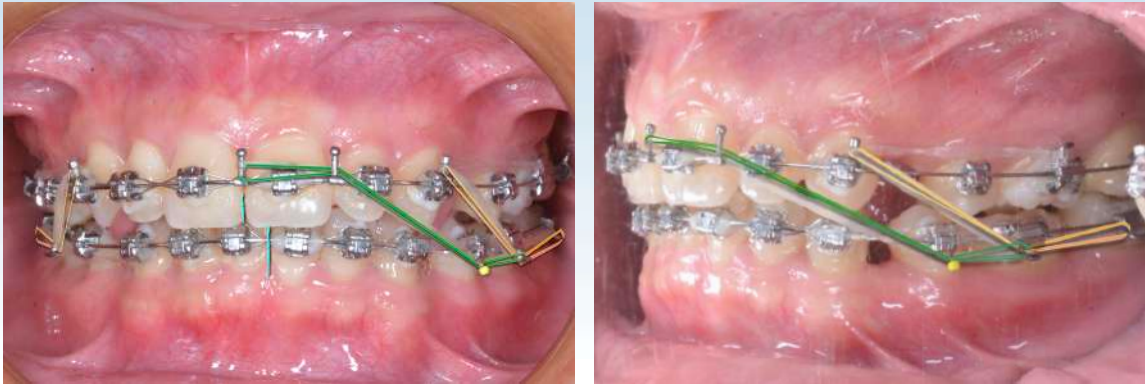
By the 4<sup>th</sup> month, both arches were advanced to 0.014 × 0.0275-in CuNiTi archwires for further alignment and leveling. The posterior crossbite was corrected by the 6<sup>th</sup> month, allowing discontinuation of the cross elastics and removal of the posterior bite turbos.

At the 7<sup>th</sup> month, both arches were progressed to 0.018 × 0.0275-in TMA archwires. Anterior bite turbos were placed on the maxillary incisors, and Class II elastics (Fox, 1/4-in, 3.5 oz; Ormco, Glendora, CA) were applied to guide the mandibular dentition and establish ideal overjet and overbite.

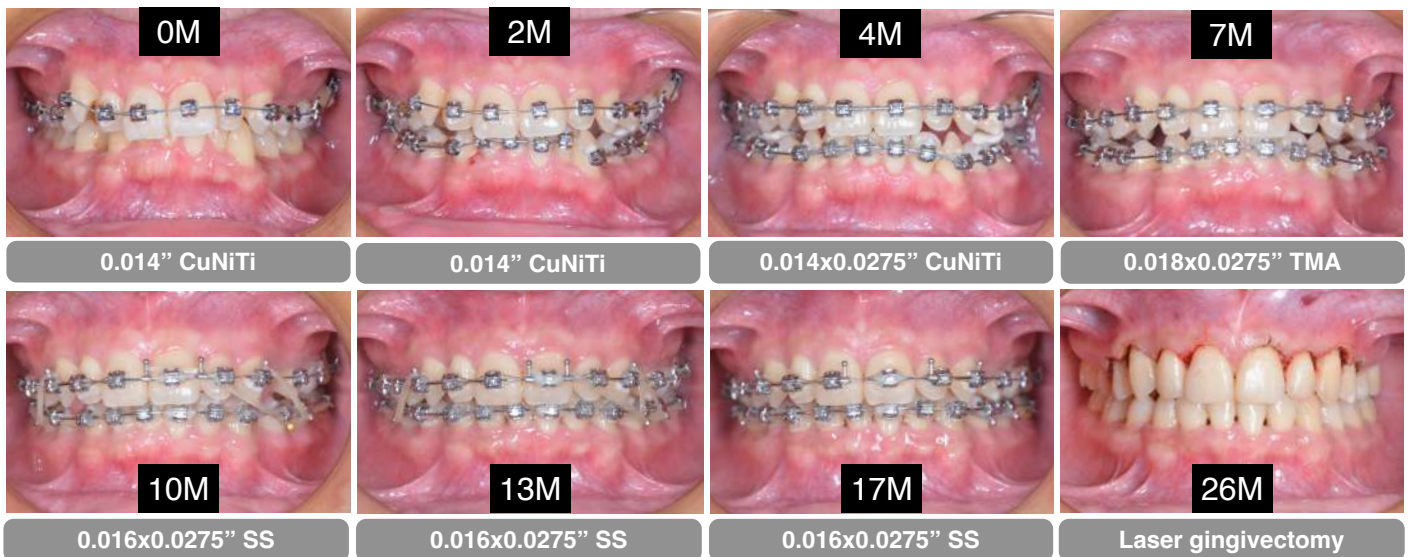
By the 8<sup>th</sup> month, both arches were advanced to 0.016 × 0.0275-in stainless steel archwires, and elastic chains (power chains) were used to initiate closure of the extraction spaces. At the 10<sup>th</sup> month, Class II L-shaped elastics (Fox, 1/4-in, 3.5 oz; Ormco, Glendora, CA) were continued, and Z-shaped elastics were added on the left side to correct the dental midline

(Fig. 6). Finishing was completed on 0.016 × 0.0275-in stainless steel archwires with continued space closure and midline refinement. The archwire sequence employed was 0.014-in CuNiTi, 0.014 × 0.0275-in CuNiTi, 0.018 × 0.0275-in TMA, and 0.016 × 0.0275-in stainless steel. Full treatment progress is documented in figures 7-11.

Active treatment was completed at the 26<sup>th</sup> month, and all brackets and appliances were removed. Laser gingivectomy was performed for minor gingival recontouring to improve dental proportions while biological width was considered prior to the gingivectomy.<sup>9-11</sup> Clear overlay retainers were delivered for both arches, with full-time wear for the first 6 months followed by nighttime wear only. Fixed retainers were delivered for both maxillary and mandibular anteriors. At the 1-month follow-up, the gingival tissues showed favorable healing with well-contoured gingival margins (Fig. 12).



**Fig. 6:**  
Class II L-shaped elastics (orange line) with Z-shaped elastics (green line) were coordinated to facilitate ideal overjet and midline correction. Both elastics were Fox elastics (1/4-in, 3.5 oz; Ormco, Glendora, CA).

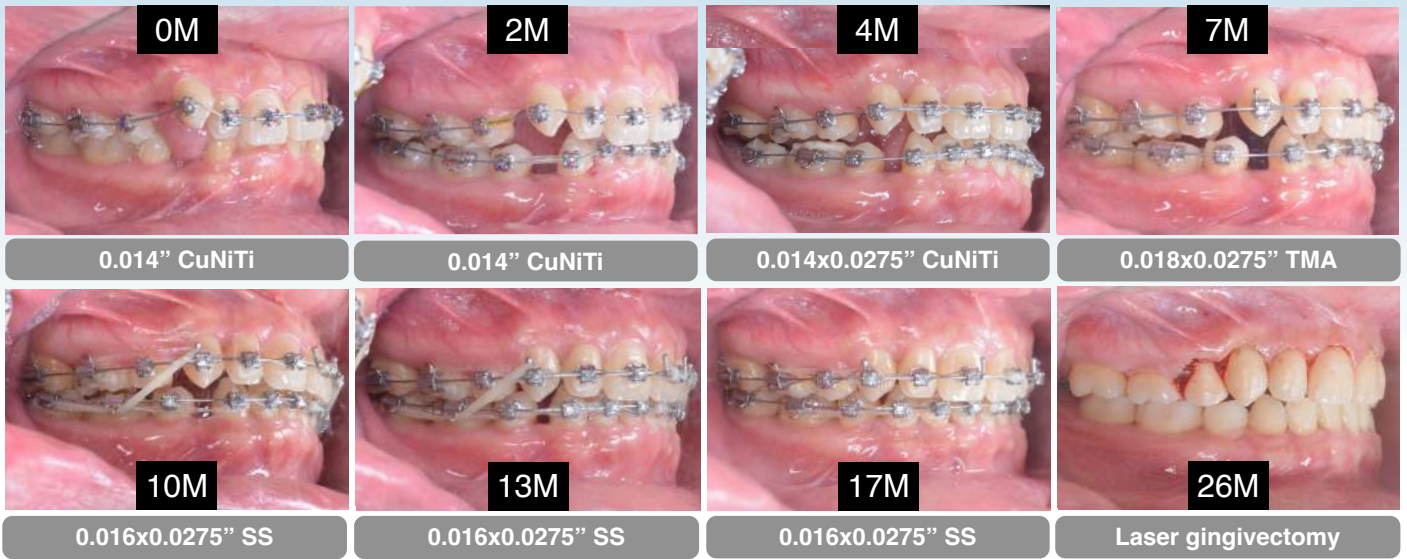


**Fig. 7:**  
Treatment progression is shown in the frontal view in months (M) with arch wire specification shown from the start of treatment (0M) to twenty-six months (26M). Treatment progression demonstrating favorable correction of the deep overbite with anterior bite turbos and Class II elastics. Note the subsequent midline correction achieved with unilateral Z-shaped elastics.

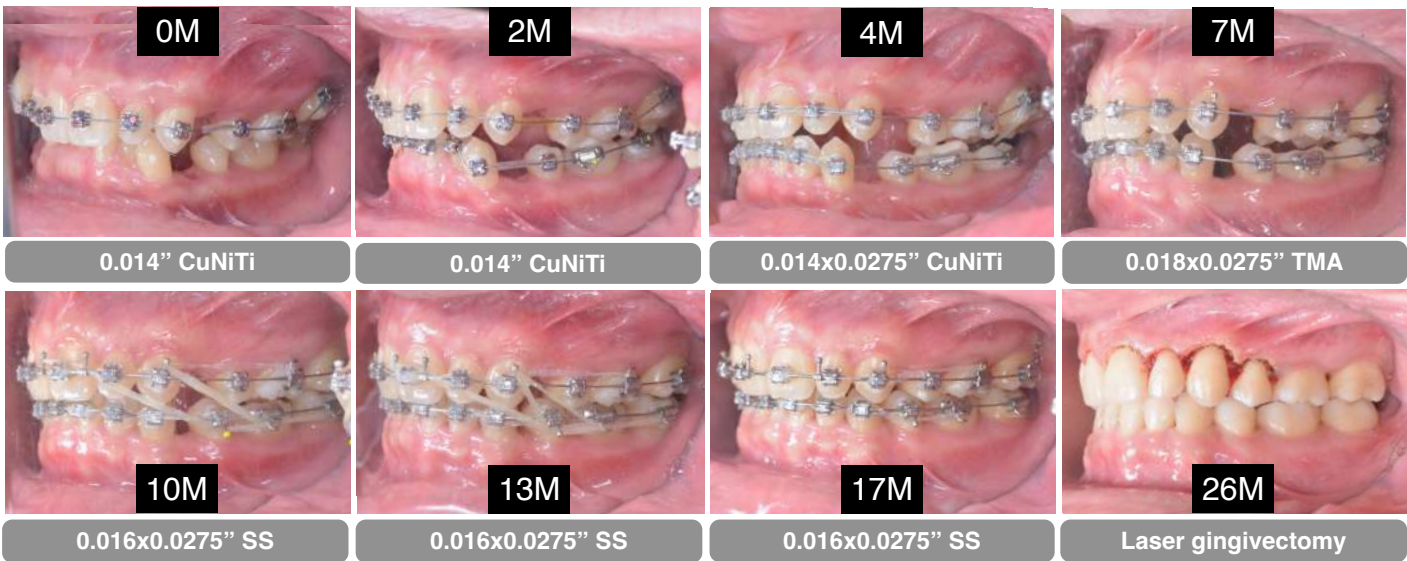
## Treatment Results

After active treatment, the deep overbite was significantly improved with concurrent leveling of the curve of Spee, resulting in ideal overjet and overbite relationships. The posterior occlusion

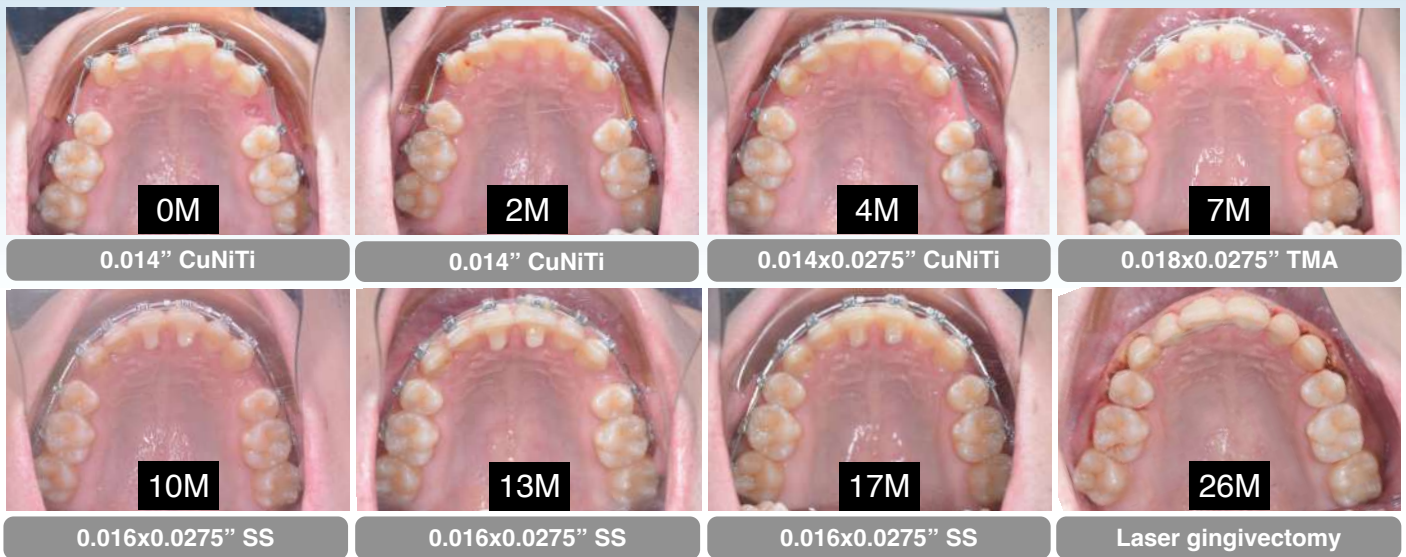
demonstrated good interdigitation, and the dental midlines were coincident (Fig. 13). Nearly ideal dental alignment was achieved, as evidenced by an American Board of Orthodontics Cast-Radiograph Evaluation (CRE)<sup>12</sup> score of 10 points (Worksheet 2). The remaining discrepancies were primarily related



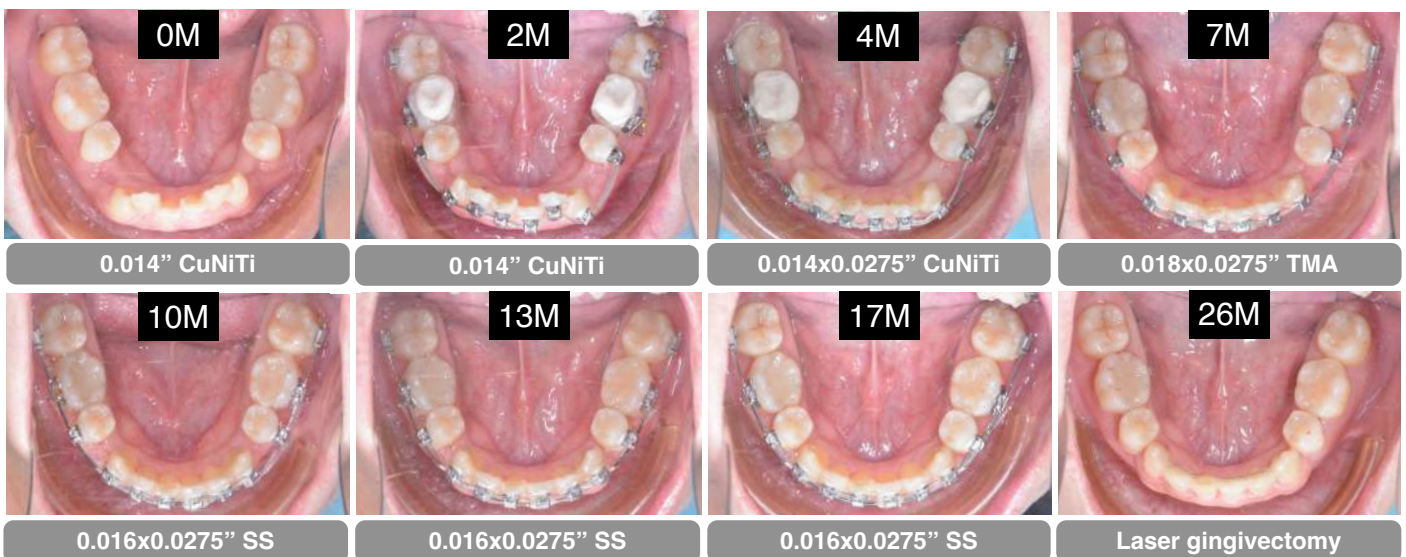
■ Fig. 8: Treatment progression from the right buccal view



■ Fig. 9: Treatment progression from the left buccal view. Buccal crossbite of the UL7 was corrected and posterior bite turbos were removed following crossbite correction (7M). In the later stage, a unilateral Z-shaped elastic was used to facilitate midline correction (10M).



**Fig. 10:** Treatment progression from the maxillary occlusal view. Anterior bite turbos were added in the 7<sup>th</sup> month (7M) of treatment with the combination of Class II elastics to facilitate deep bite correction and space closure.



**Fig. 11:** Treatment progression from the maxillary occlusal view. Mandibular crowding was resolved with extraction space, and posterior bite turbos were placed on the mandibular first molars to open the bite and facilitate crossbite correction (2M).



■ **Fig. 12:**

(a) A frontal view of the anterior maxillary segment shows poor dental proportions after active treatment of brackets. (b) Following the gingivectomy the gingival margins are near-ideal and tooth proportions improved. (c) One month after gingivectomy, soft tissue response was favorable with harmonious tooth proportions obtained.

to minor overjet and root angulation. The Pink and White esthetic score was 3 due to enlarged U1s tooth size (Worksheet 3).

The posttreatment panoramic radiograph demonstrated well-aligned dentition with satisfactory overall alignment (Fig. 14). Slight deviations in root angulation were noted in the maxillary right lateral incisor (UR2) and mandibular second premolars (L5s). The increased overjet of UR3, UR2, and UL2 (Fig. 15) maybe attributed to tongue thrusting during swallowing and should be addressed through habit modification.

The posttreatment lateral cephalogram (Fig. 16) and superimposition (Fig. 17; Table 1) showed that, although the skeletal relationship remained Class II, the maxillary incisors exhibited decreased inclination (U1-SN: 103° to 93°), whereas the mandibular incisors showed improved inclination (L1-MP: 100° to 94°). The facial profile was well maintained, remaining straight (Figs. 1 and 13). The retroclination of the maxillary incisors is likely attributable to the effects of Class II and midline-correcting elastics, which produce retractive forces on the anterior segment, in conjunction with space closure following bilateral first

premolar extractions. In addition, intrusion of the anterior teeth and extrusion of the posterior teeth are achieved (Fig. 17).

Following completion of active treatment, gingival recontouring with gingivectomy resulted in a marked improvement in gingival architecture and tooth proportion (Fig. 12), contributing to enhanced esthetics (Worksheet 3).

## Discussion

A key aspect of this case was the staged application of bite turbos to address distinct treatment objectives. Immediately after bracket bonding, posterior bite turbos fabricated with glass ionomer cement (Fuji II type II, GC America, Alsip IL) were placed on the mandibular first molars in conjunction with cross elastics to correct the severe posterior crossbite between UL7 and LL7, effectively resolving the transverse discrepancy within 4 months (from the 2<sup>nd</sup> to the 6<sup>th</sup> month). After correction of the posterior crossbite, treatment progressed to anterior bite turbos placed on the palatal surfaces of the maxillary incisors. In conjunction with Class II elastics, this approach



■ Fig. 13: Posttreatment facial and intraoral photographs



■ Fig. 14: Posttreatment panoramic radiograph



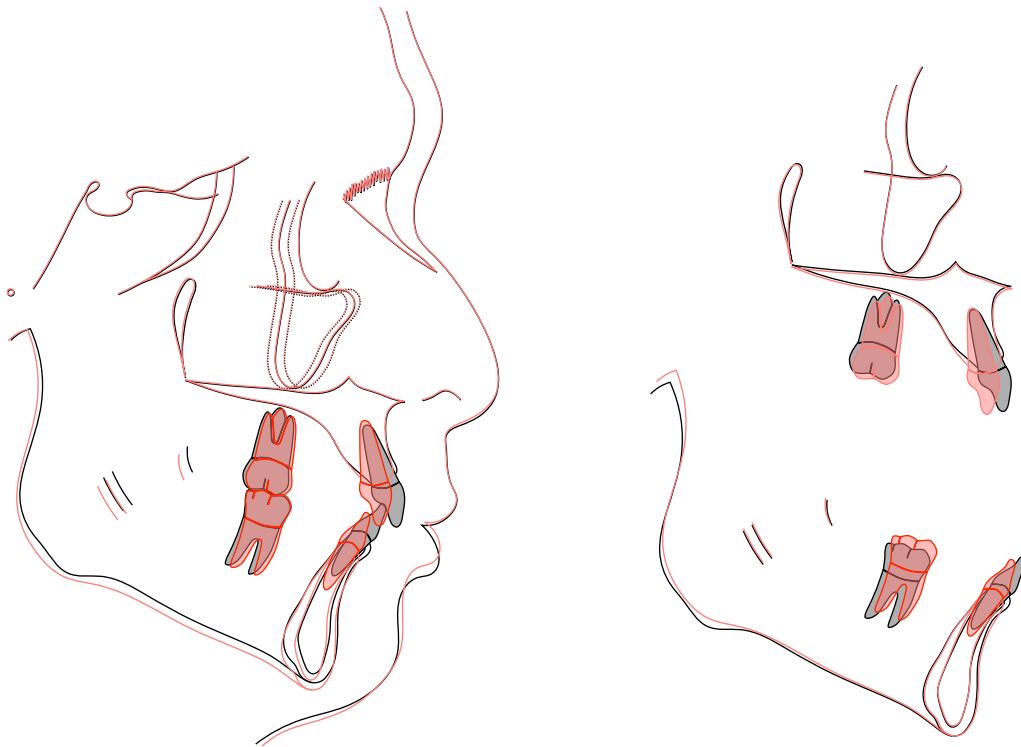
■ Fig. 15: Posttreatment intraoral photograph revealed increased overjet in UR3, UR2, and UL2, which may be attributed to tongue thrust.



■ Fig. 16: Posttreatment cephalometric radiograph

facilitated correction of the deep overbite, guided the mandible forward, and promoted posterior disclusion, thereby improving vertical interdigitation and allowing passive eruption of the mandibular posterior teeth.<sup>13</sup> This staged protocol enabled efficient leveling of the deep curve of Spee and establishment of ideal overjet and overbite.

Although anterior bite turbos can promote posterior disclusion, they cannot substitute for posterior bite turbos for two main reasons: mandibular anterior crowding and the initial upright (palatally tipped) position of the maxillary incisors. First, during the initial stage, the presence of mandibular anterior crowding would

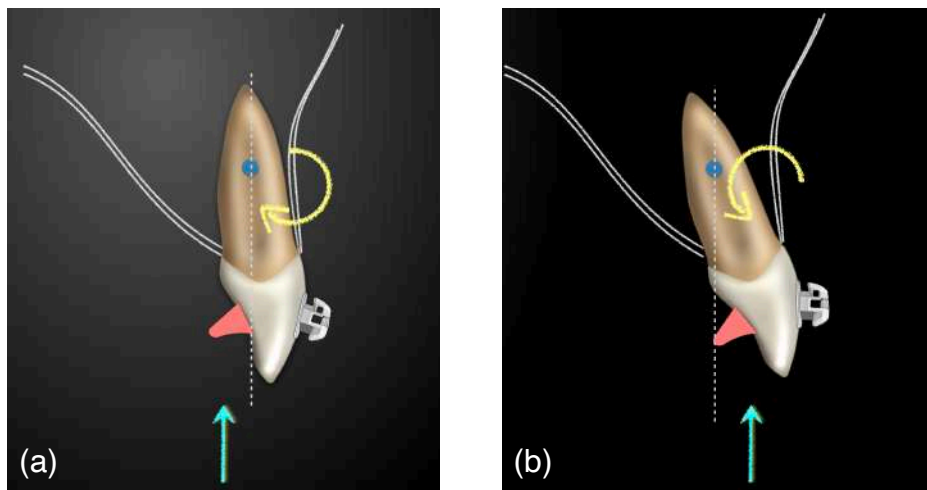


■ Fig. 17: Superimposition of the cephalometric tracings before (black) and after (red) treatment documented retroclination of the maxillary incisors, anterior intrusion, posterior extrusion and clockwise rotation of the mandible with maintenance of a favorable facial profile.

concentrate occlusal forces on a limited number of teeth, potentially increasing the risk of dental trauma and complicating anterior alignment, with a possible risk of archwire deformation or fracture. Second, in the presence of relatively upright maxillary incisors, placement of anterior bite turbos may create a force vector from the mandibular incisors that is applied lingual to the center of resistance of the maxillary incisors. This results in a clockwise rotation tendency, further uprighting the maxillary incisors. If the force is applied excessively, this movement may bring the roots of maxillary incisors closer to the buccal cortical bone and increase the risk of undesirable root resorption (Fig. 18). Accordingly, in light of these considerations, posterior bite turbos were employed during the initial stage. Following correction of the posterior crossbite, the posterior bite turbos were removed. Anterior bite turbos were subsequently introduced

once mandibular alignment had improved and the maxillary incisors had been proclined to a more favorable position.

Another important aspect was the use of a reengineered passive self-ligating bracket system with a parallelogram-shaped slot, used in conjunction with round-sided rectangular archwires (Figs. 19 and 20). When transitioning from an initial round wire to a 0.014 × 0.0275-in CuNiTi archwire, vertical play was maintained while horizontal play was minimized within the 0.028-in slot. This allowed relatively passive decrowding and alignment while maintaining arch form and improving rotational control. As the archwire progressed to 0.018 × 0.0275-in TMA, the wire became more fully engaged within the parallelogram slot (Fig. 20), initiating effective torque expression and allowing controlled



■ Fig. 18:

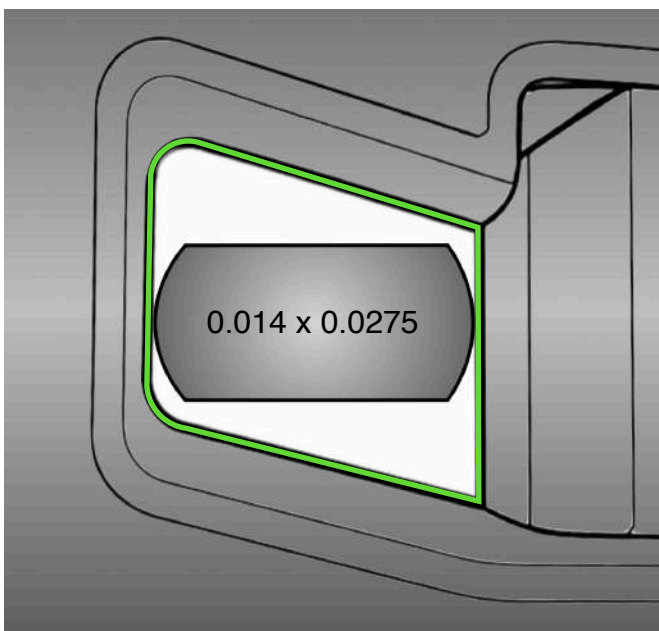
(a) When the maxillary incisors remain relatively upright, placement of anterior bite turbos is deferred, as occlusal contact (blue arrow) is behind center of resistance (dark blue dot), which may generate a clockwise moment (yellow curved arrow) on the incisors, resulting in further retroclination. (b) When anterior bite turbo is placed on relatively flared incisors, the occlusal force (blue arrow) would produce a counter-clockwise moment (yellow arrow), which is more favorable for establishing ideal inclination, overjet, and overbite.

preparation for subsequent space closure and Class II mechanics.

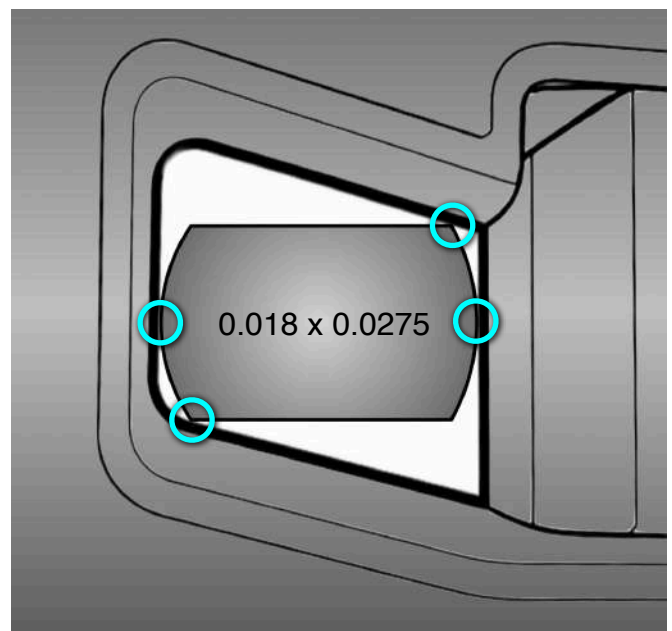
With further progression to a  $0.016 \times 0.0275$ -in stainless steel archwire, the treatment focus shifted to space closure, settling of the posterior occlusion, and final adjustment of overjet and overbite. The slightly smaller dimension of this wire provided additional freedom for efficient space closure; however, a mild degree of maxillary incisor torque loss was observed, with the inclination decreasing from  $103^\circ$  to  $93^\circ$ , likely influenced by the use of Class II elastics. Despite this, the final occlusion and facial esthetics remained within an acceptable range. Notably, although Class II elastics typically tend to procline the mandibular incisors, the

mandibular incisor inclination improved from  $100^\circ$  to  $94^\circ$ , indicating effective torque control throughout treatment.

Midline correction was addressed in the later stage using unilateral Z-shaped elastics on the left side after placement of the rigid stainless steel archwire (Fig. 6). At this stage, the anterior dentition had been fully consolidated, and the rigidity of the archwire provided sufficient control to support asymmetric mechanics. As a result, the midline discrepancy was effectively corrected without inducing occlusal canting or unwanted side effects. This further demonstrates that the bracket system was able to maintain both horizontal and vertical control even when a slightly smaller finishing archwire was used.



**Fig. 19:** Sagittal view of the reengineered passive self-ligating procline (high-torque) bracket. A  $0.014 \times 0.0275$ -in CuNiTi wire, a round-sided rectangular shape wire, is placed in the parallelogram slot (green line).



**Fig. 20:** Sagittal view of the reengineered passive self-ligating procline (high-torque) bracket. As the archwire progressed to  $0.018 \times 0.0275$ -in CuNiTi, engagement increased, establishing at least four points of contact (blue circles) and improving torque control.

Based on these observations, the reengineered bracket system provided reliable torque expression and mechanical control throughout treatment. Although a 0.016 × 0.0275-in stainless steel archwire was used for finishing in this case, the use of a 0.018 × 0.0275-in stainless steel archwire may further enhance torque control in similar situations.

## Conclusions

1. The staged use of posterior and anterior bite turbos, combined with cross elastics and Class II elastics, effectively addressed transverse discrepancies (posterior crossbite), vertical problems (deep bite), and sagittal control (facilitating anchorage control during space closure), resulting in ideal overjet and overbite.
2. The parallelogram slot design with round-sided rectangular archwires provided efficient three-dimensional control with reliable torque expression while maintaining arch form.
3. To further minimize maxillary incisor torque loss, a 0.018 × 0.0275-in stainless steel finishing archwire may provide near-full slot engagement and improved torque control in similar cases.

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# Discrepancy Index Worksheet

**TOTAL D.I. SCORE** 17

**OVERJET** 3 mm

- 0 mm. (edge-to-edge) =
- 1 - 3 mm. = 0 pts.
- 3.1 - 5 mm. = 2 pts.
- 5.1 - 7 mm. = 3 pts.
- 7.1 - 9 mm. = 4 pts.
- > 9 mm. = 5 pts.

Negative OJ (x-bite) 1 pt. per mm. Per tooth =

Total = 0

**OVERBITE** 6 mm

- 0 - 3 mm. = 0 pts.
- 3.1 - 5 mm. = 2 pts.
- 5.1 - 7 mm. = 3 pts.
- Impinging (100%) = 5 pts.

Total = 3

**ANTERIOR OPEN BITE**

0 mm. (Edge-to-edge), 1 pt. per tooth  
Then 1 pt. per additional full mm. Per tooth

Total = 0

**LATERAL OPEN BITE**

2 pts. per mm. Per tooth

Total = 0

**CROWDING** (only one arch) Ⓛ 9 mm

- 1 - 3 mm. = 1 pt.
- 3.1 - 5 mm. = 2 pts.
- 5.1 - 7 mm. = 4 pts.
- > 7 mm. = 7 pts.

Total = 7

**OCCLUSION**

- Class I to end on = 0 pts.
- End on Class II or III = 2 pts. per side \_\_\_\_\_ pts.
- Full Class II or III = 4 pts. per side \_\_\_\_\_ pts.
- Beyond Class II or III = 1 pt. per mm. \_\_\_\_\_ pts.  
additional

Total = 0

**LINGUAL POSTERIOR X-BITE**

1 pt. per tooth Total = 0

**BUCCAL POSTERIOR X-BITE** 27 X-bite

2 pts. Per tooth Total = 2

**CEPHALOMETRICS** (See Instructions)

ANB  $\geq 6^\circ$  or  $\leq -2^\circ$  = 4 pts. ANB =  $6^\circ$

Each degree  $< -2^\circ$  \_\_\_\_\_ x 1 pt. = \_\_\_\_\_

Each degree  $> 6^\circ$  \_\_\_\_\_ x 1 pt. = \_\_\_\_\_

**SN-MP**

$\geq 38^\circ$  = 2 pts.

Each degree  $> 38^\circ$  \_\_\_\_\_ x 2 pts. = \_\_\_\_\_

$\leq 26^\circ$  = 1 pt.

Each degree  $< 26^\circ$  \_\_\_\_\_ x 1 pt. = \_\_\_\_\_

1 to MP  $\geq 99^\circ$  = 1 pt.

Each degree  $> 99^\circ$  1 x 1 pt. = 1

Total = 5

**OTHER** (See Instructions)

Supernumerary teeth \_\_\_\_\_ x 1 pt. = \_\_\_\_\_

Ankylosis of perm. Teeth \_\_\_\_\_ x 2 pts. = \_\_\_\_\_

Anomalous morphology \_\_\_\_\_ x 2 pts. = \_\_\_\_\_

Impaction (except 3<sup>rd</sup> molars) \_\_\_\_\_ x 2 pts. = \_\_\_\_\_

Midline discrepancy ( $\geq 3$ mm) @ 2 pts. = \_\_\_\_\_

Missing teeth (except 3<sup>rd</sup> molars) \_\_\_\_\_ x 1 pt. = \_\_\_\_\_

Missing teeth, congenital \_\_\_\_\_ x 2 pts. = \_\_\_\_\_

Spacing (4 or more, per arch) \_\_\_\_\_ x 2 pts. = \_\_\_\_\_

Spacing (Mx cent. diastema  $\geq 2$ mm) @ 2 pts. = \_\_\_\_\_

Tooth transposition \_\_\_\_\_ x 2 pts. = \_\_\_\_\_

Skeletal asymmetry (nonsurgical tx) @ 3 pts. = \_\_\_\_\_

Adtl. treatment complexities \_\_\_\_\_ x 2 pts. = \_\_\_\_\_

Identify:

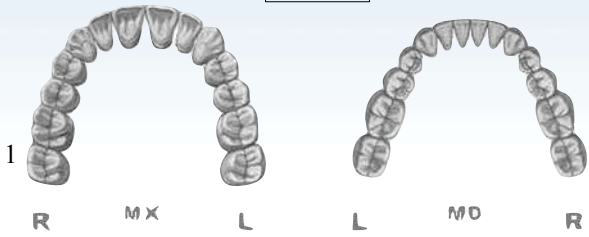
Total = 0

# Cast-Radiograph Evaluation

Total Score: 10

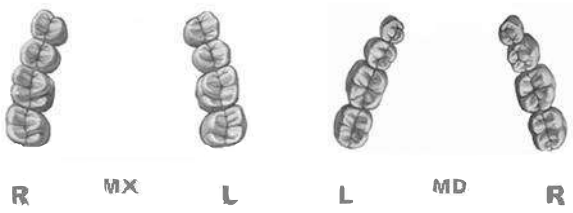
## Alignment/Rotations

1



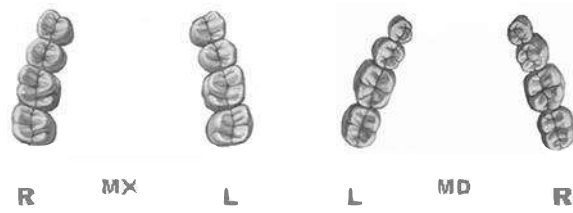
## Marginal Ridges

0



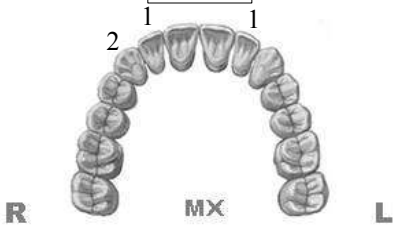
## Buccolingual Inclination

0



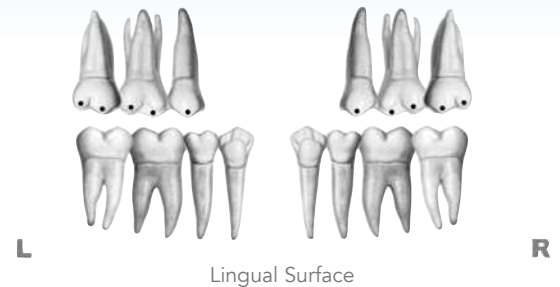
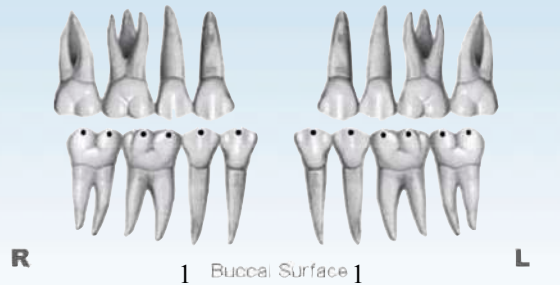
## Overjet

4



## Occlusal Contacts

2



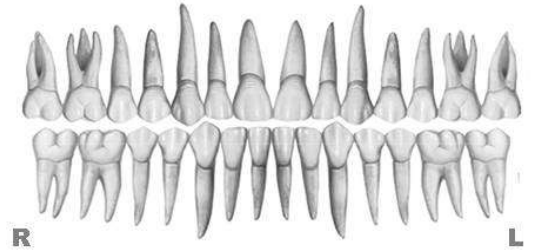
## Occlusal Relationships

0



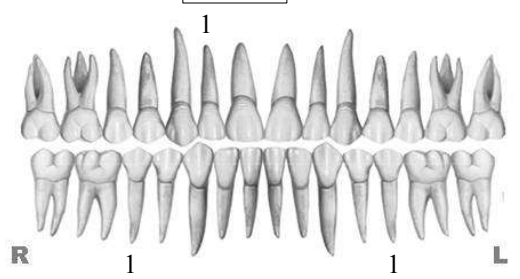
## Interproximal Contacts

0



## Root Angulation

3

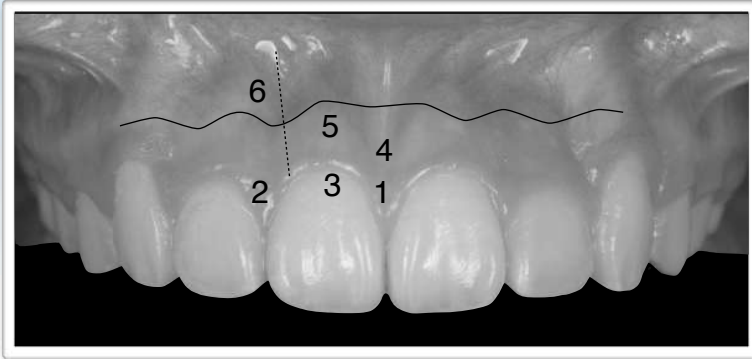


**INSTRUCTIONS:** Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

# IBOI Pink & White Esthetic Score

Total Score = 3

## 1. Pink Esthetic Score

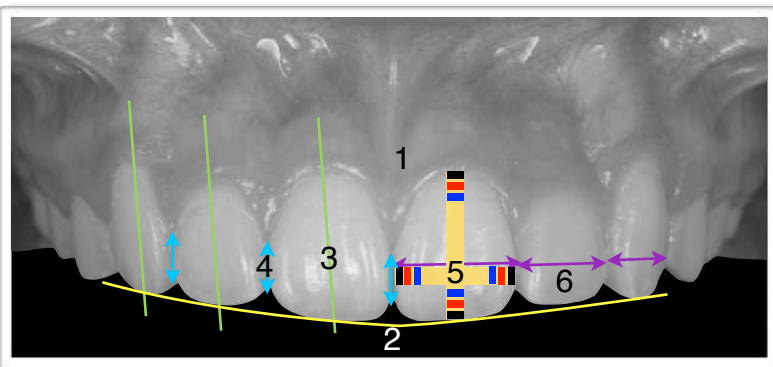


Total = 1

1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

## 2. White Esthetic Score (for Micro-esthetic)



Total = 2

1. Midline	0	1	2
2. Incisor Curve	0	1	2
3. Axial Inclination (5°, 8°, 10°)	0	1	2
4. Contact Area (50%, 40%, 30%)	0	1	2
5. Tooth Proportion	0	1	2
6. Tooth to Tooth Proportion	0	1	2

1. Midline	0	1	2
2. Incisor Curve	0	1	2
3. Axial Inclination (5°, 8°, 10°)	0	1	2
4. Contact Area (50%, 40%, 30%)	0	1	2
5. Tooth Proportion	0	1	2
6. Tooth to Tooth Proportion	0	1	2

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# 2026 Beethoven International Advanced Orthodontic Mentorship Program

## Screws, Ultima & Aligners



Tue 9:20 AM-12:00 PM (Taiwan Time / GMT +8)

Dates (12 sessions):

2026 1/13, 2/10, 3/10, 4/21, 5/19, 6/2,  
7/7, 8/18, 9/8, 10/20, 11/10, 12/15



**Led by Dr. Chris Chang** and the Beethoven Orthodontic team, the Beethoven International Advanced Orthodontic Mentorship Program offers a range of topics designed for orthodontists seeking to stay at the forefront of the digital era.

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1. **Detailed ABO case presentations:** with a focus on miniscrews, the Damon Ultima system, and aligner treatments.
2. **Real-world clinical insights:** addressing common mistakes in orthodontics and proven solutions shared by our experienced team.

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- Develop skills to **organize and analyze clinical cases effectively.**
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Join us for a monthly, in-depth learning journey that will **enhance your clinical skills and empower you to confidently tackle orthodontic challenges.**

\* **A certificate will be awarded upon completion of 6 presentations and the publication of 2 case reports.**

\*\* **Course fees include two-year free access to course recordings.**

\*\*\* **Live webinars and recordings can only be accessed on iPad/iPhone (no Android).**





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18 pts

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▲ Case report(s) published at least once in referral journals.

● Referral journals/Research paper - 3 points  
ABO case report - 2 points  
Clinical tip - 1 point

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Lynn Hsu



29 pts

Dr. 李雙安  
Angle Lee



26 pts

Dr. 蘇釜璋  
Bill Su



24 pts

Dr. 徐重興  
Eric Hsu



22 pts

Dr. 葉信吟  
Hsin-Yin Yeh



20 pts

Dr. 黃育新  
Yu-Hsin Huang



18 pts

Dr. 黃祈  
Richie Huang



16 pts

Dr. 邱上珍  
Grace Chiu



13 pts

Dr. 黃瓊嬋  
Sabrina Huang



13 pts

Dr. 鄭惠文  
Joy Cheng



13 pts

Dr. 林彥君  
Lexie Lin



13 pts

Dr. 曾淑萍  
Shu-Ping Tseng



12 pts

Dr. 林曉鈴  
Sheau-Ling Lin



10 pts

Dr. 張倩瑜  
Charlene Chang



10 pts

Dr. 林佳宏  
Alex Lin



10 pts

Dr. 林森田  
Chris Lin



10 pts

Dr. 黃登楷  
Kevin Huang



6 pts

Dr. 張馨文  
Sara Chang



6 pts

Dr. 李名振  
Major Lee



6 pts

Dr. 陳惠華  
Judy Chen



6 pts

Dr. 魏明偉  
Ming-Wei Wei



6 pts

Dr. 黃荷薰  
Ashley Huang



6 pts

Dr. 李彥峰  
Yen-Feng Lee



6 pts

Dr. 張銘津  
Ariel Chang



5 pts

Dr. 彭緯綸  
Wei-Lun Peng



4 pts

Dr. 呂詩薇  
Julie Lu



4 pts



# Products

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# 2026 一年一度 Damon Master Program



全新改版的 2026 年貝多芬高效 Damon 矯正大師系列課程，是由國際知名講師張慧男醫師親自規劃及授課，課程特色強調由臨床病例帶動診斷、分析、治療計畫擬定與執行技巧，本年度亦特別加入最新的**數位矯正與隱形牙套**的內容，並邀請了貝多芬牙科集團各院院長演講**特別矯正專題**。

此外，透過數位影片反覆觀看，結合矯正與電腦教學，課堂助教協助操作，讓學員在短時間能快速上手，感染「熱愛矯正學，熱愛學矯正」的熱情。

名額有限，一年僅有一次機會在台完整體驗 Damon 矯正大師課程，錯過只能等明年囉！

## Module 1 - 3/26 (9:20-18:00)

1. Selecting your ideal first case
2. Bonding position
3. Bonding + BT + cephal tracing
4. TADs + space closing + hook + spring
5. Finishing bending & fixed retainer

## Module 2 - 4/16

1. Four stages of efficient orthodontic treatment
2. Simple and effective anchorage system
3. Extraction vs. non-extraction analysis

Practice 1: Clinical photography (張譯文, 張瑜珍醫師)

Practice 2: Patient photo management (金牛頓工程師)

## Module 3 - 4/23

1. Soft & hard tissue diagnostic analysis
2. Big overjet correction
3. Damon diagnosis & fine-tuning

Practice: Ceph tracing (金牛頓工程師)

## Module 4 - 5/14

1. Excellent finishing
2. Retention & relapse

Practice: Ceph superimposition & measurement (金牛頓工程師)

## Module 5 - 6/25

1. Simplify your system
2. Extraction vs. non-extraction

Practice: Case report demo (陳俊宏醫師)

## ▲ Computer training (Mac): 1:30-3:00 pm

時間：週四全天 (Module 1: 9:20-18:00, Module 2-11: 9:20-17:00)

地點：新竹市建中一路25號2樓 (交大華廈)

費用含課程視訊\*、課程電子書與材料。

\*贈送之課程視訊提供兩年時間串流觀看。

課程贈品二選一：

A. 專用迷你螺絲操作組 或 B. 矯正精修班單年視訊課程

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02-27788315 #120

中區 張馨云

04-23058915

南區 王慧靜

07-2260030

## Module 6 - 7/2

1. Class III correction
2. Class II correction

Topic: Early orthodontic treatment (曾淑萍醫師)

## Module 7 - 7/23

1. Upper impaction
2. Lower impaction
3. Gummy smile correction

Topic: Modified VISTA (蘇登璋醫師)

## Module 8 - 8/13

1. ABO DI, CRE workshop (林彥君醫師)
2. Open bite

Topic: Ortho-viewed interdisciplinary treatment (徐重興醫師)

## Module 9 - 8/27

1. Implant-ortho combined treatment
2. Asymmetry

Topic: Impacted cuspid treatment (張譯文, 張瑜珍醫師)

## Module 10 - 9/17

1. Minor surgeries in orthodontics
2. Digital orthodontics

Topic: Modified 2X4 appliance in ortho treatment (徐玉玲醫師)

## Module 11 - 10/1

1. Aligner design
2. Comprehensive aligner treatment
3. Aligner & its challenges

Topic: Pre-aligner treatment (林詩詠醫師)

## ▲ Special lecture: 1:30-3:00 pm



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# A Two-Phase Clear Aligner Therapy for Bimaxillary Protrusion with Severe Rotation of Lower Left Second Molar

## Abstract

**History:** A 24yr-1mo-old male presented with a chief complaint (CC) of crooked teeth.

**Diagnosis:** The patient was diagnosed with bimaxillary protrusion combined with severe mesial-out rotation of LL7, and lingual crossbite of UL7. The Discrepancy Index (DI) was 9.

**Treatment:** Segmental fixed appliance combined with a ramus screw were installed to correct the severely rotated LL7 during the 6-month pre-aligner treatment. After the therapy, the rotation was successfully corrected. However, the side effect was extrusion of LL7, which resulted in poor occlusal contact that evolved into a posterior open bite during aligner treatment. Three stages of aligners (43, 18, and 15 sets respectively) were used to correct the bimaxillary protrusion, posterior open bite, and lingual crossbite of UL7.

**Results:** After 31 months of active treatment, this malocclusion, with a Discrepancy Index of 9 points, was treated to a Cast-Radiograph Evaluation (CRE) score of 6 points and a Pink and White esthetic score of 2 points. The patient was pleased with the treatment outcome.

**Conclusions:** Hybrid mechanics combining the strengths of fixed appliances and clear aligner therapy are effective in correcting bimaxillary protrusion and severe rotation of molars. (*J Digital Orthod* 2026;78:52-70; reprinted from *J Digital Orthod* 2021;64:4-22)

### Key words:

Clear aligner therapy (CAT), segmental braces, clear aligner, ramus screws, bimaxillary protrusion, non-extraction, temporary skeletal anchorage devices (TSADs)

## Introduction

Bimaxillary protrusion is a condition characterized by protrusive and proclined upper and lower incisors in addition to an increased procumbency of the lips. This type of malocclusion can occur in almost every ethnic group, although it is more prevalent in African American<sup>1-4</sup> and Asian<sup>5-7</sup> populations.<sup>8</sup>

The treatment of bimaxillary protrusion can be satisfactorily corrected by orthodontic or surgical treatment, or a combination of both. Orthodontic treatment involves retraction of the anterior teeth by extraction of the first premolar and placement of infrazygomatic crest (IZC) screws if necessary.<sup>9</sup>

With regard to mild or moderate bimaxillary protrusion, the space required to retract incisors is less than the size of a premolar, and this can result in inefficient use of the extraction space. Clinically, the space distal to the second molars can be used to retract the entire dentition with the aid of skeletal anchorage. The infrazygomatic crest in the maxilla and the buccal shelf area in the mandible are recommended sites for placing temporary skeletal anchorage devices (TSADs).<sup>10</sup>

The Invisalign® system, introduced by Align Technology Inc. (Santa Clara, Calif) in 1999, involves moving teeth in increments with a series of removable clear polyurethane trays (aligners).<sup>11</sup> The

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*Publisher, Journal of Digital Orthodontics (Center)*

**W. Eugene Roberts,**

*Editor-in-Chief, Journal of Digital Orthodontics (Right)*



manufacturer claims that Invisalign can effectively perform the following orthodontic movements: alignment after interproximal reduction, dental expansion, flaring, and distalization.<sup>12-14</sup> Therefore, for mild protrusion, clear aligners can perform anterior retraction without miniscrews or extraction.

On the other hand, the weakness of tooth movement with clear aligners includes rotation and extrusion, especially in the posterior teeth; fixed appliances and auxiliary miniscrews are an effective adjunct for clear aligner therapy.



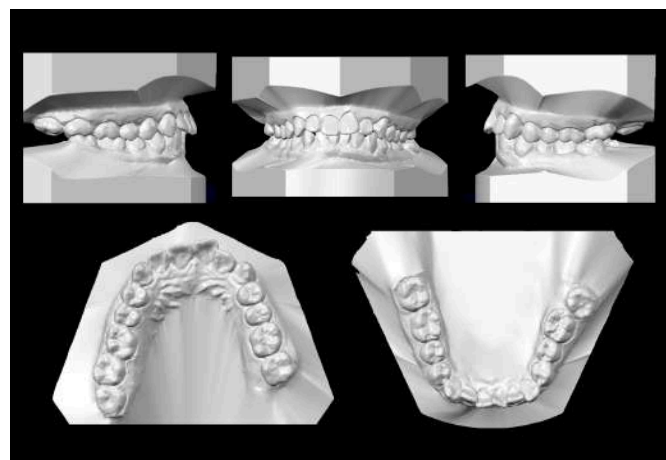
■ **Fig. 1:** Pre-treatment facial and intraoral photographs

This case report documents treatment for a 24-year-old male with a Class I skeletal pattern, moderate bimaxillary protrusion, severe rotation of LL7, and lingual crossbite of UL7. This malocclusion was successfully corrected by combining fixed appliances, a ramus screw, and clear aligner therapy.

The dental nomenclature for this report is a modified Palmer notation. Upper (*U*) and lower (*L*) arches, as well as the right (*R*) and left (*L*) sides, define four oral quadrants: UR, UL, LR and LL. Teeth are numbered 1-8 from the midline in each quadrant, e.g., a lower right first molar is LR6.

### Diagnosis and Etiology

A 24-year-old male sought consultation for orthodontic treatment with a chief complaint of crooked teeth. The pre-treatment intraoral photographs, dental models, and radiographs are shown in Figs. 1-4. Clinical examinations showed a 3mm overjet and 2mm overbite. Bilateral canine and molar Class I relationships were also noted.



■ Fig. 2: Pre-treatment study models (casts)

Furthermore, there was minor crowding in anterior areas bimaxillarily.

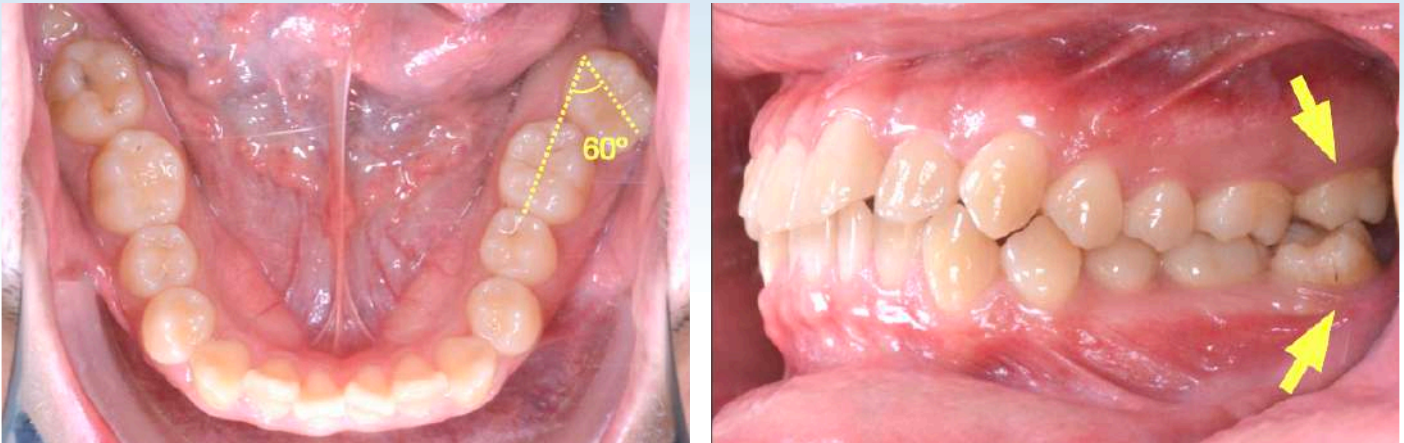
Most importantly, a 60° mesial-out rotation of LL7 and lingual crossbite of UL7 were noted (Fig. 5). A panoramic radiograph revealed that there was a mesial-tilting, impacted LR8 (Fig. 4). Pre- and post-treatment lateral cephalometric measurements are presented in Table 1.



■ Fig. 3: Pre-treatment panoramic radiograph



■ Fig. 4: Pre-treatment cephalometric radiograph



■ Fig. 5: A 60° mesial-out rotation of LL7 and lingual cross bite of UL7 were shown in the occlusal and buccal views.

The pre-treatment data indicated a facial pattern of the skeletal Class I jaw relationship ( $SNA\ 90^\circ$ ,  $SNB\ 86^\circ$ ,  $ANB\ 4^\circ$ ), a low mandibular plane angle ( $26^\circ$ ), and mildly protrusive upper and lower lips (2mm and 3mm to the E-Line). The bimaxillary incisors increased axial inclination ( $U1\text{-to-}SN\ 120^\circ$  and  $L1\text{-to-}MP\ 100^\circ$ ). The American Board of Orthodontics (ABO) Discrepancy Index (DI) was 9 as shown in the subsequent worksheet.

## Treatment Objectives

The treatment objectives were to improve the patient's facial and dental esthetics, obtain an optimal inclination of his anterior teeth, obtain normal overjet and overbite, and maintain Class I molar and canine relationships.

## Treatment alternatives

Based on facial and dental analysis, proclined and crowded incisors combined with mild facial protrusion were diagnosed. The patient was more concerned about dental than facial esthetics. Thus, a

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-TX	POST-TX	DIFF.
$SNA^\circ\ (82^\circ)$	90°	90°	0°
$SNB^\circ\ (80^\circ)$	86°	86°	0°
$ANB^\circ\ (2^\circ)$	4°	4°	0°
$SN-MP^\circ\ (32^\circ)$	26°	26°	0°
$FMA^\circ\ (27^\circ)$	19°	19°	0°
DENTAL ANALYSIS			
U1 TO NA mm (4mm)	7	5	2
U1 TO SN° (104°)	120°	108°	12°
L1 TO NB mm (4mm)	8	6	2
L1 TO MP° (90°)	100°	95°	5°
FACIAL ANALYSIS			
E-LINE UL (-1mm)	2	1	1
E-LINE LL (0 mm)	3	2	1
%FH: Na-ANS-Gn (56%)	55%	56%	1%
Convexity: G-Sn-Pg (13°)	5°	4°	1°

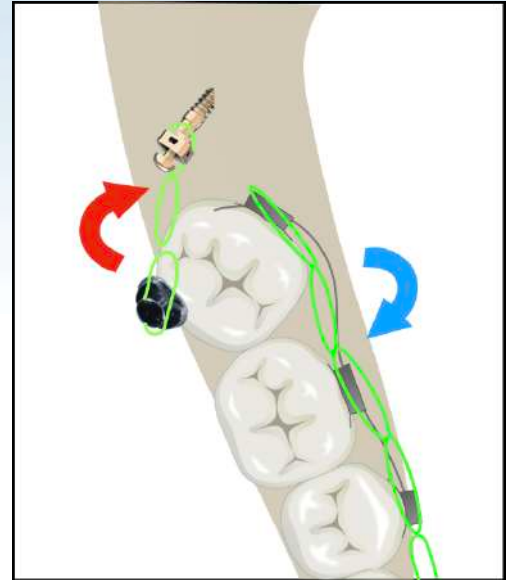
■ Table 1: Cephalometric Summary

non-extraction treatment approach was considered optimal. The orthodontic treatment indicated was a two-phase approach. In the first phase, a segmental fixed appliance would be bonded from LL4 to LL7 and a 2x14-mm OrthoBoneScrew® (OBS, iNewton, Inc., Hsinchu City, Taiwan) would be placed in the left ramus to correct severely rotated LL7. In the second phase, clear aligners (Invisalign®, Align Technology, Inc., San Jose, CA, USA) would be used to correct the remaining dental problems.

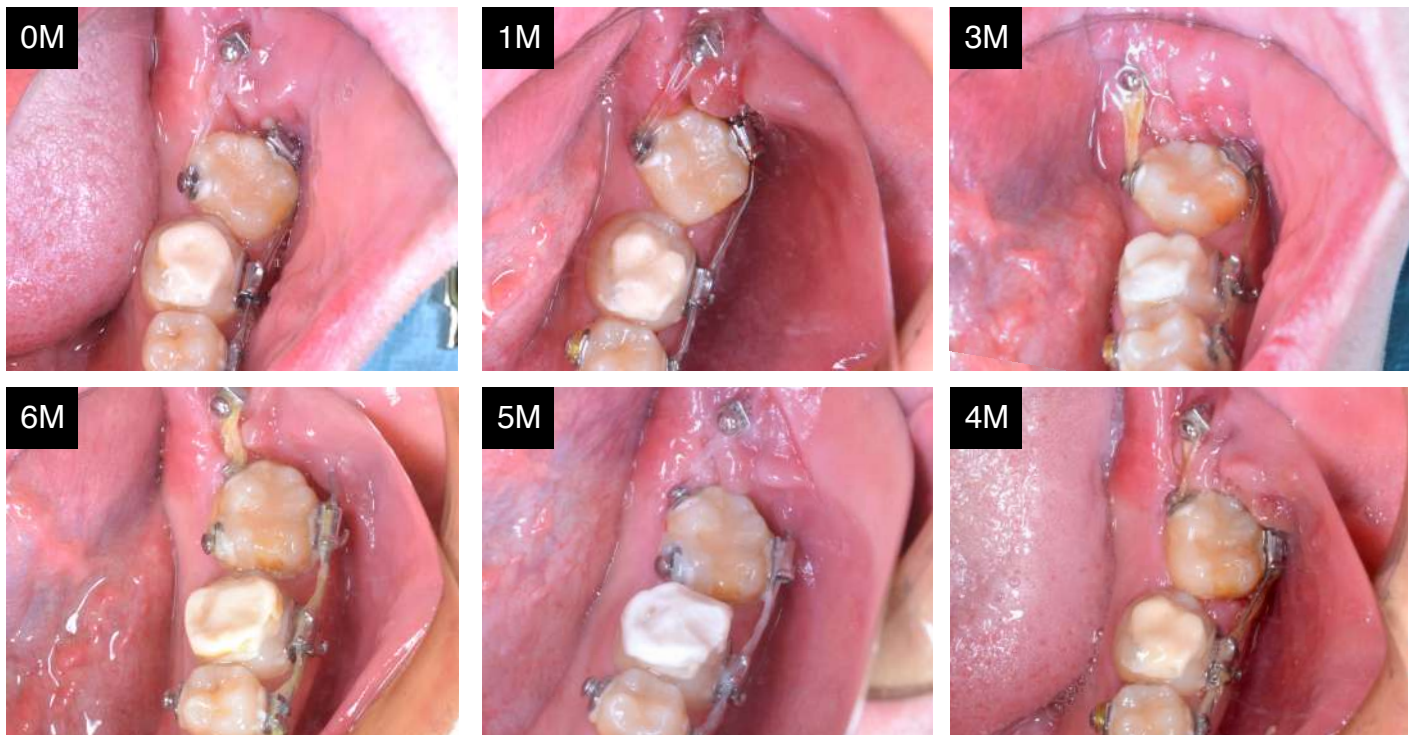
## Treatment Progress

### Phase 1: Fixed appliance

After UR8 and LR8 were removed, LL4 to LL7 were bonded with conventional ligation brackets and a 0.014-in copper-nickel-titanium archwire was placed. A 2x14-mm OBS was inserted in the left ramus. One



■ **Fig. 6:** The red arrow shows the power chain force retracted from the button on the lingual surface of LL7 to the ramus screw, which distalized the LL7. The blue arrow shows the power chain force, retracted from LL4 to LL7, which provided protraction. The red and blue forces resulted in clockwise rotation of LL7.



■ **Fig. 7:** Treatment progress in months (M) showing in six occlusal views arranged in clockwise order



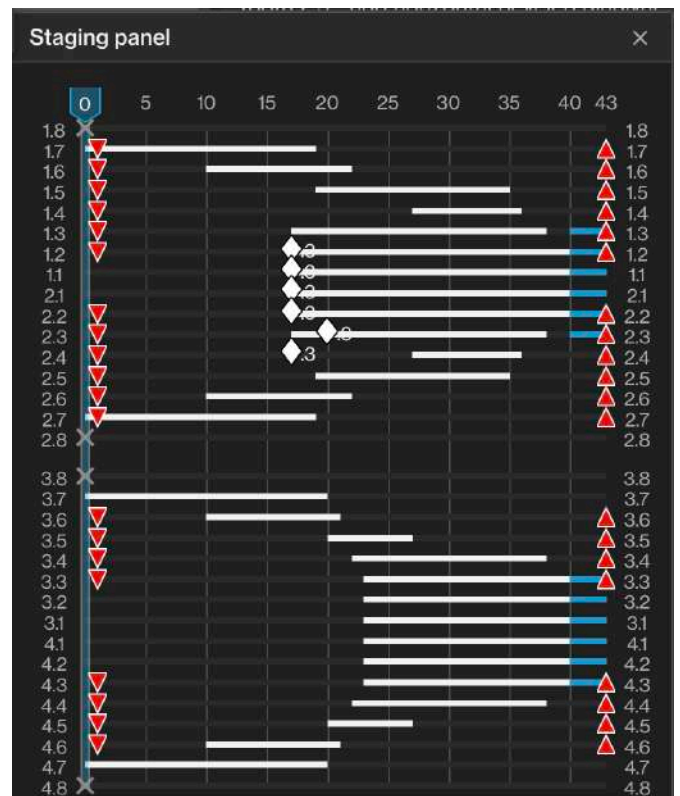
■ Fig. 8: Intraoral photos after phase 1 treatment

button was bonded on the lingual side of LL7. The rotation mechanics are shown in Fig. 6. The treatment progress is shown in Fig. 7. After 6 months of active treatment, the rotated LL7 was successfully corrected, but it resulted in extrusion and tipping that resulted in an occlusal prematurity of the lingual cusp of LL7. Therefore, a posterior open contact was noted (Fig. 8).

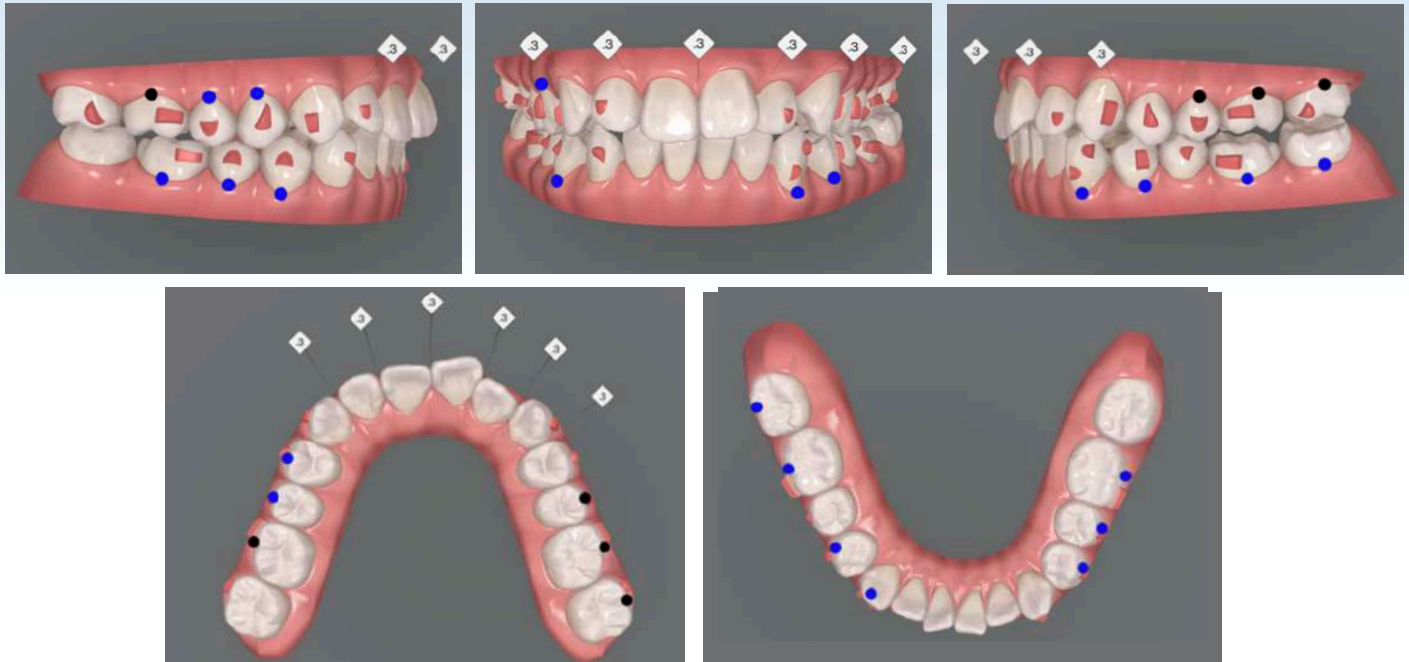
## Phase 2: Clear aligner stage

### Protocols of clear aligner

iTero Element® intraoral scans (Align Technology, Inc., San Jose, CA, USA) provided a 3D dataset. The ClinCheck® system (Align Technology, Inc., San Jose, CA, USA) was used to plan the treatment and project the outcome. A complete treatment simulation is described below.<sup>12</sup> All posterior teeth were moved 1mm distally in sequential retraction (Fig. 9), and arch expansion was set at 0.3mm. During stage 18, Inter-



■ Fig. 9: Staging panel showing increments of aligner activation



**Fig. 10:** Prescribed optimized attachments, conventional attachments, and IPR are shown in five views of the arches. Blue dots indicate variably predictable tooth movements, and black dots indicate less predictable tooth movements. See text for details.

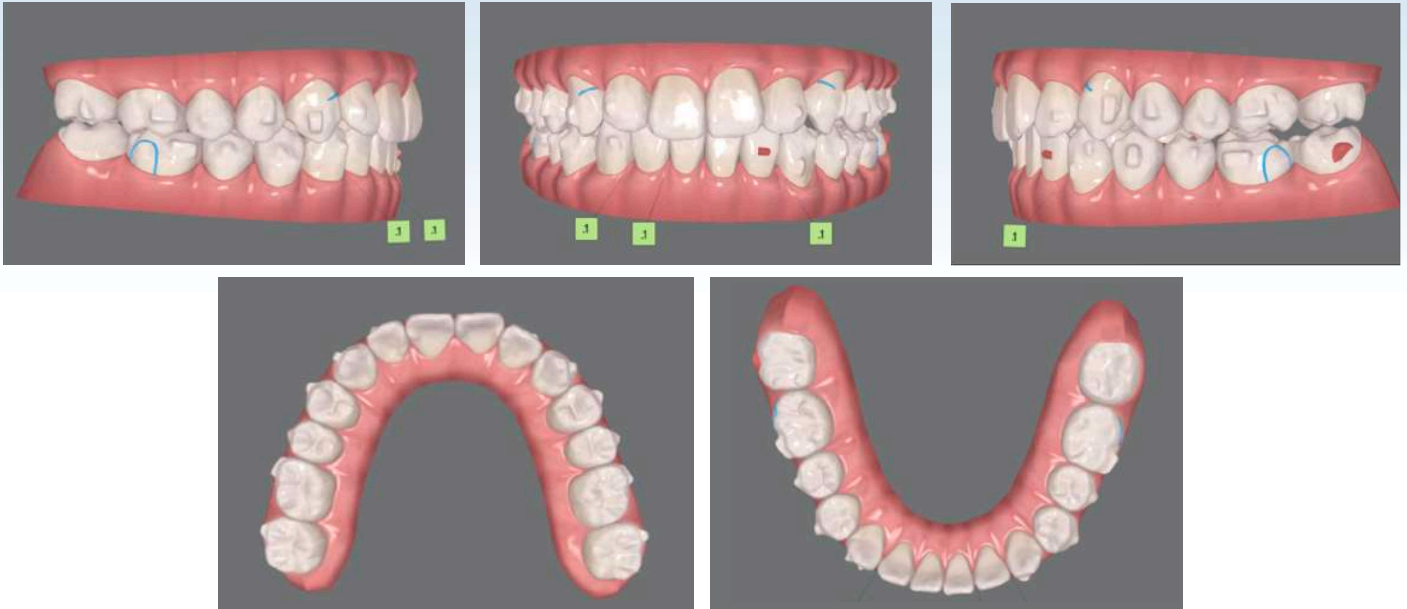
proximal reduction (IPR) was performed on all the upper anterior teeth to create space for anterior retraction. Both prescribed optimized attachments and conventional attachments were applied in sequential staging, and the predictable difficulty of tooth movement is shown in Fig. 10. Blue dots indicate variably predictable tooth movement and black dots indicate less predictable tooth movement. UR6 and UL5-UL7 were extrusions of more than 1mm. UR4, UR5, LL4, LL6, and LR4-LR6 were extrusions between 0.5 to 1mm. LL7 was an intrusion between 0.5 to 1mm. LL3 was root movement between 4 to 6mm.

### Treatment Progress of Clear Aligner

In the aligner stage, sequential distalization, arch expansion, and IPR were performed to resolve the crowding and bimaxillary proclination. 0.3mm IPR

was carried out in stage 18. After 15 months and 43 sets of aligners, the first stage was completed and the arch was well expanded. However, the UL1 was not rotated perfectly, and there was still posterior open contact from LL3 to LL7. Therefore, additional aligner therapy was required (Fig. 11).

In the second stage, which lasted 4 months and involved 18 sets of aligners, the UL1 was rotated correctly and the arch was slightly expanded. 0.1mm IPR was performed between LL1 and LL2, and from LR1 to LR3. At the 15<sup>th</sup> set of aligners during the second stage, posterior open contact was still noted on the left side (Fig. 12). In order to fix this problem, buttons were bonded on the buccal surfaces of UL4-UL6, LL5, and LL6. Short elastics (*Chipmunk 1/8-in, 3.5-oz*) were retracted from UL4 to LL5, UL5 to LL6,



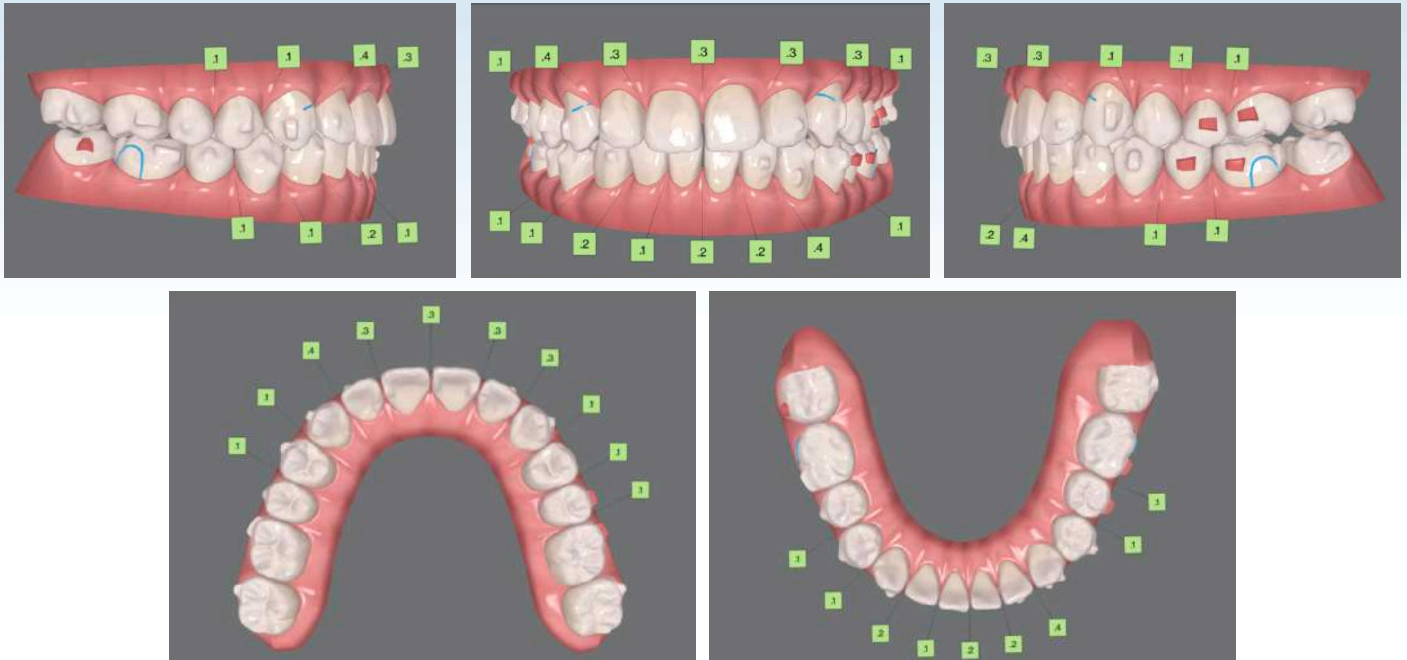
■ Fig. 11: The first aligner of the second stage



■ Fig. 12: The 15<sup>th</sup> aligner of the second stage

and UL6 to LL6. After 2 weeks, the open contact of UL4 and UL5 was improved. The remaining problems were posterior open contact on LR7, LL6,

and LL7. Hence, additional therapy was necessary (Fig. 13).



■ Fig. 13: The first aligner of the third stage

In the third stage, 15 sets of aligners were used in 3 months. 0.1-0.3mm IPR was performed to resolve bilateral canine Class II relationship and occlusal fittings. Details are displayed in Fig. 13.

The patient went through 3 stages and used 76 (43+18+15) sets of aligners in 23 months. After 29 months of treatment, all attachments and auxiliaries were removed. Essix retainers (*Densply Sirona, Charlotte, NC, USA*) were delivered for both arches. The patient was instructed to wear them full time for the first month, and only while sleeping thereafter.

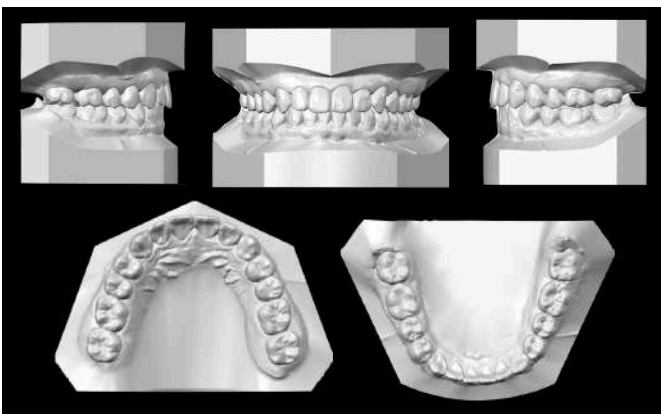
## Treatment Results

The treatment results for this patient were excellent. All teeth were aligned in their proper positions (*Figs. 14 and 15*). Bilateral occlusions are Class I with a

normal overjet and overbite. All treatment objectives were achieved. A panoramic radiograph revealed good root parallelism (*Fig. 16*). The cephalometric measurements (*Table 1*) and the cephalometric superimposition (*Figs. 17 and 18*) showed the maxillary incisors were retroclined by 12 degrees, and the mandibular incisors were retroclined by 5 degrees. The maxillary and mandibular molars were slightly uprighted. The CRE score was 6 points as shown in the subsequent Worksheet 2. Most points were for the compromised occlusal contact of LL6, LL7, and LR7. The Pink and White esthetic score was 2 points, as documented in Worksheet 3 at the end of this report. The patient was satisfied with his teeth and profile.



■ Fig. 14: Post-treatment facial and intraoral photographs



■ Fig. 15: Post-treatment study models (casts)



■ Fig. 16: Post-treatment panoramic radiograph

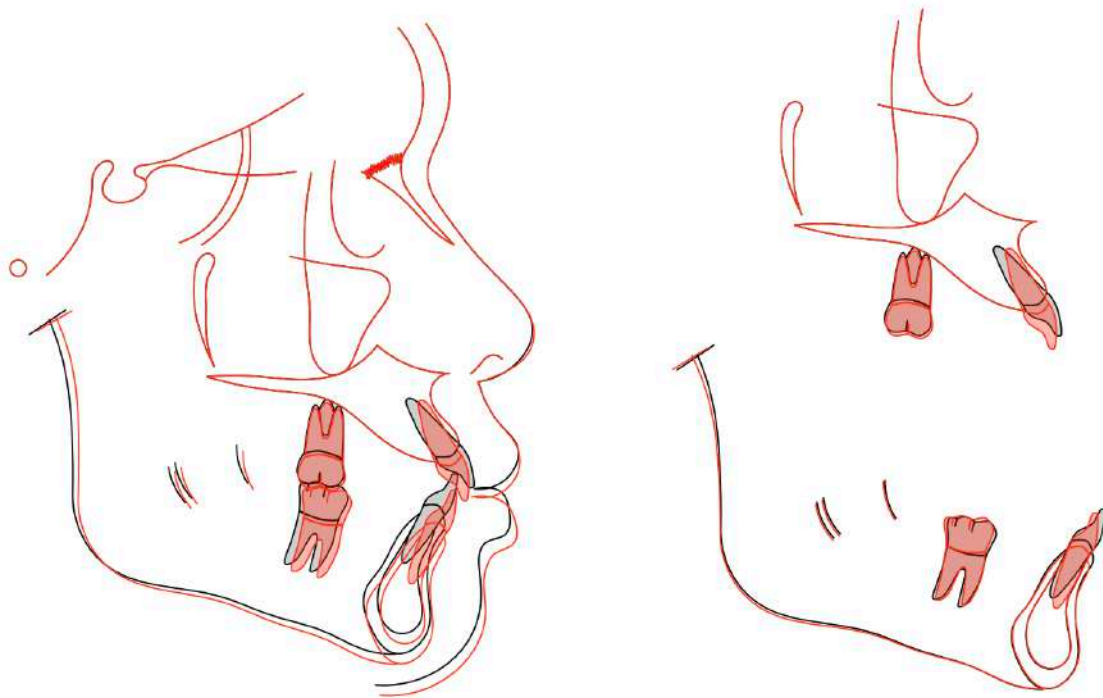


■ Fig. 17: Post-treatment cephalometric radiograph

## Discussion

### Mild Bimaxillary Protrusion Protocol: Using Clear Aligner Therapy

Patients with bimaxillary protrusion generally have Class I molar and canine relationships, which generally result in good oral function. Careful and complete skeletal, dental, and soft tissue evaluations are necessary before treatment planning. The treatment methods should be selected according to patient's chief complaint(s) and clinical diagnosis.<sup>10</sup> For the current patient, the upper and lower lips were beyond the E-line 2mm and 3mm respectively. His profile was classified as mild to moderate bimaxillary protrusion, so a non-extraction orthodontic treatment was feasible. The molars



■ Fig. 18: Superimposition of pre-treatment (black) and post-treatment (red) cephalometric tracings

could be retracted using skeletal anchorage to gain the extra space required to perform anterior tooth retraction and resolve both the anterior crowding as well as proclination.<sup>10</sup>

With the development of clear aligners, molar retraction, arch transverse expansion, and IPR were all successful in gaining space for incisal retraction and relieving crowding. In this present case, 1mm of retraction, 2-3mm of arch expansion, and multiple IPR adjustments were set in all four quadrants during the three stages of aligner therapy. As a result, bimaxillary incisors were retroclined and retrusive. There are studies which compared the ratios of dental movement to soft tissue movement - most

commonly the amount of upper incisor retraction to upper lip retraction - in an attempt to establish guidelines for clinical management. A 2.2:1 upper lip-to-upper incisor ratio (5.2mm of upper incisor retraction to 2.4mm of upper lip retraction) was reported in these studies.<sup>1,15,16</sup>

The amount of incisor retraction in this case was only 2mm, and it resulted in 1mm of lip retraction. The clear aligner therapy improved the inclination of the anterior incisors and aligned the dentition successfully, but change in the profile was not significant. Since the patient cared more about dental than facial esthetics, he was still satisfied with the treatment outcome.

	Green	Blue	Black
Surgery	No	No	Yes
Extraction	No	Incisor extraction	Premolar extraction
Distalization	< 2 mm	2-4 mm	> 4 mm
Mesialization	No	< 2 mm	> 2 mm
Crowding	< 6 mm	6-8 mm	> 8 mm
Spacing	< 4 mm	4-8 mm	> 8 mm
Expansion per quadrant	< 2 mm	2-4 mm	> 4 mm
Anterior Crossbite	Involving 1 tooth	Involving 2 bilateral teeth	Involving multiple teeth
Anterior Intrusion	< 2.5 mm	2.5-3 mm	> 3 mm
Posterior Intrusion	No	< 1 mm	> 1 mm
Anterior Extrusion	< 2.5 mm	2.5-3 mm	> 3 mm
Posterior Extrusion	No	< 1 mm	> 1 mm

■ Table 2: Complexity evaluation chart for clear aligner therapy from Invisalign®.<sup>17</sup> See text for details.

### Limitation of Clear Aligners

Table 2 from the Invisalign® website<sup>17</sup> is a useful tool to evaluate the degree of complexity in treating a specific patient with clear aligner therapy.

1. If all items are in the Green column, then a Green protocol should be followed, indicating a simple and/or more predictable treatment approach.
2. If at least one item is in the Blue column and none in the Black column, then a Blue protocol should be followed, indicating a moderate and/or variably predictable treatment approach.
3. If at least one item is in the Black column, then a Black protocol should be followed, which means the treatment will be more complex and/or less predictable.

In addition, Invisalign® asserts that, without the use of additional techniques, aligners can resolve rotations of 40° in the upper and lower central incisors, 45° in canines and premolars, 30° in lateral incisors, and 20° in molars. Radicular movements of 4mm and 2mm can be achieved in the anterior and posterior teeth respectively.<sup>18</sup>

Although the SmartTrack features automatically-placed optimized attachments for rotational movements greater than 5 degrees, rounded teeth are not gripped well by the aligners. Despite the relatively low accuracy of rotation, the progress of the maxillary incisors and canines was encouraging.<sup>19</sup>

According to Haouili,<sup>19</sup> the least accurate tooth movement was rotation (46%), and this movement was particularly challenging for canines, premolars,

and molars. Due to poor aligner grip around the shorter clinical crown and the decreased forces on the terminal tooth within the aligner, the second molars are difficult to rotate. Similar findings were observed by Simon et al.<sup>20</sup> and Charalampakis.<sup>21</sup>

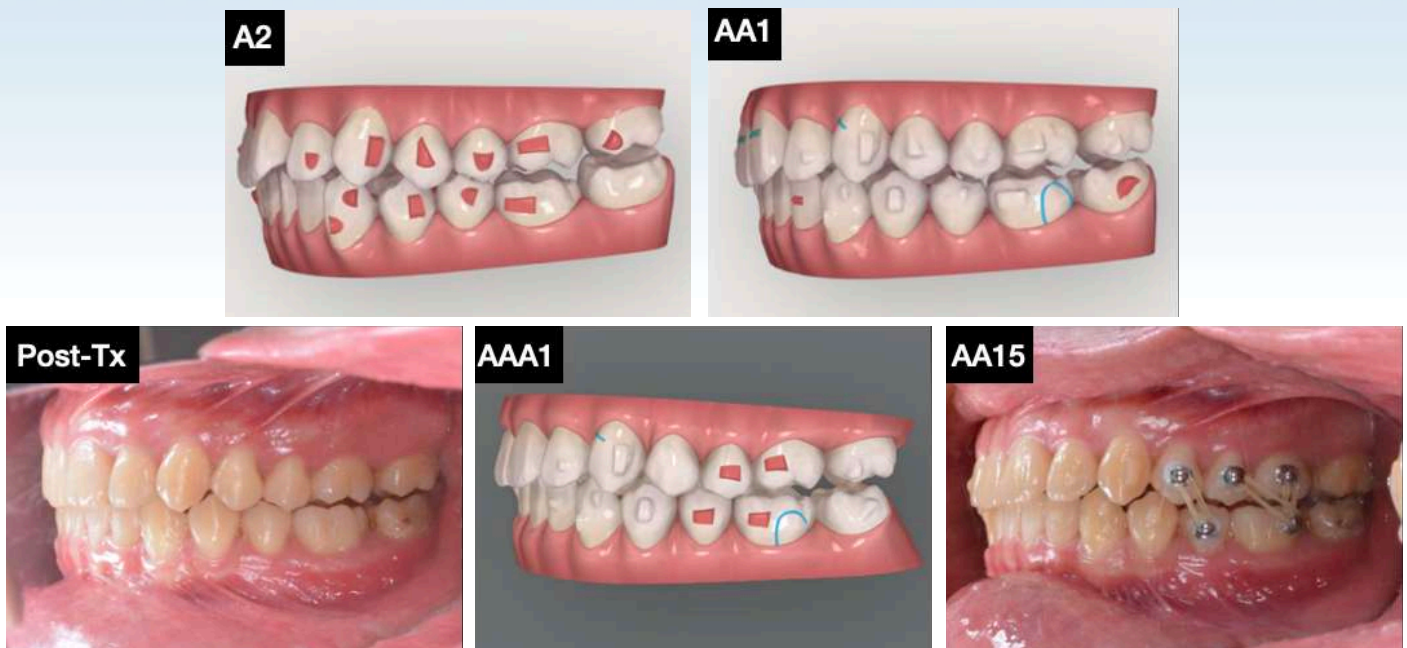
In the present case, rotation of 60° for LL7 was noted. It is almost impossible to correct severe rotation like this with clear aligner therapy, without an extremely long treatment period. Utilizing TSADs and traditional fixed appliances, the severe LL7 rotation was corrected in 6 months.

### Extrusion of Posterior Teeth: Can Clear Aligner Therapy Fix It?

According to the findings from Haouili,<sup>19</sup> maxillary incisor extrusion (55%) has the highest accuracy, whereas extrusion of the maxillary and mandibular molars (40%) has the lowest accuracy. The higher accuracy of incisor extrusion and molar intrusion, as well as the low accuracy of incisor intrusion and molar extrusion, would suggest that Invisalign® is more effective in bite closure, rather than bite opening.

Although the rotation of LL7 was resolved by a fixed appliance and a ramus screw, the extrusion and tipping side effects on the LL7 resulted in open contacts in the whole arch.

As can be seen in Table 2, extrusions and intrusions of more than 1mm are less predictable in the posterior teeth. According to ClinCheck®, UR6 and UL5-UL7 were difficult extrusion (>1mm), UR4, UR5, LL4, LL6, LL7 as well as LR4-LR6 were moderate extrusion (0.5-1mm), and LL7 was moderate intrusion (0.5-1mm) in the first stage.



■ Fig. 19:

The treatment progress to correct left posterior second molar occlusal contact is shown in clockwise order. **A2**: the second aligner of the first stage. **AA1**: the first aligner of the second stage. **AA15**: the 15<sup>th</sup> aligner of the second stage. **AAA1**: the first aligner of the third stage.

After the first stage of clear aligner therapy, LL7 was difficult extrusion ( $>1\text{mm}$ ), and UL4-UL7 as well as LL4-LL7 were moderate extrusion ( $0.5\text{-}1\text{mm}$ ) as detected in ClinCheck® of the second stage.

After completing the second stage, left side posterior open contact was still noted. To resolve this posterior open contact, buttons were bonded on UL4-UL6, LL5, and LL6. Short elastics (*Chipmunk 1/8-in, 3.5-oz*) were applied for two weeks as shown (Fig. 19). UL6, UL7 and LL7 were detected as moderate extrusion ( $0.5\text{-}1\text{mm}$ ) in the third stage ClinCheck®.

After a 2-phase orthodontic treatment, slight posterior open bite was still found on LL6, LL7, and LR7. The treatment progress for the correction of this left posterior open contact is shown in Fig. 19.

According to the above information, the open contact was improved progressively but slowly. Although Invisalign admits that significant extrusion is hard to achieve, it is still possible even though aligners are more helpful for retraction. If this case were re-treated, elastics for occlusal fitting could be indicated after the first stage to perform extrusion. The second stage of clear aligner therapy should be delayed until the posterior open bite is reduced to less than  $0.5\text{mm}$  space.

## Conclusions

1. The use of clear aligners is an innovative orthodontic modality. Molar retraction, arch expansion, and IPR can solve moderate crowding

and protrusion without the assistance of extraction or TSADs.

2. However, clear aligner therapy has its limitations. For this patient, LL7 was rotated severely by 60 degrees. Clear aligner therapy is unlikely to resolve this challenging problem in a reasonable period of time. TSADs and elastic retraction are indicated to prepare the dentition for aligner resolution of the malocclusion.
3. Hence, traditional fixed appliances and innovative clear aligner therapy are combined to resolve severe malocclusion. These two treatment approaches cannot replace each other, so a hybrid treatment method is indicated to achieve desired outcomes more efficiently and effectively.<sup>17</sup>

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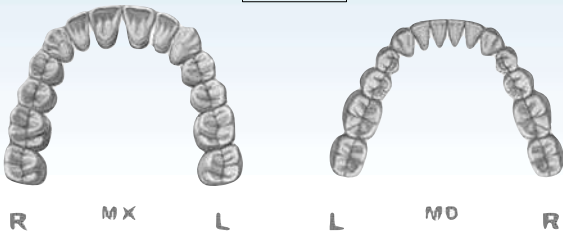


# Cast-Radiograph Evaluation

Total Score: 6

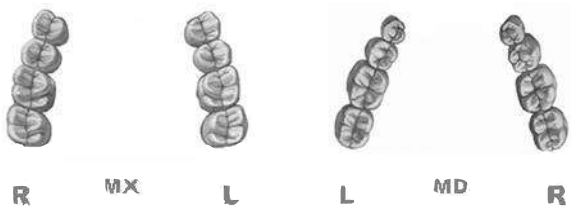
## Alignment/Rotations

0



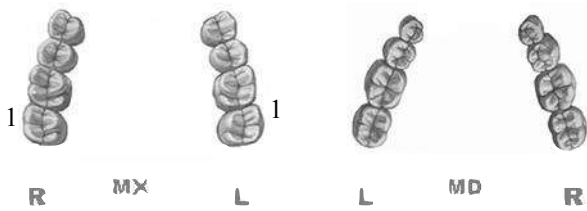
## Marginal Ridges

0



## Buccolingual Inclination

2



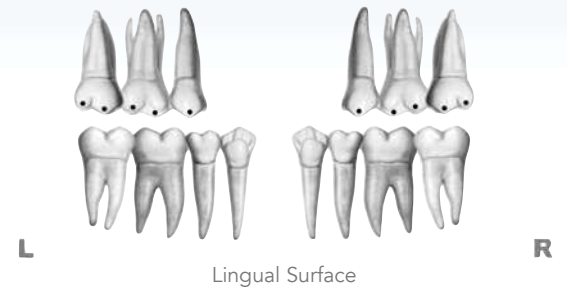
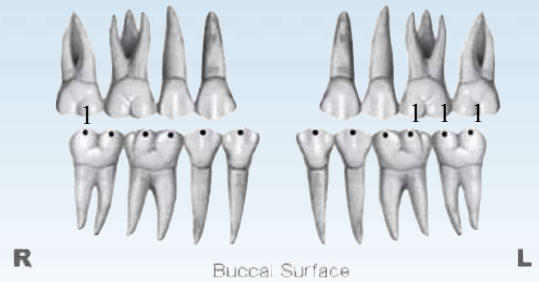
## Overjet

0



## Occlusal Contacts

4



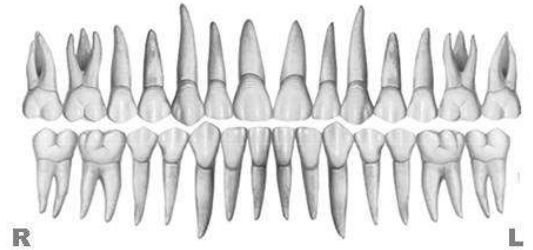
## Occlusal Relationships

0



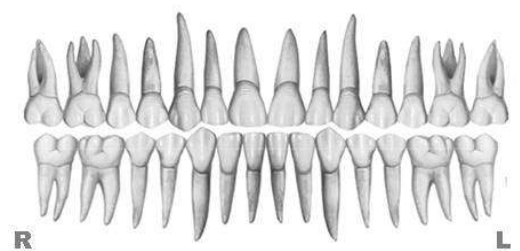
## Interproximal Contacts

0



## Root Angulation

0

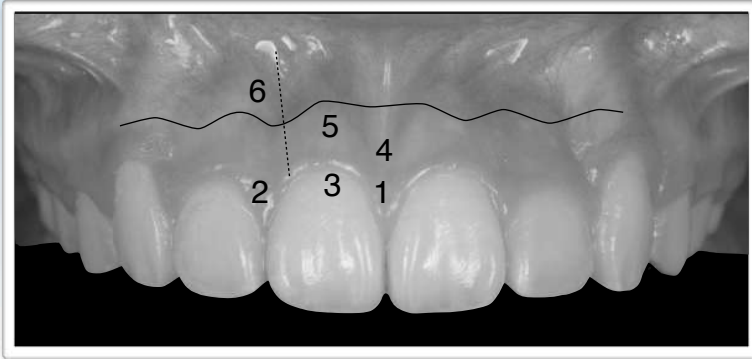


**INSTRUCTIONS:** Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

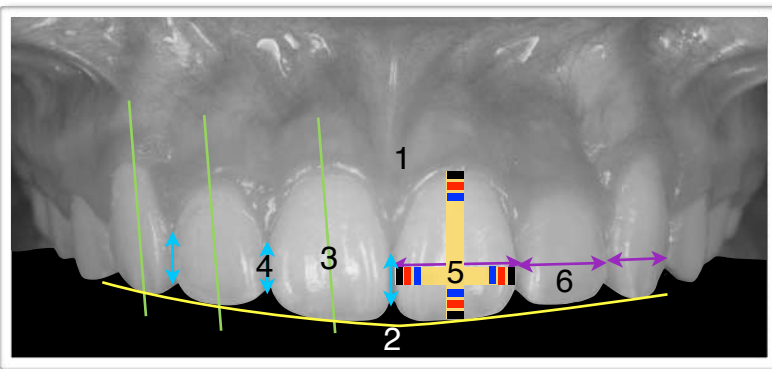
# IBOI Pink & White Esthetic Score

Total Score = 2

## 1. Pink Esthetic Score



## 2. White Esthetic Score (for Micro-esthetic)



Total = 0

1. M & D Papillae	0 1 2
2. Keratinized Gingiva	0 1 2
3. Curvature of Gingival Margin	0 1 2
4. Level of Gingival Margin	0 1 2
5. Root Convexity ( Torque )	0 1 2
6. Scar Formation	0 1 2

1. M & D Papillae	<span style="border: 1px solid red; border-radius: 50%; padding: 2px;">0</span> 1 2
2. Keratinized Gingiva	<span style="border: 1px solid red; border-radius: 50%; padding: 2px;">0</span> 1 2
3. Curvature of Gingival Margin	<span style="border: 1px solid red; border-radius: 50%; padding: 2px;">0</span> 1 2
4. Level of Gingival Margin	<span style="border: 1px solid red; border-radius: 50%; padding: 2px;">0</span> 1 2
5. Root Convexity ( Torque )	<span style="border: 1px solid red; border-radius: 50%; padding: 2px;">0</span> 1 2
6. Scar Formation	<span style="border: 1px solid red; border-radius: 50%; padding: 2px;">0</span> 1 2

Total = 2

1. Midline	0 1 2
2. Incisor Curve	0 1 2
3. Axial Inclination (5°, 8°, 10°)	0 1 2
4. Contact Area (50%, 40%, 30%)	0 1 2
5. Tooth Proportion	0 1 2
6. Tooth to Tooth Proportion	0 1 2

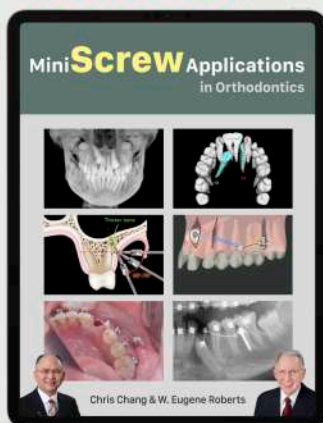
1. Midline	<span style="border: 1px solid red; border-radius: 50%; padding: 2px;">0</span> 1 2
2. Incisor Curve	<span style="border: 1px solid red; border-radius: 50%; padding: 2px;">0</span> 1 2
3. Axial Inclination (5°, 8°, 10°)	0 <span style="border: 1px solid red; border-radius: 50%; padding: 2px;">1</span> 2
4. Contact Area (50%, 40%, 30%)	<span style="border: 1px solid red; border-radius: 50%; padding: 2px;">0</span> 1 2
5. Tooth Proportion	<span style="border: 1px solid red; border-radius: 50%; padding: 2px;">0</span> 1 2
6. Tooth to Tooth Proportion	0 <span style="border: 1px solid red; border-radius: 50%; padding: 2px;">1</span> 2

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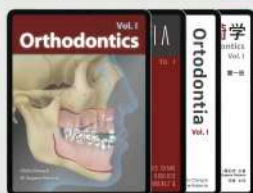
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Chris Chang & W. Eugene Roberts

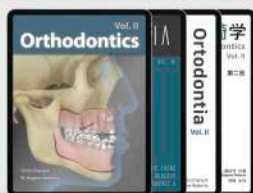
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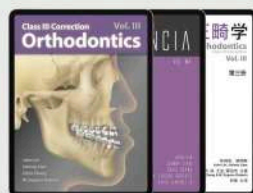
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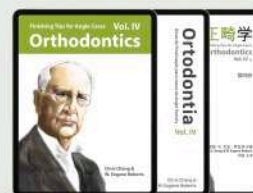
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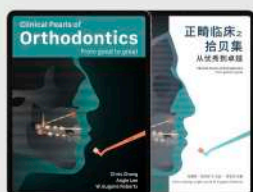
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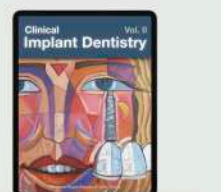
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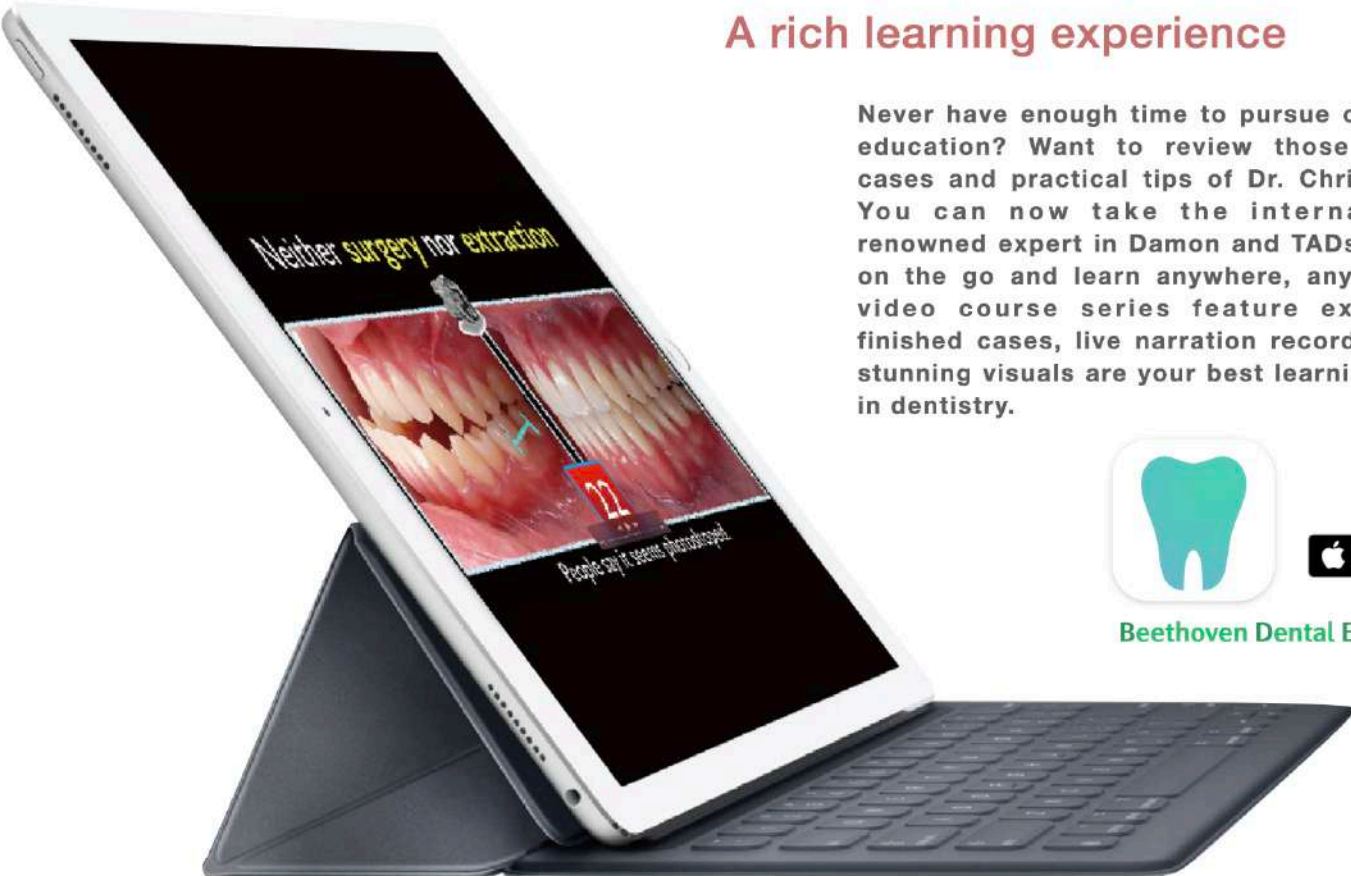
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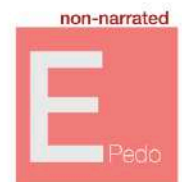
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