

Crowded Class II Division 2 Malocclusion with Class I Molars Due to Blocked In Lower Second Premolars

Abstract

An 18y2mo female presented a Class II Division 2 malocclusion associated with typical dental alignment problems: retroclined upper central incisors, labially flared maxillary lateral incisors, deep overbite, and severe crowding. Skeletally the malocclusion was complicated by a retrognathic mandible (ANB of 9°) steep mandibular plane angle (MPA 34°) and severe facial convexity (24°). Despite the Class II/2 pattern, the molars were Class I due to ectopic eruption and mesial migration of the mandibular first molars, which resulted in the second premolars being blocked out. The Discrepancy Index (DI) was 37. Treatment mechanics were passive self-ligating brackets, early light short elastics (ELSE), anterior bite turbos, and extra-alveolar (E-A) miniscrews in the infrazygomatic crests to retract the entire maxillary arch. Nonextraction treatment for 32 months resulted in an acceptable skeletal compromises (4° increase in the MPA and lower incisor to mandibular plane angle of 109°), but dental alignment was excellent, as documented with Cast-Radiograph (CRE) score of 22 and a Pink and White (P&W) dental esthetics score of 3. (Int J Ortho Implantol 2014;35:64-78)

Key words: Class II division 2 malocclusion, self-ligating appliance, bite turbo, bone screw anchorage

History and Etiology

It is more difficult to finish severe malocclusions well.¹ Of the common malocclusions, Class II Division 2 (Class II/2) malocclusions are the most challenging,² and extended treatment times (>36 months) contribute to an inferior result.³ The traditional treatment approaches involves headgear, functional appliances and/or orthognathic surgery. However, these methods are all problematic with respect to compliance, extended treatment time and/or postoperative complications.¹⁻³

The present patient is a 18-year-and-2-month-old female who presented with her mother for orthodontics evaluation (Figs. 1-3). Chief complaints were crooked teeth and flared upper lateral incisors. Despite a distinct Class II/2 skeletal and dental pattern with bimaxillary crowding, the molars were Class I and both lower second premolars were blocked in to the lingual. The etiology of this complex malocclusion is multifactorial.³

Developmentally the patient had a severely retrusive mandible which is a growth deficit that usually involves both polygenetic genetic traits and environmental factors.⁴ The subsequent development of the dental aspects of the malocclusion appears to be environmental based on the following scenario. Maintaining lip competence in the present of a Class II skeletal pattern results in lingual tipping of the maxillary central incisors, which blocks out the lateral incisors to the labial. The Class I molar relationship is probably due to the ectopic eruption in the mandibular arch: 1st molars erupted mesially into a Class I relationship, causing premature loss of the 2nd deciduous molars, which in turn resulted in blocked in 2nd premolars. Thus, the Class I molar relationship is actually a complicating factor for a Class II/2 skeletal malocclusion.

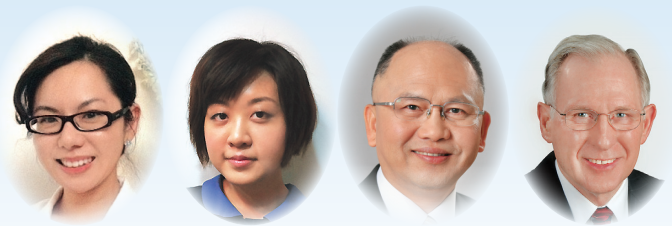
The patient was treated to a pleasing result in 23 months as documented in Figs. 4-6. Radiographs

Dr. Sophia Pei-Wen Shu, *Instructor*
Beethoven Orthodontic Course (left)

Dr. Hsin Yin Yeh, *Diplomate*
International Association for Orthodontists & Implantologists (middle)

Dr. Chris Chang, *Publisher*
International Journal of Orthodontics & Implantology (middle)

W. Eugene Roberts, *Consultant*
International Journal of Orthodontics & Implantology (right)



■ Fig. 1: Pre-treatment facial photographs



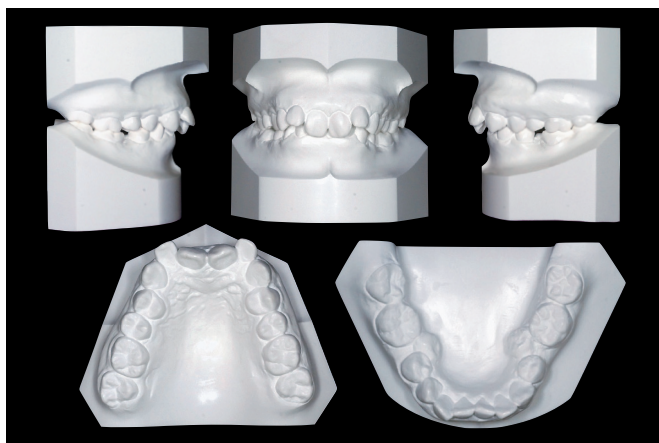
■ Fig. 4: Post-treatment facial photographs



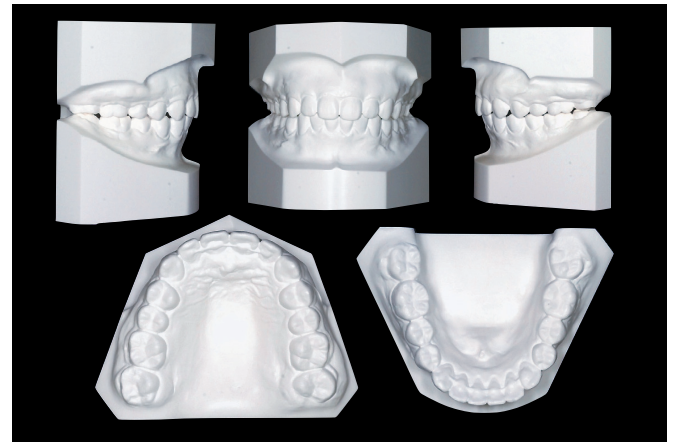
■ Fig. 2: Pre-treatment intraoral photographs



■ Fig. 5: Post-treatment intraoral photographs



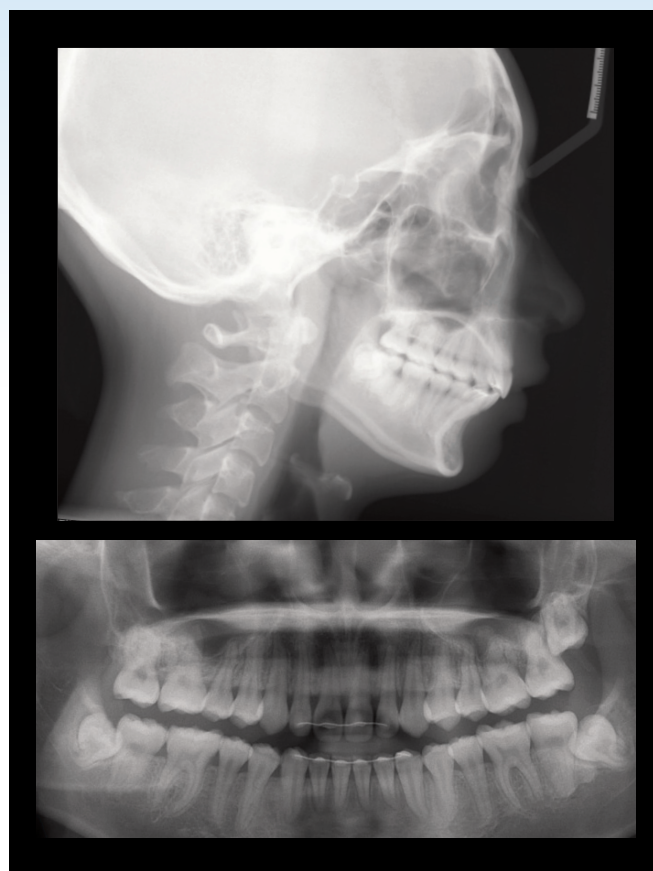
■ Fig. 3: Pre-treatment study models (casts)



■ Fig. 6: Post-treatment study models (casts)



■ Fig. 7:
Pre-treatment lateral cephalometric and panoramic radiographs



■ Fig. 8:
Post-treatment lateral cephalometric and panoramic radiographs



■ Fig. 9: Cephalometric tracings are superimposed on the anterior cranial base, maxilla and mandible.

before and after treatment are shown in Figs. 7 & 8, respectively. Fig. 9 documents the treatment with superimposed cephalometric tracings.

Diagnosis

1. Angle Classification:

Class I molar relationship
(due to lingually blocked-in of 2nd premolars)

2. Tooth Size Arch Length Discrepancy:

Maxillary: 6 mm,

Mandibular: 10 mm

3. Crossbite:

Bilateral lingual crossbite of mandibular second premolars

4. Facial:

Gummy smile, convex profile, and mandibular retrusion

5. Radiographic\Cephalometric:

a. Skeletal: Class II (SNA 84°, SNB 75°, ANB 9°);
increased mandibular plane angle (SN-MP 34°)

b. Dental: 100% overbite; lingually tipped upper central incisors

6. Radiographic\Panoramic:

Three impacted 3rd molars (UL, LL, LR)

As shown in the subsequent worksheet, the American Board of Discrepancy Index (DI) was 37.

Specific Objectives of Treatment

Maxilla (all three planes):

- A - P: *Maintain*
- Vertical: *Maintain*
- Transverse: *Maintain*

Mandible (all three planes):

- A - P: *Maintain*
- Vertical: *Maintain if possible, but posterior rotation is likely with efficient mechanics for treatment in < 36 mo.*
- Transverse: *Maintain*

Maxillary Dentition

- A - P:
 - a. Molars: *Retract*
 - b. Incisors: *Tip labially*
- Vertical: *Maintain*
 - a. Molars: *Maintain*
 - b. Incisors: *Intrude*
- Inter-molar Width: *Increase*
- Inter-canine Width: *Maintain*
- Buccolingual Inclination: *Maintain*

Mandibular Dentition

- A - P:
 - a. Molars: *Retract*
 - b. Incisors: *Maintain*
- Vertical:
 - a. Molars: *Extrude*
 - b. Incisors: *Intrude*
- Inter-molar Width: *Increase*
- Inter-canine Width: *Maintain*
- Buccolingual Inclination: *Maintain*

Facial Esthetics:

- Correct relatively protrusive upper lip, maintain lip competence

Other:

- Correct the gummy smile by improving upper incisor alignment; consider follow-up gingivectomy if needed

Treatment Plan

Smooth the facial surface of upper left central incisor before bonding. Bond both arches with a full fixed appliance. Place upper anterior bite turbos on the lingual surface of both central incisors and correct the deepbite with extrusion of the other teeth in the arch. Place early light short elastics (2 oz) to correct Class II buccal segments. Treat the lingual crossbite of the lower 2nd premolars with cross elastics (3.5 oz). Place miniscrews in the infrazygomatic crests bilaterally, to retract the upper posterior segments to attain Class I buccal segments. Apply Class II and posterior vertical elastics as needed. Detail the final occlusion and remove all fixed appliances. Retain the corrected dentition with upper 2-2 and lower 3-3 fixed retainers plus a clear overlay retainer for the maxillary arch. Extraction of all 3rd molars is recommended.

Appliances and Treatment Progress

A .022" slot Damon Clear bracket system (Ormco, Glendora, CA) was selected. The maxillary arch was bonded with standard torque brackets except for high torque brackets on the canines. The upper arch was fitted with a .014" CuNiTi archwire (Fig.



■ **Fig. 10:**

The maxillary arch was bonded with Damon Q Clear with standard torque brackets on the incisors and high torque brackets on the canines. A .013" CuNiTi archwire was inserted.

10), followed by the sequence for .018" CuNiTi, rectangular .014x.025" CuNiTi, .017x.025" TMA, and .019x.025" pre-torqued CuNiTi.

One month later, the lower arch was bonded with low torque brackets and an .014" CuNiTi archwire was placed. The subsequent archwire sequence was .018" CuNiTi, rectangular .014x.025" CuNiTi, and .017x.025" TMA for detailing. In order to open space for the lower 2nd premolars, open coil springs were applied bilaterally between the 1st premolars and 1st molars (Fig. 11). Drop in hooks were inserted into the brackets of the upper 1st premolars. The patient was instructed to wear Class II early light short elastics (Parrot 5/16, 2 oz) bilaterally full time. The elastics extended from the upper 1st premolar to the lower 1st molar bilaterally to retract the upper anterior teeth and reduce the overjet (Fig. 12). Anterior bite turbos were bonded on both upper central incisors to help correct the deep bite (Fig. 13).

After 8th months of initial alignment and leveling in



■ **Fig. 11:**
Open coil springs were applied bilaterally between the 1st premolars and 1st molars to open the space for the 2nd premolars.



■ **Fig. 12:**
Class II elastics (Parrot 5/16, 2 oz) were used to reduce the overjet.



■ **Fig. 13:**
After the initial alignment of the maxillary arc, anterior bite turbos were bonded on both upper central incisors to correct the deep bite.

both arches, 2x12 mm stainless steel mini-screws (OrthoBoneScrew®, Newton's A Ltd., Hsinchu, Taiwan) were inserted in the infrazygomatic crests bilaterally. Elastometric chains from the bone screws to the upper canines were used to retract the maxillary anterior segment (Fig. 14).

One year after the initiation of treatment, spaces between the 1st premolars and 1st molars was created with open coil springs, and brackets were bonded on the lower 2nd premolars (Fig. 15). Since



■ **Fig. 14:**
OrthoBoneScrew® mini-screws were implanted bilaterally in the infrazygomatic crests as anchorage to retract the maxillary dentition.



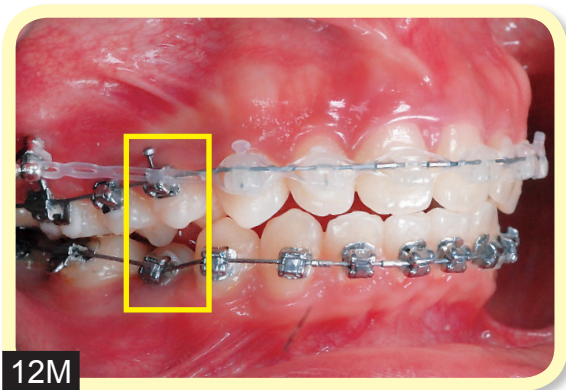
■ **Fig. 15:**
The 2nd premolars brackets were bonded once adequate space was obtained. A lingual button was bonded on the lower right 2nd premolar.

the lower right 2nd premolar was still tilted lingually, a lingual button was bonded on it. A cross elastic (*Chipmunk* 1/8, 3.5 oz) was applied from upper 2nd premolar to lower 2nd premolar to correct the buccal crossbite (*Fig. 16*).

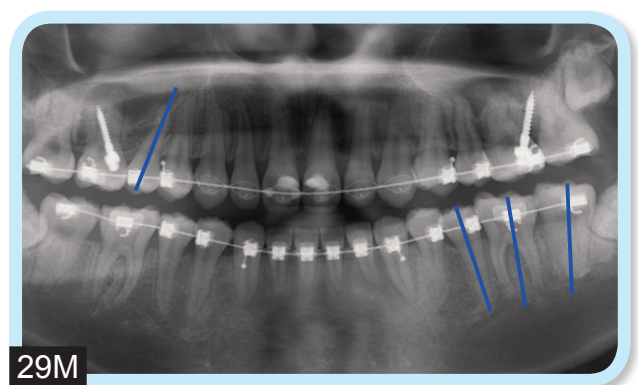
In the 22nd month, a maxillary .019x.025" pre-torqued archwire was inserted to apply lingual root torque to the anterior segment (*Fig. 17*). A progress panoramic radiograph was taken to evaluate axial inclinations

(*Fig. 18*). Brackets were repositioned to achieve the desired outcome.

One month before removing all fixed appliances, the upper archwire was sectioned distal to the canines, and continuous vertical elastics (*Ostrich* 3/4, 2 oz) were utilized to settle the occlusion (*Fig. 19*).⁵ Once an optimal finished occlusion was achieved, all fixed appliances were removed. The total active treatment time was 32 months.



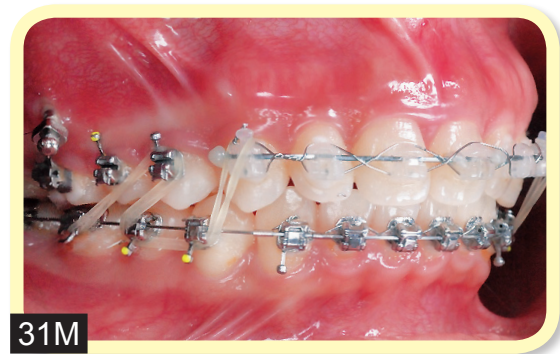
■ **Fig. 16:**
A cross elastic (*Chipmunk* 1/8, 3.5 oz) was applied from the upper 2nd premolar to the lower 2nd premolar to correct the buccal crossbite.



■ **Fig. 18:**
A progress panoramic radiography was taken to evaluate axial inclinations: brackets were repositioned on teeth marked with blue lines.



■ **Fig. 17:**
An .019x.025" maxillary pre-torqued archwire was used to apply lingual root torque in the anterior segment.



■ **Fig. 19:**
To settle the posterior occlusion, the upper archwire was sectioned distal to the canine, continuous intermaxillary elastics (*Ostrich* 3/4, 2 oz) were prescribed.

Results Achieved

Maxilla (all three planes):

- A - P: *Maintained*
- Vertical: *Maintained*
- Transverse: *Maintained*

Mandible (all three planes):

- A - P: *Retracted*
- Vertical: *Increased with a clockwise rotation of the mandible*
- Transverse: *Maintained*

Maxillary Dentition

- A - P:
 - a. Molars: *Retracted*
 - b. Incisors: *Tipped labially*
- Vertical:
 - a. Molars: *Maintained*
 - b. Incisors: *Maintained*
- Inter-molar Width: *Expanded*
- Inter-canine Width: *Maintained*
- Buccolingual Inclination: *Maintained*

Mandibular Dentition

- A - P:
 - a. Molars: *Retracted*
 - b. Incisors: *Tipped labially (109° to mandibular plane)*
- Vertical:
 - a. Molars: *Maintained*

b. Incisors: *Maintained*

- Inter-molar Width: *Expanded*
- Inter-canine Width: *Maintained*
- Buccolingual Inclination: *Uprighted*

Facial Esthetics:

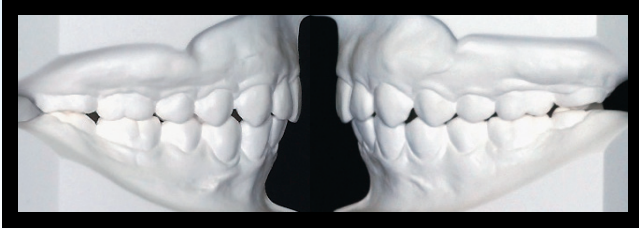
- Lip profile retracted, despite posterior mandibular rotation, facial convexity was unchanged

Retention

Fixed retainers were bonded to each tooth in the upper 2-2 and lower 3-3 areas. Upper and lower clear overlay retainers were delivered with instructions to wear them full time for the first 6 months and nights only thereafter. Home hygiene and retainer care instructions were provided.

Final Evaluation of Treatment

The ABO Cast-Radiograph Evaluation (CRE) score was 22 points, which indicated an optimal dental alignment for this challenging malocclusion. The large overjet and deep bite were corrected, but significant discrepancies were noted for occlusal relationships (Fig. 20) and alignment of second molars (Fig. 21). The dental esthetics were good as documented by the IBOI Pink & White Esthetic score of 3. However, there were minor deficiencies in maxillary midline papilla, incisal curvature (*smile arc*) axial inclination of incisors. Overall, the lingually tipped upper central incisors and the flared lateral incisors were well aligned, considering the skeletal



■ **Fig. 20:**
The occlusal relationships for canines and premolars were still slightly Class II on the finish casts.



■ **Fig. 21:** The second molars were not well aligned.

limitations (ANB 9°). Improved axial inclination of the maxillary incisors resulted in less gingival exposure when smiling: gingivectomy was not necessary (Fig. 22).

The 4° posterior rotation of the mandible did not compromise the facial profile, but it did require excessive inclination of the lower incisor to correct the overjet. However, the treatment was considered optimal for this difficult malocclusion (DI 37) because the excellent dental result (CRE 22), treatment was completed in 32 months, and an acceptable facial result was achieved. Attempting to avoid



■ **Fig. 22:**
The excessive gingival display when smiling was improved and the patient is satisfied with her smile.

the increase in the vertical dimension of occlusion would probably increase the treatment time and result in an inferior overall outcome.¹⁻³

Discussion

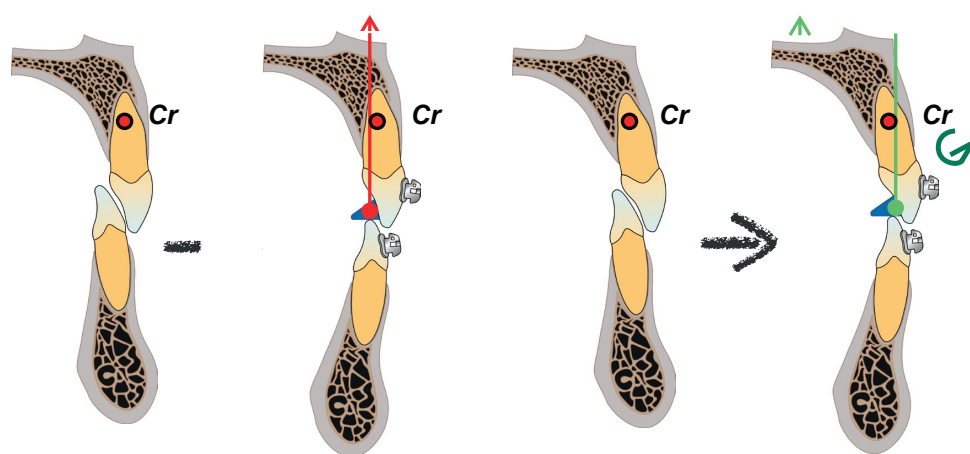
The Class II/2 pattern of malocclusion exhibits complex characteristics such as severe anterior crowding, with retroclined maxillary central incisors/ lateral incisors and flared maxillary lateral incisors/ canines, deep overbite, and retrusive mandibular or short lower anterior face height.⁶ Class II/2 malocclusion is relatively rare in the Chinese population, with an incidence of 0.5%-5%,⁷ but it is a very challenging to treat and has a high risk of relapse.⁸ Treatment for Class II/2 requires careful diagnosis and a treatment plan involving esthetics, occlusion, and function. It is critical to analyze patient's facial profile, skeletal pattern, and severity of dental malocclusion carefully in the treatment plan as well.⁹ The objective of treatment for Class II/2 usually involves correcting the intrusion of the

upper incisors and deep overbite and achieving a satisfactory skeletal, dental, and soft tissue relationship.¹⁰ Depending on the patient's age and growth potential, there are several options for treating this Class II/2 malocclusion, e.g., fixed and functional appliances, headgears, and orthognathic surgery. However, it is important to choose an efficient option to complete the correction in <36 months to avoid compromises associated with extended treatment times.¹⁻³

The present patient preferred nonsurgical orthodontic treatment to minimize the risk of facial compromise. Extraction treatment for Class II/2 has a tendency to flatten the facial profile and deepen the bite.¹¹ Pitts¹² suggests: *"Only extract for the face, not for the space!"* The patient's pre-treatment cephalometric radiograph (Fig. 7) showed a slightly protruded profile for both lips due to the flaring of the upper lateral incisors and fairly narrow arches. A non-extraction treatment plan was indicated and the Damon self-ligating system was selected.

Using Damon self-ligating brackets and NiTi archwires, the variable torque control brackets allow the roots of the teeth to begin to upright during the leveling phase. With variable torque brackets, the upper anterior teeth are readily leveled and aligned.¹³ This preliminary alignment provided space for the lower segment to be bonded (Fig. 12). At the same appointment, anterior bite turbos were placed on the upper central incisors (Fig. 13).

Anterior bite turbos are excellent tools for the correction of deep bite if opening the bite and posterior mandibular rotation are acceptable mechanics. They are easy to use and decrease the treatment time for many patients. However, for lingually tipped upper central incisors, the line of occlusal force may be lingual to the center of resistance (CR) which can result in more lingual tipping. Thavarungkul¹⁴ suggests bonding the anterior bite turbos after both central incisors have been proclined slightly. This allows the force vector to pass in anterior of CR in order to correct the deep bite (Fig. 23).



■ Fig. 23:

Left: If anterior bite turbos are applied before the initial alignment of the incisors, the line of occlusal force may be distal to the center of resistance (CR) resulting in more lingual tipping.

Right: After some labial movement of the maxillary central incisor crowns, the line of force (green) is labial to CR which is a preferable force system. (Diagram Courtesy of Dr. Rungsi Thavarungkul)¹⁴

In addition, early light elastics also play an important role in correcting deep bite and aligning the anterior teeth. Using early light short elastics has the advantage of controlling the vertical dimension without decreasing the smile arch and sagittal correction in the early stage of treatment for deep bite. The light force reduces the side effects of the horizontal component of force which can produce unnecessary tipping of the teeth. Pitts¹⁵ also suggests, “keeping the elastics distal” to facilitate posterior extrusion for the deep bite case. For the present patient, anterior bite turbos and Class II elastics resolved the overjet problem, but extruded the mandibular molars, which increased the mandibular plane angle due to posterior rotation of the mandible. However, this skeletal compromise was indicated to meet the patient’s objectives and control the duration of treatment. Extended treatment times for difficult malocclusions often result in inferior results.¹⁻³

For Class II/2 malocclusion, anchorage control is one of the most difficult problems. En masse movement of the anterior segment and improvement in the facial profile can be accomplished with E-A miniscrew anchorage.¹⁶ Miniscrew anchorage is an effective tool for improving maxillary incisor inclination consistent with a proper molar relationship.¹⁷⁻¹⁹ It is also a minimally intrusive method that reduces treatment time and simplifies mechanics for managing dentoalveolar protrusion.²⁰ Studies have shown miniscrew anchorage or headgear can achieve acceptable results for the retraction of incisors. However, with miniscrew anchorage, it does not require patient cooperation

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	84°	84°	0°
SNB°	75°	75°	0°
ANB°	9°	9°	0°
SN-MP°	34°	38°	4°
FMA°	30°	34°	4°
DENTAL ANALYSIS			
U1 TO NA mm	-3 mm	-1 mm	2 mm
U1 TO SN°	84°	103°	19°
L1 TO NB mm	4 mm	7 mm	3 mm
L1 TO MP°	95°	109°	14°
FACIAL ANALYSIS			
E-LINE UL	2 mm	0 mm	2 mm
E-LINE LL	1 mm	1 mm	0 mm

■ Table 1: Cephalometric summary

and minimal pain is associated.²¹⁻²² E-A miniscrew can improve the facial profile of Class II/2 patients without wearing an inconvenient and embarrassing headgear device.

Conclusion

Skeletal Class II/2 with a deep bite and severe crowding is a challenging malocclusion that may require facial compromise to attain an optimal result in minimal treatment time. Infrazygomatic crest miniscrew anchorage is effective for retracting the maxillary arch. Moreover, anterior bite turbos are effective appliances for resolving deep bite, but they increase the vertical dimension of occlusion, which increases overjet and the mandibular plane.

Combined miniscrew anchorage and anterior bite turbos are an efficient option for treating Class II/2, but judicious application of the mechanics and management of side effects are required.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE

37

OVERJET

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

=

4

OVERBITE

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

Total

=

5

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)

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

2 pts. per tooth

Total =

4

CEPHALOMETRICS (See Instructions)ANB $\geq 6^\circ$ or $\leq -2^\circ$ = 4 pts.Each degree $< -2^\circ$ _____ x 1 pt. = _____Each degree $> 6^\circ$ 3 x 1 pt. = 3**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 $> 99^\circ$ _____ x 1 pt. = _____

Total

=

7

OTHER (See Instructions)

Supernumerary teeth	_____ x 1 pt. = _____
Ankylosis of perm. teeth	_____ x 2 pts. = _____
Anomalous morphology	1 x 2 pts. = 2
Impaction (except 3 rd molars)	_____ x 2 pts. = _____
Midline discrepancy (≥ 3 mm)	@ 2 pts. = _____
Missing teeth (except 3 rd molars)	_____ x 1 pts. = _____
Missing teeth, congenital	_____ x 2 pts. = _____
Spacing (4 or more, per arch)	_____ x 2 pts. = _____
Spacing (Mx cent. diastema ≥ 2 mm)	@ 2 pts. = _____
Tooth transposition	_____ x 2 pts. = _____
Skeletal asymmetry (nonsurgical tx)	@ 3 pts. = _____
Addl. treatment complexities	4 x 2 pts. = 8

Identify: 1. Irregular facial surface was found on the upper left central incisor.
2. Molar relationship was supposed to be full Class II on both side but the mandibular 1st molars mesially shifted due to the mandibular 2nd premolars were lingual blocked-in.

Total

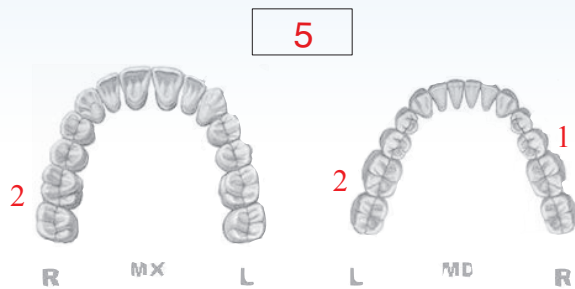
=

10

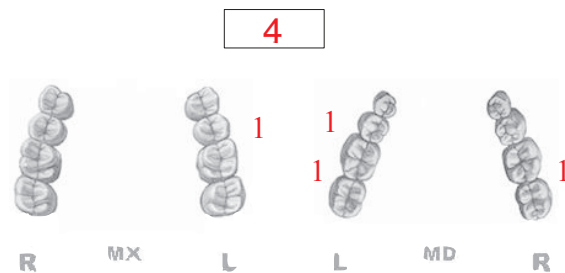
Cast-Radiograph Evaluation

Total Score: **22**

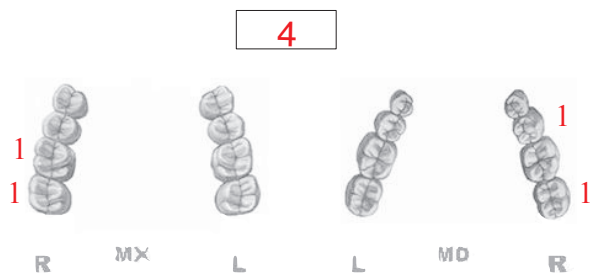
Alignment/Rotations



Marginal Ridges



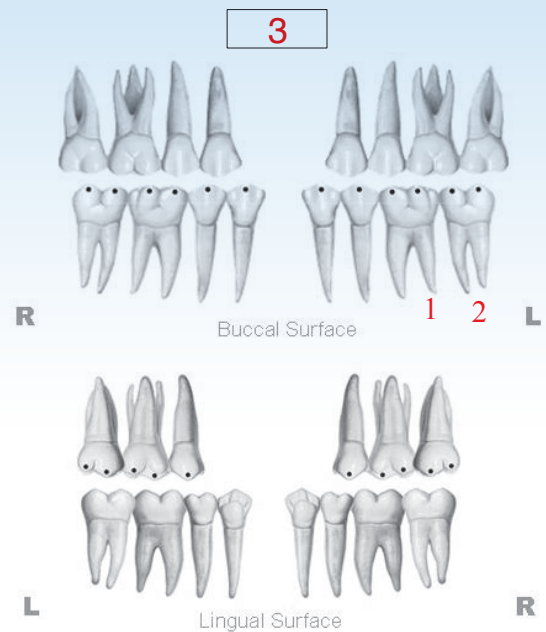
Buccolingual Inclination



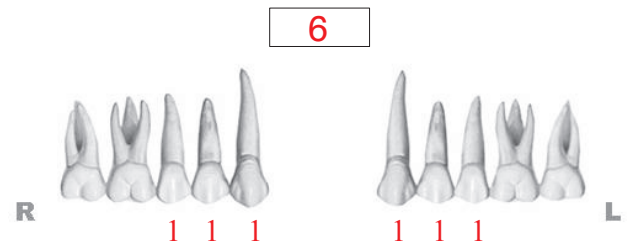
Overjet



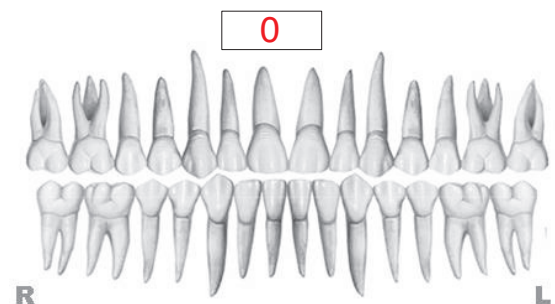
Occlusal Contacts



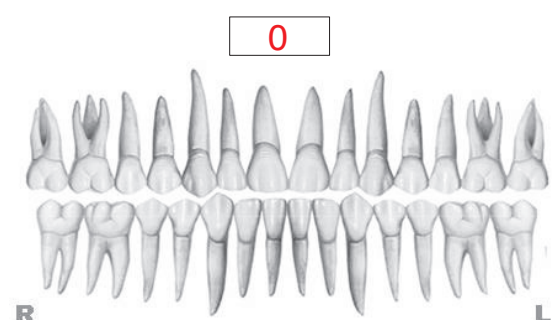
Occlusal Relationships



Interproximal Contacts



Root Angulation

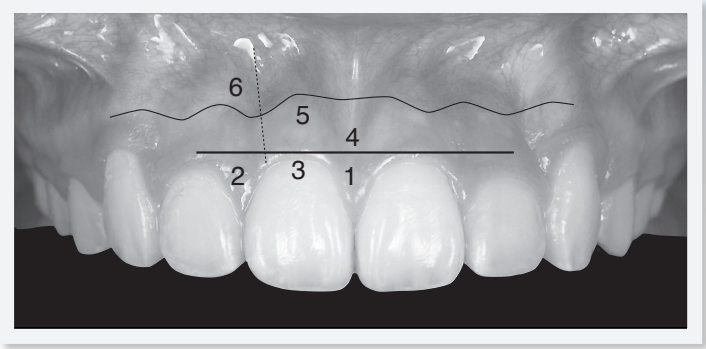


INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 3

1. Pink Esthetic Score

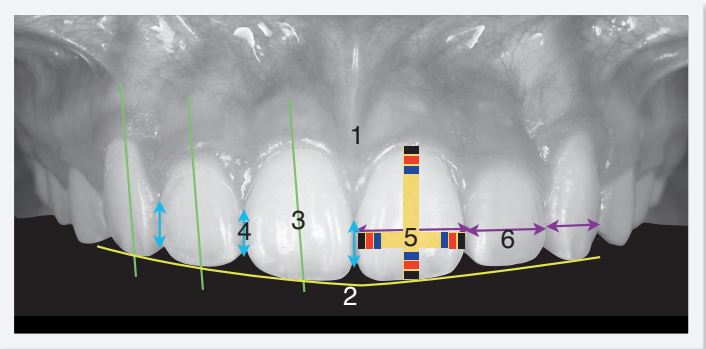


Total = 1

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-esthetics)



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 (1:0.8)	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 (1:0.8)	0	1	2
6. Tooth to Tooth Proportion	0	1	2