Class III Camouflage Treatment: Premolar Extractions, Bite Turbos, and Differential Space Closure

Abstract

History: A 24 year-old male presented with protruded chin, crowded dentition, and poor smile esthetics. There was no contributing medical or dental history. Previous orthodontists recommended orthognathic surgery, but the patient preferred a more conservative approach.

Diagnosis: Skeletal Class III malocclusion (SNA 89˚, SNB 86˚, ANB -3˚) was complicated with bimaxillary protrusion, anterior crossbite and a concave profile. Asymmetric buccal segments were more Class III on the right side (8mm), and the mandibular midline was deviated 4mm to the left. The Discrepancy Index (DI) was 42 points.

Treatment: Four 1st premolars were extracted to provide space for camouflage treatment. Class III elastics and an inclined bite plane on the lower incisors were used to correct the anterior crossbite. The buccal segment asymmetry and crowding were resolved with differential space closure and Class III elastics in all four quadrants. Posterior crossbite tendency was controlled with cross-elastics and upper archwire expansion.

Results: Retraction of the lower anterior segment improved facial convexity from 0˚ to 2˚. After 30 months of active treatment, this severe skeletal malocclusion was corrected to an excellent Cast-Radiograph Evaluation (CRE) of 26 points and a Pink & White dental esthetic score of 5.

Conclusions: Severe Class III skeletal malocclusion can be resolved with extractions and camouflage treatment. Mandibular buccal shelf bone screw anchorage may improve incisal angulation. (J Digital Orthod 2020;60:40-55)

Key words:
Class III malocclusion, non-surgical treatment, anterior crossbite, bite turbos, torque selection

Introduction

Class III malocclusion is challenging particularly when there are asymmetric skeletal components. For non-growing adults, camouflage treatment rather than orthognathic surgery has long been debated.[1] If the patient desires a skeletal correction, orthognathic surgery is necessary. However, the expense and surgical morbidity are unattractive aspects, so camouflage treatment was developed to achieve an acceptable, compromised outcome.[2] Non-extraction camouflage treatment can be accomplished with Class III elastics if the malocclusion is symmetric, and it is acceptable to open the vertical dimension of occlusion. However, in the presence of substantial crowding and intermaxillary asymmetry, extraction in all four quadrants is preferable because it provides space for differential space closure. Class III camouflage treatment with extractions can improve the ANB angle and decrease facial convexity with little or no change in the vertical dimension of occlusion (*facial height*).[3-8] With careful selection and diagnosis, 92% of adult Class III malocclusion patients can be effectively treated with orthodontic therapy alone.[1]

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This case report documents the conservative management of an adult skeletal Class III malocclusion complicated with anterior crossbite, asymmetric molar relationship, and midline deviation (*Figs. 1-5*). Conservative treatment (*Figs. 6-8*) resulted in an acceptable camouflage result (*Figs. 9-12*).

■ *Fig. 1*: *Pre-treatment facial and intraoral photographs. See text for details.*

■ *Fig. 2:*
   The facial profile and frontal intraoral views are compared in centric occlusion (C₀) and centric relation (Cᵣ). In the Cᵣ position, the incisors are in an end-to-end relationship, and the facial profile is acceptable.

The dental nomenclature for this report is a modified Palmer notation with four oral quadrants: upper right (*UR*), upper left (*UL*), lower right (*LR*), and lower left (*LL*). From the midline, the permanent teeth are numbered 1-8, e.g., a lower right first molar is LR6.

Diagnosis and Etiology

A 24-yr-5-mo-old male presented for orthodontic consultation with the following chief concerns: protruded chin, crowded dentition, and poor smile esthetics (*Figs. 1-5*). There was no contributing medical or dental history. The clinical examination showed a protrusive lower lip, an anterior crossbite from UR2 to UL3, and distally tipped lower incisors (*Fig. 5, Table 1*). The overjet was -5mm, and the overbite was 2mm. Crowding was severe (*15mm*) in the maxillary arch, but it was only moderate (*5mm*) in the mandibular arch. The molar relationship was asymmetrical full-cusp Class III (*right side*) and end-on Class III (*left side*) (*Fig. 4*). Lin's 3-Ring Diagnosis (*Fig. 13*) revealed (*1*) an orthognathic profile, (*2*) 3mm anterior functional shift, and (*3*) near Class I buccal relationships in Cᵣ (*Figs. 2 and 5, Table 1*). The panoramic radiograph showed asymmetrical temporomandibular joints but no specific intraoral dental problems (*Fig. 3*). Cephalometric analysis (*Table 1*) documented an ANB angle of -3˚ and protruded lower lip (*7mm to the E-Line*). A careful evaluation of
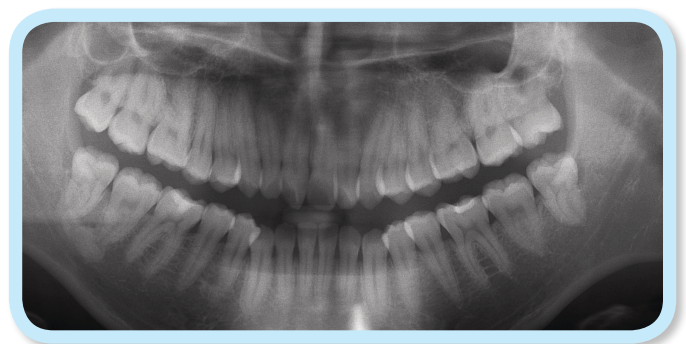
■ *Fig. 3: Pre-treatment panoramic radiograph*

Fig. 4:
Pre-treatment study casts show a full cusp Class III molar relationship on the right side, but the left side is only a half cusp Class III. Distally inclined lower incisors and an anterior crossbite complicate the malocclusion. See text for details.

Fig. 5:
Pre-treatment cephalometric radiograph shows the anterior crossbite. See text for details.

the Discrepancy Index (*DI=42*) (*Worksheet 1*) and Lin's 3-Ring Diagnosis (*Fig. 13*) indicated conservative treatment was feasible, but Chang's extraction

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA˚ (82°)	86°	85.5°	0.5°
SNB˚ (80°)	89°	87°	2°
ANB˚ (2°)	-3°	-1.5°	1.5°
SN-MP˚ (32°)	36°	37°	1°
FMA˚ (25°)	28°	29°	1°
DENTAL ANALYSIS			
U1 To NA mm (4mm)	8	7	1
U1 To SN˚ (104°)	123°	116°	7°
L1 To NB mm (4mm)	5.5	2	3.5
L1 To MP˚ (90°)	78°	75°	3°
FACIAL ANALYSIS			
E-LINE UL (-1mm)	-0.5	-1	0.5
E-LINE LL (0mm)	7	1	6
%FH: Na-ANS-Gn (53%)	53%	55%	2%
Convexity: G-Sn-Pg' (13°)	0°	2°	2°

Table 1: Cephalometric summary

decision chart (*Table 2*) indicated that extractions were needed to manage the asymmetry, protrusion, and crowding.

Treatment Objectives

The treatment objectives were: (*1*) correct the anterior crossbite; (*2*) relieve the crowding of the upper anterior teeth; (*3*) retract the lower lip; (*4*) create ideal overbite and overjet; and (*5*) establish functional Class I molar and canine relationships.

Treatment Plan

Extract all four first premolars to relieve the crowding while maintaining the position of the upper lip.

Correct the anterior crossbite with an inclined bite plate on the lower anterior segment and Class III elastics. Install 2x12-mm OrthoBoneScrews (*OBS®s*) (*iNewton, Inc., Hsinchu, Taiwan*) in the mandibular buccal shelves if supplemental anchorage is required. Because of extensive Class III elastic mechanics, bracket requirements for the anterior segments are low torque in the upper, and high torque in the lower arches (*Figs. 14, 16, and 18*).

Treatment Alternatives

The preferred orthognathic surgical options were Le Fort I with bilateral intraoral vertical ramus osteotomies. The patient declined surgery because of the hospitalization, high cost, and risk of complications.

Treatment Progress

A 0.022-in slot Damon Q® fixed appliance (*Ormco, Brea, CA, USA*) with passive self-ligating (*PSL*) brackets was selected. After the 1st premolars were extracted, the lower arch was bonded with super

■ *Fig. 7:*
The negative overjet decreased from -5mm at the start of treatment (0M) to -1.5mm at eight months (8M). At 13 months (13M), the anterior inclined bite plate was bonded on the lower incisors as shown in the buccal (left) and frontal (right) views.
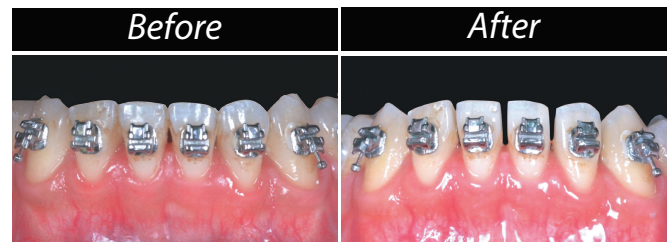
■ *Fig. 8:*
The IPR procedure is shown before and after the incisors were reshaped to eliminate black interproximal spaces, increase contact area, and provide space to retract the anterior segment.

■ *Fig. 6:*
At two months (2M), open coil springs and elastomeric chains are applied to help relieve crowding. By the 5th month, a 0.014-in CuNiTi wire is engaged in all of the upper brackets. In the 8th month of treatment, crowding is relieved, anterior alignment is improved, and most of the extraction space is closed. See text for details.

high torque brackets in the anterior segment (*Fig. 14*). Two months later, the upper arch was bonded with standard torque brackets. To prevent binding and notching of the archwire in the UR1, UR2, and UL2 brackets,[15] open coil springs (*nickel-titanium springs*) were placed on the archwire to open space (*Fig. 6, left*). The initial archwire was 0.014-in copper-nickel-titanium archwire. Class III early light short elastics (*Parrot, 5/16-in, 2-oz; Ormco, Brea, CA, USA*) were placed from the mandibular second premolars to the maxillary 1st molars. In addition, a five-ring power-chain was placed bilaterally from

the maxillary canines to the maxillary 1st molars to close the extraction spaces and relieve the anterior crowding. By the 5th month of treatment, the open coil springs were removed, and the mandibular archwire was changed to 0.014x0.025-in copper-nickel-titanium (*Fig. 6*). In the 8th month, the crowding was nearly resolved. In the 13th month, the upper and lower archwires were both changed to 0.016x0.025-in SS. The overjet decreased from -5mm to -1.5mm, and the extraction spaces in the upper arch were decreased. An anteriorly inclined bite plate was bonded from tooth LL2 to LR2 to

■ *Fig. 9: Post-treatment facial and intraoral photographs*

correct the anterior crossbite (*Fig. 7*). Class III elastics (*Fox, 1/4-in, 3.5-oz; Ormco, Brea, CA, USA*) and five-ring power-chains were used to retract the lower anterior teeth. After four months with the bite plate, the anterior crossbite was corrected. In the 26th month, interproximal reduction was performed in the lower anterior segment to reduce dark triangles (*Fig. 8*). Final space closure and detailing were accomplished. After 30 months of active treatment, all appliances were removed.

Treatment Result

Correction of the anterior crossbite and retraction of the lower lip significantly improved the facial profile (*Fig. 9*). Both arches were well aligned and optimally interdigitated, resulting in a near ideal Class I occlusion with coincident midlines (*Fig. 10*). Panoramic radiography revealed good axial alignment of the dentition (*Fig. 11*). Cephalometric superimpositions revealed mandibular incisors were retracted about 7mm, and axial inclinations were acceptable (*Fig. 12*). These outcomes indicated the effect of space closure was well compensated by the high-torque brackets and the reverse Curve of Spee in the archwire (*Fig. 12*). Maxillary incisors were maintained in the original anterior-posterior (*A-P*) plane, and their axial inclination was improved (*U1-SN: 123˚ to 116˚*). This was not an ideal outcome, but it was acceptable for the camouflage correction of a severe skeletal Class III malocclusion. The mandible was rotated clockwise (*posteriorly*) because of the lower molar extrusion due to Class III elastics. The protrusive lower lip was corrected by retracting the lower incisors (*Fig. 12*).

The Cast Radiograph Evaluation (*CRE*) score was 26 points, as shown in the supplementary Worksheet 2. The major residual discrepancies were the buccolingual inclination (*7 points*). Dental esthetics were acceptable as documented by a Pink and White esthetic score of 5, as shown in Worksheet 3. This conservative treatment plan required ~2.5 years (*30 mo*) of active treatment. The patient was pleased with the dental and facial outcomes.
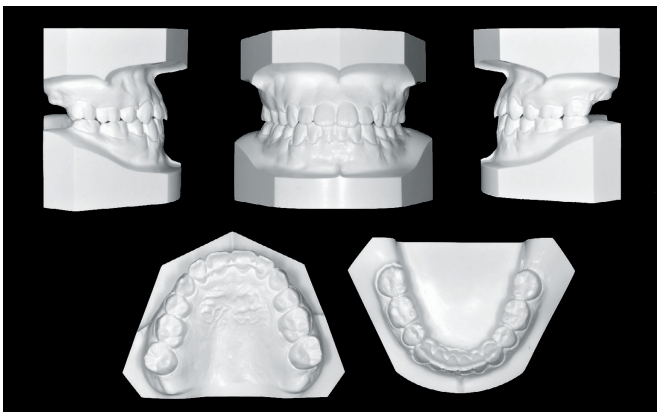
■ *Fig. 10: Post-treatment study models (casts)*
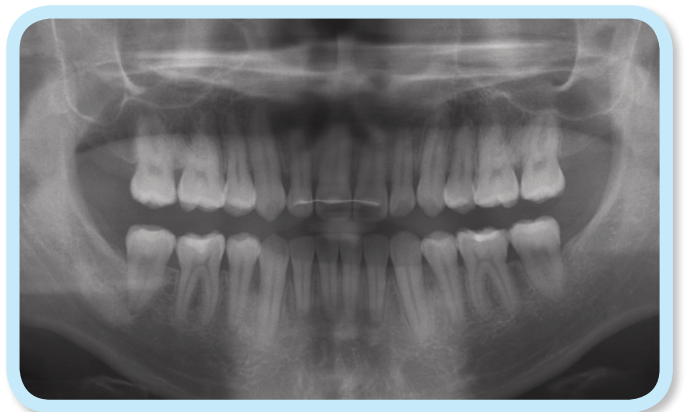
■ *Fig. 11: Post-treatment panoramic radiograph*
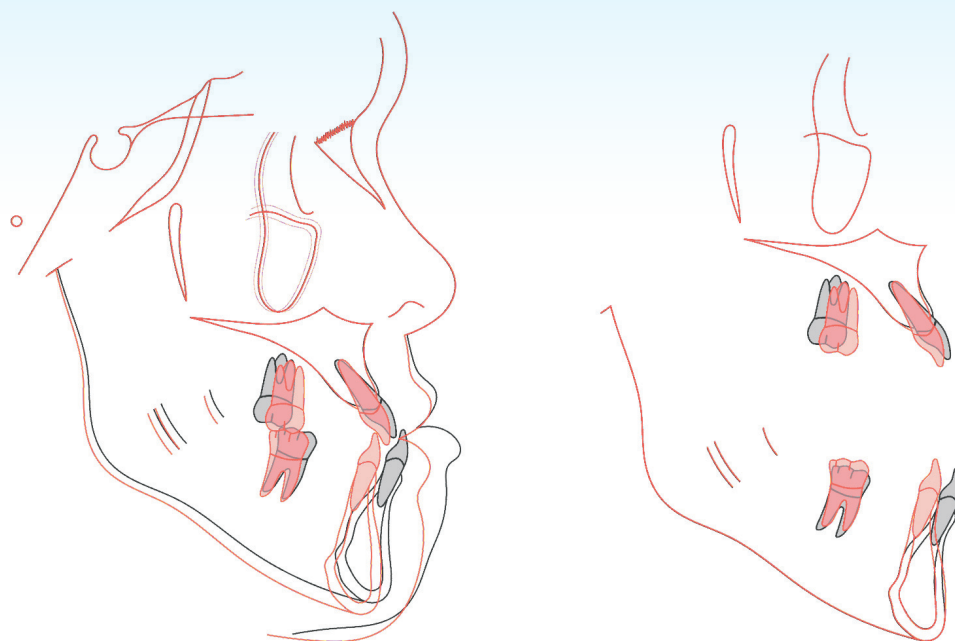
■ *Fig. 12:*
   Superimposed cephalometric tracings (pre-Tx: black; post-Tx: red) indicate that the mandible rotated clockwise, which contributed to the retraction of the lower lip (left). In the maxillary arch (upper right), incisors were also retracted. Lower incisors were bodily retracted to correct the anterior crossbite (lower right). See text for details.

The four-year follow-up record (*Fig. 19*) shows stable occlusion and pleasant esthetics. The periodontal state is healthy and shows no gingival recession at all. The posterior openbite is resolved by itself. No signs of relapse are noted, and no symptoms of TMD are present.

Discussion

The specific indication for orthognathic surgery is a malocclusion with skeletal or dentoalveolar anomalies that cannot be adequately corrected with tooth movement alone.[12] The American Association of Oral and Maxillofacial Surgeons recommends orthognathic surgery if horizontal overjet is zero or negative, and the A-P molar discrepancy is >4mm

Class III. The present patient is clearly in the zone for orthognathic correction because overjet was -4mm and molar discrepancy was 5mm. However, a substantial functional shift may accentuate a dental discrepancy, e.g., anterior crossbite.[13] Non-surgical treatment may be feasible by correcting the shift and increasing the lower facial height. The 3-Ring Diagnosis developed by Lin is particularly helpful for treatment planning of marginal Class III malocclusions (*Fig. 13*).[16,18] There are three favorable indicators for the present patient when he was positioned in centric relation: an orthognathic profile (*acceptable facial balance*), buccal segments near Class I, and an A-P functional shift of ~3mm into maximal intercuspation.

Class III camouflage treatment may result in increased axial inclination of the maxillary incisors and decreased axial inclination of the mandibular incisors, particularly if there is an underlying Class III skeletal discrepancy.[16,17,18,25] Low-torque brackets are usually recommended for the upper incisors, but standard torque brackets were used even though the inclination of the upper incisors was 123° to the SN plane (*Table 1*). This flexibility reflects extractions to provide the space needed to correct 15mm of anterior crowding; then little A-P movement of the upper incisors is required. When lingually-tipped lower incisors (*L1-MP: 78°*) are retracted, two methods can be used to increase incisal torque: (*1*) turn the low-torque brackets upside down to produce high-torque effects[19,21,25] (*Fig. 14*); and (*2*)

place a pre-torqued archwire such as 0.016x0.025-in or 0.019x0.025-in NiTi.[18,25,26] When comparing the pre-treatment and post-treatment cephalometric measurements (*Table 1, Fig. 12*), lower incisor torque was managed effectively. According to the decision table formulated by Chang (*Table 2*), extractions were needed to efficiently relieve the upper arch crowding while maintaining the nasolabial angle. In the lower arch, extraction of the mandibular 1st premolars was helpful to (*1*) provide space for lower incisor retraction; and (*2*) prevent the distal angulation of the terminal molar compared to retraction of the entire lower arch.

The protocol for bite turbos (*glass ionomer cement occlusal bite raisers*) was necessary for correction of the anterior crossbite[20,25] because they: (*1*) prevent premature occlusal contact on brackets, (*2*) control wear on the teeth particularly with parafunction, (*3*) facilitate arch development, and (*4*) create interocclusal space for the crossbite correction. Bite turbos can be placed in the anterior or posterior

Profile: Orthognathic profile at C_R position
Class: Canine and molar Class I relationship
FS: Functional shift ($C_O \neq C_R$)
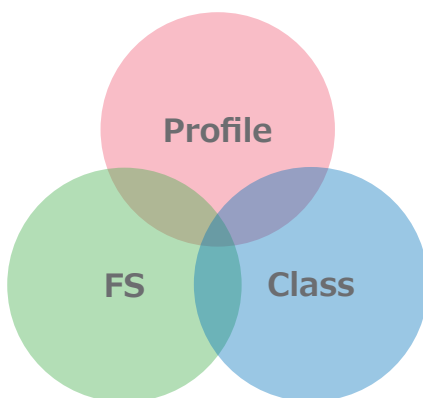
■ *Fig. 13:*
The Class III diagnostic system of Lin evaluates the facial profile and molar classification in C_R, as well as any functional shift from C_R to C_O. If the profile is acceptable in C_R, the molars are in or near Class I, and there is a significant functional shift, the patient can usually be managed effectively with conservative camouflage treatment.

■ *Fig. 14:*
Reversing a low torque bracket (-11°) results in a high-torque bracket (+11°). See text for details.

	Ext.	Not
1. Profile	Protrusive	Straight
2. Md. angle	High	Low
3. Bite	Open	Deep
4. Ant. inclination	Flaring	Flat
5. Crowding	> 7mm	None
6. Decay/missing	Present	????
7. P't perception	OK	No
8. Etc...		

■ *Table 2:*
Chang's extraction decision chart suggests removing premolars because of a protrusive facial profile and crowding >7mm.

segments of either arch. There are some limitations for bite turbo applications, e.g., it is best to avoid: (*1*) weak teeth, such as upper lateral incisors, endodontically treated teeth, and/or periodontally compromised dentition, (*2*) teeth with large restorations or temporary crowns, (*3*) isolated teeth subject to high stress, and (*4*) target teeth that are to be moved. When the occlusion is discluded, make sure the bite opening is bilateral and comfortable for the patient. For the present patient, it was necessary to level and align multiple teeth, so the bite turbos were on the second molars (*Fig. 15*). Opening the bite accelerated the initial stage of the orthodontic treatment. By the 13th month, all the teeth were provisionally aligned, and the anterior inclined bite plane[10] (*glass ionomer resin*) was constructed (*Fig. 16*). Four months were required to correct the anterior crossbite with the inclined plane and Class III elastics.

When correcting a Class III malocclusion, lingual posterior crossbite is a common complication associated with lower arch retraction. There are several strategies to manage posterior crossbite tendency: (*1*) use lighter force to close posterior space; (*2*) bond buttons on the lingual so space closure mechanics can be applied simultaneously on the buccal and lingual surfaces; and (*3*) design archwire compensation. For the present patient, posterior crossbite was first noted 26 months into treatment. The upper archwire was expanded in the posterior, and crossbite elastics were applied (*Fig. 17*).
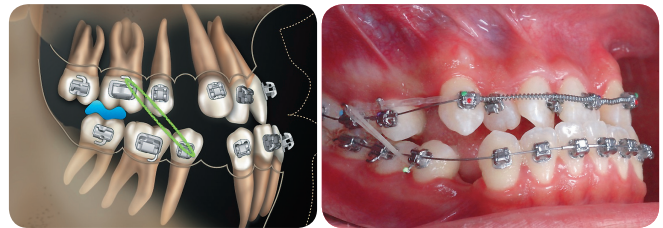
■ *Fig. 15:*
Posterior bite-turbos (blue) opened the bite to prevent incisal bracket prematurities in occlusion. Early light short Class III elastics (green) were worn from U6 to L5.
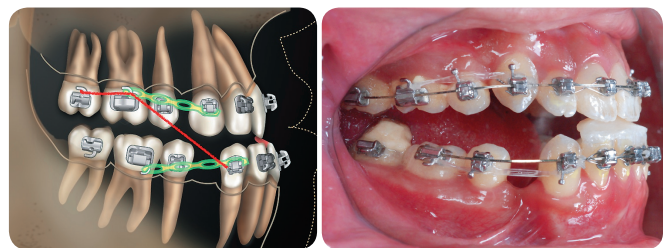
■ *Fig. 16:*
Left: *Thirteen months into treatment, the mechanics were space closure with chains of elastics (green) and Class III elastics (red).*
Right: *An anteriorly inclined bite plate was constructed with glass ionomer cement on the lower incisors to help correct the anterior crossbite. The lower archwire was cut distal to the lower first molars to decrease the friction for sliding space closure mechanics.*

The lower Curve of Spee (*CoS*) was increased by the occlusal moment produced by the elastic chains used for differential space closure to correct the Class III buccal segments (*Fig. 18*). This is a common problem when closing extraction spaces even if the dentition is well aligned. Beginning at 13 months, a reverse curve in the lower archwire corrected the CoS. By the 20th month, the CoS was again increased as the lower incisors tipped lingually (*Fig. 18*). Another reverse CoS in the archwire compensated for this unwanted side effect. By the 24th month into treatment, the CoS problem was resolved.

Conclusions

A severe skeletal malocclusion was treated to an acceptable outcome without orthognathic surgery. Differential diagnosis utilizing Lin's 3-Ring Diagnosis and Chang's extraction decision table helped formulate an effective yet conservative treatment plan. Thirty months of carefully-sequenced treatment achieved an acceptable result.

In retrospect, mandibular buccal-shelf bone screws may have decreased treatment time and improved axial inclination of the incisors.

Fig. 19 documents the current condition of the patient 4 years post-treatment.
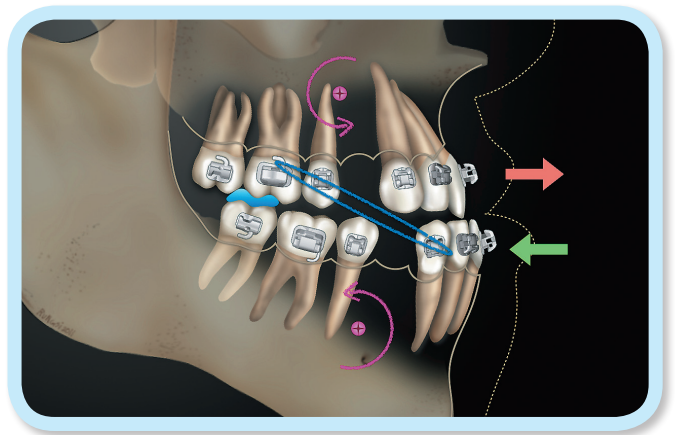
■ *Fig. 18*:
Class III elastics (blue) rotate each arch around a center of resistance as depicted by magenta curved arrows and dots with a cross in the center. These mechanics tip the upper anterior segment labially (pink arrow), and the lower anterior segment lingually (green arrow). See text for details.

16 x 25 SS
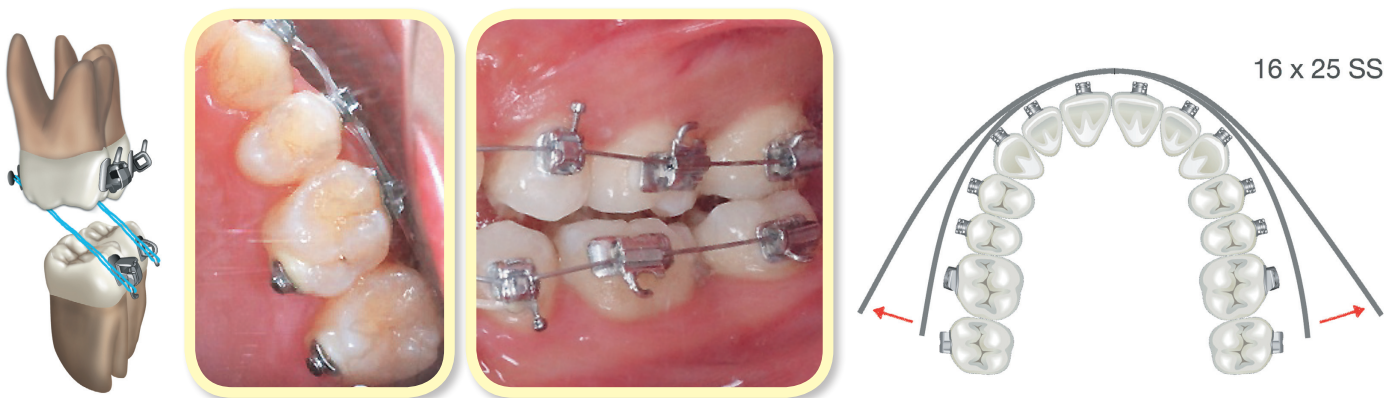
■ *Fig. 17*:
In the 27th month of treatment, a posterior crossbite tendency was noted for the UL6 and UL7. Buttons were bonded on the palatal surfaces of the affected molars and 3.5oz crossbite elastics were applied (left). In addition, the upper 0.016x0.025-in stainless steel archwire was expanded (red arrows on the right).

Acknowledgments

■ *Fig. 19: Facial and intraoral photographs at 4-year follow-up*

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Discrepancy Index Worksheet

TOTAL D.I. SCORE   42

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   =   19

OVERBITE

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

Total   =   0

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   =   6

LINGUAL POSTERIOR X-BITE

1 pt. per tooth   Total   =   0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth   Total   =   0

CEPHALOMETRICS   (See Instructions)

ANB $\geq$ 6° or $\leq$ -2°   = ⟨4 pts.⟩

  Each degree < -2° _____ x 1 pt. = ___1___

  Each degree > 6° _____ x 1 pt. = _____

SN-MP

  $\geq$ 38°   =   2 pts.
  Each degree > 38° _____ x 2 pts. =_____

  $\leq$ 26°   =   1 pt.
  Each degree < 26° _____ x 1 pt. = _____

1 to MP $\geq$ 99°   =   1 pt.
  Each degree > 99° _____ x 1 pt. = _____

Total   =   5

OTHER   (See Instructions)

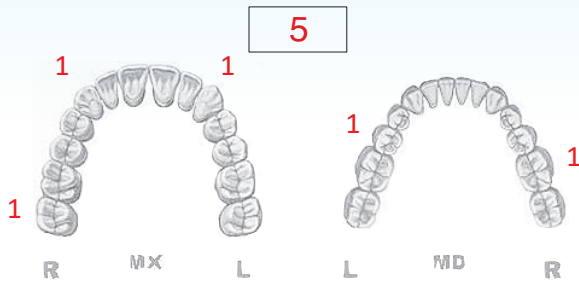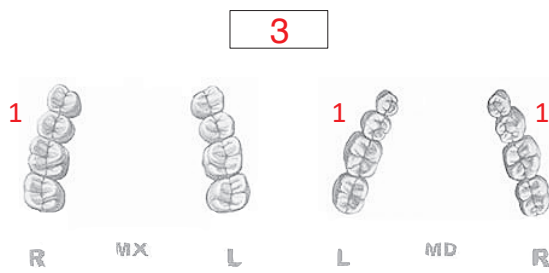|		
Supernumerary teeth	_____ x 1 pt. =	_____
Ankylosis of perm. teeth	_____ x 2 pts. =	_____
Anomalous morphology	_____ x 2 pts. =	_____
Impaction (except 3rd molars)	_____ x 2 pts. =	_____
Midline discrepancy (≥3mm)	@ 2 pts. =	2
Missing teeth (except 3rd molars)	_____ x 1 pts. =	_____
Missing teeth,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

Identify:

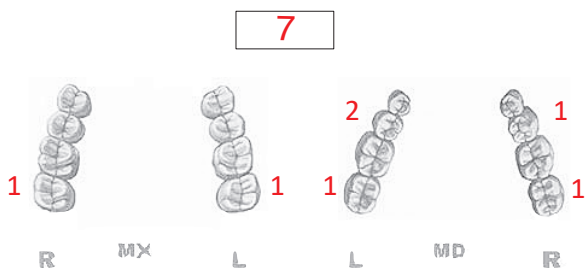Total   =   5

Cast-Radiograph Evaluation

Total Score: 26

Occlusal Contacts

5

1

R   Buccal Surface   L

1   1   1   1

L   Lingual Surface   R

Alignment/Rotations

5

1   1

1

1

1

R   MX   L   L   MD   R

Marginal Ridges

3

1   1   1

R   MX   L   L   MD   R
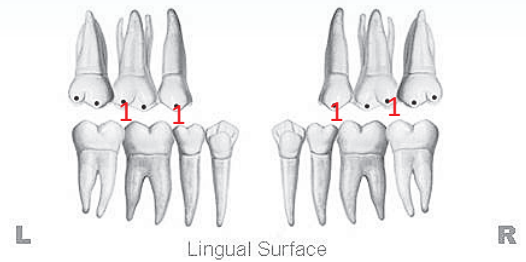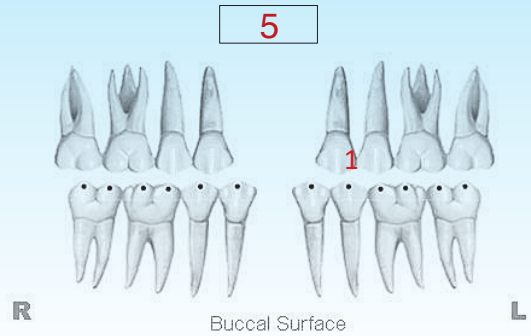
Occlusal Relationships

0

R   L

Buccolingual Inclination

7

2   1

1   1   1   1

R   MX   L   L   MD   R
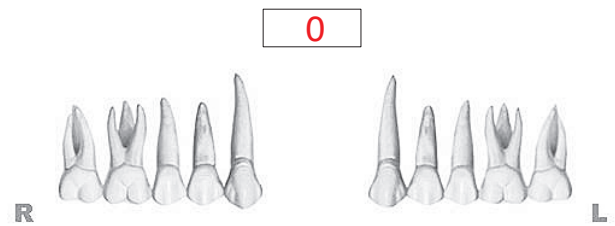
Interproximal Contacts

0

R   L

Overjet

6

1   1   2   2

R   MX   L

Root Angulation

0

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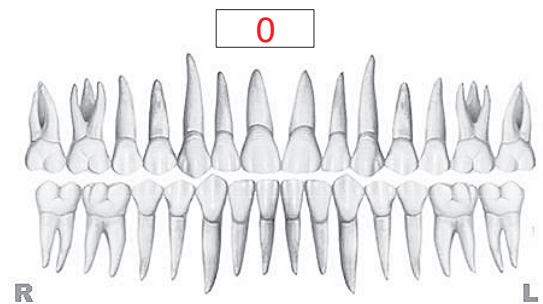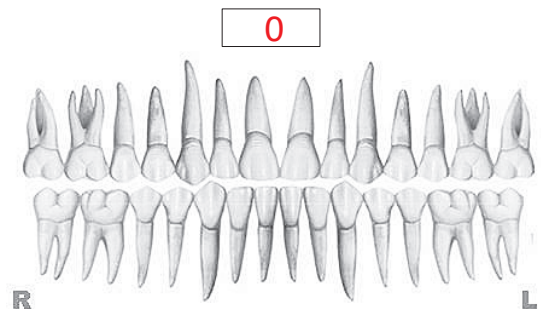
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score (Before Surgical Crown Lengthening)
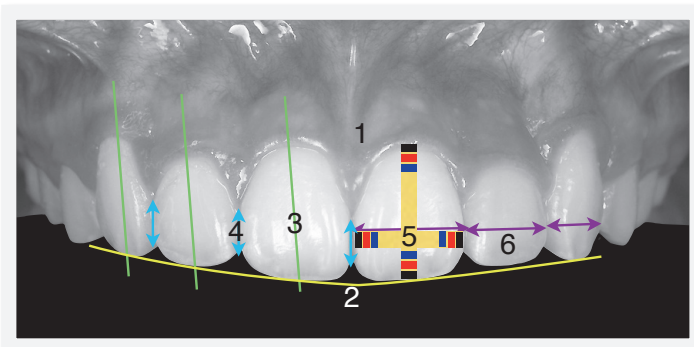
Total Score: = | 5 |

1. Pink Esthetic Score
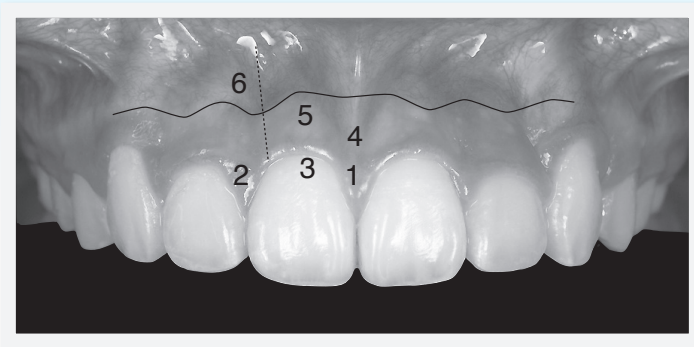
Total = | 2 |

	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

	0	1	2
1. M & D Papilla	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 = | 3 |

	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

	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