Correction of Anterior Crossbite Complicated with Two Supernumerary Teeth

History And Etiology

A 12-year-1-month-old girl was accompanied by her parents for evaluation of a crowded dentition (*Fig. 1*). The chief complaint was an unesthetic smile due to a maxillary anterior crossbite and crowding. There was no other contributory medical or dental history. Clinical examination revealed an anterior crossbite, with blocked out right and left maxillary canines, and a bilateral class I molar relationship (*Figs. 2 and 3*). The patient was treated to an acceptable result as documented in Figs. (*4-6*); however, the treatment of the anterior crossbite (*Fig. 7*) was complicated by the presence of two supernumerary teeth (*mesiodens*) in the premaxillary region (*Figs. 8*). Figures 9 and 10 provide a direct comparison of the cephalometric and panoramic radiographs before and after treatment, respectively. Figure 11 shows the superimposition of the tracings for the before and after treatment cephalometric radiographs.

Diagnosis

Cephalometric and panoramic radiographs (*Fig. 9*) document the overall complexity of the malocclusion. A periapical radiograph (*Fig. 8*) revealed that one of the supernumerary teeth was superimposed just below the CEJ of the upper right central incisor, and its crown was oriented

Fig. 1: Pretreatment facial photographs

Fig. 2: Pretreatment intraoral photographs

Fig. 3: Pretreatment study models

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Dr. Chris Chang, Director, Beethoven Orthodontic Center (middle)
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International Journal of Orthodontics & Implantology (left)

Fig. 4: Posttreatment facial photographs

Fig. 5: Posttreatment intraoral photographs

Fig. 6: Posttreatment study models

in an occlusal direction. The other mesiodens was superimposed on the apical third of the upper left central incisor in an inverted orientation (*Fig. 8*). Although cephalometric and occlusal radiographs may provide additional information, but precise localization of each mesiodens requires 3D imaging. The latter was not deemed necessary for the present patient.

Skeletal:

- Skeletal Class III (*SNA 76°, SNB 75°, ANB 1°*)
- High mandibular plane angle (*SN-MP 43°, FMA 34°*)

Dental:

- Class I occlusal relationships on both sides
- Anterior crossbite from #7 to #10 (*Fig. 7*)
- 12 mm of crowding in the upper arch (*severe*)
- 3 mm crowding in the lower arch (*mild*)
- Blocked out maxillary canines
- Upper midline 2 mm left of the facial midline Facial: The profile was protrusive, primarily due to the prominent position of the lower lip.

ABO Discrepancy Index (*DI*) was 37 as shown in the subsequent worksheet.

Fig. 7: Severely crowded upper anterior teeth and mildly crowded lower anterior teeth. Anterior crossbite with blocked out canine.

Fig. 8:
Two supernumerary teeth were distributed in the premaxilla with opposite apico-coronal directions.

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	76°	76°	0°
SNB°	75°	75°	0°
ANB°	1°	1°	0°
SN-MP°	43°	44°	1°
FMA°	34°	35°	1°
DENTAL ANALYSIS			
U1 TO NA mm	6 mm	7 mm	1 mm
U1 TO SN°	107°	110°	3°
L1 TO NB mm	10 mm	7 mm	3 mm
L1 TO MP°	97°	91°	6°
FACIAL ANALYSIS			
E-LINE UL	-1 mm	0 mm	1 mm
E-LINE LL	4 mm	2 mm	2 mm

Table. 1: Cephalometric summary

Specific Objectives Of Treatment

Maxilla (*all three planes*):

- A - P: Allow for normal expression of growth
- Vertical: Allow for normal expression of growth
- Transverse: Maintain

Mandible (*all three planes*):

- A - P: Allow for normal expression of growth
- Vertical: Allow for normal expression of growth
- Transverse: Maintain

Maxillary Dentition

- A - P: Maintain incisors and protract molars
- Vertical: Maintain
- Inter-molar Width: Maintain

Mandibular Dentition

- A - P: Retract incisors and protract molars
- Vertical: Extrude consistent with normal growth
- Inter-molar / Inter-canine Width: Maintain

Facial esthetics:

- Maintain the upper lip relationship
- Retract the lower lip

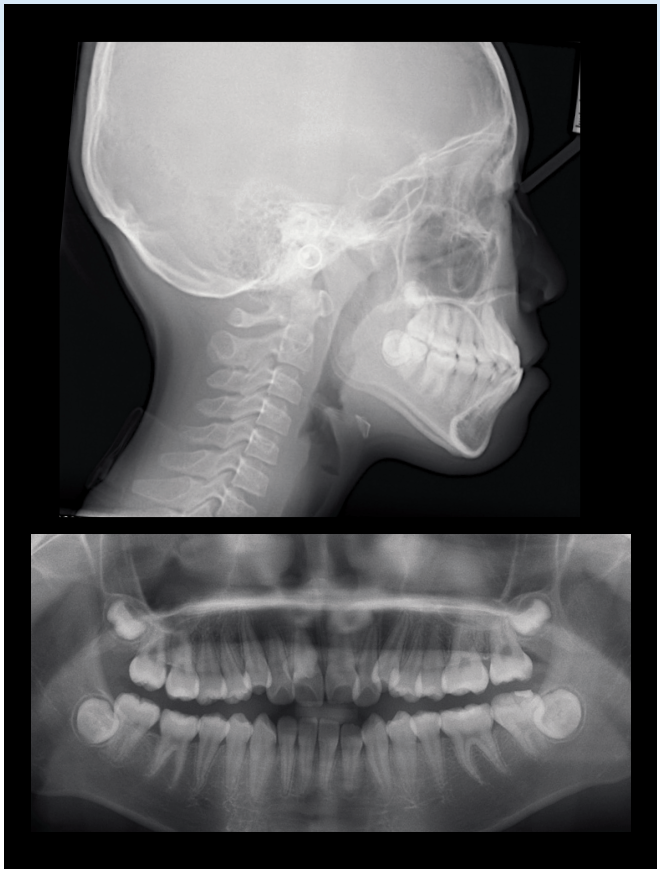


Fig. 9: Pretreatment pano and ceph radiographs.

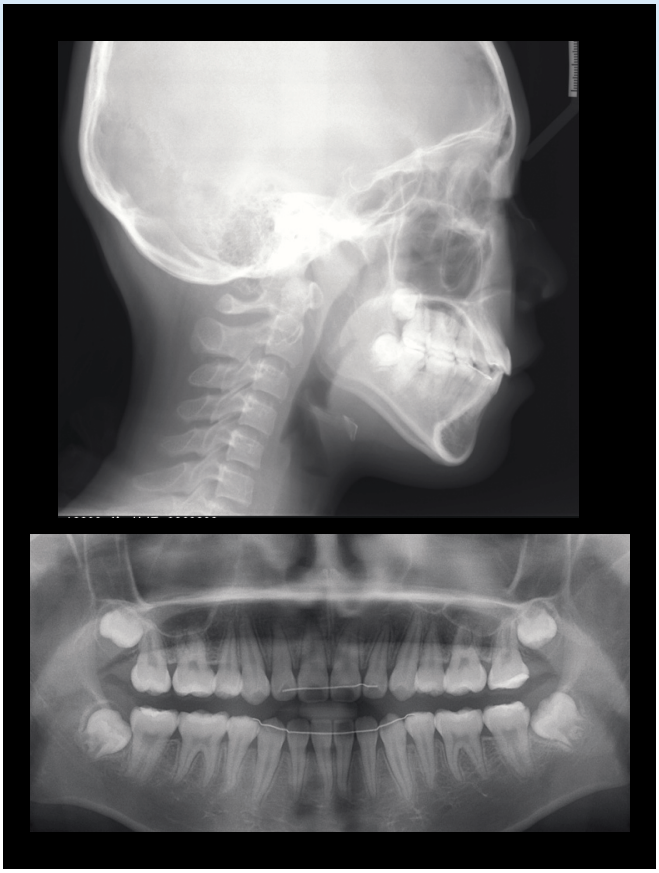


Fig. 10: Posttreatment pano and ceph radiographs.

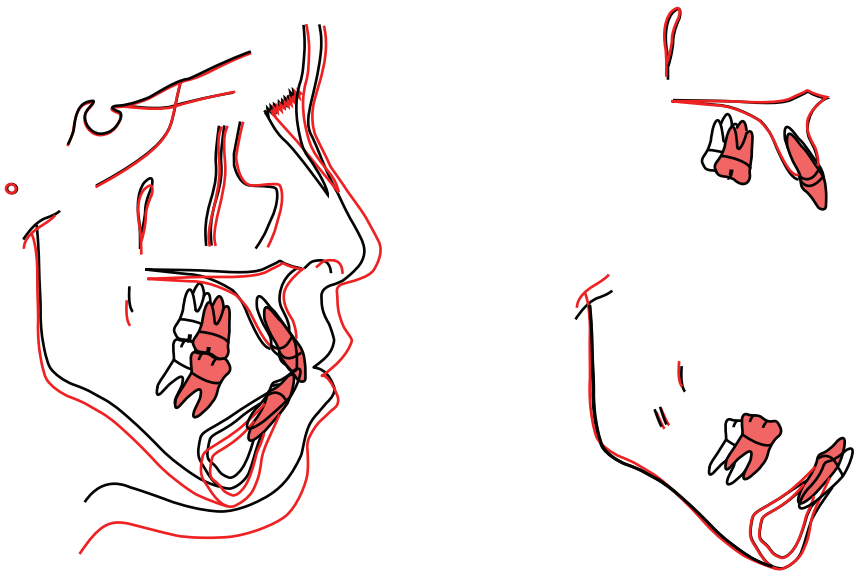


Fig. 11:

Superimposed tracings show the noticeable growth and clockwise rotation of the mandible, the marked lingual tilting of the lower incisors, and the mesial shifts of the molars with unchanged class I relationship. The profile was improved.

Treatment Plan

- Extraction first premolars in all four quadrants to resolve crowding.
- Open the bite using anterior bite turbos to assist the anterior crossbite correction.
- Retract the canines to resolve crowding.
- Close residual space with elastics and power chains.
- Monitor and reassess the need for removing the supernumerary teeth during leveling and aligning.
- Correct root torque of upper lateral incisors.
- Retention: lower lingual fixed retainer and a clear overlay for the maxillary arch

Fig. 12:
The brackets were bonded up-side down on the upper lateral incisors for torquing roots forward.

Fig. 13:
Two bite turbos were bonded on the lingual side of lower central incisors for disarticulation

Appliances And Treatment Progress

A .022" slot Damon Q bracket system (*Ormco*) was used. Standard torque brackets were bonded on the upper dentition. The upper lateral incisor brackets (*U2: +6°*) were bonded upside down to achieve improved facial root torque (*Fig. 12*). The initial archwire was .014" CuNiTi. Bite turbos were bonded on the lingual surface of the lower central incisors to assist anterior crossbite correction (*Fig. 13 and 17*). The upper left lateral incisor was ligature-tied to the archwire, but the slot was not engaged to avoid a heavy initial force (*Fig. 12*). A protective sleeve was placed between teeth #11 and 13. One month later, standard torque brackets were bonded on the lower dentition and a .014" CuNiTi wire was engaged. In the 3rd month of active treatment, the crowding had been relieved and the anterior crossbite was corrected. Subsequently, an upper .018" CuNiTi arch wire was placed and posterior bite turbos were bonded occlusally on the lower first molars, and the lingual turbos on the lower incisors were removed. Drop-in hooks (*Ormco*) were fitted in the vertical slot of the upper canines to secure class II elastics (*Quail 3/16" 2 oz*)(*Fig. 15*). To correct the lingual tipping of tooth # 18, a lingual button and short, light cross elastics (*Quail 3/16" 2 oz*) were used. In the 4th month

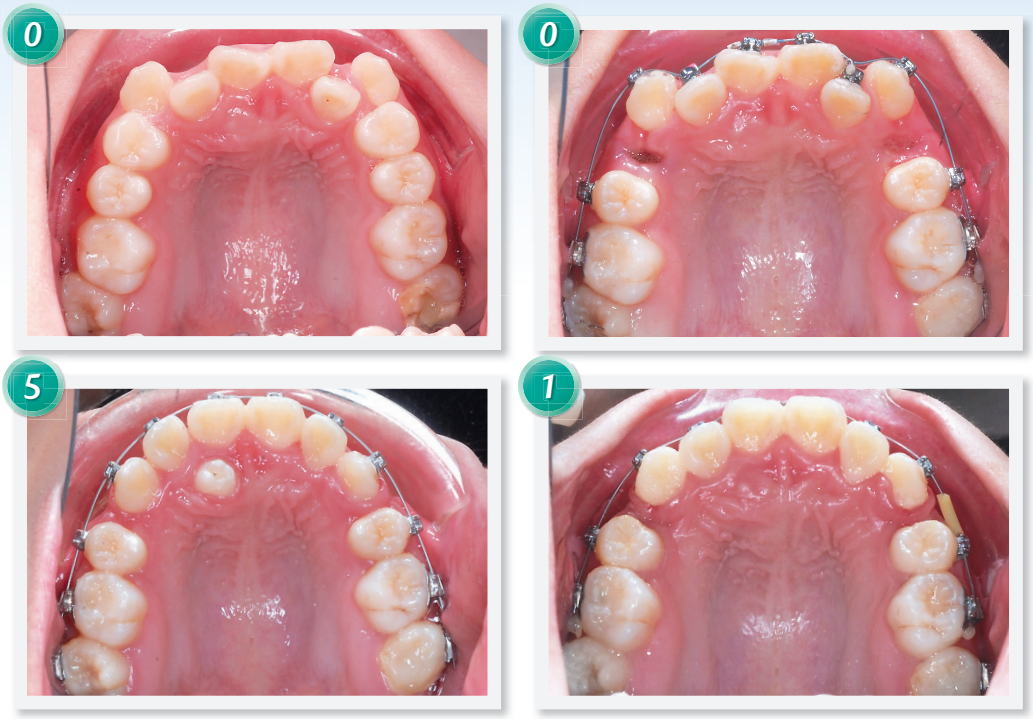


Fig 14:

Progress photographs revealed the teeth with light forces in a passive system moved and followed the path of least resistance, then extraction spaces were reduced rapidly and the dentition was aligned well. One of the supernumerary teeth exposed and extracted without any complications.

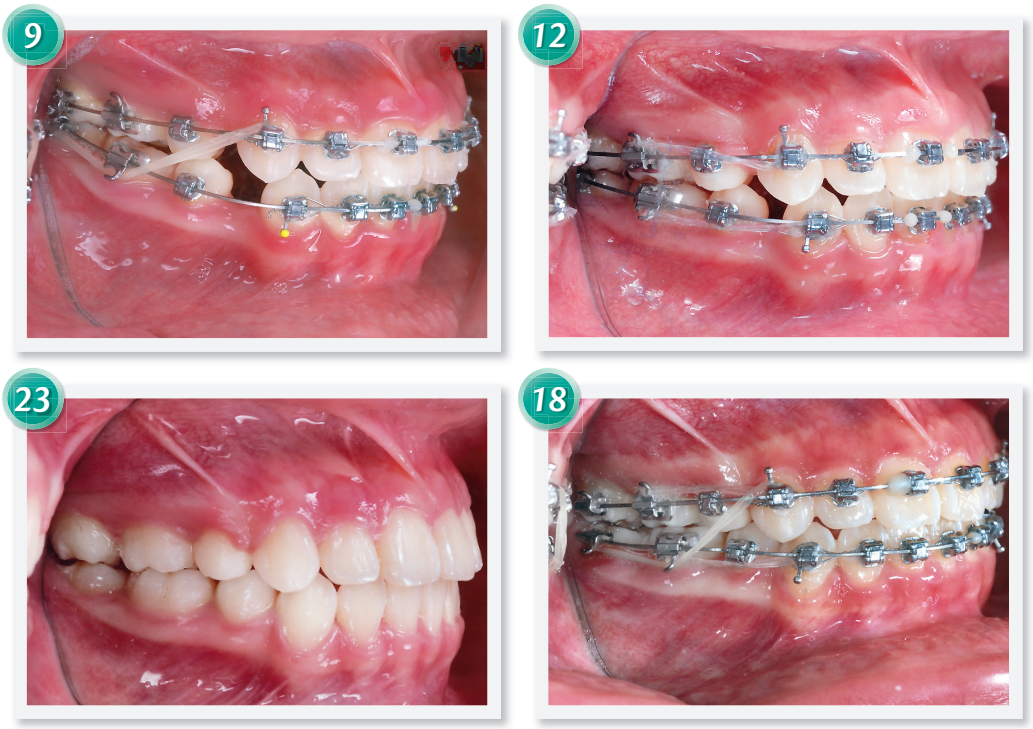


Fig 15: Power chains and L-type elastics were used for closing residual extraction spaces and detailing the occlusion.

of treatment, a new upper .014x.025" CuNiTi arch wire and lower .018" CuNiTi arch wire were placed.

In the 5th month, an upper .017x.025" TMA wire and lower .014x.025" CuNiTi wire were utilized. A figure-eight ligature was tied across the six upper anterior teeth to maintain space closure. The palatally exposed supernumerary tooth on the right side was extracted (*Fig. 14 and 16*). In the 8th month, bite turbos were added on the palatal side of the upper central incisors to hold the overbite, and the bite turbos on the lower first molars were removed. Class II elastics

Fig. 16: The tuberculate type of the supernumerary tooth.

Fig. 17:

Illustration for molding the lower lingual bite turbos with light-cured material that was filled in a detachable and rubbery silicone mold.

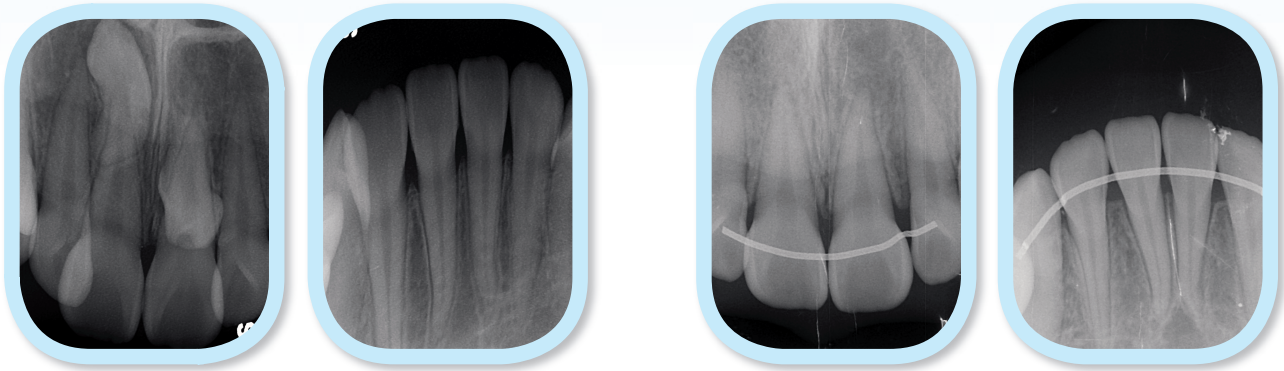


Fig. 18:

The pre-treatment and post-treatment periapical films revealed that no obvious root resorption was observed and the roots of the sentral lower incisors were too close.

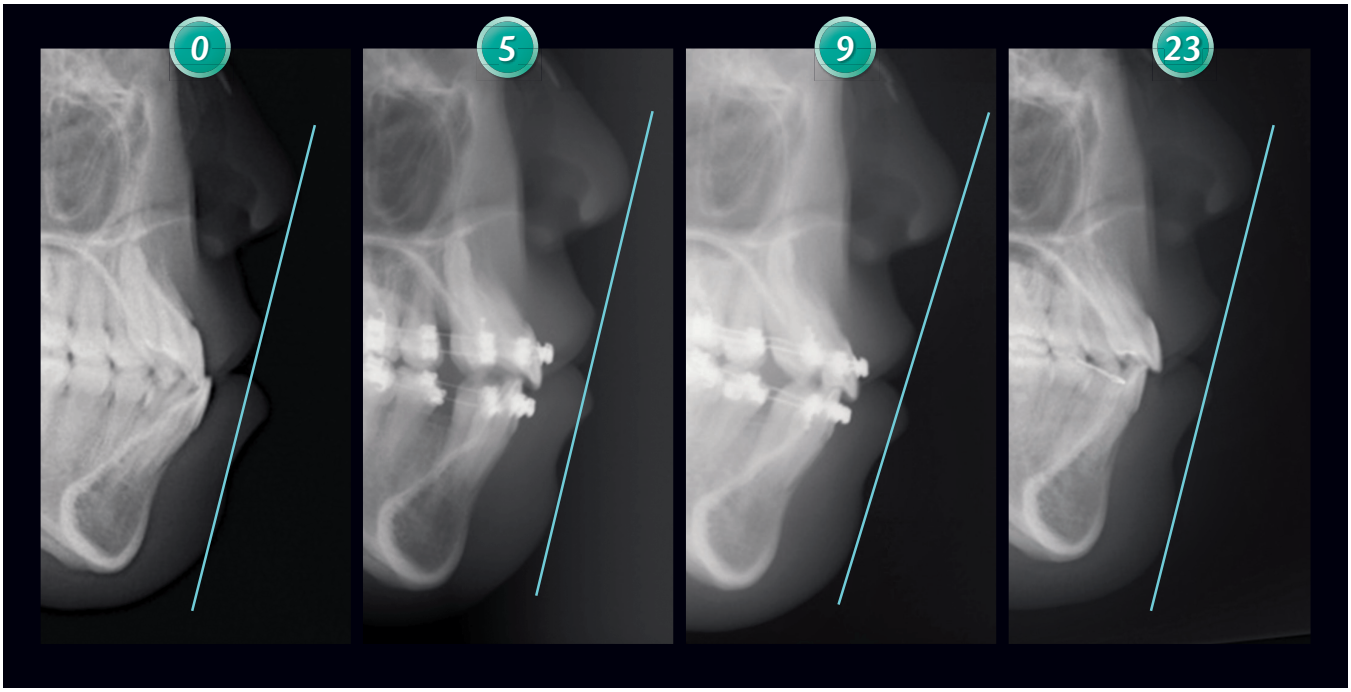


Fig. 19:

Progress cephalograms revealed that the profile and anterior crossbite had been rapidly improved in the initial five months with bite turbos bonded on the lingual side of lower central incisores. Finally, the lip prominence was finally acceptable with respect to the E-line.

(*Fox 1/4" 3.5oz*) and triangular elastics (*Fox 1/4" 3.5oz*) on teeth # 14, 19 and 20 were used to correct the lower lingual tipping. In the 10th month, the upper arch wire was changed to .019x.025" stainless steel and the lower arch wire was changed to .017x.025" TMA. Drop-in hooks were fitted on the lower canines for space-closure. A figure-eight ligature tie was applied to six lower anterior teeth to maintain space closure.

L-type elastics (*Fox 1/4", 3.5oz*) from the upper canines to the lower molars were used for class II correction and detailing of the occlusion (*Fig. 15*). In the 18th month, an off-set bend was incorporated for alignment of tooth # 30. In the 19th month, the other supernumerary tooth was extracted using palatal flap surgery. In the 20th month, the bracket on tooth #10 was repositioned to a normal position to reduce the excess buccal root torque, and the arch wire was reduced to a flexible .014x.025" CuNiTi wire. In the 23rd month, all fixed appliances were removed and retainers were delivered (*Fig. 18*).

Results Achieved

Maxilla (*all three planes*):

- A - P: Anterior
- Vertical: Inferior
- Transverse: Maintained

Mandible (*all three planes*):

- A - P: Anterior
- Vertical: Increased consistent with favorable growth
- Transverse: Maintained

Maxillary Dentition

- A - P: Slight labial tipping of the incisors and forward movement of the molars
- Vertical: Slightly extruded incisors
- Inter-molar / Inter-canine Width: Increased / maintained

Mandibular Dentition

- A - P: Retracted incisors, forward movement of the molars
- Vertical: Increased
- Inter-molar / Inter-canine Width: Increased / Increased Facial Esthetics:
- An orthognathic profile was achieved (*Fig. 19*)

Retention

A fixed retainer was bonded on all the maxillary incisors. In the mandibular arch, a fixed retainer was bonded from #29 to #20 in the mandibular arch (*Fig. 18*). An upper clear overlay was delivered. The patient was instructed to wear it full time for the first 6 months and nights only thereafter. The patient was instructed in proper home hygiene care and maintenance of the retainers.

Final Evaluation Of Treatment

The major discrepancies in the anterior teeth were corrected to normal overjet and overbite (*Fig. 19*). All premolar-extraction space was closed. The 2mm

upper dental midline was corrected to be coincident with the facial midline. The blocked out canines were well aligned, and the gingival texture was healthy. The ABO Cast-Radiograph Evaluation score was 24 points, as documented on the form appearing later in this report. The score is within the usual limit of 34 for an ABO case report. As demonstrated in Figures 20-23, the following deviations from ideal were noted:[1]

- The upper left incisors and two upper second molars exhibited distal-in rotation, but the lower right premolar exhibited mesial-in rotation
- Marginal ridge discrepancy existed only between teeth #13,14 (*Fig. 20*)
- Discrepancies in buccolingual inclination were evident in teeth # 2, 3, 14 and 29 (*Fig. 23*)
- Excessive buccal overjet was observed at the buccally tilted upper right second molar
- Occlusal contact was absent for the distobuccal cusp of the lower left first molar
- Occlusal relationships (*interdigitation*) were not ideal for the canines and premolars (*Fig. 21 and 22*)
- Root angulation was not parallel between lower first incisors (*Fig. 18*)

Cephalometric analysis and super-imposition of the start and finish tracings (*Fig. 11*) revealed retraction of the lower incisors and flaring of

Fig. 20: The marginal ridge discrepancy between # 13,14.

Fig. 21: The occlusal relationship at #6 deviated over 2mm.

Fig. 22: The occlusal relationship at #11 deviated over 2mm.

the upper incisors. All the molars were moved mesially and the mandibular occlusal plane had a slight clockwise rotation. The upper incisors to SN increased from 107° to 110° and the lower incisors to the mandibular plane angle decreased from 97° to 91°. The mandible showed a substantial increase in length and both the lower molars and incisors were extruded.

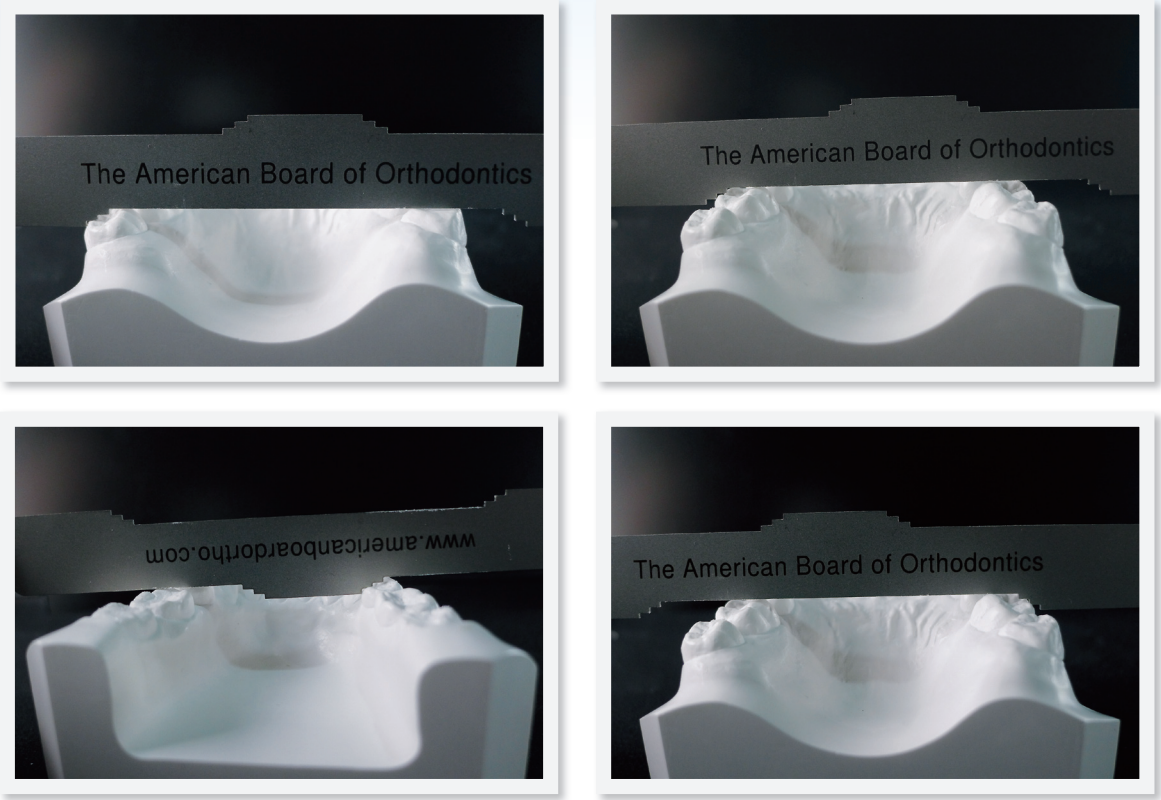


Fig.23: The buccolingual inclinations in posterior teeth # 2, 3, 14 and 29.

Discussion

The major problems for the patient were the anterior crossbite and the crowding. The Discrepancy Index Score was 37.[2-3] To correct the anterior crossbite, there are six approaches suggested by Dr. Chang:[4]

1. Inclined plane: labial tipping of a single retroclined and unrotated tooth; treatment time is limited to 2 months to avoid excessive eruption of the posterior teeth in the early mixed dentition.

2. "*2x4*" appliance with bite turbos: correct multiple teeth in crossbite and/or rotated teeth with long span open coil springs and lower anterior lingual bite turbos.

3. "*2x4*" appliance with bite turbos followed by a full fixed appliance: correct anterior crossbite in the mixed dentition then treat permanent dental problems with a full fixed appliance.

4. Full treatment with Damon appliances, bite turbos, and early light short elastics (*ELSE*): Correct anterior crossbite with Damon passive ligature system, bite turbos and early light short elastics in the permanent dentition.

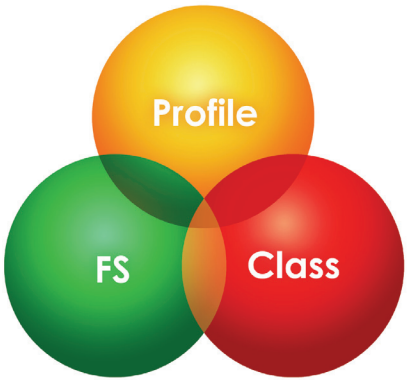
5. Full treatment (*Damon appliances, bite turbos, ELSE*) with bone screws: Correct severe anterior crossbite in permanent dentition with the Damon passive ligature system, bite turbos, ELSE, and bone screws. Bone screws can provide excellent anchorages for full arch movement, which significantly reduces the need for orthognathic surgery.

6. Orthognathic surgery

For the present patient's anterior crossbite, associated with a severely crowded dentition and a bilateral class I molar relationship, is best managed with the 4th approach (*full treatment*) combined with extraction of all 1st premolars. At the beginning, light force generated by a small diameter CuNiTi wire in the tube-like brackets guided the crowded teeth to the aligned positions.[5] Open coil springs used to create space is not indicated unless the teeth are too crowded to bond brackets. Bonding lingual bite turbos, instead of using an inclined plane to unlock interdigitation, allowed the malocclusion greater freedom of movement. To correct the protruded profile, all first premolars in all four quadrants were extracted to relieve the severe crowding. According to Dr. Chang's decision-making tree, there were 3 indications for extraction: protruded profile, high mandibular plane angle and severe crowding (*Table. 2*).[6] 2 oz. class II short elastics from the lower molars to the upper canines were used early, beginning immediately after the anterior crossbite was corrected. They allowed slight A-P correction and promoted development of the smile arc without affecting arch leveling.[7] By using this system, the teeth were aligned into ideal positions gently, and the extraction spaces were closed rapidly (*Figs. 14 and 15*).

According to Lin's study,[8] anterior crossbite is a common malocclusion in Chinese children. The prevalence of pseudo class III malocclusion from age 9 to 15 years is 2.31%.[8] Orthodontic treatment of anterior crossbite may be complicated by unpredictable growth. Differential diagnosis is very important for the timing of anterior crossbite treatment. Lin's Three Rings Diagnosis system is an accurate method for diagnosing over 90% of anterior crossbite patients (*Fig. 24*).[9] Complicated diagnostic procedures are simplified into 3 items: Profile, Class, and Functional Shift. The patient presented with a

Diagnosis: the Three Rings Diagnosis



Profile : profile at centric relation, orthognathic or prognathic

Class : classification of canine and molar

FS : functional shift, Yes (CO≠CR), or No (CO=CR)

Fig. 24:

The anterior crossbite diagnosis system developed by Dr. Lin simplified the complicated diagnostic procedure.

	Ext.	Not
1. Profile	Protrusion	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: The decison-making tree summarized by Dr. Chang aids in the decisions on extraction vs. non-exraction treatment plans.

orthognathic profile and the permanent first molars were in a Class I relationship bilaterally. Despite the girl's active pubertal development, this was a pseudo Class III malocclusion with a good prognosis for correcting the anterior crossbite and dental crowding.

Supernumerary teeth can have the following effects on permanent teeth: interfere with the eruption, cause ectopic eruption, contribute to crowding, cause root resorption, be manifest as pulp damage and/or undergo cystic degeneration.[10-11]

The most frequent site of occurrence is near the midline or in the terminal molar area. A panoramic radiograph is useful for imaging most supernumerary teeth, but for this patient, a periapical radiograph of maxillary anterior region provided a clearer image in 2-D (*Figs. 8 and 18*). The most important considerations are when and how to remove the supernumerary teeth.[12] Since the supernumerary teeth closely approximated the crowded teeth, their removal was delayed until the anterior segment was aligned. As the crowding was gradually relieved, one of the supernumerary teeth erupted into the palate, allowing for a simple extraction. Unfortunately, the other inverted supernumerary tooth required palatal flap surgery for removal.

When blocked out palatally maxillary lateral incisors are corrected with light round wires, they are usually excessively tipped to the labial, and require a great deal of labial root torque. Bonding pretorqued brackets upside down reverses the torque from +6° to -6° which improves the inclination of the lateral incisors as they are aligned. Wire-bending and torquing springs can also be used to correct lateral incisor torque, but bonding the brackets upside down is more efficient. However, it is important to carefully monitor the alignment of the lateral incisors to avoid over-torquing them.

Conclusion

Anterior crowding and crossbite, in the presence of a bilateral class I molar relationship, were corrected rapidly with efficient mechanics. An unattractive dentition was dramatically reversed to a delightful smile in only a few months, but the growth of this young female was still somewhat unpredictable. For pseudo Class III or mild True Class III patients, there is a good prognosis. However, it is advisable to tell the patients that despite a high success rate of over 90%, there is no guarantee of 100% success.[9]

Acknowledgement

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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 = 14

OVERBITE

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

Total = 2

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. additional	_____ pts.

Total = 0

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB ≥ 6° or ≤ -2° = 4 pts.

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

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

SN-MP

≥ 38° = 2 pts.

Each degree > 38° 5 x 2 pts. = 10

≤ 26° = 1 pt.

Each degree < 26° _____ x 1 pt. = _____

1 to MP ≥ 99° = (1 pt.)

Each degree > 99° _____ x 1 pt. = _____

Total = 12

OTHER (See Instructions)

Supernumerary teeth	2 x 1 pt. =	2
Ankylosis of perm. teeth	_____ x 2 pts. =	_____
Anomalous morphology	_____ x 2 pts. =	_____
Impaction (except 3rd molars)	_____ x 2 pts. =	_____
Midline discrepancy (≥3mm)	@ 2 pts. =	_____
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. =	_____
Addl. treatment complexities	_____ x 2 pts. =	_____

Identify:

Total = 2

IMPLANT SITE

Lip line : Low (0 pt), Medium (1 pt), High (2 pts) = _____

Gingival biotype : Low-scalloped, thick (0 pt), Medium-scalloped, medium-thick (1 pt), High-scalloped, thin (2 pts) = _____

Shape of tooth crowns : Rectangular (0 pt), Triangular (2 pts) = _____

Bone level at adjacent teeth : ≤ 5 mm to contact point (0 pt), 5.5 to 6.5 mm to contact point (1 pt), ≥ 7mm to contact point (2 pts) = _____

Bone anatomy of alveolar crest : H&V sufficient (0 pt), Deficient H, allow simultaneous augment (1 pt), Deficient H, require prior grafting (2 pts), Deficient V or Both H&V (3 pts) = _____

Soft tissue anatomy : Intact (0 pt), Defective (2 pts) = _____

Infection at implant site : None (0 pt), Chronic (1 pt), Acute(2 pts) = _____

Total = 0

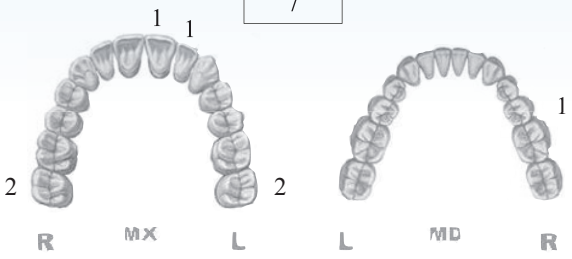
Cast-Radiograph Evaluation

Case # **Patient**

Total Score: 24

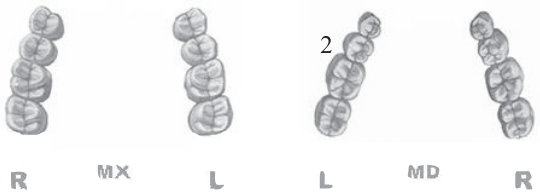
Alignment/Rotations

7



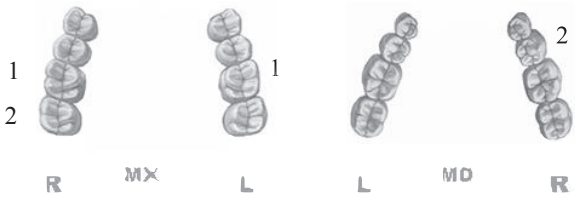
Marginal Ridges

2



Buccolingual Inclination

5

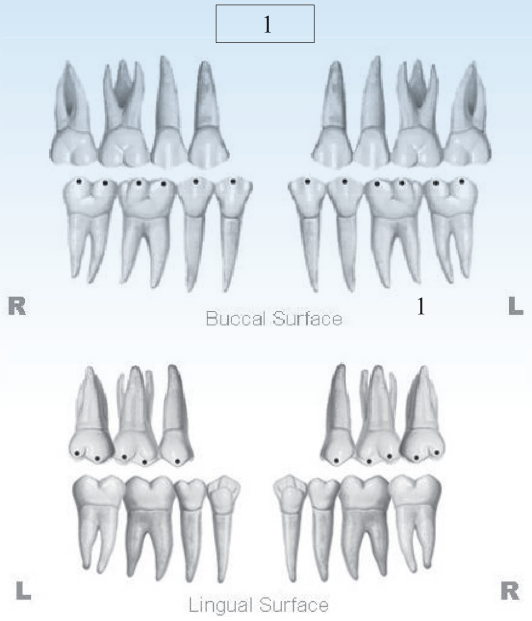


Overjet

1

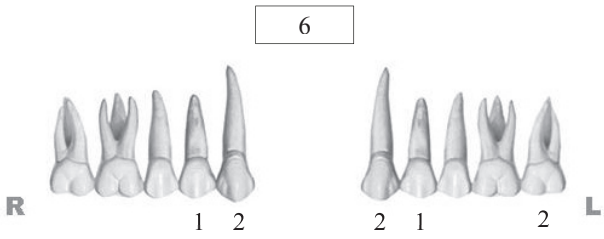
Occlusal Contacts

1



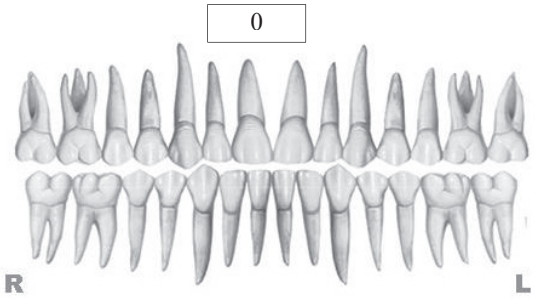
Occlusal Relationships

6



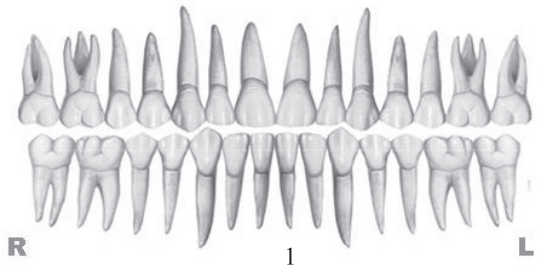
Interproximal Contacts

0



Root Angulation

1



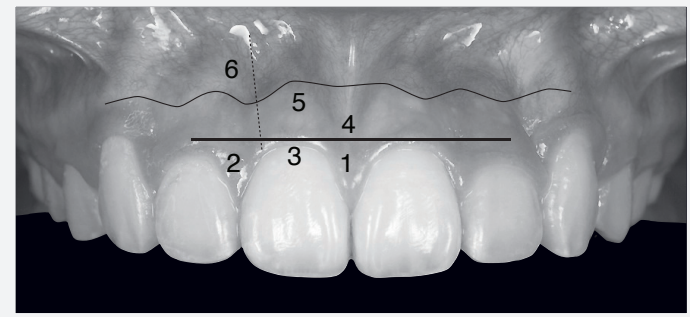
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 6

Pink Esthetic Score

Total = 2

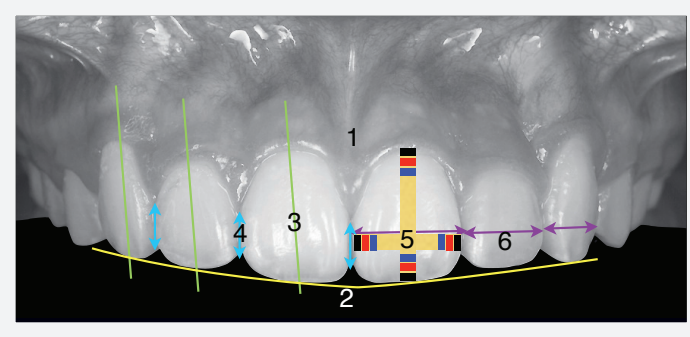


Mesial Papilla	0	1	2
Distal Papilla	0	1	2
Curvature of Gingival Margin	0	1	2
Level of Gingival Margin	0	1	2
Root Convexity (Torque)	0	1	2
Scar Formation	0	1	2

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

White Esthetic Score (for Micro-esthetics)

Total = 4



Midline	0	1	2
Incisor Curve	0	1	2
Axial Inclination (5˚, 8˚,10˚)	0	1	2
Contact Area (50%, 40%, 30%)	0	1	2
Tooth Proportion (1:0.8)	0	1	2
Tooth to Tooth Proportion	0	1	2

Midline	(0)	1	2
Incisor Curve	0	(1)	2
Axial Inclination (5˚, 8˚,10˚)	0	(1)	2
Contact Area (50%, 40%, 30%)	(0)	1	2
Tooth Proportion (1:0.8)	0	(1)	2
Tooth to Tooth Proportion	0	(1)	2