

# Early Treatment of Anterior Crossbite Combined with Bilateral Maxillary Labially Impacted Canines

## History and Etiology

A 10-year 10-month girl (Fig. 1) was referred by her pedodontist for orthodontic evaluation because of multiple problems of frontal teeth: retained deciduous incisors, anterior crossbite, and ectopic eruption of lateral incisors (Fig. 2). No contributing medical problems were reported. There was no history of dental trauma, oral habits, or temporomandibular dysfunction. Oral hygiene was acceptable. Clinical examination revealed a mild facial asymmetry with the mandible deviated to the left (Fig. 1), Class I buccal segments (Fig. 3), a missing mandibular right 2<sup>nd</sup> molar with retained roots, and caries in both left 2<sup>nd</sup> deciduous molars. As shown in Figs. 4-6 the malocclusion was corrected to a near ideal result. The pretreatment and posttreatment cephalometric and panoramic radiographs are presented in Figs. 7-8. The panoramic radiograph (Fig. 7) revealed that the crowns of both maxillary canines overlap the adjacent lateral incisors, indicating they will be impacted. A conebeam computed tomography (CBCT) image confirmed the abnormal labial position of both maxillary canines (Fig. 9), and superimpositions of cephalometric tracings document the treatment relative to a challenging growth pattern (Fig. 10). The cephalometric measurements are presented in Table 1.



■ Fig. 1: Pre-treatment facial photographs



■ Fig. 2: Pre-treatment intraoral photographs



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

**Dr. Wei Lun Peng,**

Lecturer, Beethoven Orthodontic Course (Left)

**Dr. Chris Chang,**

Founder, Beethoven Orthodontic Center

Publisher, International Journal of Orthodontics & Implantology (Center)

**Dr. W. Eugene Roberts,**

Editor-in-chief, International Journal of Orthodontics & Implantology (Right)



■ Fig. 4: Post-treatment facial photographs



■ Fig. 5: Post-treatment intraoral photographs



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

## Diagnosis

### Skeletal:

- Skeletal Class I (SNA 80°, SNB 79°, ANB 1°)

### Dental:

- Bilateral Class I molar relationship
- Anterior cross bite of the maxillary left central and both lateral incisors (#7, 9, 10)
- Retained deciduous teeth: *Both maxillary lateral incisors* (#7d, 10d)
- Residual roots: *Mandibular right 2<sup>nd</sup> deciduous molar* (#20d)

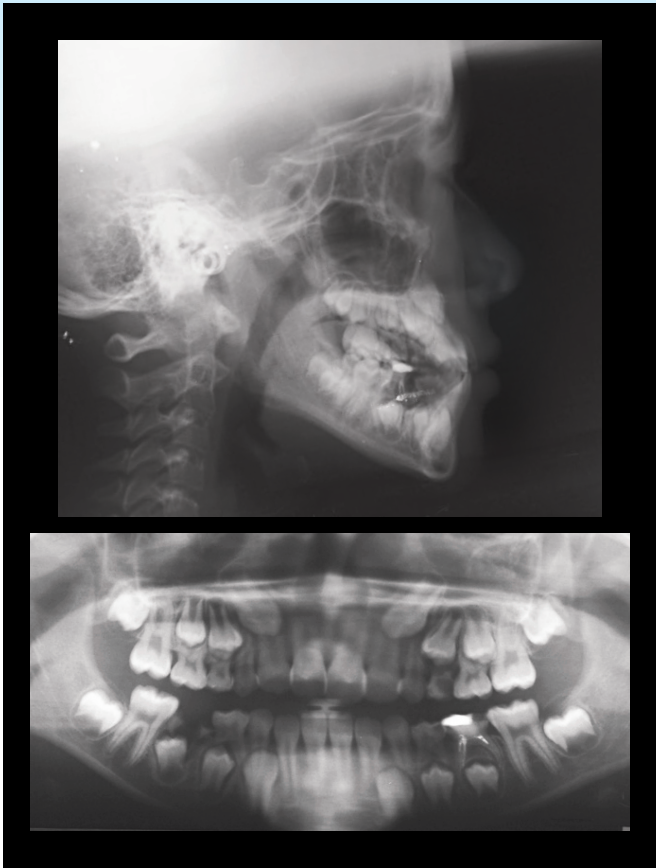
### Facial:

- Slight facial asymmetry with the mandible deviated to the left
- Straight profile and lip protrusion were within normal limits (WNL)
- Vertical proportion was WNL

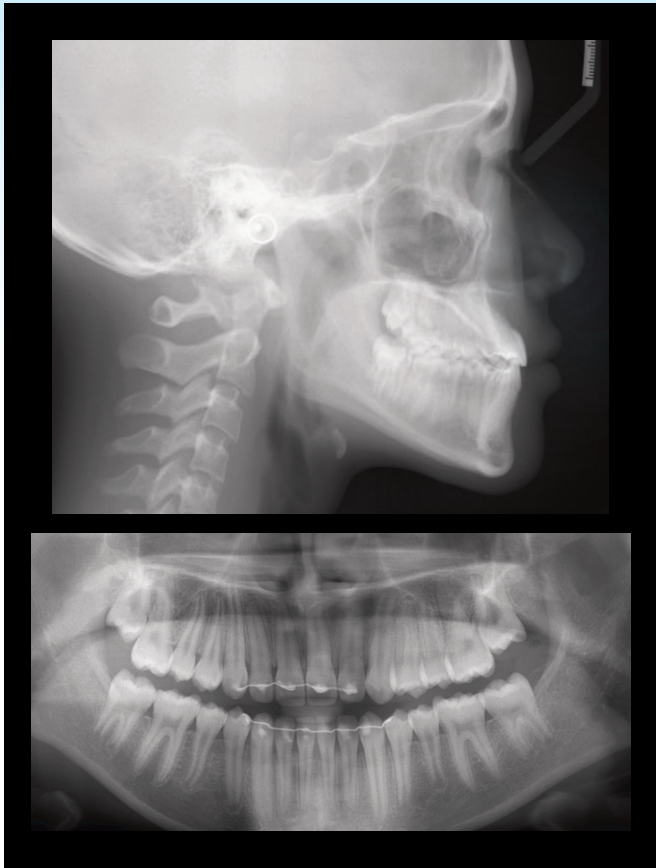
## Specific Objectives Of Treatment

### Maxilla (all three planes):

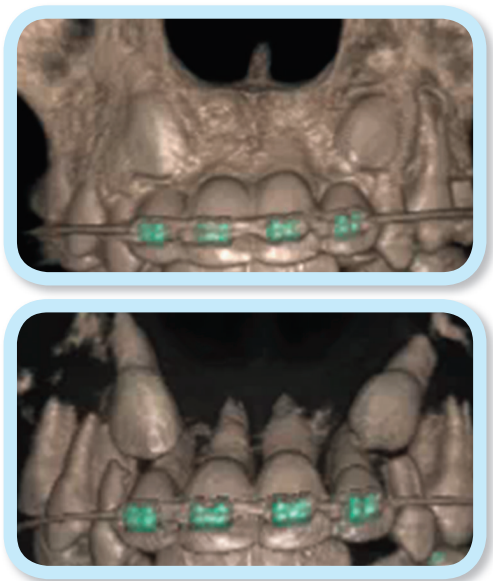
- A - P: *Anterior*
- Vertical: *Maintain*
- Transverse: *Maintain*



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



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

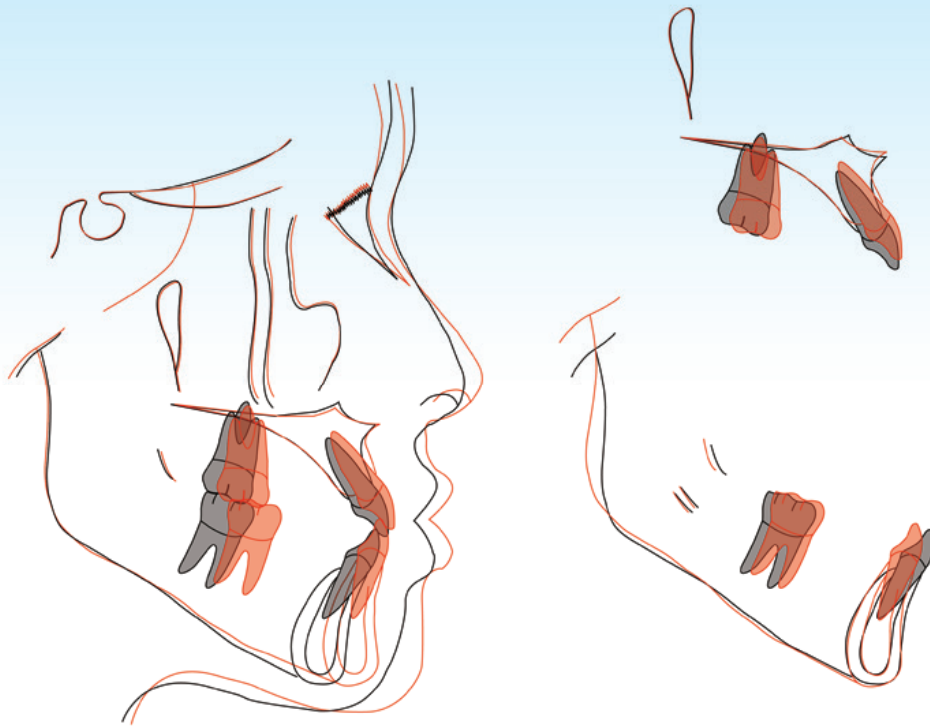


■ Fig. 9:  
The 3-D image showed the crowns of the labially impacted canines positioned mesially across the roots of the adjacent lateral incisors.

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	80°	80°	0°
SNB°	79°	83°	4°
ANB°	1°	-3°	4°
SN-MP°	39°	38°	1°
FMA°	30.5°	29.5°	1°
DENTAL ANALYSIS			
U1 TO NA mm	5 mm	6 mm	1 mm
U1 TO SN°	103°	105°	2°
L1 TO NB mm	3.5 mm	2.5 mm	1 mm
L1 TO MP°	88.5°	76°	12.5°
FACIAL ANALYSIS			
E-LINE UL	0 mm	-1 mm	1 mm
E-LINE LL	2.5 mm	0.5 mm	2 mm

■ Table 1: Cephalometric summary





■ Fig. 10: Superimposed tracings.

Class I molar relationship was retained, and the straight profile was maintained. The ramus and the body of the mandible kept growing and moving forward throughout the treatment. The labially tipped crown of lower incisors were uprighted because anterior cross bite was corrected. But  $ANB^\circ$  was changed from  $1^\circ$  to  $-3^\circ$ , a tendency of skeletal class III was suspected and should be kept in follow up for its skeletal development.

#### 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: Anterior to correct anterior crossbite
- Vertical: Maintain
- Transverse: Maintain

#### Mandibular Dentition:

- A - P: Retract incisors as needed to correct anterior crossbite
- Vertical: Maintain
- Transverse: Maintain

#### Facial Esthetics:

- Maintain a straight profile and vertical proportion consistent with expression of normal growth

#### Treatment Plan

Non-extraction treatment in two phases was indicated because of the mild crowding, anterior crossbite and probable maxillary canine impactions. Mixed dentition treatment begins with a maxillary two-by-four fixed appliance and a lower lingual arch. Bite turbos will be applied to the lower dentition to facilitate the space management and correction of the anterior crossbite. After alignment of the maxillary incisors and correction of the anterior crossbite, a CBCT demonstrated that the maxillary



canines were labially impacted. Following eruption of the permanent premolars, phase II treatment with a full fixed appliance was indicated. Open coil springs were inserted between the first premolars and incisors to provide sufficient space for the maxillary canines. If the canines failed to erupt spontaneously, surgical intervention is indicated to expose the crowns and bond attachments for traction. After finishing the treatment, fixed anterior retainers were planned for both the upper and lower arches, with a clear retainer overlay for the upper arch.

### Appliances and Treatment Progress

A lower lingual arch were placed to maintain space, and prevent mesial drifting of mandibular first molars. A maxillary two-by-four appliance (*standard .022" twin brackets*), with bite turbos on the mandibular lateral incisors, was used to correct the anterior crossbite. Five months later, the crossbite was corrected and the lower right 2<sup>nd</sup> premolar had erupted (Fig. 11). Once positive overjet was achieved, the bite turbos were removed. The lingual arch and maxillary brackets were removed in the 14<sup>th</sup> month

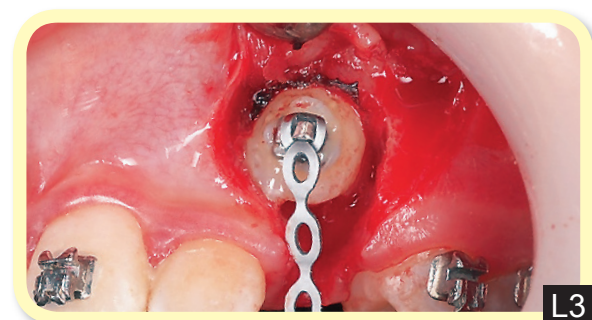
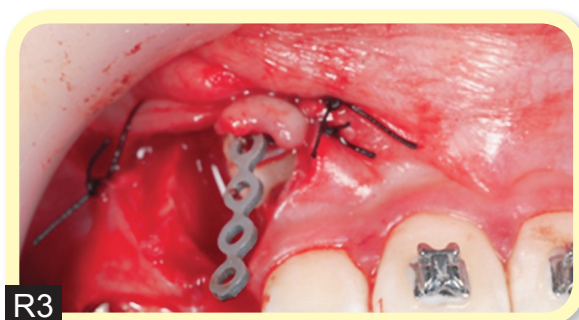
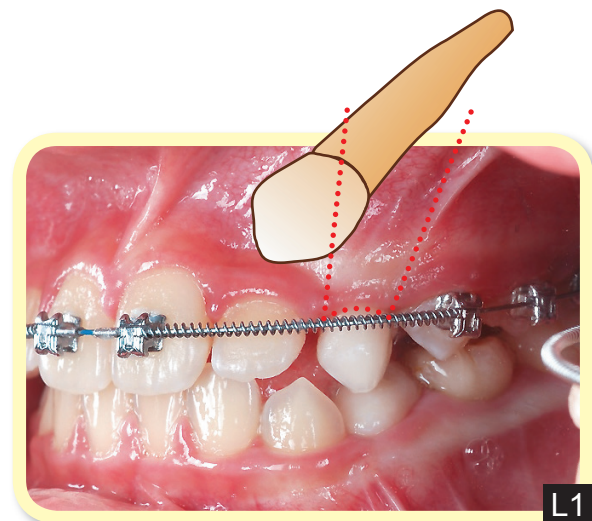
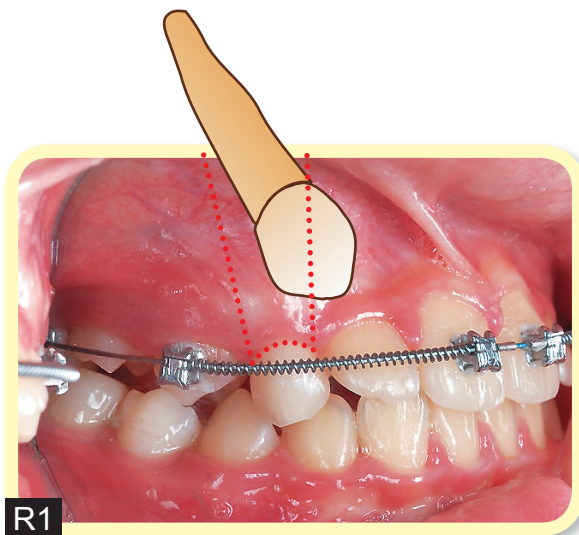


■ Fig. 11:

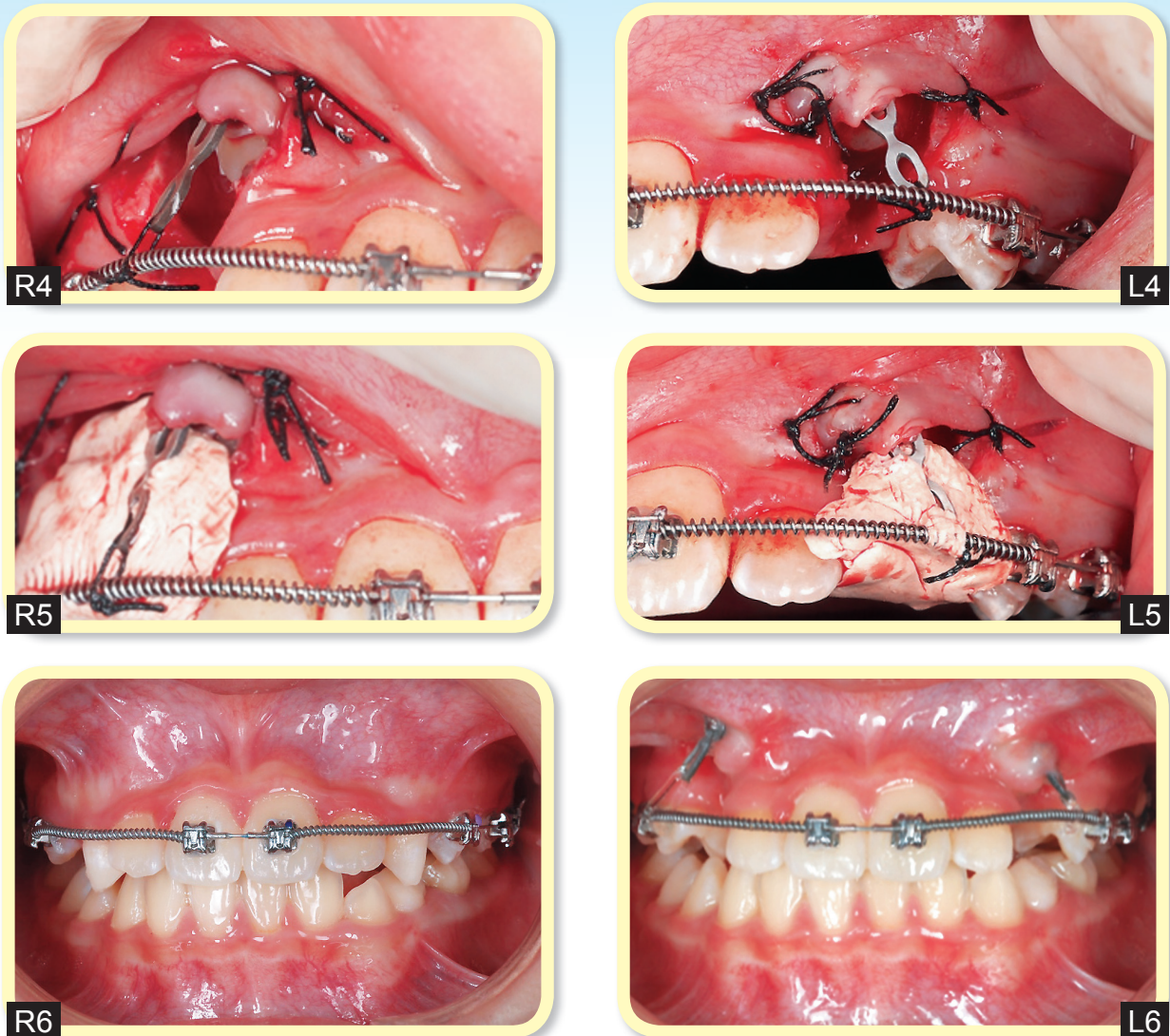
*Intraoral Radiograph - frontal and occlusal view of the initial visit, 1<sup>st</sup>, 5<sup>th</sup> month of the treatment. A 2×4 appliance was placed in the upper arch initially and a lingual arch was fabricated for the lower dentition, combined with bite turbos on the lower incisors. In 5 months, the anterior cross bite was correct and #29 erupted into the oral cavity.*

of the treatment. In the 16<sup>th</sup> month, .022" Damon 3 MX<sup>®</sup> brackets (Ormco) were bonded on the upper central incisors and 1<sup>st</sup> premolars (Fig. 12). A .014" CuNiTi arch wire was inserted and open coil springs were placed to create enough space for maxillary canines. The three-dimensional CBCT image (Fig. 9) indicated that the maxillary canine crowns were positioned labially and mesially, overlapping the roots of the adjacent lateral incisors. A bilateral

apically positioned flap (APF) was performed (Fig. 12) to expose the labial surface of the impacted cuspids. Eyelet tubes were bonded on the exposed labial surfaces and power chains were attached from the tubes to the arch-wire to extrude the impacted cuspids into the oral cavity. No brackets were placed on the lateral incisors to allow them the freedom to move out of the path of the extruding canines. This "free body" approach helps to protect adjacent







**Fig. 12:** Surgical procedures

- L1, R1: The 3-D radiograph indicated the precise location of the impacted cuspids, both of which were positioned apically to the mucogingival junction. A direct incision line outside of the crown for exposure may result in loss of keratinized gingiva after extruding them into the oral cavity. Therefore, a bilateral apically positioned flap was indicated.
- L2, R2: Bone reduction was made to uncover the labial surface of the crowns.
- L3, R3: Placing eyelet tubes on each side.
- L4, R4: Tied with power chains to the archwire.
- L5, R5: Finally, sutured and covered with Coe-Pak® to facilitate wound healing.
- L6, R6: 1 month later, keratinized soft tissue formed surrounding the crowns.

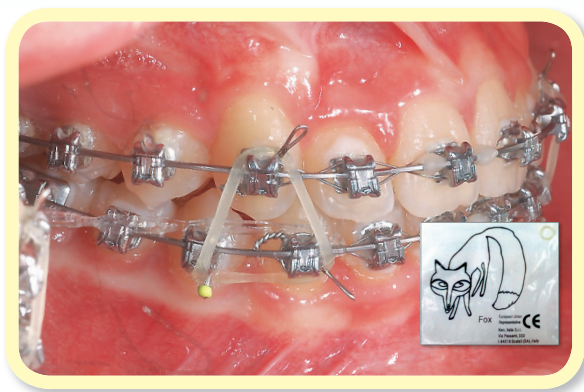
teeth as the impaction is moved into the arch. One month postoperatively (17<sup>th</sup> month of treatment), the surgical area was healed and keratinized gingival tissue surrounded the crown of both cuspids. The impacted cuspids continued moving backward and downward during the following 6 months.

In the 22<sup>nd</sup> month of the treatment, both canines were almost fully erupted, so they were bonded with Damon 3 MX® brackets. In the 25<sup>th</sup> month, .022" Damon 3 MX® brackets were placed on the lower dentition. Both arches were leveled and aligned with .014" CuNiTi wires, followed by .014x.025" NiTi wires.



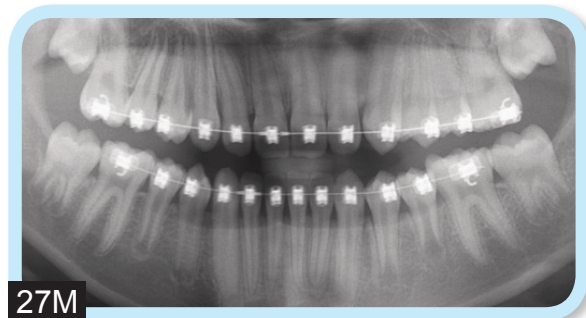
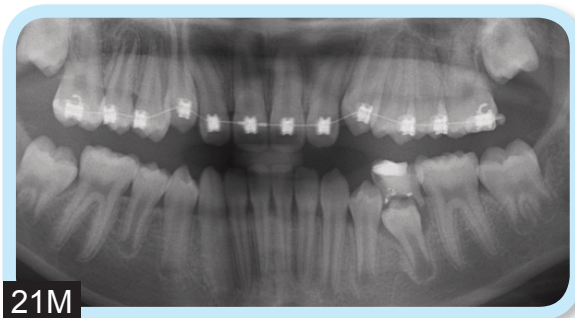
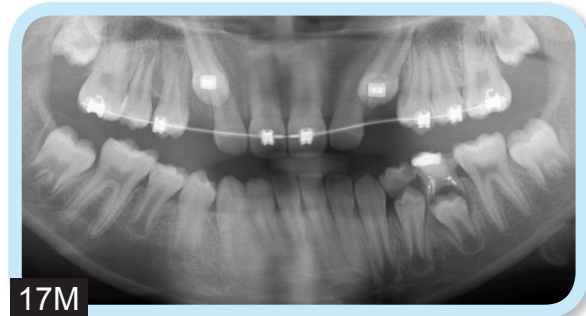
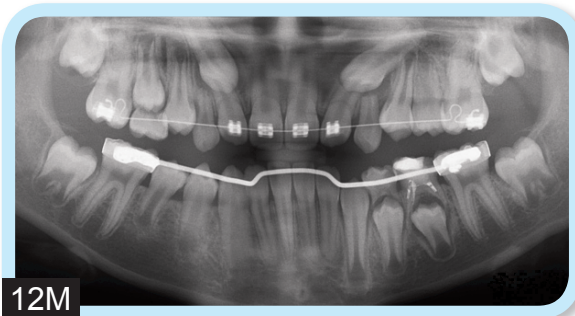
At the 30<sup>th</sup> month of treatment, a .017x.025" low friction TMA wire was placed in the upper arch. This wire was adjusted to reduce the torque for the flared lateral incisors. In the 31<sup>st</sup> month of the treatment, the maxillary canines were not in occlusion, so bilateral triangular elastics were used to improve and settle the occlusion (Fig. 13). The route of traction for

recovering the maxillary incisors is shown in Fig. 14. The fixed appliances were removed in the 36<sup>th</sup> month of treatment. Fixed anterior retainers were bonded from the maxillary right 1<sup>st</sup> premolar to the left lateral incisor (UR-UL2), and between the 1<sup>st</sup> premolars in the mandibular arch (LR4-LL4). A clear, overlay retainer was delivered for the upper arch.



■ Fig. 13:

31<sup>st</sup> month of treatment. A bilateral triangular elastic (Fox 1/4" 3.5oz,Ormco) was used to improve intermaxillary occlusal contact of canines and premolars.



■ Fig. 14:

Four panoramic radiographs indicated the traction route of two impacted cuspids. The traction route was outward, backward, and downward. Consequentially, these two cuspids could eventually erupt into the oral cavity, and were later leveled and aligned.

### Final Evaluation of Treatment

The Cast-Radiograph Evaluation score was 22 points, which was deemed adequate to qualify as a board case report. The major discrepancies were in marginal ridge discrepancies, axial inclination problems, and excessive overjet. The flared upper lateral incisors, which were protracted to correct the anterior crossbite, could have been improved by torquing springs or by bonding brackets upside down. In addition, the brackets on the lower 2<sup>nd</sup> premolars could have been positioned more gingivally to eliminate marginal ridge discrepancies with the adjacent molars, and also improve intermaxillary occlusal contacts.

As documented by the superimposed tracings, the patient's straight profile was maintained. However, the mandible grew anteriorly during treatment, and continued to grow anteriorly for 2 years after treatment (Fig. 15). This tendency toward a skeletal Class III malocclusion will be carefully monitored.

Despite developing into a compensated Class III occlusion after treatment, the smile arc was acceptable (Fig. 15), but there was a noticeable decrease in maxillary anterior tooth display. The gingival display of the maxillary anterior region improved without any further treatment (Fig. 16). The casts demonstrate that the occlusion remained Class I on a Class III skeletal base. Fig. 18 is a schematic drawing of the recently developed VISTA technique, which would have been a good option for the present patient. Fig. 19 is a profile comparison before treatment, after fixed appliances were removed, and

at two-year follow-up. Despite a strong anterior (Class III) growth pattern, facial esthetics are acceptable.



■ Fig. 15: 2-year post-treatment facial photographs

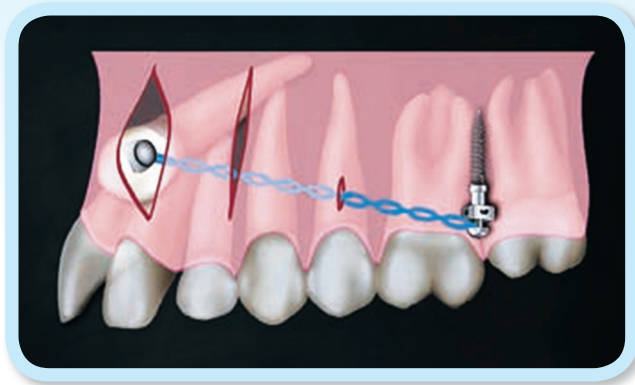


■ Fig. 16: 2-year post-treatment intraoral photographs



■ Fig. 17: 2-year post-treatment study models





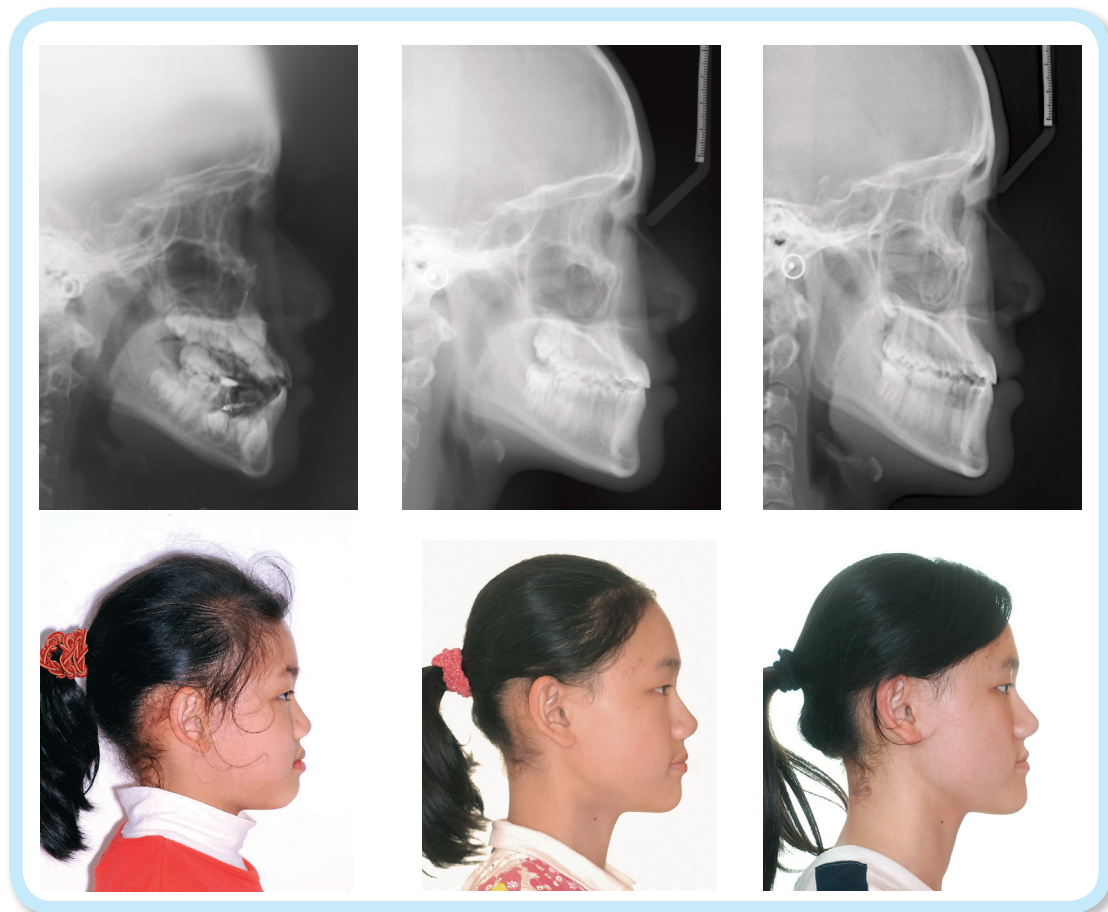
■ Fig. 18:

Vertical Incision Subperiosteal Tunnel Access (VISTA), a minimally invasive technique, combined with bone screws, is also indicated in labially impacted cuspids.

	E	APF	CE
B-L position (if surrounding bone wrapped the surface of crown)	×	×	○
Crown apical to MGJ	×	○	○
The mount of attached gingiva < 2-3mm	×	○	×
M-D position (if the crown's position overlapped with the root of lateral incisor)	×	○	×

E: excisional uncovering; APF: apically positioned flap; CE: closed eruption technique; MGJ: mucogingival junction

■ Table 2: Surgical considerations for labially impacted cuspids



■ Fig. 19:

Comparison of pre-treatment, post-treatment, and 2-year post-treatment cephalometric and lateral facial photographs. Straight profile was maintained, but the continuous mandibular development which might result in Class III molar relationship may require future treatment intervention.



## Discussion

### Anterior Crossbite

Anterior crossbite is defined as a lingual maxillary incisor and/or canine position relation to the mandibular arch.<sup>1</sup> Traumatic occlusion, associated with a crossbite, may result in dehiscence, gingival recession, and labial attrition of maxillary incisor. Early treatment to correct this malocclusion is indicated to facilitate the eruption of the canines and premolars into a Class I relationship, as well as to eliminate traumatic occlusion to the incisors, and improve expression of a normal growth pattern.

Before correcting anterior crossbite, it is important to analyze the following data:<sup>2</sup>

- cephalometric/skeletal analysis
- patient's profile
- the dental relationship of molars and cuspids
- dental arch width and length
- extent of the anterior crossbite
- stage of tooth eruption
- axial inclination and rotation of anterior teeth

There are several treatment options for correcting an anterior crossbite:<sup>2,3</sup>

1. tongue blade therapy
2. reverse orientation a stainless steel crown
3. fixed or removable mandibular inclined plane made of acrylic
4. two-by-four appliance
5. full mouth fixed appliance, etc

The first three types of treatment are most appropriate for single tooth anterior crossbites in the mixed dentition.<sup>2</sup> In the present case, there are three

upper incisors involved in the anterior crossbite. Moreover, the suspected impacted maxillary canines and the mild crowding must also be taken into consideration. Therefore, mixed dentition treatment with a two-by-four appliance, combined with anterior bite turbos, was the optimal approach, selected for the present patient.

### Labially impacted canine

The etiology of impacted canine is often attributed to abnormal position of tooth buds, associated with an arch length and/or width deficiency. The three methods for diagnosing impacted canines are inspection, palpation, and radiography. Inspection and intraoral palpation of the canine bulge are useful for determining the general location of the impacted canine.<sup>4</sup> However, three-dimensional CBCT images are the standard of care for providing the most accurate information about the location of the impaction relative to its adjacent teeth.

### Treatment modalities of labially impacted canine

For impacted canines, non-extraction treatment is indicated unless there are other complications, such as severe crowding, ankylosis, uncontrolled infection, internal or external root resorption, severe root dilacerations, and/or pathology that may compromise adjacent teeth during or after orthodontic treatment.<sup>5</sup>

### Non-surgical approach:

According to the Williams<sup>6</sup> study in 1981, selective removal of deciduous cuspids is a suggested interceptive measure in Class I uncrowded malocclusions. Olive<sup>7</sup> concluded that creating space for the impacted canine with fixed appliances, and waiting for spontaneous eruption, is an effective option.

### Surgical approach:

Many impacted canines cannot be treated with non-surgical methods. If impacted canines do not erupt after a year of treatment, then surgical intervention is indicated. Kokich<sup>8</sup> summarized three techniques for treating labially impacted maxillary canines, including excisional uncovering, apical positioned flap, and the closed eruption technique. Their indications and contraindications are shown in Table 2. In the present case, both impacted canines were tilted mesially and positioned across the middle of the root of the adjacent lateral incisors. In addition, there was no bone covering the crowns. Therefore, an apical positioned flap was chosen to uncover two impacted cuspids to allow for traction.

For less scar formation, particularly in the esthetic zone, the Vertical Incision Subperiosteal Tunnel Access (VISTA) technique (*Fig. 18*), provides a minimally invasive alternative for the surgical treatment of labial impactions.<sup>9,10</sup>

### Conclusion

Anterior cross bite and impacted cuspids are commonly found in young children in Taiwan. Both of which can be detected at the age of 8. The earlier the signs and symptoms are noted and treated, the less complication will occur later.

There are several effective treatment options for anterior crossbite. When the problem involves multiple teeth and other complications, such as crowding or impaction, a two-by-four appliance is usually recommended.

The three steps for effectively managing impacted canines include (1) use of three dimensional

radiographic imaging, (2) a proper design for surgical intervention, and (3) precise mechanics of force system design.

### Acknowledgements

Special thanks to Dr. Yu Lin Hsu and Ms. Tzu Han Huang for proofreading this article.

### References

1. Mok CW, Wong RW. Self correction of anterior crossbite: a case report. *Cases J* 2009;2:67-69.
2. Chachra S, Chaudhry P. Comparison of Two Approaches For The Treatment of Anterior Cross Bite. *Indian J Dent Sciences* 2010;6:33-35.
3. Jirgensone I, Liepa A, Abeltins A. Anterior crossbite correction in primary and mixed dentition with removable inclined plane (Bruckl appliance). *Stomatogija Baltic Dent Maxillofacial J* 2008;10:140-144.
4. Richardson G, Russell KA. A Review of Impacted Permanent Maxillary Cuspids-Diagnosis and Prevention. *J Can Dent Assoc* 2000;66:497-501.
5. Tseng SP, Chang CH, Roberts WE. High Maxillary Canine Impaction with Mesial and Labial Displacement-ABO Case Report. *News & Trends in Orthodontics* 2009;18:36-44.
6. Williams B. Diagnosis and prevention of maxillary cuspid impaction. *Angle Orthod* 1981;51:30-40.
7. Leite HR, Oliveira GS, Brito HH. Labially displaced ectopically erupting maxillary permanent canine: interceptive treatment and long-term results. *Am J Orthod Dentofacial Orthop* 2005;128:241-251.
8. Kokich VG. Surgical and orthodontic management of impacted maxillary canine. *Am J Orthod Dentofacial Orthop* 2004;126:278-283.
9. Su B, Hsu YL, Chang CH, Roberts WE. Soft Tissue Considerations for The management of Impactions. *Int J Orthod Implantol* 2011;24:50-59.
10. Hsu YL, Chang CH, Roberts WE. A closed eruption technique Modified from Vertical Incision Subperiosteal Tunnel Access VISTA. *Int J Orthod Implantol* 2011;24:60-67.



## Discrepancy Index Worksheet

TOTAL D.I. SCORE **20**

### 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 = **10**

### 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 = **2**

### 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 = **0**

### CEPHALOMETRICS (See Instructions)

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

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

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

SN-MP

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

Each degree  $> 38^\circ$  **1** x 2 pts. = **2**

$\leq 26^\circ$  = 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 = **4**

### 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)	<b>2</b> x 2 pts. = <b>4</b>
Midline discrepancy ( $\geq 3$ mm)	@ 2 pts. = _____
Missing teeth (except 3 <sup>rd</sup> molars)	_____ x 1 pts. = _____
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. = _____
Addl. treatment complexities	_____ x 2 pts. = _____

Identify:

Total = **4**



## Cast-Radiograph Evaluation

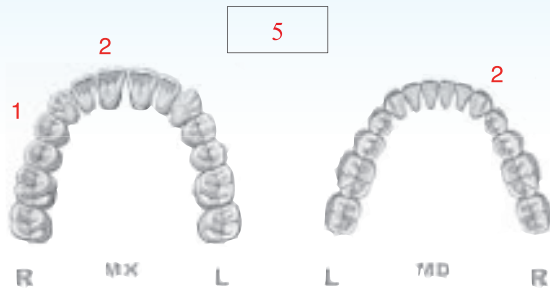
Case #

Patient

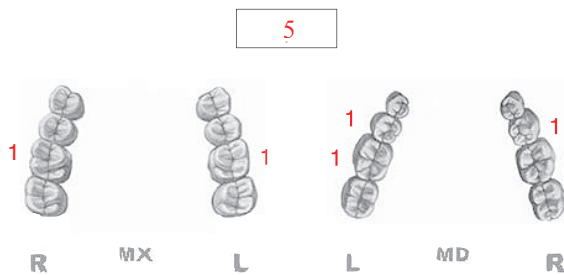
Total Score:

**22**

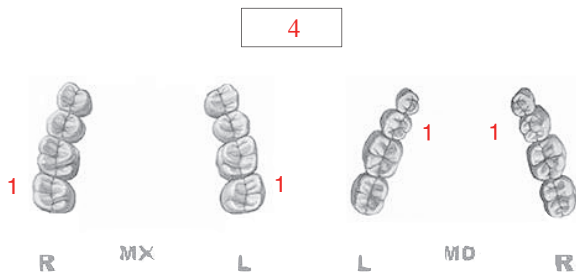
### Alignment/Rotations



### Marginal Ridges



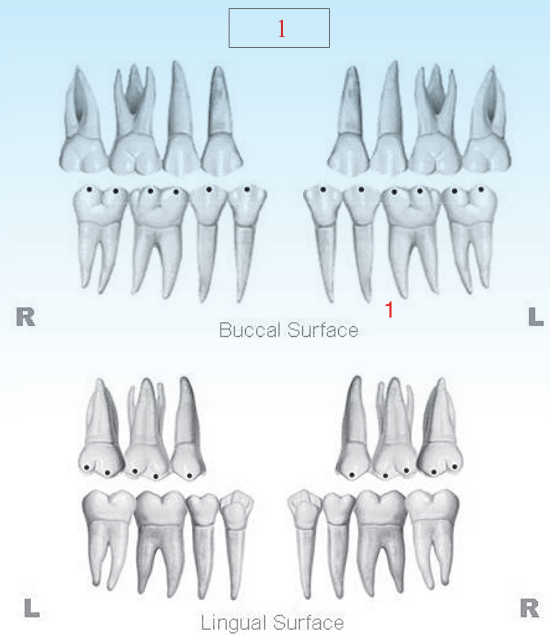
### Buccolingual Inclination



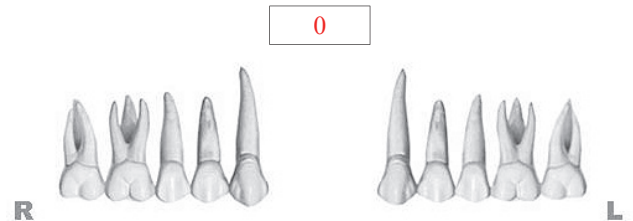
### Overjet



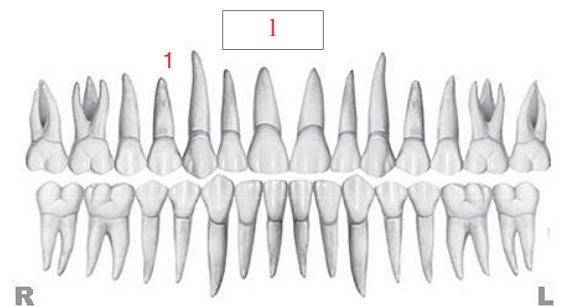
### Occlusal Contacts



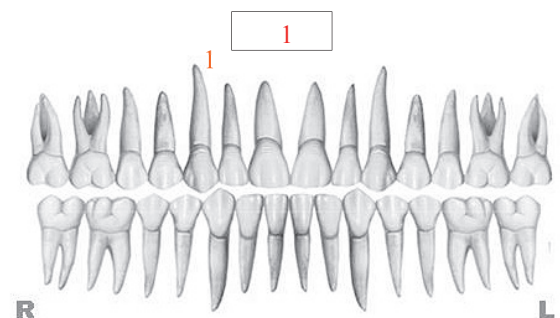
### Occlusal Relationships



### Interproximal Contacts



### Root Angulation

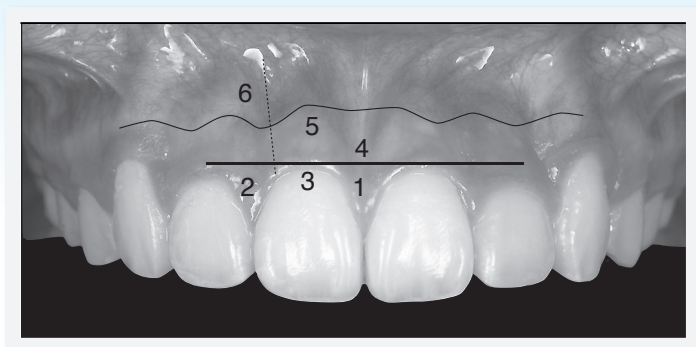


**INSTRUCTIONS:** Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

## IBOI Pink & White Esthetic Score (Before Surgical Crown Lengthening)

Total Score: = **7**

### 1. Pink Esthetic Score

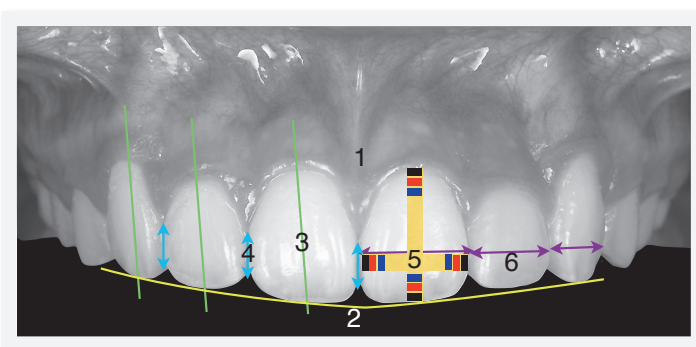


1. Mesial Papilla	0	1	2
2. Distal Papilla	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity ( Torque )	0	1	2
6. Scar Formation	0	1	2

Total = **5**

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 )



1. Tooth Form	0	1	2
2. Mesial & Distal Outline	0	1	2
3. Crown Margin	0	1	2
4. Translucency ( Incisal third )	0	1	2
5. Hue & Value ( Middle third )	0	1	2
6. 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 ( 1:0.8 )	0	1	2
6. Tooth to Tooth Proportion	0	1	2