# Early Intervention of Class III Malocclusion and Impacted Cuspids in late mixed dentition

### History And Etiology

A 10 year and 2 month girl was referred by her family dentist for orthodontic consultation (Fig. 1). There was no contributory medical or dental history. Her chief complaint was a protrusive lower lip with the mouth closed. The relatively severe Class III developing malocclusion is documented in Figs. 2 and 3. The patient and her parents desired comprehensive orthodontic treatment to achieve an ideal profile and alignment of the entire dentition (Figs. 4-6). The pretreatment and posttreatment radiographic documentation is shown in Figs. 7 and 8, respectively. Fig. 9 illustrates the influence of the functional shift on facial esthetics, indicating that the patient is a good candidate for conservative management of this severe malocclusion in the late mixed dentition.

The initial clinical examination in centric occlusion revealed a full Class III malocclusion with an anterior crossbite of about 5mm (*overjet -5mm*) and an overbite of 5mm. The mandibular dental midline was 2 mm to the left of the facial and maxillary midlines (*Fig. 7*); distally positioned maxillary incisors with blocked out canines were the contributing factors. All deciduous teeth were exfoliated except the lower right primary second molar (*Fig. 7*). The pretreatment panoramic radiograph (*Fig. 7*) revealed that both maxillary canines were superiorly positioned and blocked out. Although the treatment plan was to achieve an ideal alignment of the impacted cuspids



Fig 1: Pretreatment facial photographs



Fig. 2: Pretreatment intraoral photographs



Fig. 3: Pretreatment study models

Dr. Yu Lin Hsu, Lecturer, Beethoven Orthodontic Course (right) Dr. Chris HN Chang, Director, Beethoven Orthodontic Center (middle) Dr. Eugene W. Roberts, Consultant, International Journal of Orthodontics & Implantology (left)





Fig. 4: Posttreatment facial photographs



Fig. 5: Posttreatment intraoral photographs



Fig. 6: Posttreatment study models

(*Fig.* 8), there was inadequate space for them to erupt. Fig. 10 documents the cephalometric history of the treatment rendered.

## Diagnosis

### Skeletal :

- Skeletal Class III with SNA 80°, SNB 85° and ANB -5° (*Fig. 7 and Table 1*).
- Normal mandibular plane angle (SN-MP 33°, FMA 28.5°).

### Dental :

- Right end-on Class III molar relationship Let full cusp Class III molar relationship
- OB: 5 mm OJ: -5 mm
- Space deficiency in the maxilla was ~12mm Deep Curve of Spee in the mandibular arch Retained right mandibular primary second molar. No signs or symptoms of TMJ dysfunction Discrepancy Index (*DI*): 54

### Facial :

• Protrusive lower lip associated with functional shift for maximum interscuspation.

## 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



#### Fig. 7:

Pretreatment pano and ceph radiographs show multiple impacted permanent teeth and retained primary molar.



Fig. 9. Lateral profile in CO and CR position.



#### Fig. 8:

Posttreatment pano and ceph radiographs show a balancing lip profile.

CEPHALOMETRIC					
SKELETAL ANALYSIS					
	PRE-Tx	POST-Tx	DIFF.		
SNA°	80°	81.5°	1.5°		
SNB°	85°	85.5	0.5°		
ANB°	-5°	-4°	1°		
SN-MP°	33°	34°	1°		
FMA°	28.5°	30°	1.5°		
DENTAL ANALYS	SIS				
U1 TO NA mm	5 mm	9 mm	4 mm		
U1 TO SN°	113°	118°	5°		
L1 TO NB mm	4 mm	2 mm	0.5 mm		
L1 TO MP°	85°	83°	2°		
FACIAL ANALYSIS					
E-LINE UL	-2 mm	-1 mm	1 mm		
E-LINE LL	5 mm	-0.5 mm	5.5 mm		

Table. 1: Cephalometric summary



Fig. 10: Superimposed tracings show intrusion of mandibular incisors, flaring of maxillary incisors, and favorable growth of the mandible.

Mandible (all three planes):

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

### Maxillary Dentition

- A P : retract molars and protract incisors
- Vertical : Allow for normal extrusion with growth
- Inter-molar Width : Expand to correct cross-bite and make room for impacted cuspids.

### Mandibular Dentition

- A P : Retract anterior teeth
- Vertical : Tip-back posterior teeth (*extrude and retract*)
- Inter-molar / Inter-canine Width: Maintain

Facial Esthetics : correct mandibular lip protrusion in centric occlusion.

## Treatment Plan

Considering the patient's centric relation (CR) profile and age, a non-extraction treatment plan with a full fixed orthodontics appliance was indicated (Fig. 9). A .022" slot Damon D3MX bracket system (Ormco) was selected because of the self-ligated feature for inducing light forces to increase arch width and create space for the unerupted teeth. To maximize the arch expansion effect, bite turbos were used to unlock the bite. Class III elastics were used to correct the A-P discrepancy by flattening the occlusal plane and opening the vertical dimension of occlusion (VDO). To enhance the camouflage effect, short Class III elastics with light force were initiated early in the treatment. To compensate for the side effects of Class III elastics, flaring of maxillary incisors and retracting mandibular incisors, low

torque brackets were used on maxillary incisors and high torque brackets were bonded on mandibular incisors. Bilateral extra-alveolar bone screws(2x12 mm, OrthoBoneScrew<sup>®</sup>, Newton's A, Inc.) in the the buccal shelves were needed to achieve a Class I molar relationship in the final stage of treatment. Superimposed cephalometric tracings document the correction of the malocclusion (Fig. 10).

### **Appliances And Treatment Progress**

.022" Damon D3MX<sup>®</sup> brackets (*Ormco*) were bonded on maxillary teeth first because maxillary arch treatment was expected to take more time. NiTi open coil springs were placed to create space for the maxillary canines and the maxillary left second premolar. Bite turbos were bonded bilaterally on the maxillary 1<sup>st</sup> molars to facilitate arch expansion (*Fig.* 11).

In the 4<sup>th</sup> month of treatment, the arch wire was changed to .014X.025 CuNiTi and the activation of the NiTi open coil springs was retained. The maxillary incisors were protracted to an edge-to-edge position in the 7<sup>th</sup> month of treatment, and an anterior bite turbo were bonded on the lingual surface of mandibular central incisors to facilitate overjet and overbite correction (*Fig. 12*).

In the 11<sup>th</sup> month of treatment, the mandibular teeth were bonded with up-side-down low torque brackets which results in a high torque effect (*Fig. 13*). The maxillary teeth were erupted in the 12<sup>th</sup> month, and lingual buttons were bonded on the upper left



Fig. 11:

The bite turbos were bonded on bilateral maxillary 1<sup>st</sup> molar, and NiTi open coil springs were placed to create space for the impacted teeth.



Fig. 12:

The anterior bite turbo were bonded on the lingual surface of mandibular central incisors.



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Fig. 13:
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The mandibular teeth were bonded with up-side-down low torque brackets which would present high torque effect.



#### Fig. 14:

Lingual buttons were bonded on #12 and #13. Power chains were attached to these two premolars for correction of rotation. Notice that the impacted cuspids were autuerupting due to the creation of space.



#### Fig. 15:

In the 18<sup>th</sup> month, all impacted teeth were erupted and bonded. Class III elastics (Parrot 5/16, 2 oz.) wearing was reinforced. Overjet was 0 mm.



#### Fig. 16:

In the 31<sup>st</sup> month on treatment, two extra-alveolar bone screws were inserted into bilateral buccal shelves to retract the mandibular anteriors.

first and second premolars for correction of rotation (*Fig. 14*); meanwhile, the overjet was 0mm. The importance of wearing Class III elastics (*Parrot 5/16, 2 oz.*) full time was reinforced to both the patient and her parents (*Fig. 15*).

After 8 months of alignment and leveling, OJ was -1mm due to slight flaring of mandibular incisors. Class III elastics force was increased (*Fox ¼*, *3.5 oz.*). The maxillary arch wire was changed to a .016x.025 20° pre-torque CuNiTi wire to correct the axial inclinations of the maxillary incisors with labial root torque. A similar archwire was placed in the mandibular arch to achieve lingual root torque of the mandibular incisors. In the 31<sup>st</sup> month on treatment, two extra-alveolar bone screws (*2X12 mm, OrthoBoneScrew*<sup>\*</sup>, *Newton's A, Inc.*) were inserted into bilateral buccal shelves to retract the mandibular anteriors (*Fig. 16*). After 5 months, OJ was corrected to 2 mm. In order to improve the posterior occlusion, the mandibular arch wire was cut until 3-3



#### Fig. 17:

In the 34<sup>th</sup> month, the upper archwire was sectioned distal to the cuspids. Light vertical elastics (2 oz) were used for final detailing.

and continuous vertical elastics (*Ostrich ¾, 2oz.*) were introduced (*Fig. 17*). Appliances were subsequently removed and retainers were delivered after 37 months of active treatment.

### **Results Achieved**

#### Maxilla :

- A P : Moved anterior~1-2 mm at A point
- Vertical : Maintained.
- Transverse : Maintained.

#### Mandible :

- A P : Anteriorly and inferiorly with growth
- Vertical : Increased
- Transverse : Maintained.

### Maxillary Dentition :

- A P : Increased ~4 mm.
- Vertical : Molar extruded ~ 1-2 mm.
- Inter-molar Width : Increased ~1 mm

### Mandibular Dentition :

- A P : Maintained.
- Vertical : Molar extruded ~ 2-3 mm.
- Inter-molar Width : Maintained.

#### Facial Esthetics :

• Improved by protraction of the upper lip and retraction of the lower lip.

### Retention

The upper 2-2 and lower 3-3 fixed retainers were bonded on every tooth after the finish records were obtained (*Figs. 4-6 and 8*). An upper clear overlay retainer was delivered, and the patient was instructed to wear it full time for the first 6 months and nights only thereafter.

### Final Evaluation of Treatment

The ABO Cast-Radiograph Evaluation was scored at 34 points indicating a finished occlusion that may be acceptable for a board case because of the difficulty of the malocclusion (*DI=54*). A DI-CRE-P&W comparative table is proposed that weights an acceptable finish to the initial severity or complexity of the malocclusion (*DI score*). Based on Table 2, a CRE score of up to 34 points is acceptable for a malocclusion with a DI of 54. The major discrepancies in the finished occlusion (*Fig.* 6) were marginal ridge discrepancies and occlusal interdigitation due to the tip-back mechanism for Class III correction.

Treatment timing is crucial for Class III correction. In review of the whole treatment sequence, fixed

DI	CRE	P&W
10-19	≦26	≦ 12
20-29	≦30	≦ 12
30-39	≦34	≦ 12
40-49	≦36	≦ 12
50-70	≦38	≦ 12

Table 2: Discrepancy Index, Cast Radiographic Evaluation, and Pink & White score comparative table (Chang C. Advanced Damon Course No. 11: DI and CRE, Beethoven Podcast Encyclopedia in Orthodontics 2011, Newton's A Ltd, Taiwan)



Fig. 18 &19: The changes of anterior teeth inclination and later profile in treatment progress.

appliance therapy could have been delayed. It would have been better to use phase I treatment with removable appliances for correction of anterior cross bite and expansion of maxilla during the early mixed dentition, and delay the full fixed appliance (*phase II*) until all 2<sup>nd</sup> molars had erupted.

Skeletally, the patient showed a favorable growth pattern, without excessive forward mandibular growth. Besides, the growth of her nose and the advancement of the lips improved facial harmony (*Figs. 18 and 19*). However, the remaining growth potential of her mandible needs to be closely followed into the adult years.

### Discussion

In treating young Class III patients, correct diagnosis, appropriate treatment timing and treatment mechanics have long been challenging, due to unpredictable growth and development. However, the following indicators suggest a favorable prognosis: 1. an orthognathic profile in CR position (*Fig.* 2), 2. a functional shift, 3. a low to average mandibular plane angle, 4. no open bite, and 5. no severe crowding.<sup>1</sup> According to Lin's Three Rings Diagnosis,<sup>2</sup> a Class III patient, who has an orthognathic profile in CR position, usually has a favorable prognosis with a conservative treatment.

In general, treatment timing should be delayed until the end of puberty for severe skeletal Class III patients. For the present patient, maxillary deficiency was noted when determining treatment timing. Compared with good mandibular development, the anterior crossbite has resulted in a severe space deficiency in the maxilla. Subsequently, bilateral maxillary cuspids were impacted. The exaggerated Curve of Spee and deep overbite may worsen as growth continues, so early orthodontic intervention was indicated to decrease the complexity of future treatment. However, one of the main disadvantages of early treatment with fixed appliances in late mixed dentition is prolonged treatment time.<sup>3</sup> Waiting of eruption of 2<sup>nd</sup> molars often exhausts the patients' patience and the family may request premature

termination of treatment with a compromised result. The CRE score of 34 for the present patient could have been improved to the usual board standard (*<26 points*) with about 6 more months treatment with fixed appliances.

When dealing with jaw relation problems in children, two phase orthodontic treatment is often recommended.<sup>4</sup> Phase one treatment addresses the anterior crossbite and deficient maxillary width development. An appropriate appliance might be the D-gainer of Damon System, in combination with maxillary arch expansion (*Fig. 20*).<sup>5</sup> The mechanics of the D-gainer is to expand the arch with light continuous force delivered with passive self-ligated brackets, high-tech CuNiTi wires, and NiTi open coil springs.<sup>6</sup> The use of NiTi open coil springs can create spaces easily and efficiently (Fig. 21).<sup>7</sup> This approach usually requires 9 to 12 months to reach phase one treatment goals. After completion of the phase one treatment, the patient is monitored for growth pattern, particularly with regard to mandibular prognathism. Phase two treatment starts after eruption of the 2<sup>nd</sup> molars. This stage of treatment is simplified because the crossbite and maxillary width deficiency were corrected in Phase I. Compared with early fixed appliance treatment in mixed dentition, two phase treatment can be more effective to manage treatment time. With the patients' active participation, ideal treatment results can be more easily achieved for developing malocclusions that require interceptive (Phase I) and definitive (Phase II) treatment.



#### Fig. 20:

The D-gainer of Damon system, a simple 2x4 or 4x2 fixed appliance, is used to correct anterior crossbite and expand the maxillary arch combined with open coil springs in the same time.



#### Fig. 21:

Creation of space by NiTi open coil springs was easy and efficient. Bilateral impacted cuspids were auto-erupted after 12 months of active treatment.

Another important factor was the mechanics of the treatment. To correct the A-P discrepancy and crowding, extraction was a treatment option. Sarver<sup>8</sup> has expressed concern that extraction in young patients increases buccal corridors or at least reduces the possibility of improving them. In view of the considerable growth potential, non-extraction treatment is indicated. For arch expansion and correction of the A-P discrepancy, a passive self-ligating system with Class III elastics was used.<sup>9</sup> Extraalveolar miniscrews may be applied if intermaxillary elastics fail to achieve the desired result.<sup>10</sup>

With the Damon system, auxiliary appliances are not necessary to relieve space deficiency.<sup>11</sup> Continuous light-force mechanics generate alignment from canine to molar associated with a lateral expansion of alveolar bone. Mikulencak's<sup>12</sup> thesis compared the amount of arch expansion between rapid maxillary expansion and Damon system alignment. He found no difference in the amount of molar tipping between the two methods indicating that the maxillary arch can be expanded with light force.<sup>12</sup>

Bite turbos for Class III treatment in numerous ways: 1. protect the enamel from bracket wear or accidental debonding, 2. improve the effect of light

wires on arch development, 3. improve the effect of early light elastics for A/P, vertical and transverse corrections, and 4. may have a positive impact on the correction of excessively low or high mandibular plane angles (brachy-facial or dolichofacial patients).<sup>13</sup> For the present patient, using posterior bite turbos in the beginning of treatment disarticulated the arches, allowing freedom for tooth movement and arch expansion (Fig. 11). In the 7<sup>th</sup> month of treatment, the anterior bite turbos were bonded on the lingual surface of the mandibular central incisors to facilitate crossbite correction and serve as a vertical stop for overbite (Fig. 12). The Curve of Spee was flattened as the molars extruded. Proper torque control is challenging with extensive Class III elastics therapy. Selection of brackets with varying torque levels allows rectangular leveling wires to deliver differential moments as needed early in treatment. There are times, however, when a rectangular archwire fails to provide adequate torque, so it is advisable to use a .016x.025/.019x.025 pre-torgued Ni-Ti<sup>®</sup> (20° of torque) wire to assist in developing



Fig. 22: Progress of A-P discrepancy correction. Notice the torque control of maxillary and mandibular anteriors.

a favorable facial root torque.<sup>13,14</sup> For the present patient, low torque brackets on the maxillary teeth, high torque brackets (*low torque brackets bonded upside-down*) on the mandibular teeth, and a .016x.025 pre-torqued Ni-Ti<sup>®</sup> wire were applied. Even this, the torque of maxillary incisors was changed from 112° to 118°, and from 85° to 83° for mandibular incisors. The result was not ideal because of Class III mechanism but acceptable, as documented in Fig. 22.

### Conclusion

Treatment timing is crucial for young Class III patients. Early intervention in late mixed dentition with a full fixed appliance Damon system, in combination with intermaxillary elastics and extraalveolar bone screws, effectively manages the problem. However, phase one treatment with removable and/or limited fixed appliances can correct the abnormal growth pattern, allowing a shorter period of fixed appliance treatment after the second molars erupt. The latter approach avoids the patient 'burn-out' associated with excessive treatment time, and allows the clinician to achieve a better result by retaining patient cooperation until detailing is completed.

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## **Discrepancy Index Worksheet**

54

#### TOTAL D.I. SCORE

#### **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 =



#### **ANTERIOR OPEN BITE**

0 mm. (edge-to-edge), 1 pt. per tooth then 1 pt. per additional full mm. per tooth



#### LATERAL OPEN BITE

Total

2 pts. per mm. per tooth

П	[ot	to1
	0	Lai



#### **<u>CROWDING</u>** (only one arch)

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

#### **OCCLUSION**

Class I to end on End on Class II or III Full Class II or III Beyond Class II or III		0 pts. 2 pts. per side 4 pts. per side 1 pt. per mm. additional 2 <u>pts.</u> 2 <u>pts.</u>
Total	=	6

### LINGUAL POSTERIOR X-BITE

1 pt. per tooth	Total	=		3
BUCCAL POSTERIO	<u> DR X-I</u>	<u>BITE</u>		
2 pts. per tooth	Total	=		0
<b>CEPHALOMETRIC</b>	<u>S</u> (S	ee Instruct	tions)	
ANB $\geq 6^{\circ}$ or $\leq -2^{\circ}$			=	4 pts.
Each degree $< -2^{\circ}$	3	_x 1 pt.	=	7
Each degree $> 6^{\circ}$		_x 1 pt.	=	
SN-MP $\geq 38^{\circ}$ Each degree $> 38^{\circ}$		x 2 pts	=	2 pts.
$\leq 26^{\circ}$ Each degree $< 26^{\circ}$		_x 1 pt.	=	1 pt.
1 to MP $\geq$ 99° Each degree $>$ 99°		_x 1 pt.	= =_	1 pt.
OTHED (See by the	Tot	al	=	8

#### Supernumerary teeth $x_1 pt. =$ Ankylosis of perm. teeth \_\_\_\_x 2 pts. = \_\_\_\_ Anomalous morphology \_\_\_\_x 2 pts. = \_x 2 pts. = \_\_\_ Impaction (except 3<sup>rd</sup> molars) 2 4 Midline discrepancy ( $\geq$ 3mm) (a) 2 pts. = x 1 pts. = Missing teeth (except 3<sup>rd</sup> molars) Missing teeth, congenital $_x 2 \text{ pts.} =$ x 2 pts. =Spacing (4 or more, per arch) Spacing (Mx cent. diastema $\geq 2$ mm) @ 2 pts. =\_ \_x 2 pts. = Tooth transposition @ 3 pts. =\_\_\_ Skeletal asymmetry (nonsurgical tx) Addl. treatment complexities \_x 2 pts. = \_\_\_\_

#### Identify: Trans-alveolar impaction

	Total	=	4	
IMPLANT SITE		<u></u>		
Lip line : Low (0 pt), Medium (1 p	pt), High (2 pts)		:	=
Gingival biotype : Low-scallo	ped, thick (0 pt),	Medium-sc	alloped, med	lium-thick (1 pt),
High-scalloped, thin (2 pts)			:	=
Shape of tooth crowns : R	ectangular (0 pt),	Triangular	(2 pts)	=
Bone level at adjacent tee	eth∶≤5 mm to	contact po	oint (0 pt), 5.	5 to 6.5 mm to
contact point (1 pt), $\ge$ 7mm to contact Bone anatomy of alveolar	t point (2 pts) • crest : H&V	sufficient ((	0 pt), Deficie	= nt H, allow
simultaneous augment (1 pt), Deficien	t H, require prior	grafting (2	pts), Deficie	nt V or Both
H&V (3 pts)			:	=
Soft tissue anatomy : Intact	(0 pt), Defective	(2 pts)		=
Infection at implant site : No.	ne (0 pt), Chronic (	1 pt), Acute(	2 pts)	=
	Total	=		]

Total



**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





2. White Esthetic Score ( for Micro-esthetics )





Total =	2		
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
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

Total =	1		
1. Tooth Form	0	1	2
2. Mesial & Distal Outline	0	1	2
3. Crown Margin	0	1	2
4. Translucency ( Incisal thrid )	0	1	2
5. Hue & Value ( Middle third )	0	1	2
6. 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