Conservative Treatment of an Angle Class III Malocclusion with Severe Open Bite and Negative Overjet with Clear Aligners

Abstract

History: A 31-year-old male presented for orthodontic consultation with a severe Class III malocclusion, anterior open bite of 5 mm, and a posterior crossbite on both sides. The chief complaints were poor esthetics and inadequate masticatory function.

Diagnosis and Etiology: A narrow upper arch and constricted in the 1st molars area, resulted in a crossbite relation on both sides. There was a wide lower arch and moderate crowding in the lower anterior dentition. Anterior open bite was 5 mm, extending to the 2nd premolar area. There was a full-cusp Class III malocclusion with end-to-end crossbite on both sides. However, cephalometric analysis showed a Skeletal Class I relationship with a straight profile. The etiology for the the anterior open bite is likely related to external factors such as pre-existing thumb-sucking as a child and existing habits such as mouth breathing and interincisal tongue posture which inhibited eruption of upper and lower anterior teeth. There was proclination of upper incisors and crowding of lower incisors. A high mandibular angle (FMA, 35°) led to a hyperdivergent facial pattern, anterior open bite, and Class III malocclusion.

Treatment: A non-surgical, orthodontic approach with clear aligners and elastics was planned. Full pre-treatment evaluation was carried out. Digital intraoral scanning for digital impressions were done by iTero Element II. Full records and prescription form were submitted for Invisalign comprehensive clear aligners. On arrival of the aligners, a set of 59 aligners was prescribed. After one week, at the second visit, attachments where bonded, and early Class III elastics were used. The patient was appointed every 4 weeks, with 7-day intervals between aligner changes. On completion of the aligner treatment, a significant improvement in overjet and overbite, as well as Class I molar and canine relationships on both sides, were achieved. Retention was done with clear retainers. (J Digital Orthod 2025;77:4-20)

Outcomes: Treatment goals were achieved after 18 months of treatment with clear overlay aligners.

Key words:
Class lll malocclusion, Class lll molar relationship, open bite, crossbite, Class lll elastics, overjet , overbite

Introduction

A 31-year-old male presented with chief complaints of incompetent lips and anterior open bite. He was previously seen by other orthodontists and was told only surgery can solve his problem. Oral soft tissues, periodontium, frena, and gingiva were examined. All were found to be within normal limits. Oral hygiene was very good. No significant medical or dental histories were noted.

Diagnosis and Etiology

Pre-treatment facial and intraoral photographs (Fig. 1) showed a hyperdivergent facial pattern with a straight profile, incompetent lips, and protrusive lower chin. The pre-treatment close-up photographs (Fig. 1) showed a normal lip line smile and 5-mm anterior open bite extending to the 2nd premolars on both sides. The open bite was prominent at the canine area. There was proclined upper anteriors and moderate crowding of lower anterior teeth. A

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■ **Fig. 1:** *Pre-treatment facial and intraoral photograph*

constricted upper arch at premolars and 1st molars resulted in crossbites on both sides. A 7-mm Class III malocclusion at 1st molars and canines was observed on both sides. All four wisdom teeth were fully erupted (Fig. 1). The lower mid line was shifted 2 mm to the right side. The patient complained about occasional pain and discomfort in the temporo-mandibular joints (TMJs). He reported mouth breathing habit since childhood because of chronic blocked nose and recurrent pharyngitis. Pre-treatment panoramic and cephalometric radiographs are shown in Figs. 3 and 4, respectively. Cephalometric analysis showed a hyperdivergent skeletal Class I pattern with a protrusive mandible

Fig. 2: Pre-treatment intraoral digital scans
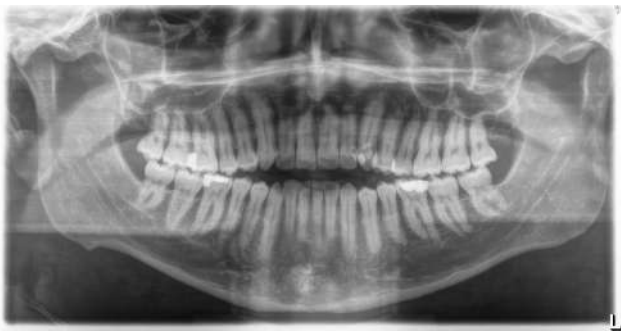
Fig. 3: Pre-treatment panoramic radiograph

Fig. 4: Pre-treatment cephalometric radiograph

and severe Class III dental relationships, as seen clearly in the pretreat mentintraoral digital scans (Fig. 2). The pre-treatment panoramic radiograph showed no significant pathological lesions in the hard tissues (Fig. 3). From the pre-treatment cephalometric radiograph (Fig. 4), pre-treatment analysis data showed the ANB angle was 1˚, the FMA angle was 35˚, the upper incisors were proclined 109˚, and the lower incisors were retroclined 90˚ to the mandibular plane. The cephalometric values are summarized in Table 1. The American Board of Orthodontics (ABO) Discrepancy Index (DI) was 70, as documented in Worksheet 1. The patient was successfully treated with a conservative non-surgical protocol with extraction of the lower 3rd molars only and Class III elastics. Lower molars retraction protocol and the use of early Class III elastics for anchorage were prescribed. A satisfactory esthetic smile was achieved at the end of the treatment, with a Cast-Radiograph Evaluation score of 1 and Pink and White score of 3 as documented in Worksheets 2 and 3 respectively.

Treatment Objectives

In order to improve esthetics of the patient's smile, treatment objectives were (1) sequential retraction of lower posterior teeth to produce a Class I molar and

canine relations on both sides, (2) expansion of the upper arch around the 1st molars and premolars area to correct the crossbite, and (3) extrusion and retraction of anterior teeth to correct the open bite. Extrusion of the upper premolars corrects lateral open bite on both sides Retraction of the lower anterior teeth produces relative extrusion added to the absolute extrusion to improve the vertical dimension of occlusion (VDO). Selective proclination and retroclination of lower anterior teeth to correct the moderate crowding. The patient's chief concerns were esthetics beside the difficulty to close the lips and incising food (Fig. 1). An orthognathic surgical option was previously suggested by other orthodontists, but the patient declined this option because it was too aggressive for him. Therefore, extractions of lower 3rd molars on both sides were planned to provide space for arch retraction prior to intraoral scanning were carried out (Fig. 2). An orthodontic treatment of light force with clear aligner system (Invisalign System Align Tech Inc., San Jose, CA) was recommended to meet the patient's needs:

Treatment goals:

1. Improve overjet and overbite.

2. Achieve Class I molar and canine on both sides.

3. Correct crossbite on both sides.

4. Align lower anterior teeth.

Treatment Strategies :

1. Sequential retraction by 50% of lower posterior teeth

2. Retraction of lower anteriors

3. Constriction of lower arch

4. Expansion of upper arch

5. Extrusion of upper incisors and premolars

6. Intrusion of upper and lower molars

7. Early Class III elastics as inter-arch anchorage hooked from buttons and cutouts

Treatment Progress

The total treatment period was 18 months. The final result was documented in the finish records (Figs. 5-8). A dental scan was taken with iTero Element II (Align Tech Inc., San Jose, CA), and full records were submitted to start the analysis and treatment planning of the case. Instructions to the CAD designer were given as follows: sequential retraction of lower posterior teeth, expansion of upper arch UR5, and no placements of cuts and hooks, which were made manually later on. The treatment simulation of the initial Clincheck (Invisalign System, Align Tech Inc., San Jose, CA) was satisfactory, and minor modifications were made with 3D control. The second Clincheck was approved after reviewing the desired biomechanics design and treatment outcome.

A total of 59 aligners were used. The interval for changing was every 7 days. The treatment began on delivery of the first aligners without placing attachments for one week to allow the patient to accommodate with speech and assure more

Fig. 5: *Posttreatment facial and intraoral photographs*

Fig. 6: *Posttreatment smile of the patient*

Fig. 7: *Posttreatment panoramic radiograph*

Fig. 8: *Posttreatment cephalometric radiograph*

comfort and ease of use. The patient was instructed to wear them full time of 22 hours and was advised to remove them when eating and brushing teeth only. One week later, the patient was seen, and the teeth were polished and prepared for adhesion of attachments with the attachment template. The composite resin used was SDR Flow Bulk Fill flowable composite (SDR Flow, Dentsply Sirona, Germany).

Attachments were bonded as follows :

Upper arch :

1. Conventional rectangular horizontal attachments on UR7, UL6, and UL7

2. Optimized multiplane attachment on UR6

3. Optimized root control attachments on UR5, UR4, UR3, UL4, and UL5

4. Optimized extrusion attachments UR2, UR1, UL1, UL2, and UL3

Lower Arch:

1. Conventional rectangular vertical attachments on LR7, LR6, LL6, and LL7

2. Optimized root attachments on LR5, LR4, LL3, and LL4

3. Optimized rotation attachments on LR3 and LL5

The digital simulation of the treatment outcome was designed to meet the treatment goals (Fig. 9).

At aligners #5, three composite buttons (SDR Flow, Dentsply Sirona, Germany) were bonded on the upper canines and lower canines and 1st premolars on both sides. Cutouts were made at corresponding sites on aligners #5, 6, 7, and 8. The patient was requested to mount elastics in triangular shape (Fig. 10) on both sides while wearing the aligners. At week 9, lingual buttons were bonded on the palatal surfaces of the upper 1st molars and cutouts were made on the corresponding sites on the aligners together with the buttons on the lower canines. Other composite buttons were removed, and Class III elastics (Fox, 1/4-in, 3 oz, Ormco, CA) were prescribed. Metal buttons were bonded on the lingual surfaces of upper first molars, and two other composite buttons were bonded on the labial surfaces of the lower canines. Cutouts on the aligners
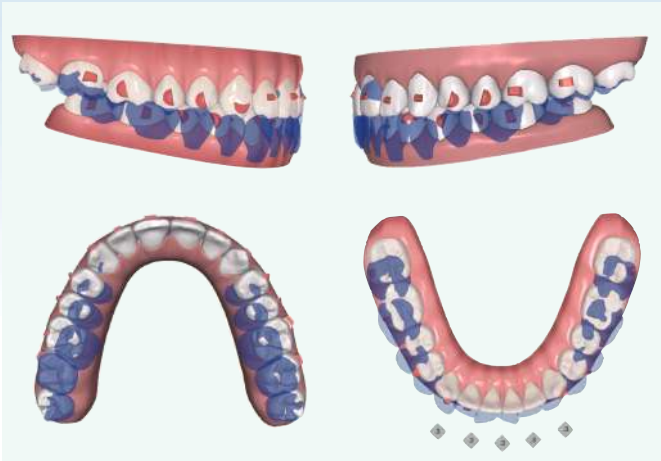
■ Fig. 9:
The Initial ClinCheck views show initial teeth position (blue) and simulated final position (white).

were made at the corresponding sites. Two elastics were hooked on the buttons (Fox, 1/4-in, 3 oz Ormco, CA) as Class III elastics on each side. The patient was given instructions on how to hook elastics and was requested to keep them hooked at all times and change every 8 hours (Fig. 11) when taken off to eat or brush teeth.

The patient was instructed to wear the last aligners and keep Class III elastics at night only till the arrival of the new aligners. A new scan was taken after aligners #59, and a new ClinCheck was generated and modified to meet the following requirements :

1. Buccal root torque of upper 1st molars

2. IPR of lower anteriors

3. Cuts for buttons on buccal surfaces of upper first molar and canines on both sides

Modifications in the attachments were as follows :

1. All the existing attachments were removed.

2. New optimized retention attachments on UR6, LR4, and LR3

3. New optimized retention attachments on UL6 and LL4

4. Optimized rotation attachment on LL3

5. IPR of 0.2 mm between lower anterior teeth to reduce the black triangle effect

The additional aligners consisted of 7 active aligners and 3 extra pairs for over correction for both arches. All the old attachments were replaced by new attachments as needed. The new attachments were placed with the use of a new template. Four metal buttons were bonded at the place of corresponding cuts, and Class III elastics (Fox, 1/4-in, 3.5 oz, Ormco, CA) were advised for full-time while using aligners. At week 8 of the additional aligners, the patient was seen every week before the insertion of the new aligners for over correction. After aligner #10, all the planned goals were achieved with satisfying results. All attachments were removed, and final records of photos, X-ray, and digital scans for clear retainers were taken. The patient was advised to wear aligner #10 for full time to hold the teeth in place and to wear Class III elastics at night time only while waiting for the retainers.

Retention

Digital scans for clear removable retainers were taken with iTero scanner. Clear retainers (Vivera, Align Tech., CA) were delivered after two weeks and advised to

■ **Fig. 10:** *Triangle elastics and bite block effect*

■ **Fig. 11a:** *Class III and crossbite elastics from the right buccal view*

■ **Fig. 11b:** *Class III and crossbite elastics from the frontal view*

CEPHALOMETRIC SUMMARY			
	PRE-TX	POST-TX	DIFF.
SKELETAL ANALYSIS			
SNA˚ (82˚)	78˚	77˚	1˚
SNB˚ (80˚)	77˚	77˚	0˚
ANB˚ (2˚)	1˚	0˚	1˚
SN-MP˚ (32˚)	44	41˚	3˚
FMA˚ (25˚)	35˚	34˚	3˚
DENTAL ANALYSIS			
U1 TO NA mm (4 mm)	6	6	0
U1 TO SN˚ (104˚)	109˚	106˚	3˚
L1 TO NB mm (4 mm)	5	3	2
L1 TO MP˚ (90˚)	90˚	75˚	13˚
FACIAL ANALYSIS			
E-LINE UL (-1 mm)	-7	-7	0
E-LINE LL (0 mm)	-2	-2	0
%FH: Na-ANS-Gn (53%)	54%	55%	1%
Convexity:G-Sn-Pg' (13˚)	25˚	17˚	-8˚

■ **Table 1:** *Cephalometric summary*

■ **Fig. 11c:** *Occlusal view shows the sites of bonded buttons.*

be used full time for six months. Cuts were made manually for Class III elastics to be used at night only with fox elastics (Fig. 12).

Treatment Results

Posttreatment documentation with photographs (Figs. 5 and 6), radiographs (Figs. 7 and 8),

cephalometric measurements (Table 1), and superimposed tracings (Fig. 13) indicated that both the overbite and over jet were within normal ranges. Class I molar and class I canine at both sides were achieved. Alignment and retraction of lower anteriors and crowding was eliminated. Extrusion of upper anteriors, closing of the open bite, and leveling of the curve of Spee were achieved. Two sets, a total of 69 aligners for both arches, over 18 months produced the final results as planned in the treatment goals and were close to the original 3D ClinCheck projection.

Discussion

The biomechanics of clear aligners could be described as a sequence of crown tipping and root

■ **Fig. 12:** Clear retainers with buttons and elastics
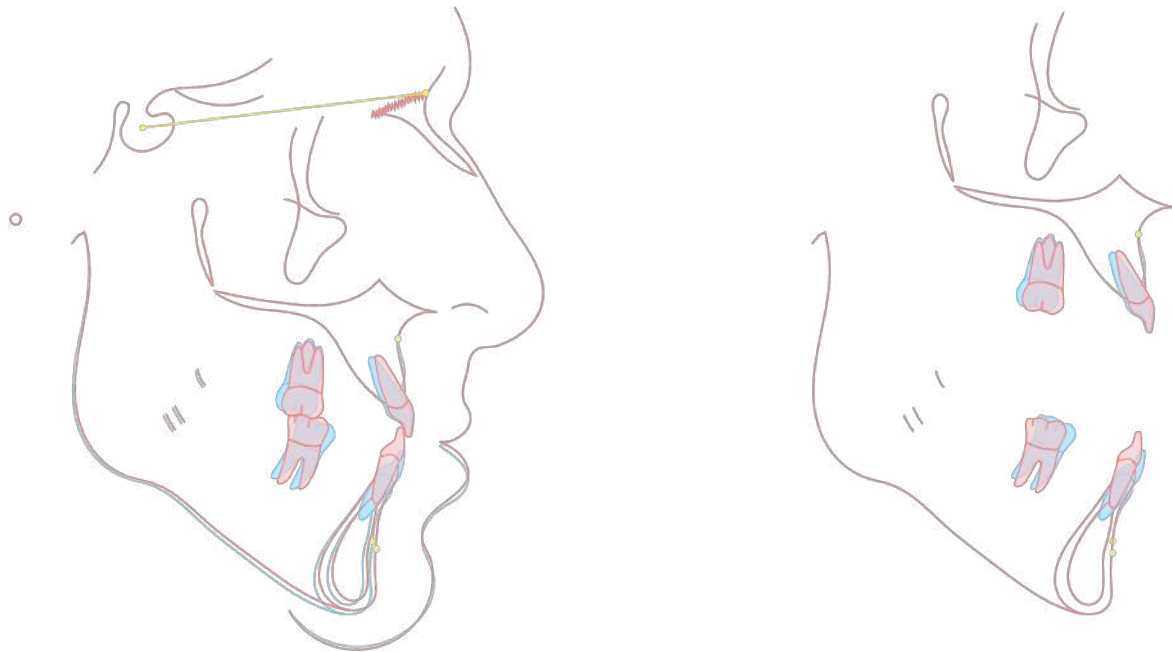
■ **Fig. 13:**
Superimposed cephalometric tracings show the dentofacial changes after 18 months of treatment (red) compared to the pre-treatment position (blue).

uprighting.[1] The current evidence in the literature of suggested that the clear aligners were effective in correcting Class III malocclusion with molar retraction.[2] The amount of molar retraction is about 2 to 3 mm, which helps in achieving molar and canine Class I relationship and also improvement of the facial profile. Clear aligner treatment is a good approach for resolving vertical discrepancies like deep bite and open bite. Successful treatment results using clear aligners for these discrepancies were reported in the literature.[3] Open bite is one of the favorable scenarios to be solved by aligners.[4] The bite block effect adds an intrusive force on posterior teeth.[5] In orthodontics, the biomechanics of open bite treatment depends on 1. extrusion of anterior teeth, 2. intrusion of posterior teeth and, 3. a combination of both mechanics.[6] The etiology of this vertical discrepancy is commonly developed at early age during the growth period.[7] Para-functional habits like tongue thrust, thumb sucking, mouth breathing, and malfunction swallowing play a big role in intervention of development of normal overbite and overjet. This case was diagnosed as a Class III canine and molar with open bite of 5 mm and negative overjet of 3 mm. Moderate crowding of lower anteriors was detected and a narrow upper arch with lateral crossbites at premolars and 1st molar could be observed on both sides. The treatment plan was set to achieve the following goals: 1. Class I molar and canine, and 2. normal overjet and overbite. The treatment strategies were designed as follow: 1. sequential retraction of lower posteriors, 2. expansion of upper lateral segment to correct the lateral crossbite, 3. extrusion of upper and lower anteriors, and 4. intrusion of upper and lower posteriors. Lower 3rd molars were extracted on both sides before delivering aligners #1. Sequential

retraction was done by 50%, meaning that distal movement of lower 2nd molar was initiated first and once it reached 50% of the distance, the retraction of 1st molars was started at aligners #5. Vertical attachments were requested on the lower molars to facilitate engagement of aligners and teeth by increasing the surface area.[8] Retraction of 2nd molar does not require anchorage as the whole arch supplies it (Figs. 14 and 15).[9] At this early stage of treatment, triangular elastics and the bite block effect of the the aligners induced a wedge effect and aided in extrusion of anterior teeth and intrusion of posterior teeth.[10] Reduction in the vertical discrepancy was noted. The retraction of 1st molar needed anchorage. Class III elastics used for anchorage to over come the side effect of retraction and prevent flaring of lower anteriors.[11] Moreover, the Class III elastics induced an auto-rotation of the mandible in counter-clockwise direction and helped in reducing the open bite. When the lower 1st molars reached 50% of the distal distance, the 2nd lower premolars started to retract and then the 1st premolars and canines. A good space of around 2 mm was observed distal to lower canines (Fig. 15). This space was enough for correcting canine relation to Class I and relieving the crowding in the lower anterior teeth. Lower anterior teeth were moved in a conservative pattern and round tripping was avoided. In the upper arch, expansion was achieved through buccal tipping and with the aid of the cross- and Class III elastics which extended from palatal buttons on upper 1st molars to lower buttons on the lower canines. This mechanism helped not only in the expansion and anchorage but also for the mandible to auto-rotate to reduce the open bite. Buccal root torque of molars was needed to upright molars and to avoid posterior opening of the bite
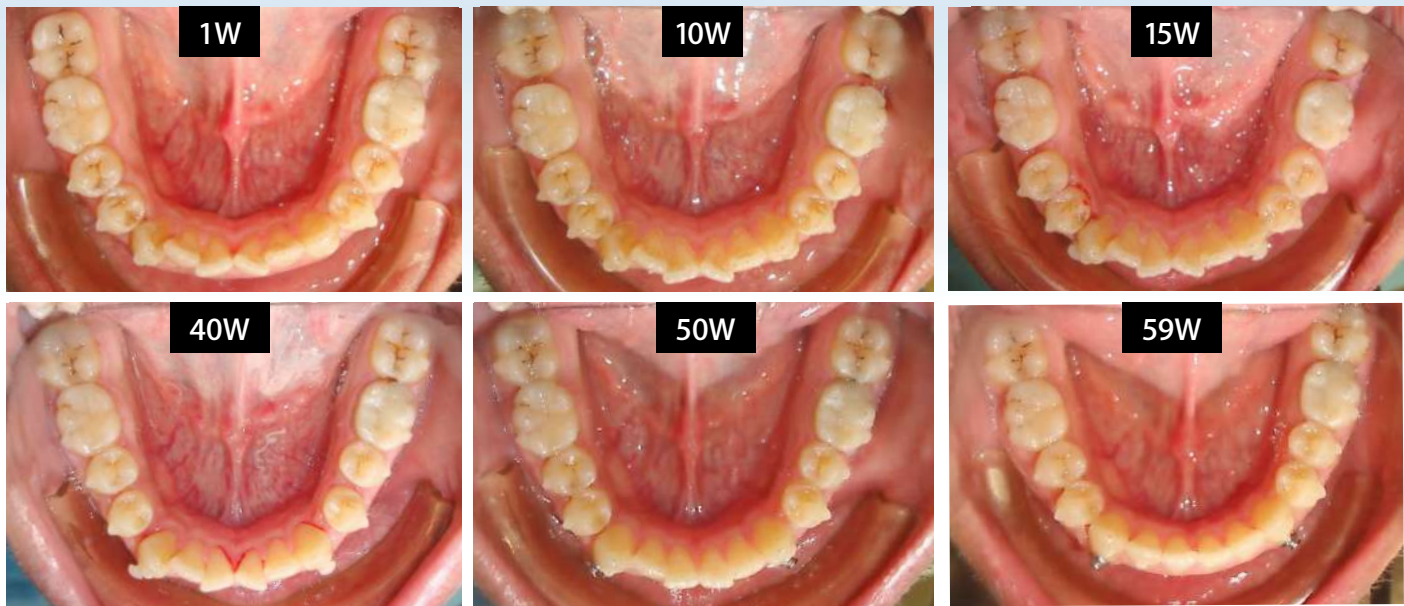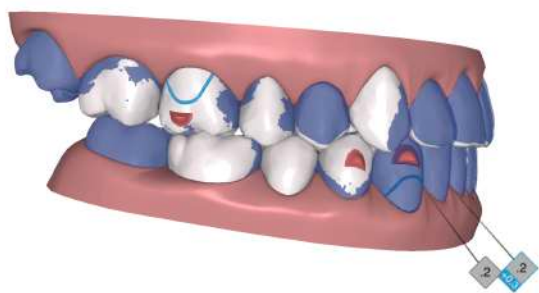
Fig. 14: Occlusal view shows the progress of sequential retraction and alignment of the lower arch in weeks (W).

Fig. 15: Lateral view shows the progress of sequential retraction and correction of open bite in weeks (W).

due to crown buccal tipping and premature occlusal contacts. In the additional aligner treatment plan, buccal root torque of upper molars was planned to overcome the posterior open bite (Fig. 16).[12] Anterior open bite was corrected with: 1. Intrusion of posterior teeth by true intrusion forces with the aid of bite block effect, as well as relative intrusion by buccal root torque of the upper and lower molars; and 2. extrusion of anterior teeth by true extrusion of upper and lower incisors and relative extrusion of lower incisors due to retraction and uprightness of lower anterior teeth. In general, the open bite was corrected by a combination of these forces.[13] The cephalometric analysis showed all these movements (Fig. 13) and the effect of the mandibular counter-clockwise rotation, which improved the overbite. The patient was requested to use Class III elastics with clear removable retainers to maintain the results. The two-year follow-up showed the retention of the treatment results (Fig. 17).

Conclusions

Clear aligners are a therapeutic modality that can be effectively employed for adult non-surgical treatment of Class III with severe open bite. Sequential retraction with Class III elastics as

■ **Fig. 16:** Additional aligners ClinCheck

■ **Fig. 17:** Two years follow up intra-oral photos

anchorage and auto-rotation of the mandible played a big role. Vertical attachments on the lower molars are recommended for retraction to increase the surface area and the aligner-teeth engagement. Extrusion and intrusion of teeth are applied depending on existence of a flat curve of Spee and low lip line. Both mechanics work in true and relative forms, and should be employed carefully. Expansion of upper posterior segment is mainly achieved by crowns tipping and could be controlled by adding buccal root torque. Careful observation of lower anterior teeth during retraction was necessary. Relative extrusion was induced and lingual root torque was needed to maintain roots within the bone envelope. Class III elastics at night with clear removable retainers to maintain the results is recommended.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE   **70**

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   =   **0**

ANTERIOR OPEN BITE

0 mm. (Edge-to-edge), 1 pt. per tooth
Then 1 pt. per additional full mm. Per tooth

Total   =   **12**

LATERAL OPEN BITE

2 pts. per mm. Per tooth

Total   =   **12**

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   =   **4**

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 __8__ pts.
Beyond Class II or III	=	1 pt. per mm. _____ pts. additional

Total   =   **8**

LINGUAL POSTERIOR X-BITE

1 pt. per tooth   Total   =   **6**

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.	=	_____
Each degree > 6° _____ x 1 pt.	=	_____
SN-MP		
$\geq$ 38°		= 2 pts.
Each degree > 38° __6__ x 2 pts.	=	__12__
$\leq$ 26°		= 1 pt.
Each degree < 26° _____ x 1 pt.	=	_____
1 to MP $\geq$ 99°		= 1 pt.
Each degree > 99° _____ x 1 pt.	=	_____

Total   =   **14**

OTHER   (See Instructions)

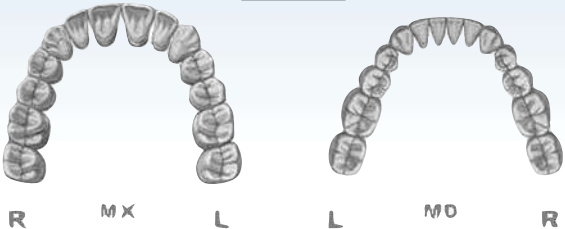|			
Supernumerary teeth	_____ x 1 pt.	=	_____
Ankylosis of perm. Teeth	_____ x 2 pts.	=	_____
Anomalous morphology	_____ x 2 pts.	=	_____
Impaction (except 3rd molars)	_____ x 2 pts.	=	_____
Midline discrepancy ($\geq$ 3mm)	@ 2 pts.	=	_____
Missing teeth (except 3rd molars)	_____ x 1 pt.	=	_____
Missing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

Identify:

Total   =   **0**
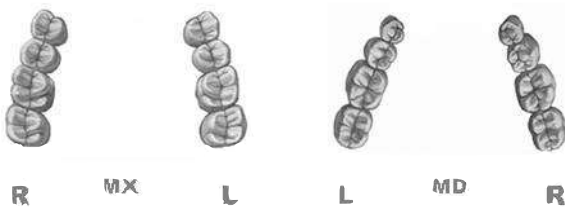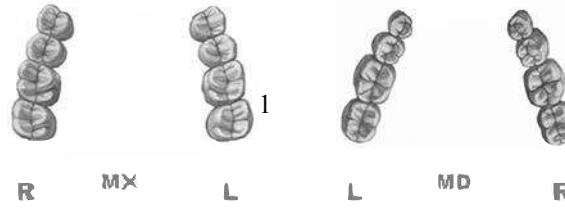
Cast-Radiograph Evaluation

Total Score: 1

Occlusal Contacts 1

Alignment/Rotations

0

R MX L L MD R

Buccal Surface

1

Lingual Surface

L R

R L

R L

Marginal Ridges

0

R MX L L MD R

Buccolingual Inclination

0

1

R MX L L MD R
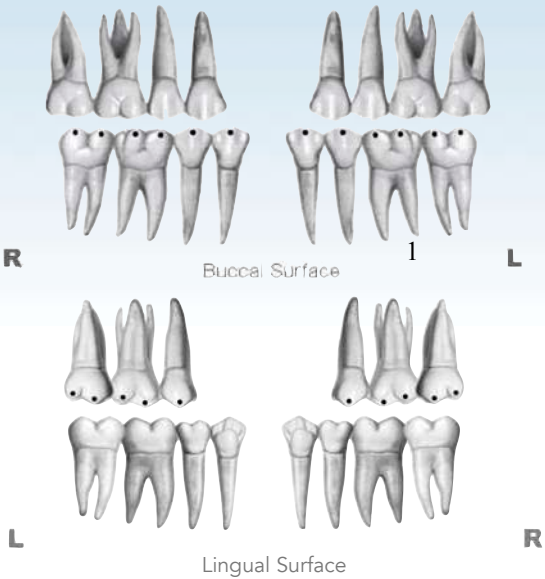
Interproximal Contacts

R L

Overjet

0

R MX L

Root Angulation

0

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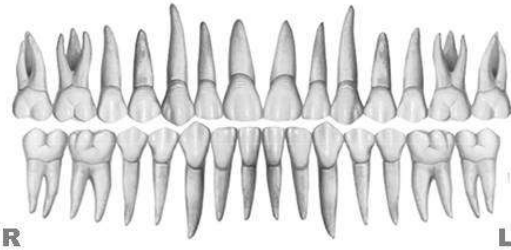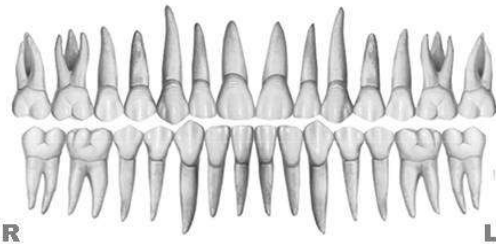
INSTRUCTIONS: Place score beside each deficient tooth in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score
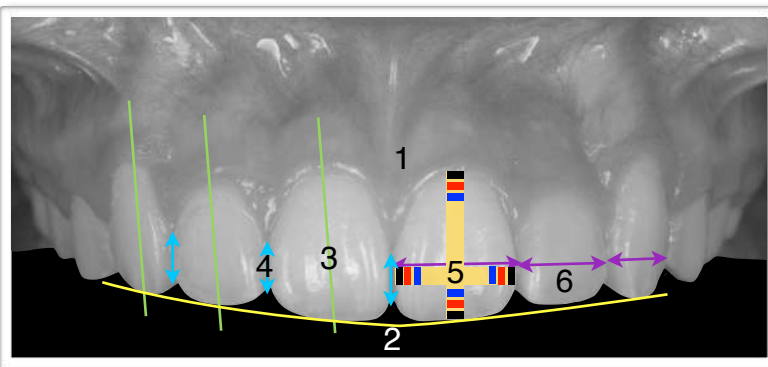
Total Score = [0]

1. Pink Esthetic Score

Total = [1]

	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 Papillae	(0)	1	2
2. Keratinized Gingiva	(0)	1	2
3. Curvature of Gingival Margin	0	(1)	2
4. Level of Gingival Margin	(0)	1	2
5. Root Convexity (Torque)	(0)	1	2
6. Scar Formation	(0)	1	2

2. White Esthetic Score (for Micro-esthetic)

Total = [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	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	(0)	1	2
6. Tooth to Tooth Proportion	(0)	1	2

OBS

OBS Super Set

Created by Dr. Chris Chang, OBS is made of medical grade, stainless steel and titanium, and is highly praised by doctors for its simplistic design, low failure rate and excellent quality. OBS is your must-have secret weapon for maximum, reliable anchorage.

Smooth Mushroom Head
For comfort & retention of elastic chain

FDA

4-way Rectangular Holes
For lever arm to solve impacted tooth

Double Neck Design
Easy hygiene control & extra attachment

Made in Taiwan

New
Titanium Higher biocompatibility*

1.5 | 1.5X8mm

Stainless Steel**

2.0 | 2.0x12mm

2.7 | 2.0x14mm (with holes)

Buy a Super Set, get *OBS Clinical Guide* (eBook) for free.

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* TADs made of Ti alloy have a lower failure rate compared to SS when placed in thin cortical bone. These results are consistent with a biocompatibility-related tendency for less bone resorption at the bone screw interface.
   Reference: Failure Rates for SS and Ti-Alloy Incisal Anchorage Screws: Single-Center, Double Blind, Randomized Clinical Trial (J Digital Orthod 2018;52:70-79)

** The overall success rate of 93.7% indicates that both SS and TiA are clinically acceptable for IZC BSs.
   Reference: Failure rates for stainless steel versus titanium alloy infrazygomatic crest bone screws: A single-center, randomized double-blind clinical trial (Angle Orthod 2019;89(1):40-46)