Class II Low Angle with Bilateral First Premolars Crossbite

History and Etiology

A young female, aged 27-years-old (*Fig. 1*), presented with a chief complaint of her irregular teeth arrangement and protruding upper anterior teeth (*Figs. 2-3*). There was no contributory medical or dental history. The clinical exam indicated that the bilateral first premolars were crossbite and a large overbite was noticed (*Fig. 2*). Her pre-treatment facial profile showed a straight profile with an acceptable soft tissue E-line projection. The pre-treatment intraoral photographs and study models revealed a bilateral end-on Class II molar relationship. The lower dental midline was shifted to the right side. No contributing habits were evident. The patient was treated to an acceptable result as documented in (*Figs. 4-9*). The cephalometric and panoramic radiographs document the pre-treatment conditions (*Fig. 7*) and the post-treatment results (*Fig. 8*). Superimposed cephalometric tracings document the treatment achieved (*Fig. 9*). The details for diagnosis and treatment will be discussed below.

Fig. 1: Pretreatment facial photographs

Fig. 2: Pretreatment intraoral photographs

Fig. 3: Pretreatment study models

Diagnosis

Skeletal:

- Skeletal Class II (*SNA 84°, SNB 79°, ANB 5°*)
- Low mandibular plane angle (*SN-MP 29°, FMA 22°*)

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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

Dental:

- Bilateral Class II malocclusion The overbite and overjet were both 6mm.
- Moderate crowding of about 3mm in the upper arch and severe crowding of about 12mm in the lower arch.
- Mandibular dental midline was 2mm deviated to the right side of the facial midline.
- Bilateral crossbite malocclusion over first premolar areas.

Facial:

- Straight profile with acceptable nose and lip position.

The ABO Discrepancy Index (*DI*) was 31 as shown in the subsequent worksheet.

Specific Objectives Of Treatment

Maxilla (*all three planes*) :

- A - P: Retract
- Vertical: Maintain
- Transverse: Maintain

Mandible (*all three planes*) :

- A - P: Maintain
- Vertical: Maintain
- Transverse: Expand the premolar area

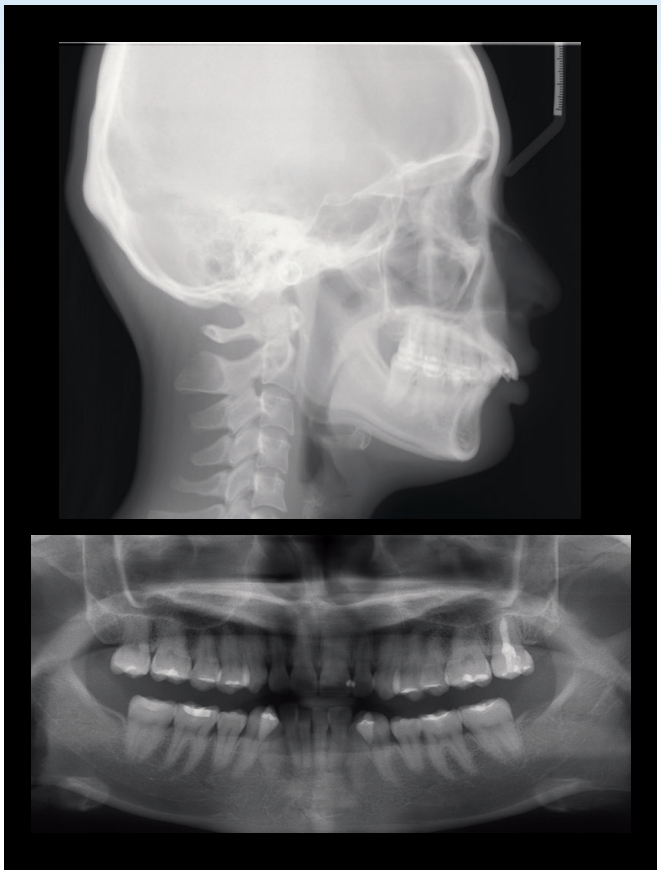

Fig. 7: Pretreatment pano and ceph radiographs.

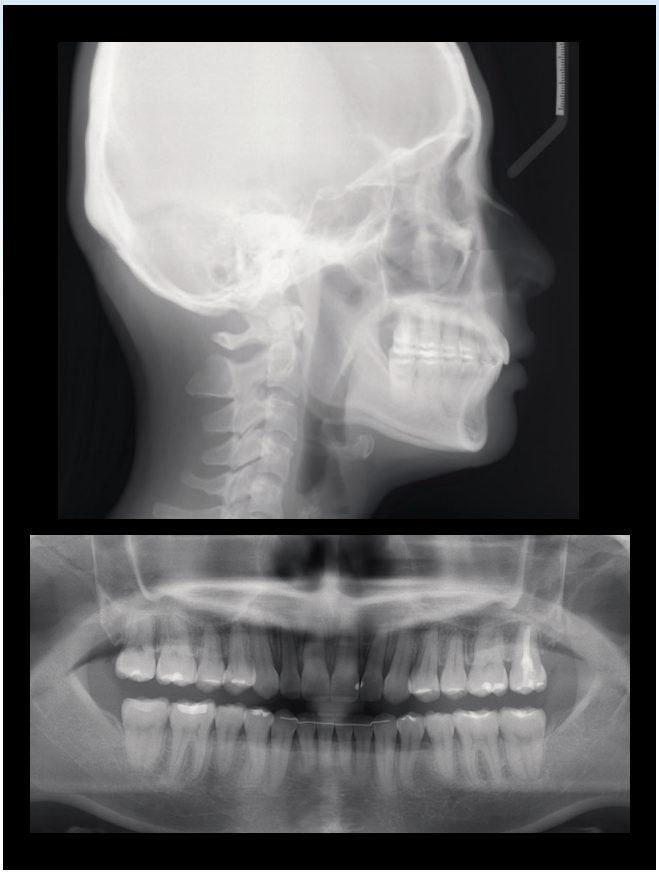

Fig. 8: Posttreatment pano and ceph radiographs.

Fig 9: Superimposed tracings

Maxillary Dentition

- A - P: Retract
- Vertical: Maintain
- Inter-molar Width: Maintain

Mandibular Dentition

- A - P: Maintain
- Vertical: Maintain
- Inter-molar / Inter-canine Width: Maintain but expand the premolar area

Facial Esthetics: Maintain

Treatment Plan

The main objectives of this case were 1. to correct the premolar crossbite and 2. to retract the upper dentition. In order to correct the crossbite, after the braces were placed on the lower arch , bilateral posterior occlusal bite turbos were added to open the bite (*Fig. 10*) and lingual buttons were bonded on the lower first premolar (*No. 21 and No. 28*) lingual site (*Fig. 11*). The purposes of bite turbos and lingual buttons were to disocclude the upper and lower teeth and facilitate the use of the corssbite elastics from #5 and #12 buccal site to the #21 and #28 lingual buttons.

Based on her straight lateral facial profile, a non-extraction treatment with a full fixed orthodontic appliance was indicated to align and level the dentition. To retract the protruded anterior teeth, two bone screws (*2x12mm OrthoBoneScrew, Newton's A inc.*) were inserted bilaterally in the infrazygomatic crest as the anchorage for retraction.

After the final detailing, the fixed appliances were removed and the corrected dentition was retained with a clear retainer in upper arch and fixed anterior retainer in lower arch.

Fig. 10:

Lower arch was bonded and an bite turbo was placed on upper second molars.

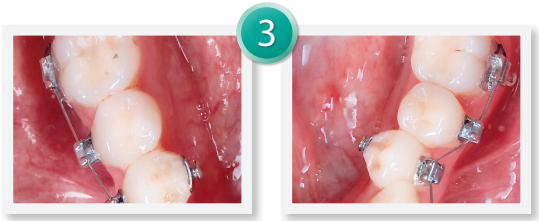

Fig. 11:

No. 21 and No. 28 lingual side were bonded with lingual buttons.

Fig. 12:

After 4 months, lower dentition crowding was relieved and the crossbite was corrected.

Fig. 13:

Two miniscrews were inserted into the IZC for upper arch distalization .

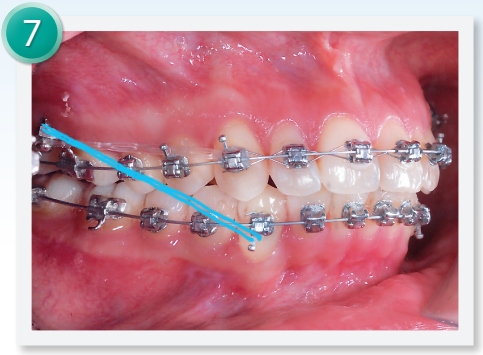

Fig. 14: Class III elastic was used.

Appliances And Treatment Progress

A 0.022" slot Damon Q bracket system (*Ormco*) was used. The mandibular arch was bonded with low torque braces on the anteriors. The archwire sequence for the upper arch was .014 CuNiTi, .018 CuNiTi, .014x25 CuNiTi, .017x25 TMA, and .019x25 SS. The lower archwire sequence was .013 CuNiTi, .018 CuNiTi, .014x25 CuNiTi, . 017x25 TMA, and .019x25 SS.

The initial archwire of the maxillary arch was .014 CuNiTi, and after one month, mandibular arch was bonded and the first archwire was .013 CuNiTi. The posterior bite turbos were placed on the maxillary 2nd molars (#*2 and* #*15*). In the 3rd month, the lingual side of lower first premolars (#*21 and* #*28*) were bonded with buttons. The crossbite elastics (*3/16", 2oz*) from the lower 1st premolars (#*21 and* #*28*) to the upper 1st premolars (#*5 and* #*12*) were introduced to correct the crossbite.

In the 4th month of treatment, the crossbite was corrected (*Fig. 12*) and the archwires were changed to .018 CuNiTi on both arches. Class II elastics (*3/16", 2oz*) from the upper 1st premolars to lower 1st molars were used to resolve the sagittal occlusal discrepancy.

In the 6th month of treatment, .014x25 CuNiTi archwires were placed in the upper and lower arches.

In the 7th month of treatment, a cephalometric film was tacken to evaluate the angulation of the anterior teeth. Two bone screws (*2x12mm OrthoBoneScrew, Newton's A inc.*) were inserted into the infrazygomatic crest. The upper 3-3 were ligated together by figures-of-eight. Elastometric chains were attached from the upper canines to the screws in order to distalize the upper dentition (*Fig. 13*). The Class III

Fig 15:

Inter Proximal Reduction (middle) was performed on upper 2-2 to reduce black triangles. (left: before IPR, right: after IPR and post-treatment)

elastics from the lower lower canines to upper screws were used to retract the lower dentitions (*Fig. 14*).

In the 9th month of treatment, the upper archwire was changed to .019x25 SS. Two hooks were clamped between the upper lateral incisors and canines bilaterally. The elastometric chains were linked from the hooks to the screws and kept as Class III elastic from the lower canines to the upper screws until the 13th month of treatment.

In the 12th month of treatment, the lower archwire was changed to .017x25 TMA. To reduce the black triangles between the lower incisors, the teeth were stripped and the space was closed using elastometric chains.

In the 16th month of treatment, Class II elastic (*1/4", 3.5 oz*) from the upper canines to lower 1st molars were used to resolve the sagittal discrepancy.

In the 21th month of treatment, a panoramic film was taken to evaluate the bracket positions relative to the axial inclinations of all teeth. Inter proximal reduction was performed on the upper 2-2 to reduce black triangles (*Fig. 15*).

Two weeks prior to the completion of active treatment, the light up-and-down elastics (*1/8", 3.5 oz*) were used from the upper 2nd molars to lower 2nd molars for final detailing. After 27 months of active treatment, all appliances were removed. Upper clear overlay and fixed anterior (*Md 3-3*) retainers were delivered for both arches.

Fig. 16: Healthy gingival was noted after crossbite was corrected.

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	84°	82°	2°
SNB°	79°	78°	1°
ANB°	5°	4°	1°
SN-MP°	29°	28°	1°
FMA°	22°	21°	1°
DENTAL ANALYSIS			
U1 TO NA mm	13mm	9mm	4mm
U1 TO SN°	113°	104°	9°
L1 TO NB mm	8mm	12mm	4mm
L1 TO MP°	108°	109°	1°
FACIAL ANALYSIS			
E-LINE UL	-1mm	-3mm	2mm
E-LINE LL	0.5mm	-2mm	1.5mm

Table. 1: Cephalometric summary

Results Achieved

Maxilla (*all three planes*) :

- A - P: Maintained
- Vertical: Maintained
- Transverse: Maintained

Mandible (*all three planes*) :

- A - P: Advanced
- Vertical: Maintained
- Transverse: Expanded in premolar area

Maxillary Dentition

- A - P: Slightly retracted
- Vertical: Intruded
- Inter-molar / Inter-canine Width: Maintained

Mandibular Dentition

- A - P: Slightly advanced incisors
- Vertical: Maintained
- Inter-molar / Inter-canine Width: Maintained

Facial Esthetics: Maintained

Retention

The fixed retainer was bonded from canine to canine in the mandibular arch. 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 the home care and maintenance of the retainers.

Final Evaluation Of Treatment

The ABO Cast-Radiograph Evaluation score was 27 points. The major discrepancies were in the occlusal relation-ships, alignment/rotation, buccolingual inclination, occlusal contacts, marginal ridges and root angulation. Because of the end-on ClassII relationship, the biggest discrepancy was in the occlusal relationship (*14 points*).

The gingival texture is healthy without any bony dehiscence or bone loss (*Figs. 8, 16*). The bilateral crossbite was corrected and the mandibular first premolar areas were expanded from 22mm to 35mm (*Fig. 17*).

Although this was a non-extraction treatment, the facial profile has still changed. The upper lip has slightly retruded by about 0.5 mm. The lower labiomental angle has incrased from 90° to 100° and has become much fuller. The lateral profile has changed and is smoother and gentler than before the treatment (*Fig. 18*).

Overall, the ClassII bilateral first premolars crossbite with a straight profile case treatment ended with to an satisfactory result. The final dentition and facial esthetics are perfect.

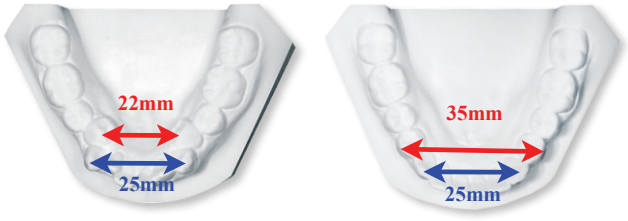

Fig. 17:

Lower arch width was expanded from 22mm (left. red line) to 35mm (right. red line). The inter canine width was kept the same of 25mm (left, right blue line)

Fig. 18: Lateral profile, before and after treatment.

Discussion

It is widely accepted that orthodontic movement can alter esthetics, and orthodontists have suggested that occlusion and facial beauty are interdependent.[1-3] So, orthodontists have attempted to predict how orthodontic tooth movement affects existing facial balance and find out what kind of treatment is favorable for this patient. The most important issue is "*extraction or not ?* "

In the past, the diagnostic tool for decision "*whether to extract or not*" was normally cephalometric radiographs.[4] However, Tweed[5] concentrated on the position and inclination of the mandibular incisors in relation to the basal bone and he also presented that the inclinations of the mandibular incisors are 90° when related to mandibular borders and the FMIA is 65°.[6] Unfortunately, totally reliance on cephalometric analysis sometimes leads to esthetic problems.[7, 8] Because there are multiple factors which can influence the values of cephalometric radiographs. Michiels[9] concluded that (*1*) measurements involving cranial base landmarks are inaccurate in defining the actual clinical profile; (*2*) measurements involving intrajaw relationships were slightly more accurate in reflecting the true profile; (*3*) no measurement is 100% accurate; and (*4*) the soft tissue thickness and axial inclination of incisors are the most important variables in inaccuracy. Another reason may be: different cephalometric analyses are used to examine the same patient, therefore, different diagnoses, treatment plans, and results can be generated. This disparity makes treatment planning based totally on cephalometry ill-advised. Cephalometric normative values may not be accurate because of different soft tissue posturing, etc.[4]

Instead of using cephalometric radiographs, several lines and angles have been used to evaluate soft tissue facial esthetics. The most commonly used is the E-line, which was described by Ricketts. When referring to the ideal E-line relationship, the lower lip should be coincident with a line from the nasal tip to the anterior chin, and the upper lip should be about 1mm behind it.[10] Ricketts also described soft tissue by relating beauty to mathematics. The divine proportion was used by the ancient Greeks (*ratio of 1.0 to 1.618*) and was applied by Ricketts to describe optimal facial esthetics.[11]

In this case, four premolars could have been extracted because of the crowded dentition and the protruding upper anterior teeth. But this decision might have worsened the esthetics because the patient had a straight profile.

It's fortune that the invention of the skeletal anchorage (*dental implants, miniplates and screws*)

can solve the crowded dentition without sacrificing the teeth and allow a more efficient and easier distalization. Preceding skeletal anchorage, there were many appliances for maxillary molar distalization, both intraorally, such as pendulum or distal jet, etc [12-15] or extraorally, such as head-geal.[16] But the intraoral distalization appliances always develop reciprocal, adverse side effects such as premolar extrusion and flaring of the incisors.[17] The extraoral appliances are anesthetic and need patient compliance. The forward movement of the distalized molars during anterior tooth retraction and patient non-cooperation often offsets the treatment effect and prolongs the treatment time.[15, 18]

When managing low-angle patients with crowding in the mandibular arch, the extraction of teeth might be a concern. Extraction may deepen the anterior overbite and make treatment more difficult. Alignment of the teeth without extractions may flare the incisors and deleteriously affect the facial profile. To minimize these problems, the mandibular molars should be distalized.[18] However, there have not been many studies of mandibular molar distalization except for lip bumper investigations. The lip bumper was shown to not only distalize the molars but also to procline the incisors.[19, 20]

To achieve the best results, the treatment plane for this end-on Class II malocclusion with straight profile and low mandibular plane angle patient was non-extraction. We chose bone screw for molar distalization and Damon's light force system to solve the crowding problem. This treatment plane required posterior movement of the maxillary dentition and anterior movement of the mandibular dentitions.

The IZC bone screws not only retracted the whole upper dentition but also were the anchorage of the mandibular teeth. We used ClassIII elastics from the lower canines to the upper screws to retract the lower dentition and relieve crowding, too. This method reduce the placement of bone screws on the lower buccal shelf and save the patient's money.

Comparing the pre-treatment and post-treatment panoramic film, we can see that after the treatment, the lower posterior teeth are more upright. This is the MEAW effect of Damon and bone screws.

The superimposition revealed that the upper incisors were intruded and retracted, and the upper molars were intruded and had moved distally. The lower incisors were moved almost bodily forward and the lower molars were uprighted and tipped back. The overbite and overjet has been reduced and the depth of the lower labiomental fold has been decreased and become smooth. The reasons that the lower incisors did not flare out bucally when the crowded dentition was aligned may be 1. The class III elastic from lower canine to upper bone screws created space. 2. The IPR (*Inter Proximal Reduction*), the main purpose of which was to reduce black triangles, made another space for the elastometric chain to retract the lower dentition and to keep the lower anterior angulation lingually.

The superimposition showed that the upper molar was slightly intruded and lower molar was

mildly extruded as a result of molar distalization. The mandibular plane angle decreased 1°. This is a different outcome from the wedging effect of the distalization appliances. When molars have been distalized by the distalization appliances, the appliances tend to open the mandibular plane and create a wedging effect. However, distalization with screws did not open the mandibular plane. The elastometric chains connected to the screws offer the controlled vertical force to prevent molars extrusion and maintain the mandibular plane angle.

The clinical crown of the uprighted 2nd molar is shorter than before (*Fig. 19*). It is important to educate our patients to clean this area and prevent pericoronitis. If the distance from the 2nd molar to ascending ramus is limited, molar distalization will be contraindicated.

Fig.19:
After treatment (right) the clinical crown of 2nd molar was shorter than before treatment (left).

After the treatment, the intercanine width was kept and the 1st premolar area had expanded 13mm. Due to the light force of the Damon system, after the expansion, no bone dehiscence and gingival recession was noticed and the final result is good and healthy.

Conclusion

The decision of orthodontic treatment may need more consideration about profile change. Extraction may cause narrowed smiles with dark corners or dished-in profiles. The Damon system and bone screws can relieve severe crowding and maintain the patient's good profile with non-extraction treatment. The early light short elastics and bite turbos can easily correct the crossbite.

References

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 31

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 = 3

OVERBITE

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

Total = 3

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 8 pts.
Beyond Class II or III	=	1 pt. per mm. additional ____ pts.

Total = 8

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 1

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° _____ x 2 pts. = _____

≤ 26° = 1 pt.

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

1 to MP ≥ 99° = 1 pt.

Each degree > 99° 9 x 1 pt. = 9

Total = 9

OTHER (See Instructions)

Supernumerary teeth	_____ x 1 pt. =	_____
Ankylosis of perm. teeth	_____ x 2 pts. =	_____
Anomalous morphology	_____ x 2 pts. =	_____
Impaction (except 3rd molars)	_____ x 2 pts. =	_____
Midline discrepancy (≥3mm)	@ 2 pts. =	_____
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: Trans-alveolar impaction

Total = 0

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

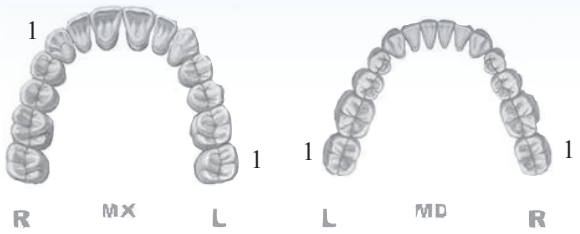
Cast-Radiograph Evaluation

Case # 1 **Patient**

Total Score: 23

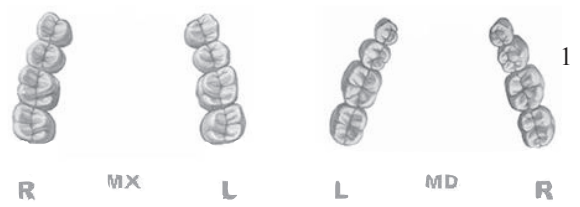
Alignment/Rotations

4



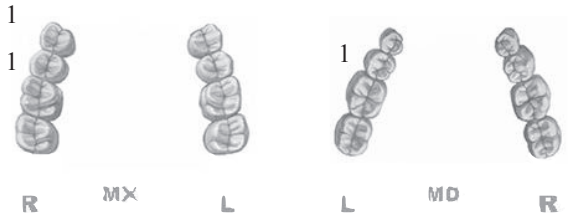
Marginal Ridges

1



Buccolingual Inclination

3

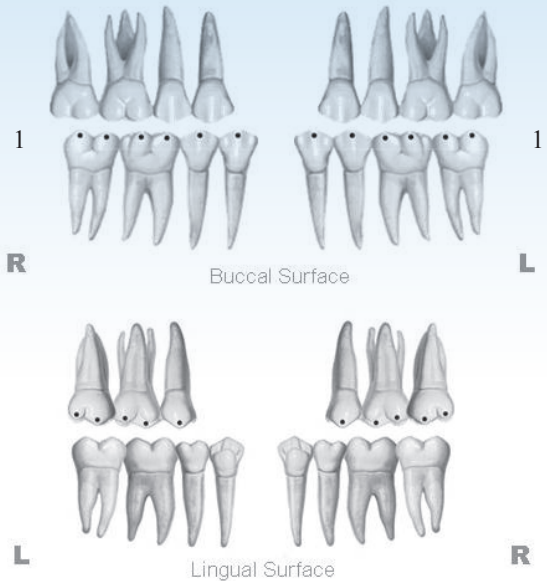


Overjet

0

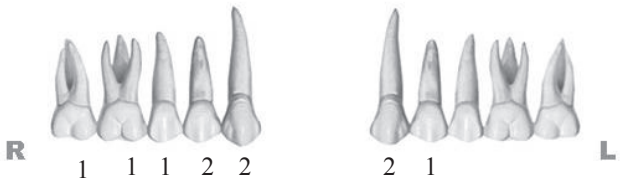
Occlusal Contacts

2



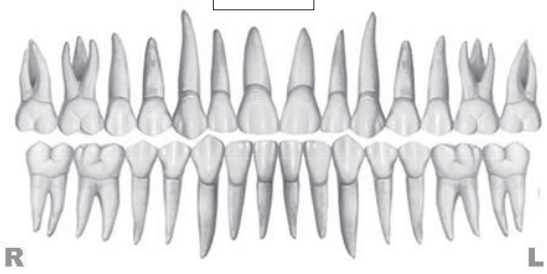
Occlusal Relationships

10



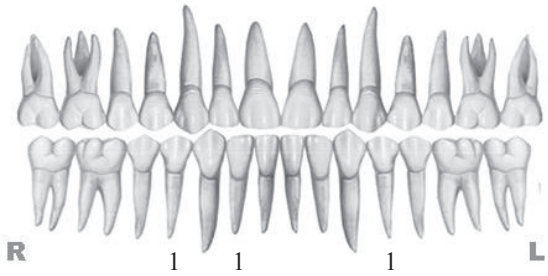
Interproximal Contacts

0



Root Angulation

3



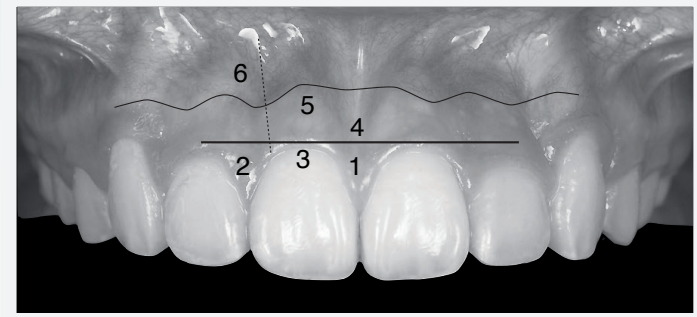
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 4

Pink Esthetic Score

Total = 2

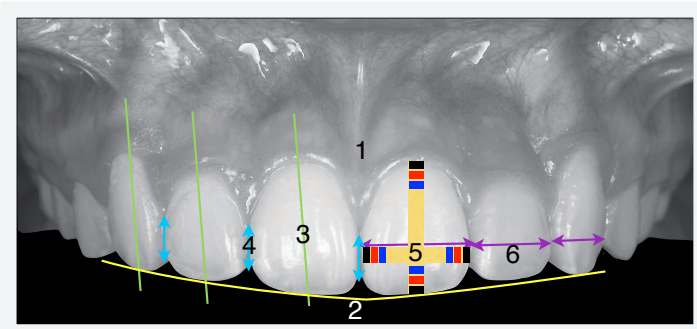


M & D Papillae	0	1	2
Keratinized Gingiva	0	1	2
Curvature of Gingival Margin	0	1	2
Level of Gingival Margin	0	1	2
Root Convexity (Torque)	0	1	2
Scar Formation	0	1	2

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 = 2



Midline	0	1	2
Incisor Curve	0	1	2
Axial Inclination (5º, 8º, 10º)	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 (5º, 8º, 10º)	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