

Class I Anterior Crossbite

Clinicians: Drs. Chris Chang, Ya Chen Chen, W. Eugene Roberts

Patient: Miss Lin

Pre-treatment Diagnosis

A 16 yr old female patient, with an anterior cross-bite and blocked-out upper canines presented for consultation. The cephalometric skeletal pattern was within normal limits (WNL) and the buccal segments were Class I bilaterally. All third molars were impacted, and both arches were constricted. Severe crowding was noted in both arches, but there was no functional shift nor history of temporomandibular disorder (TMD). The Discrepancy Index (DI) was 30.

Etiology

The malocclusion probably evolved from two developmental problems: 1. deficient arch width, due to the inadequate masticatory loading, associated with a relatively soft diet, and 2. ectopic, palatal eruption of the maxillary central incisors producing an anterior crossbite.

Facial/Soft Tissue/Macroesthetics

A slightly convex profile (G-Sn-Pg') was within normal limits (WNL) with relatively protrusive lips to the E-line (-2/+2mm), and an asymmetric vermilion display of the lower lip was found. Nasal-labial angle, facial vertical proportion, and chin projection were WNL (Fig. 1).

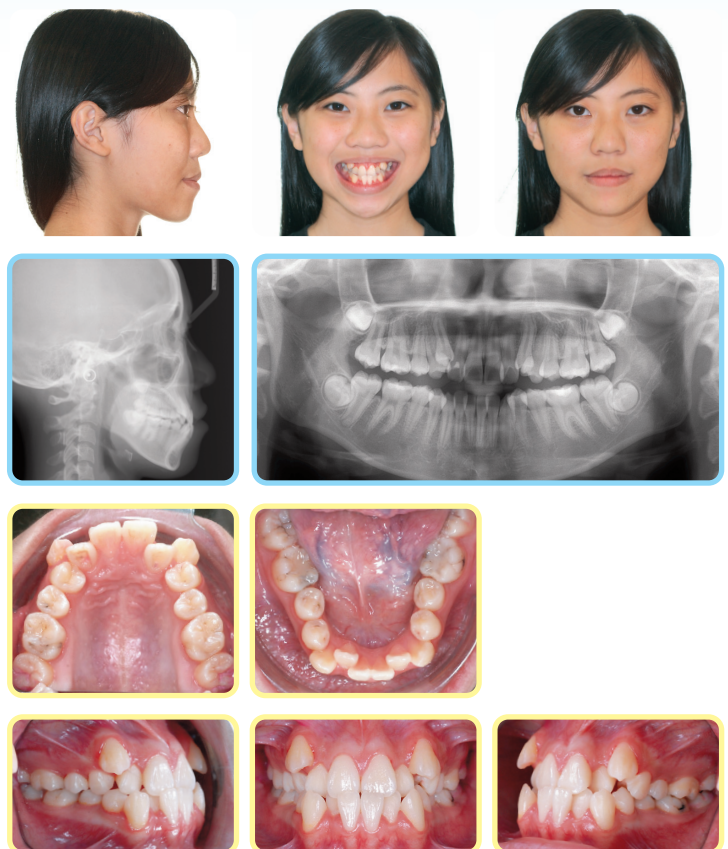
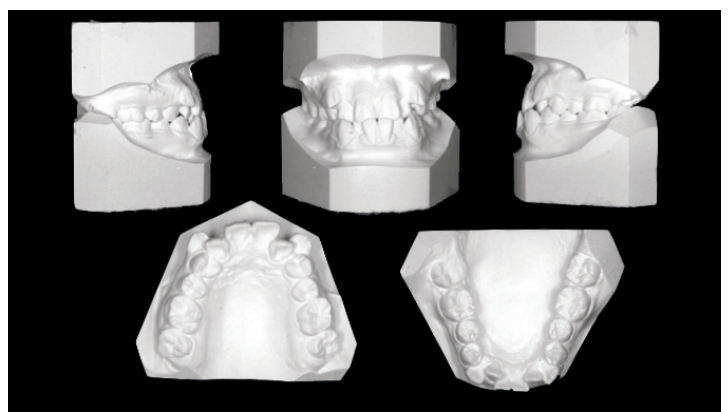


Fig. 1: Initial records



Appliance Used:

Damon® QTM

Smile/Miniesthetics

Disharmony of the smile arc was associated with an irregular anterior segment due to severe crowding, blocked out maxillary canines, anterior crossbite, and excessive buccal corridor exposure (Fig. 1).

Teeth/Microesthetics

Unesthetic dentition was due to severe intermaxillary crowding, anterior crossbite, and high blocked-out canines. Irregular gingival height was associated with gingivitis particularly on the labial surface of the canines. The upper left (UL) central incisor is ~1mm wider than the adjacent right central incisor. Caries is evident on both lower first molars (Fig. 1).

Table 1: Damon Q Variable Torque Employed

U1s: Standard torque (+15°)

U2s: Standard torque (+6°)

U3s: Super torque (+11°)

L2-2s: Standard torque (-3°)

L3s: Super torque (+13°)

Treatment Objectives and Plan

Correct oral hygiene to eliminate gingivitis and restore caries. Extract all four first premolars to resolve anterior crowding. Use a full fixed Damon Q® self ligation appliance with differential torque brackets as specified (Ormco, Glendora, CA, Table 1). Bond the upper arch, construct glass ionomer bite turbos (BTs) on the occlusal surface of the lower second molars to open the vertical dimension of occlusion (VDO). Place an .014" CuNiTi archwire to correct the anterior crossbite and align the maxillary canines. Follow the archwire sequence recommended by the manufacturer, and use pre-stretched power chain to close space in the upper (U) and lower (L) arches. Correct asymmetric tooth size and black triangles with interproximal stripping (IPR), and space closure. Detail the final alignment and occlusion with bracket repositioning and archwire adjustment, as needed.

Treatment Sequence

Caries were restored and hygiene deficiencies were corrected prior to installing the fixed appliance. The archwire sequence chart (Fig. 2) shows the mechanics plan.

U: Direct bonded brackets were placed 7-7, except for UL2 because of a lack of space. An .014" CuNiTi archwire (AW) was placed with crimpable stops mesial and distal to the UR1 bracket. An open coil spring was inserted between UL1 and UL3 to increase space (Fig. 3).

L: BTs were constructed on the occlusal surfaces of the lower second molars (LR7 and LL7).

3 Months

U: Anterior crossbite was corrected, and upper extraction spaces were almost closed. The open coil spring was reactivated by polymerizing flowable resin on the AW mesial to the UL3.

L: Brackets were direct bonded from 7-7 and an .014" CuNiTi AW was placed with crimpable stops medial and distal to the LL1. All brackets were engaged except the lingually blocked-out LR2 and LL2. Coil springs were placed to open space between LR3 and LR1, and LL1 and LL3 (Fig. 4).



■ Fig. 3: Bonding the upper arch at the start of treatment



■ Fig. 4: 3 Months progress

6 Months

U: The UL2 bracket was bonded, the UR3 and UR2 brackets were rebonded, and an .014 x .025" CuNiTi archwire was placed.

L: Open-coil springs were removed, and LL2 and LR2 were engaged on the the .014" CuNiTi archwire (Fig. 5).



■ Fig. 5: 6 Months progress

10 Months

U: IPR was performed from UR2 to UL2, and an .017 x .025" TMA archwire was placed. Drop-in hooks were inserted on the UL3 and UR3, and a 6-6 power chain was used to close interproximal spaces.

L: An .014 x .025" CuNiTi archwire was inserted (Fig. 6).



■ Fig. 6: 10 Months progress

12 Months

U: An .016 x .025" stainless steel (SS) archwire was placed with step-out bends (*canine sweep*) for UR3 and UL3, and step-down bends mesial to UR4 and UL4. The anterior segment (3-3) was laced with a SS ligature, and power chain was activated from lower 3-6, bilaterally.

L: Transitioned to .017 x .025" TMA archwire with step-up bends of R4 and L4. Placed drop-in hooks on L3 and R3. Laced 3-3 with a SS ligature tie. Power chain applied from 3-6, bilaterally.

U/L: L-shaped Class II elastics were placed bilaterally (*Fox, 1/4", 3.5 oz, full time*).

14 Months

U: Power chain activated from 3-6, bilaterally.

L: Placed an .016 x .025" SS archwire with power chain from 3-6 bilaterally, and removed the bite-turbos.

U/L: L-shaped Class II elastics on the left side to correct the midline deviation (*Fox, 1/4", 3.5 oz, full time*).

17 Months

U/L: Applied power chain 3-7, bilaterally, and maintained L-shaped Class II elastics on the left side (Fig. 7).



■ Fig. 7: 17 Months progress

20 Months

U: Placed drop-in hooks on UR5 and UL5 with power chain from 3-6, bilaterally.

L: Power chain from 3-6 bilaterally, and buttons were bonded on the lingual surface of LL5s and 6s to receive lower posterior cross-bite elastics.



U/L: Bilateral triangular cross-bite elastics L6-L7-U5 (*Chipmunk*, 1/8", 3.5 oz. full time) were prescribed, and the L-shaped Class II elastic on the left side was continued.



21 Months

All appliances were removed, and a fixed lingual retainer was bonded on the lingual surface of all teeth in the lower 3-3 with dead soft .019" SS. Clear overlay retainers were delivered for both arches with instructions for full time wear the first 6 months and nights only thereafter (Fig. 8).



■ Fig. 8: 21 Months-Treatment Complete

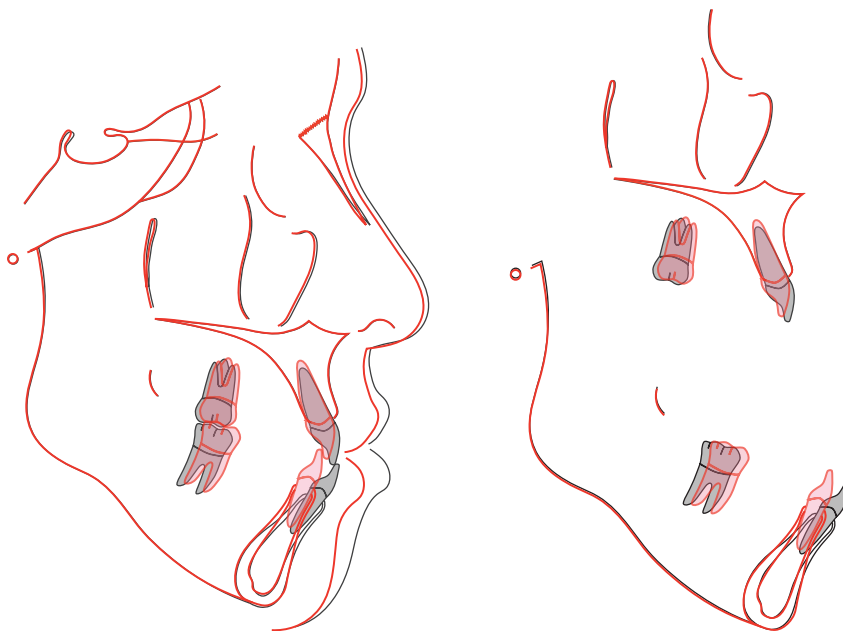
Case Discussion

There was no significant change in the mandibular plane angle or VDO, but facial convexity increased 4° as the lip protrusion was decreased. Correction of the anterior cross-bite and modest expansion of the arches resulted in an esthetic functional occlusion, that completely filled the buccal corridors when smiling. The Cast Radiograph Evaluation (CRE) was an acceptable 26 points, as documented by the worksheet at the end of this report. Alignment and intercuspation were near ideal, but third order alignment of the molars was a major deficiency (8 points).

Damon System brackets are produced with a variety of torque options. It is important

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	80°	80°	0
SNB° (80°)	78°	77.5°	0.5
ANB° (2°)	2°	2.5°	0.5
SN-MP° (32°)	44.5°	44°	0.5
FMA° (25°)	37.5°	37°	0.5
DENTAL ANALYSIS			
U1 TO NA mm (4 mm)	3 mm	6 mm	3
U1 TO SN° (110°)	101.5°	98°	3.5
L1 TO NB mm (4 mm)	9 mm	4 mm	5
L1 TO MP° (90°)	96°	87°	9
FACIAL ANALYSIS			
E-LINE UL (-2 mm)	-2 mm	-3 mm	1
E-LINE LL (0 mm)	2 mm	0 mm	2
% FH NA-ANS-GN (53%)	56.9%	56.9%	0
Convexity G-Sn-Pg' (13°)	6°	10°	4°

■ Table 2: Cephalometric Summary



■ Fig. 9:

The superimposed cephalometric tracings showed the facial profile was improved 4° after upper and lower anteriors retracted. See the Cephalometric Summary for details.

to carefully select the required torque for each tooth based on crown morphology and the applied mechanics. If torque is not appropriately applied during the alignment phase, treatment time and clinical effort are increased considerably, because torque correction requires root movement.

For the present patient, a standard torque appliance was selected for the incisors but increased torque brackets were utilized for the cuspids. This configuration is desirable for space closure mechanics because it holds the canine roots in the center of the alveolar process, and prevents excessive labial root movement during space closing.

With PSL brackets, open coil springs easily increase interproximal spaces, but the side effect is flaring the incisors. The Damon system, with open coil springs and bite turbos, facilitated the correction of the anterior crossbite within 3 months, without the aid of Class III early light short elastics (ELSE).

An interim panoramic radiograph is indicated before placing rectangular archwire(s). If the long axes of a tooth is not parallel, the bracket on that tooth is rebonded with the angle necessary to correct the inclination by releveling with a flexible archwire. Once an entire arch is leveled with correct axial inclinations, it is ready for the .014 x .025" CuNiTi. Repositioning brackets at this stage of treatment is also of great importance for an efficient, high-quality finish.



■ Fig. 10:

Comparison of the initial and final records: facial and intraoral photographs and stone casts

When transitioning to TMA finishing wires, it is important to check the dental esthetics: incisor morphology, black triangles, smile line, and overall harmony of the dentogingival display. Smile arc correction usually requires more apical or gingival positioning of the bracket. Black triangles are managed with interproximal

reduction (*IPR*) and space closure. Dental contour changes in the esthetic zone are best accomplished with fine diamond burs to achieve a more natural tooth morphology.

In Retrospect

It is important to carefully assess the finish (*Figs. 8-10*). CRE scores alignment, and the Pink & White assessment critically evaluates dental esthetics. Some of the problems detected retrospectively can be corrected during retention, but even if the patient does not benefit from the post-treatment analysis, it is an excellent learning opportunity for avoiding similar problems on future patients.

The deficiencies detected for the present patient were asymmetry in the size of the maxillary central incisors, slight midline deviation, and excessive buccal tipping of the maxillary molars. *IPR* could be performed on the distal of the UL1, followed by space closure to correct midline, if there is adequate overjet. Since there was no anterior overjet, it would be necessary to strip the lower incisors and close space to create overjet for the maxillary incisor correction. It is not wise to attempt such an extensive correction after the fixed appliances are removed, because there is no control over the axial inclinations of the teeth involved.

The Damon system is effective for expanding arches, but it is a slow process requiring light forces to generate counter-moments for



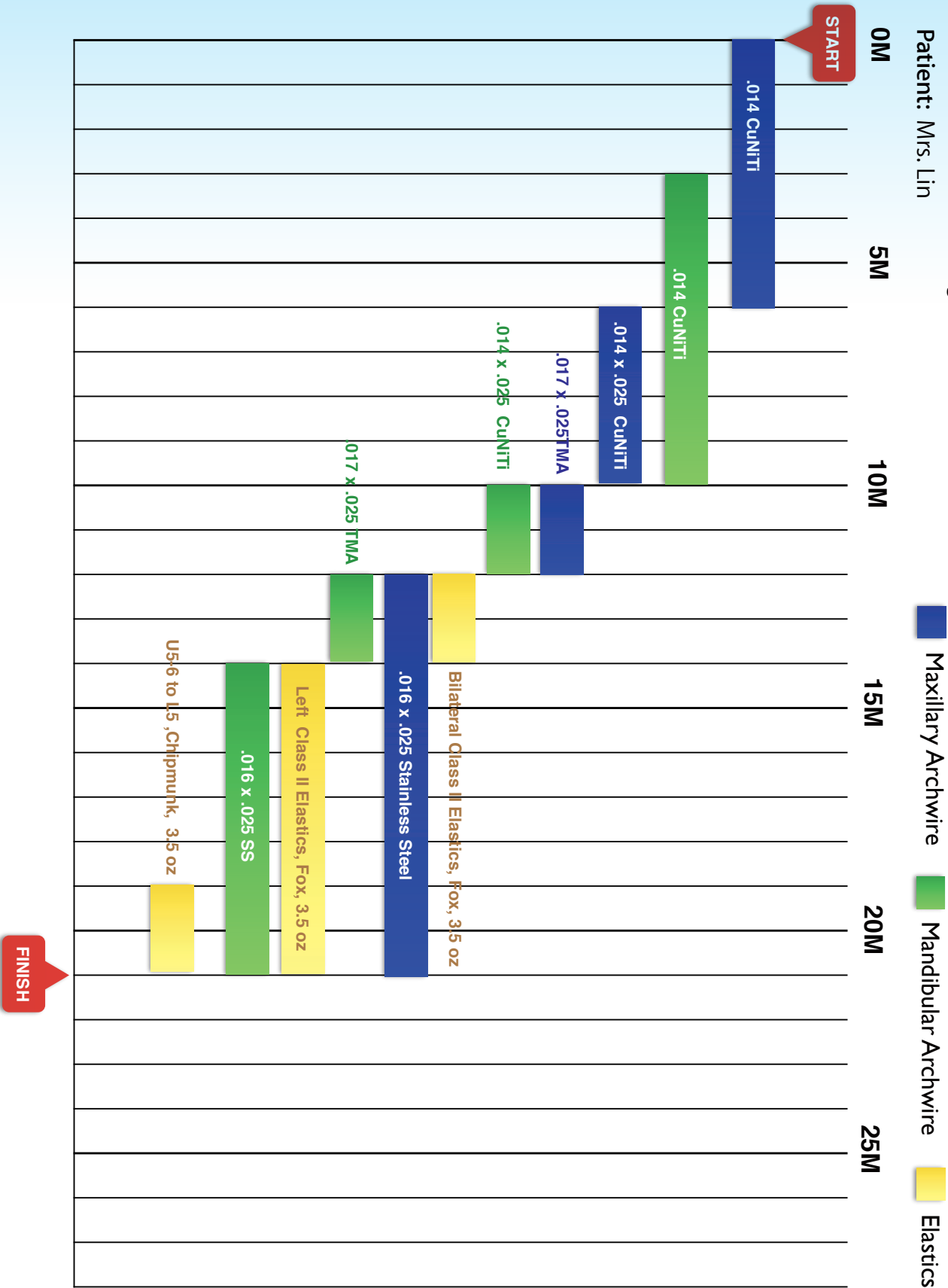
■ Fig. 11 : 1 year follow-up photographs

buccal segment translation as the cusps of the teeth are tipped into the cheek mucosa. Each light archwire must be used for a long period of time in a carefully prescribed sequence. For the present patient (*Fig. 8*), the buccal segments were excessively tipped, resulting in third order axial inclination problems, and decreased cusp contacts. In retrospect, 10-15° of progressive buccal root torque in the upper posterior segments of the TMA archwire was needed to avoid buccal tipping. This amount of torque must usually be accompanied with additional arch expansion to avoid a posterior crossbite tendency.

Some minor rotations were correctable with detailing adjustments in the SS archwire. Better arch coordination was needed to improve the occlusal relationship and dental contacts. At the debonding appointment, the gingival papilla at the maxillary midline was swollen, but the patient declined a modest gingivectomy with a Diode Laser. Despite these modest problems the CRE score for dental alignment was an acceptable 26, and dentofacial esthetics were good. One year follow-up records (*Fig. 11*) show the result was not only stable but the occlusion continued to improve.

Archwire Sequence Chart

Clinicians: Dr. Chris Chang
Patient: Mrs. Lin



Discrepancy Index Worksheet

30

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 =

9

OVERBITE

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

0

ANTERIOR OPEN BITE

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

0

LATERAL OPEN BITE

2 pts. per mm. per tooth

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.

7

OCCLUSION

Class I to end on	=	0 pts.
End on Class II or III	=	2 pts. per side _____pts.
Full Class II or III	=	4 pts. per side _____pts.
Beyond Class II or III	=	1 pt. per mm. _____pts. additional

0

LINGUAL POSTERIOR X-BITE

0

BUCCAL POSTERIOR X-BITE

0

CEPHALOMETRICS (See Instructions)

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

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

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

SN-MP

$$\geq 38^\circ = 2 \text{ pts.}$$

7

14

$$\leq 26^\circ = 1 \text{ pt.}$$

Each degree $< 26^\circ$ x 1 pt. =

1 to MP $\geq 99^\circ$ = 1 pt.

Each degree $> 99^\circ$ x 1 pt. =

14

OTHER (See Instructions)

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

Identify:

C

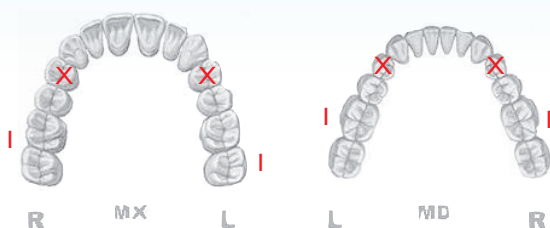
Cast-Radiograph Evaluation

Total CRE Score

26

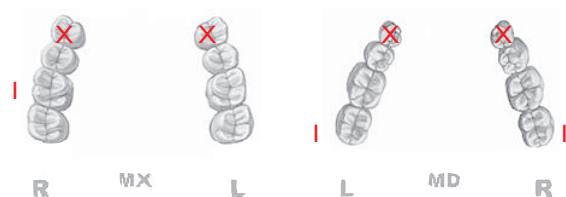
Alignment/Rotations

4



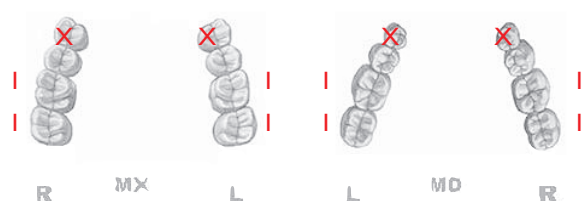
Marginal Ridges

3



Buccolingual Inclination

8



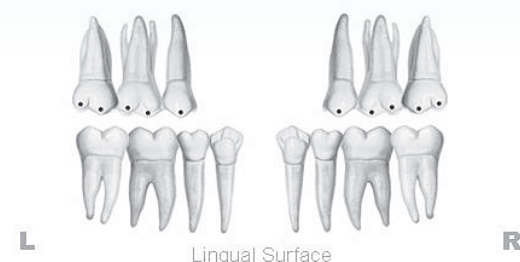
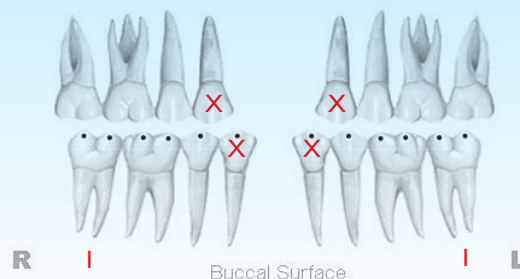
Overjet

2



Occlusal Contacts

2



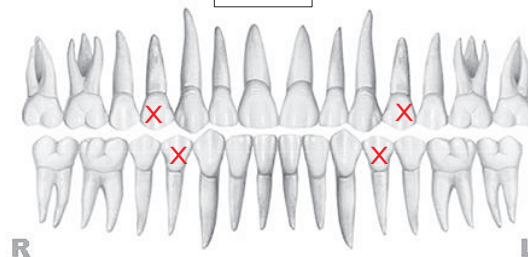
Occlusal Relationships

4



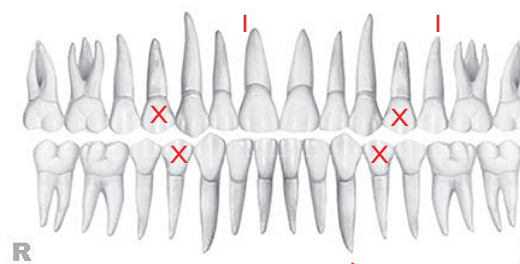
Interproximal Contacts

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.