Implant-orthodontic Combined Treatment: Over-erupted Molar and Scissors-bite Correction

History and Etiology

A 28-year-2-month-old male was referred for orthodontic consultation by his family dentist (*Fig. 1*). His chief concern was the restorative need for a missing lower molar (*Figures 2, 3*). A pre-prosthetic orthodontic plan was proposed. There was no contributory medical or dental history. Clinical examination revealed a Class I molar relationship on the right, but the left premolars were Class II (*Figures 2, 3*). The mandibular dental midline was 3 mm to the left of the facial and maxillary midlines. Cast evaluation documented the following dental problems: 1. scissors-bite over upper second molars bilaterally. 2. extrusion of the maxillary left first molar. 3. minor crowding in both arches. The patient was treated to an acceptable result as documented in Figures 4-9, as will be subsequently discussed.

Fig. 1: Pretreatment facial photographs

Fig. 2: Pretreatment intraoral photographs

Fig. 3: Pretreatment study models

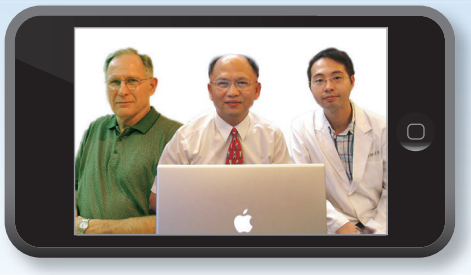
Diagnosis

Skeletal:

- Skeletal Class I (*SNA 83°, SNB 80°, ANB 3°*)
- Mandibular plane angle (*SN-MP 32°, FMA 28°*)

Dental:

- Class I molar relationship on the right side, left buccal segment is Class II
- The overbite and overjet were both 2 mm
- The mandibular dental midline was 2 mm to the left of the facial and maxillary midlines
- The lower left first molar is missing
- Slight crowding in both the upper and lower arches



Dr. Bill Su, Director, Newtons Implant Center (right)
Dr. Chris Chang, Director, Beethoven Orthodontic Center (middle)
Dr. W. Eugene Roberts, Consultant,
International Journal of Orthodontics & Implantology (left)

Scissors-bite of the second molars bilaterally (*Fig. 10*)

Extrusion of the maxillary left first molar (*Fig. 10*)

Lingual cross-bite of the left first premolars.

Facial:

Profile and lip position are within normal limits (*WNL*)

The IBOI Discrepancy Index (*DI*) was 16 as shown in the subsequent worksheet.[1]

Specific Objectives of Treatment

Maxilla (*all three planes*):

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

Mandible (*all three planes*):

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

Maxillary Dentition

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

Mandibular Dentition

- A - P: Maintain
- Vertical: Maintain
- Inter-molar / Inter-canine Width: Maintain

Facial Esthetics: Maintain

Fig. 4: Posttreatment facial photographs

Fig. 5: Posttreatment intraoral photographs

Fig. 6: Posttreatment study models

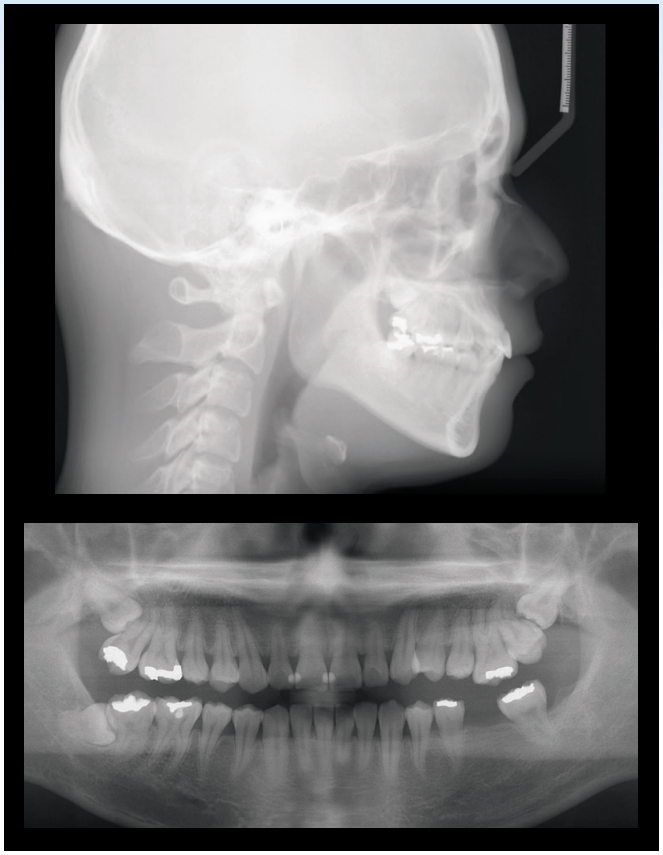


Fig.7: Pretreatment pano and ceph radiographs

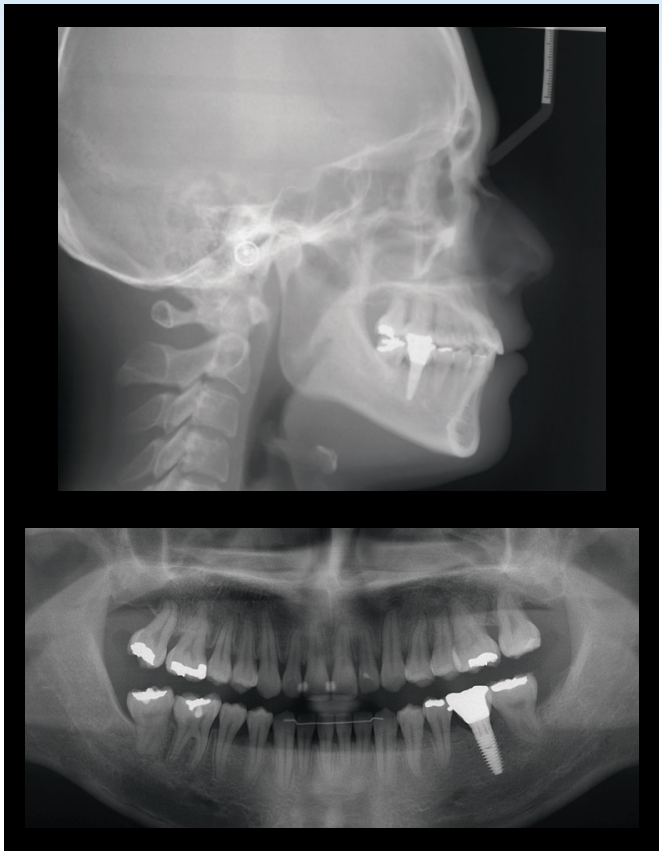


Fig. 8: Posttreatment pano and ceph radiographs

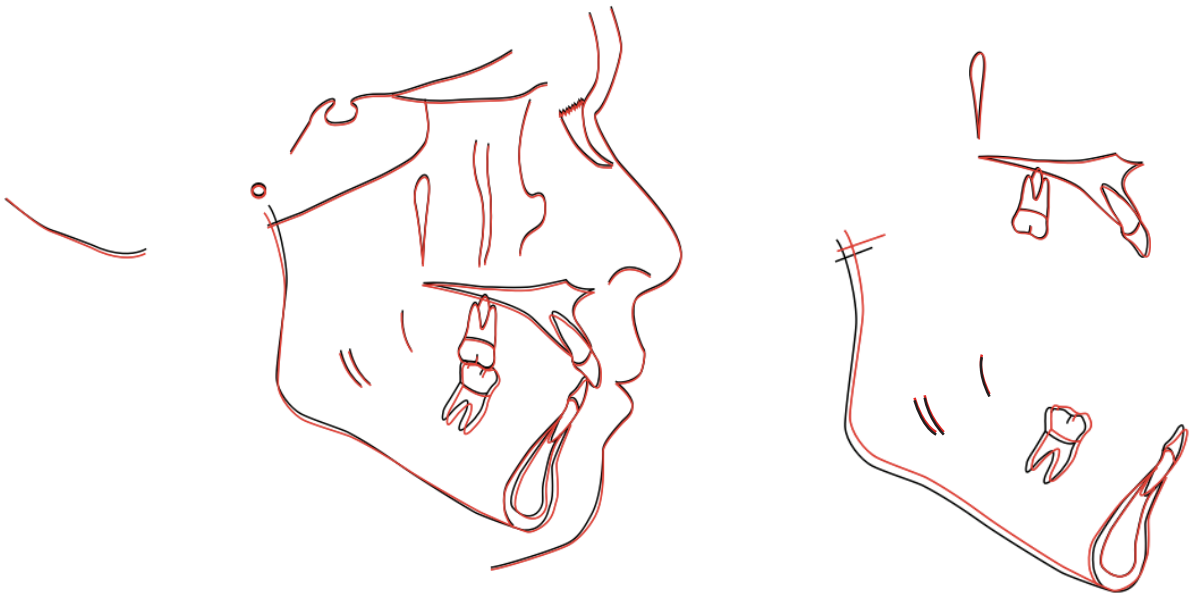


Fig. 9: Superimposed tracings, Maintain Mx. & Md. A-P position, slightly flared U & L incisors.

Fig. 10:

Over-extrusion of a maxillary molar usually results from loss of its anatagonist. The elongated edentulous space in the dentoalveolar process may lead to functional disturbances and occlusal interferences, that prove challenging for prosthetic reconstruction.

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	83°	83°	0°
SNB°	80°	81°	1°
ANB°	3°	2°	1°
SN-MP°	32°	33°	1°
FMA°	28°	29°	1°
DENTAL ANALYSIS			
U1 TO NA mm	5 mm	5 mm	0 mm
U1 TO SN°	112°	113°	1°
L1 TO NB mm	5 mm	6 mm	1 mm
L1 TO MP°	87°	89°	2°
FACIAL ANALYSIS			
E-LINE UL	0 mm	-1 mm	-1 mm
E-LINE LL	0 mm	0 mm	0 mm

Table. Cephalometric summary

Treatment Plan

Non-extraction treatment with a full fixed orthodontic appliance was indicated to align and level the dentition. Occlusal posterior bite turbos were placed on the lower right first molar and cross elastics were used for the second molar scissors-bite correction. To intrude the supra-erupted molar (*Fig. 10*), an extra-alveolar miniscrew (*2x12 mm, OrthoBoneScrew, Newton's A, Inc.*) was inserted in the hard palate, 3 mm away from mid-palatal suture (*Fig. 11*).[2]

Inter-maxillary elastics were used to correct the sagittal discrepancy and the occlusion was detailed with finishing bends. Fixed appliances were removed and the corrected dentition was retained with fixed anterior retainers on the lower arch and a clear overlay retainer on the upper arch.

Treatment Progress

For fixed appliance treatment, .022" slot Damon D3MX brackets (*Ormco*) were selected. The archwire sequence was: .014 NiTi, .016 NiTi, .014x.025 NiTi, .017x.025 TMA, and .016x.025 SS. Occlusal bite turbos, made with glass ionomer cement, were placed on lower right first molar. A button was bonded on the lingual side of the lower right second molar to accommodate upper and lower criss-cross elastics for scissors-bite correction.[3,4] After six months of initial alignment and leveling, a panoramic film was taken. All malaligned brackets were rebonded.

In the 17th month, an extra-alveolar miniscrew (*2x12 mm, OrthoBoneScrew, Newton's A, Inc.*) was inserted in the hard palate, 3 mm away from mid-palatal suture (*Fig. 11*). The miniscrew was connected to a lingual button on UL6, by a power chain designed to intrude the supra-erupted molar.

Implant Placement Procedures

The lower excessive space, due to the missing LL6 was slightly closed by sliding mechanics with power chains over an .016x22 SS wire. In the 18th month, an implant was installed to replace the missing LL6, using a surgical stent to guide the correct position of the fixture (*Fig. 12*).[5] After opening of a full thickness flap, the buccal flap was sutured on the cheek and lingual flap was tied with a needle holder and across over the mouth corner in order to obtain a clear surgical view (*Fig. 13*).

After the flap was elevated, the sharp edge of the

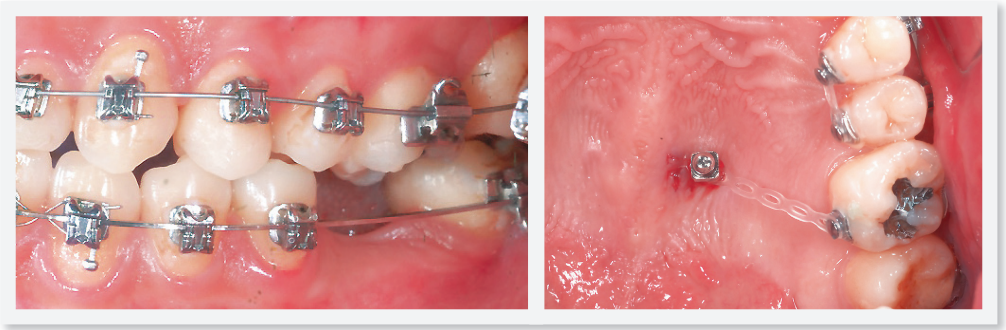


Fig. 11:

To intrude the palatal cusp of the supra-erupted molar, an extra-alveolar miniscrew (2x12 mm, OrthoBoneScrew, Newton's A, Inc.) was inserted in the hard palatine, 3 mm away from mid-palatal suture.

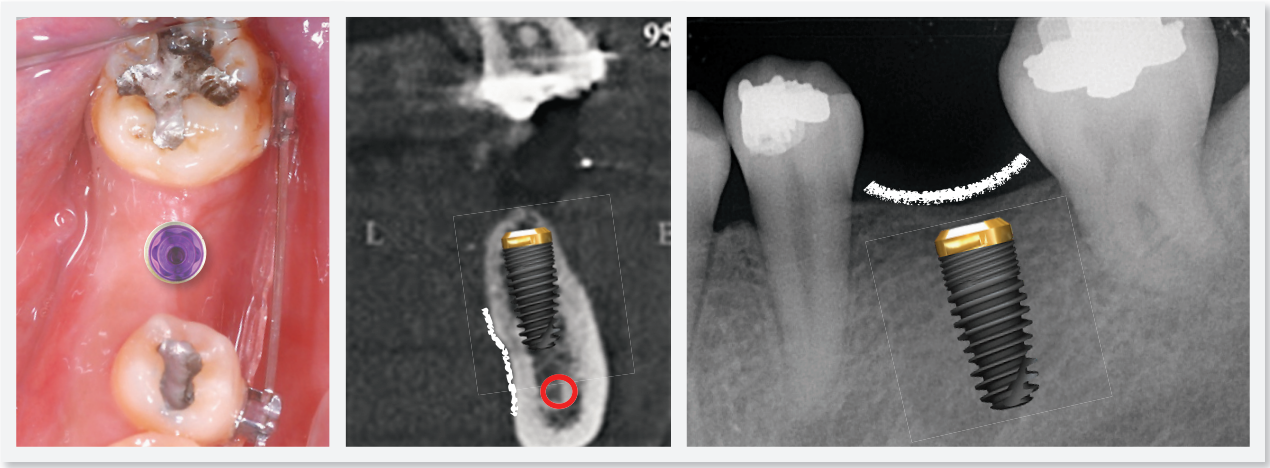


Fig. 12:

There are five factors for ideal implant position as follows: 1. M-D (center), 2. B-L (2 mm buccal bone thickness), 3. Depth (3mm depth from crown margin), 4. Angulation (max. 15°), 5. Distance to adjacent tooth / implant (≥1.5 mm for tooth, ≥ 3 mm for implant). From the CBCT slice view, anatomic risk factors on the mandible (inf. alveolar n. and lingual concavity) should be concerned.

bone was removed with a carbide round bur. From the occlusal view of the ridge, there was enough width to place 4.8 diameter implant (*Fig. 13*). Following the recommended drilling protocol,[6] a 4.8x11.5mm wide diameter fixture with pre-mounted abutment was placed (*Fig. 14*). The healing abutment with a 3 mm gingival height was placed and the flap was sutured with direct loop interrupted 5-0 nylon suture (*Fig. 15*). Fig. 16 is a view of the postoperative radiographs. Figures 18, 19 show the 3 and 9-month, respectively, postoperative intra-oral photos and peri-apical films.

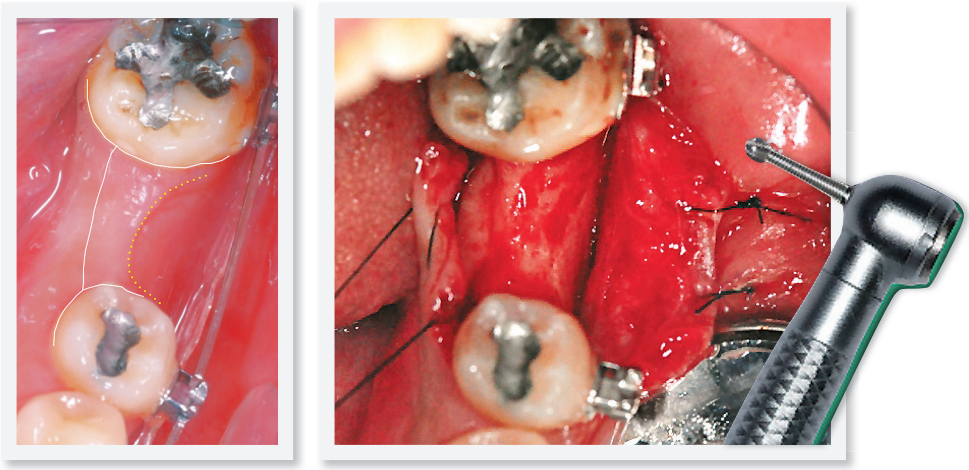


Fig. 13a, b:

Intra-sulcular and lingual horizontal incision were made and elevated the flap. the buccal flap was sutured on the cheek and lingual flap was tied with needle holder and across over the mouth corner in order to obtain the clear surgical view. Remove the sharp edge on the alveolar crest with carbide round bur.

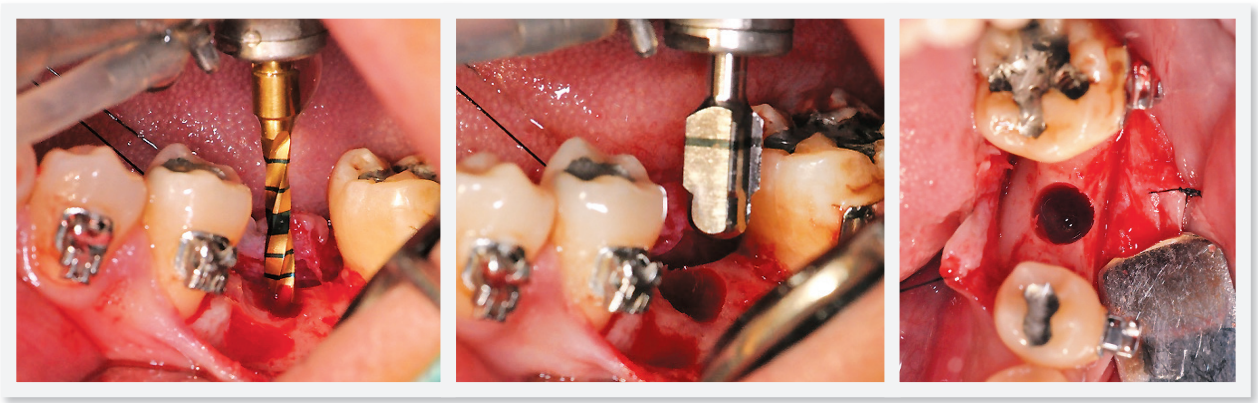


Fig. 14a, b, c:

Osteotomy procedure followed standard drilling sequence.

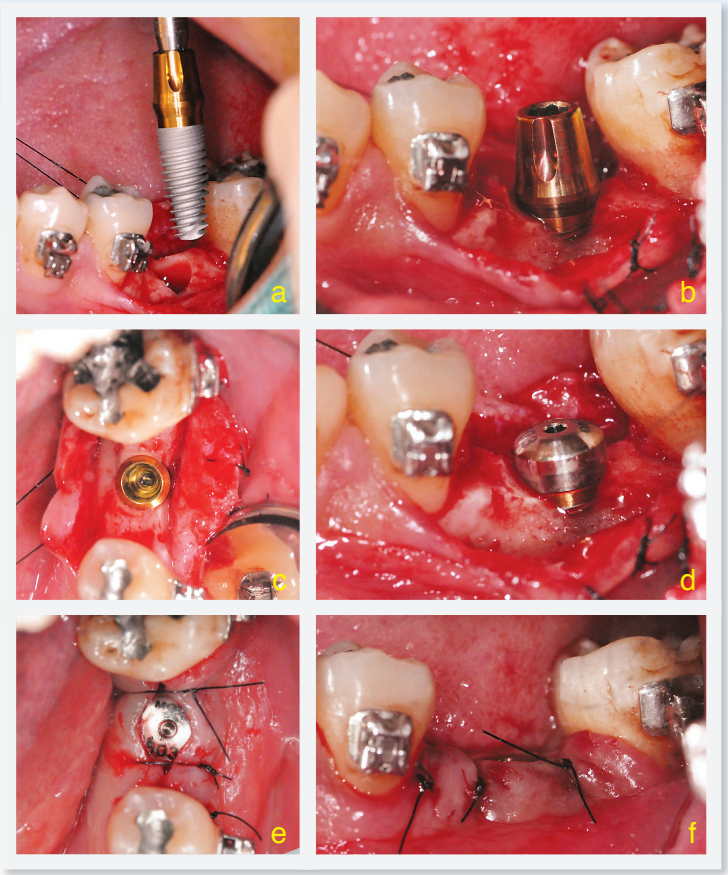


Fig. 15a, b, c, d, e, f:

4.8x11.5mm wide diameter fixture with premounted abutment was placed. The healing abutment with 3 mm gingival height replaced the abutment and sutured the flap with direct interrupted suture (5-0 Nylon).

Fig. 16:

Post-Op panorex and periapical films

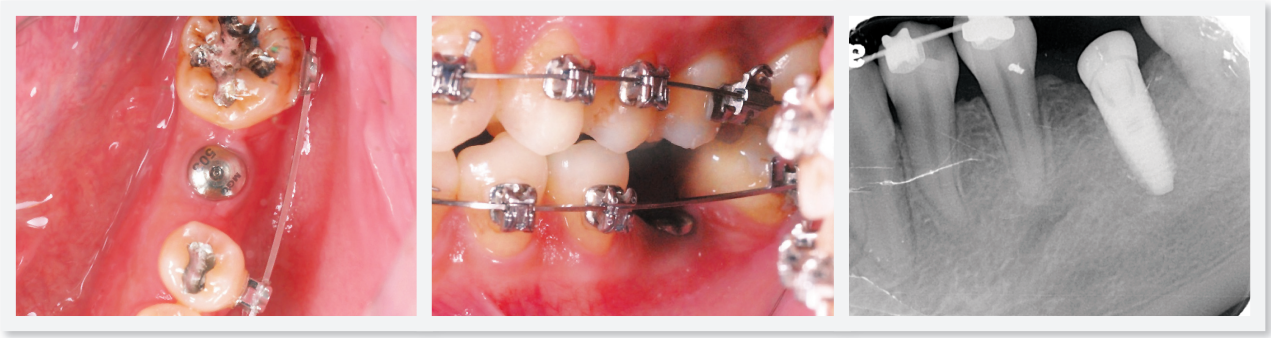


Fig. 17a, b, c: In the 21th of orthodontic tx. 3 months post-Op intra-oral photos and periapical film.

Fig. 18a, b, c: In the 28th of orthodontic tx. 9 months post-Op intra-oral photos and periapical film.

Orthodontic Finishing

In the 19th month of treatment, a torquing spring was applied upside down on the UL3 for labial root torque (*Fig. 19*). Prefinish records, consisting of study casts and panoramic film, were reviewed to assess alignment, marginal ridge discrepancies etc. according to American Board of Orthodontics' (*ABO*) evaluation standards, using the Cast-Radiographic Evaluation sheet. Teeth with second order axial inclination problems were adjusted by rebonding the brackets.[7]

In the 27th month, the upper archwire was sectioned distal to the canines, one month prior to the completion of treatment. Light up and down elastics (*2 oz*) were used for final detailing. Appliances were removed and retainers were delivered. Maxillary midline frenectomy and gingivoplasty of the maxillary lateral incisors was accomplished with a diode laser (*Fig. 20*). The single implant to replace the missing LL6 for #36 was referred for restorative care (*Figures 21-26*).[8]

Fig. 19:

In the 19th month of treatment, a torquing spring was applied upside down on the UL3 for labial root torque.

Fig. 20:

Maxillary midline frenectomy and gingivoplasty of the maxillary lateral incisors was accomplished with a diode laser.

Implant Prosthesis Fabrication

The healing abutment was removed and replaced with a multi-post abutment that had a 5.5 mm post height and 1 mm cuff height from the implant fixture.[9] Fig. 21d showed the abutment did not seat completely, so it was adjusted until the abutment was well seated. The torque rachet was applied on the screw until 35 Ncm was achieved (*Fig. 21*). A direct impression, made with polyvinyl siloxane, was poured with type IV dental stone, and the casts were subsequently articulated using the appropriate check-bite records (*Fig. 22*). Metal copping was fabricated by the laboratory, and marginal integrity was verified with a dental explorer (*Fig. 23*). Appropriate tightness of the contact area was confirmed with dental floss (*Fig. 24*). The occlusal area was made of metal, with a screw access hole, and porcelain was baked onto the buccal surface (*Fig. 25*). After clinical adjustment and verification of the fit and occlusion, the definitive crown was completed and luted to place with permanent cement. The screw access hole was filled with composite resin (*Fig. 26*).[10]

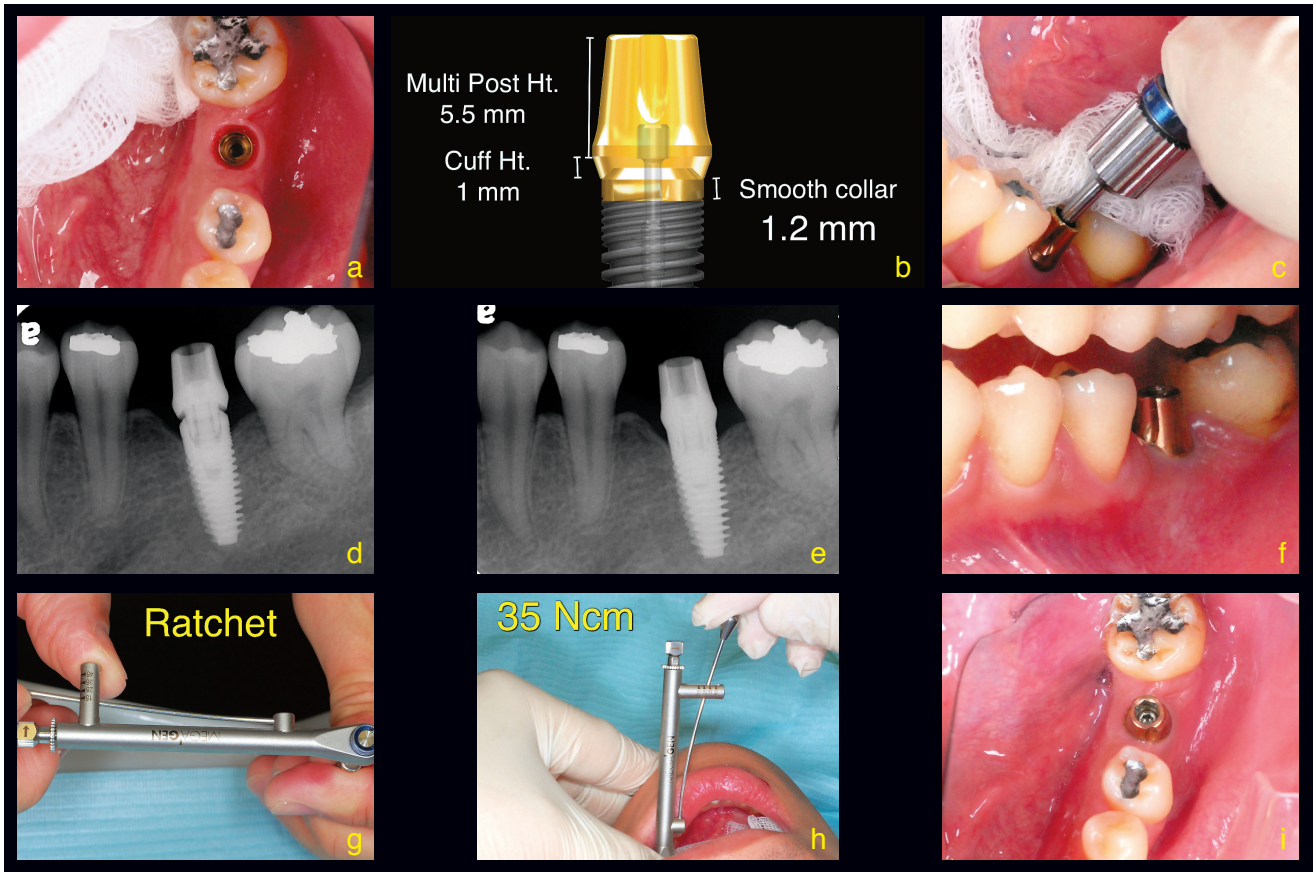


Fig. 21a, b, c, d, e, f, g, h, i:

The healing abutment was removed and replaced with a multi-post abutment that had a 5.5 mm post height and 1 mm cuff height from the implant fixture. Fig. 21d showed the abutment did not seat completely, so it was adjusted until the abutment was well seated. The torque rachet was applied on the screw until 35 Ncm was achieved.

Fig. 22a, b:

A direct impression, made with polyvinyl siloxane, was poured with type IV dental stone, andthe casts were subsequently articulated using the appropriate check-bite record

Fig. 23a, b, c:

Metal copping was fabricated by the laboratory, and marginal integrity was verified with a dental explorer.

Fig. 24a, b:

Appropriate tightness of the contact area was confirmed with dental floss.

Fig. 25a, b, c: The final prosthesis.

Fig. 26a, b, c, d:

After clinical adjustment and verification of the fit and occlusion, the definitive crown was completed and luted to place with permanent cement. The screw access hole was filled with composite resin.

Results Achieved

Maxilla (*all three planes*):

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

Mandible (*all three planes*):

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

Maxillary Dentition

- A - P: Slightly flared incisors ~1 degree
- Vertical: Maintained
- Inter-molar / Inter-canine Width: Maintained

Mandibular Dentition

- A - P: Flared incisors ~2 degrees
- Vertical: Extruded molars
- Inter-molar / Inter-canine Width: Maintained

Facial Esthetics: Maintained

Retention

The lower fixed retainer 3-3 was bonded on every tooth. 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 relative to home care and maintenance of the retainers.

Final Evaluation of Treatment

The IBOI Cast-Radiograph Evaluation scored at 26 points, which was deemed satisfactory for a board case report. The major discrepancies were problems in alignment/rotation, marginal ridge discrepancies, inclination, occlusal contacts and occlusal relationships. The lower midline was shifted to the left for about 2mm, resulting in a Class II molar, premolar and canine relationship on the left side (*Fig. 27*). Overall, there was significant improvement in both the alignment of the edentulous area and final occlusion. The patient was satisfied with the improved chewing function on the left side.

Discussion

Over-extrusion of a maxillary molar usually results from loss of its anatagonist. The elongated edentulous space in the dentoalveolar process may lead to functional disturbances and occlusal interferences, that prove challenging for prosthetic reconstruction. Conventional options for correcting the problem include: 1. coronal reduction of the molar crown, which may require root canal therapy and a full coverage restoration, or 2. posterior subapical osteotomy, with the risks of general anesthesia and molar devitalization, as well as high cost. Orthodontic intrusion of maxillary molars is difficult because a force applied on the buccal surface tends to move the root palatally, resulting in excessive occlusal prominence of the palatal cusp. Conventional techniques for intrusion require anchorage reinforcement by incorporating multiple teeth in the anchorage segment and/or the use of extraoral devices that depend heavily on patient cooperation. Routine orthodontics mechanics often result in extrusion of the anchorage teeth rather

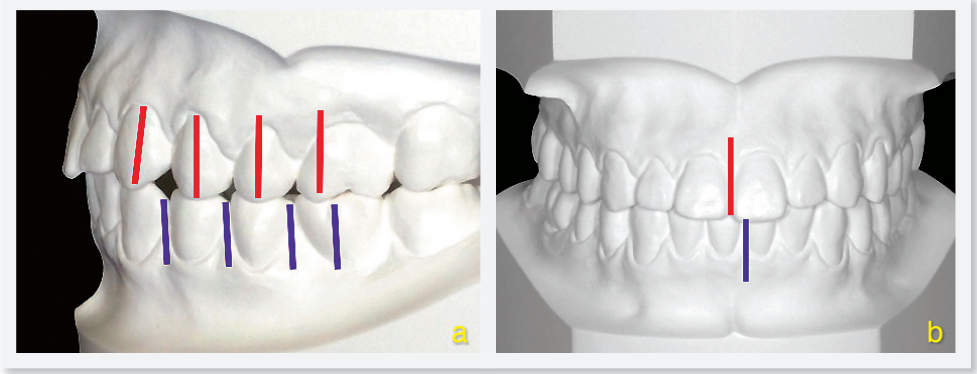


Fig. 27a,b:
The lower midline was shifted to the left for about 2mm, resulting in a Class II molar, premolar and canine relationship on the left side.

than intrusion of the extruded tooth. Preventing this side effect is the key to successful intrusion.

Skeletal anchorage, including dental implants, surgical miniplates, and miniscrews, is growing in popularity because they provide relatively rigid anchorage. For the present patient, a miniscrew was placed 2 to 3 mm away from the midpalatal suture to provide anchorage for molar intrusion. Placing the miniscrew away from the midpalatal suture avoids disturbing an important site for growth and skeletal adaptation in the maxilla. To inhibit root resorption, intrusive force levels should be kept relatively low. Although an optimal force has not yet been established for intrusion with miniscrews.[11]

Regarding to implant selection, the Taiwan Star system (*TS system*) was selected for its tapered design, 1.2 mm smooth collar, micro thread subcollar segment, and macro thread substructure (*Fig. 28*). The macro-thread substructure has a double helix design, with deep threads and a cutting edge at the apex. These surface features can provide faster and smoother self-tapping and a strong initial stability even in type IV bone (*Fig. 29*).[12] The micro-thread subcollar segment was introduced on the Astra Tech Implant System as early as 1992 and can reduce the peak stress values in the bone, inhibiting load-induced marginal bone loss[13]. Quatro-helix design can provide more initial bone contacts, prevent early bone loss and achieve faster osseointegration (*Fig. 30*).[13]

When the implant fixture is placed at the same bone level, different implant designs will cause different

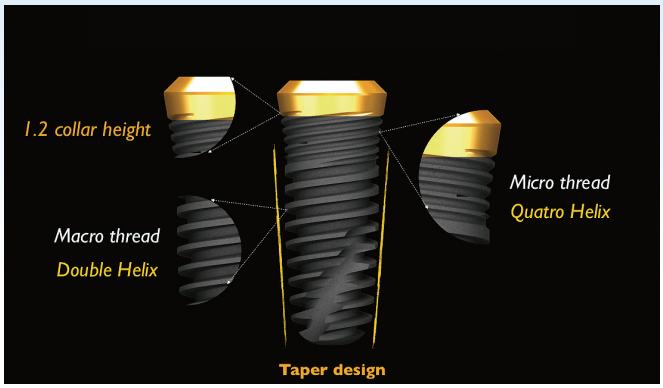


Fig. 28:
The Taiwan Star system (TS system) was selected for its tapered design, 1.2 mm smooth collar, micro thread subcollar segment, and macro thread substructure.

amounts of the bone loss. The TS system has a 1.2 mm smooth collar on the neck. Such implant fixtures can be placed on the submerged type or non-submerged type (*Fig. 31*). For the Submerged position (*1.2mm smooth collar below the bone level*), the marginal bone loss may be equal to the external system, that is ~1.5 mm (*Fig. 32*). As for the non-submerged position (*1.2mm smooth collar above the bone level*), the average marginal bone loss of the ITI system is 0.65mm.[14] The TS system has a micro-thread design similar to the Astra system and is compatible with platform switching abutments. The marginal bone loss may be much less than ITI system and equal to 0.3 mm (*Fig. 33*).[14] For the present patient, the implant fixture was placed with a non-submerged method and a 2 piece multi-post abutment was selected. The crown margin was slightly supra-gingival (*Fig. 26a*). The cement was readily removed and the oral hygiene around smooth collar was easily maintained. This approach was acceptable for the lower posterior "*unesthetic*" zone. The supra-gingival crown margin could be

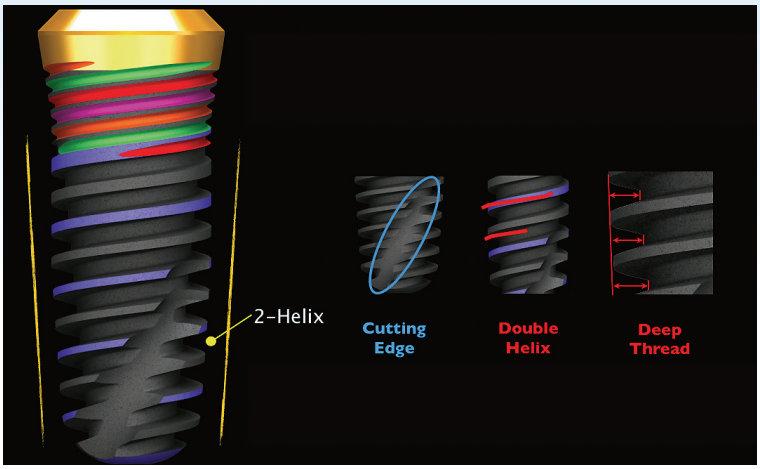


Fig. 29:

The macro-thread substructure has a double helix design, with deep threads and a cutting edge at the apex. These surface features can provide faster and smoother self-tapping and a strong initial stability even in type IV bone.

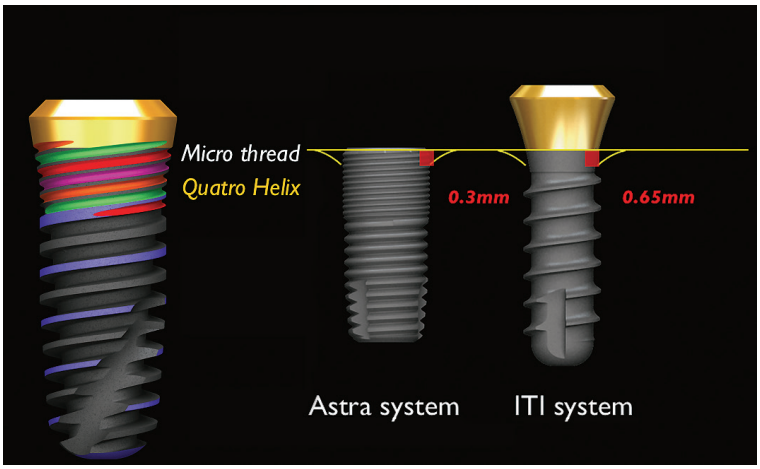


Fig. 30:

The micro-thread subcollar segment was introduced on the Astra Tech Implant System as early as 1992 and can reduce the peak stress values in the bone, inhibiting load-induced marginal bone loss. Quatro-helix design can provide more initial bone contacts, prevent early bone loss and achieve faster osseointegration.

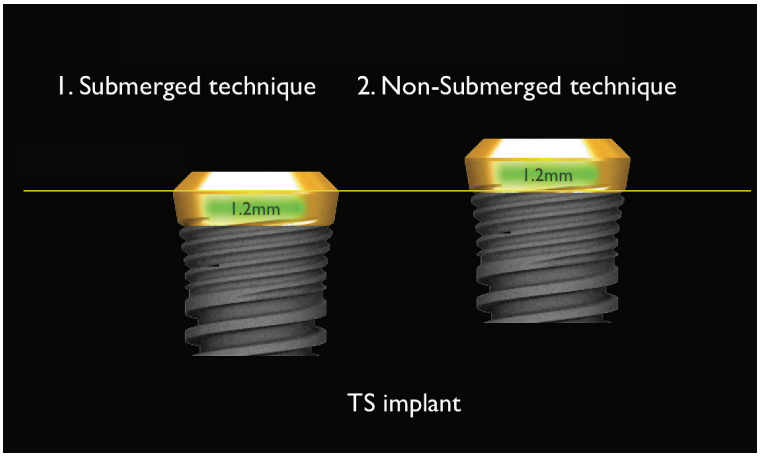


Fig. 31:

The TS system have 1.2 mm smooth collar on the neck. we can place the implant fixture on the submerged type or nonsubmerged type.

moved more apically and the restoration would be more natural-looking. The ideal implant location should be based on the cervical contour of the planned restoration planned at 3mm depth and 2mm to the lingual (*note: preserve at least 2mm of buccal bone plate*). If the buccal bone plate is less than 2mm (*Fig. 34a*), the options are: 1. place the implant more lingually, 2. choose a smaller diameter implant fixture, and/or 3. augment buccal bone with GBR procedure (*Figures 34b, c, d*), to improve buccal bone thickness.

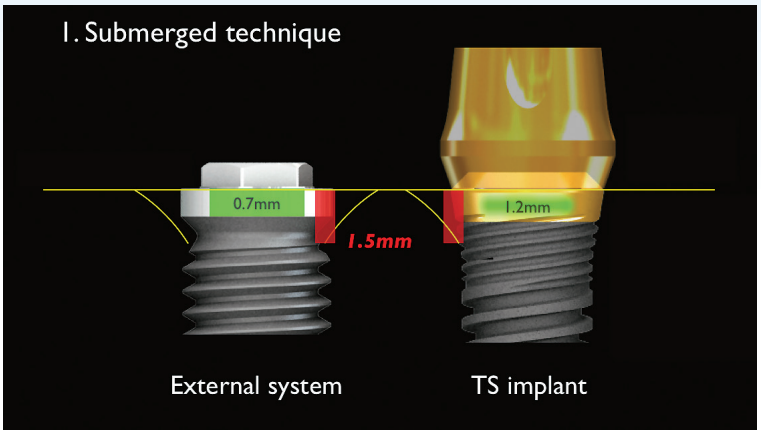


Fig. 32:

For the Submerged position (1.2mm smooth collar below the bone level), the marginal bone loss may be equal to the external system, that is ~1.5 mm.

Conclusion

Premature loss of lower first molars is frequently observed in Taiwan. This condition often results in extrusion of the antagonist maxillary molar, mesial-tilting of mandibular second molar, occlusal interferences, and great difficulty for future prosthetic reconstruction. This article attempts to present an alternative implant-ortho, combined treatment strategy for addressing this common issue. Details on the orthodontic and implant treatment process are provided as a guide to clinicians.[18]

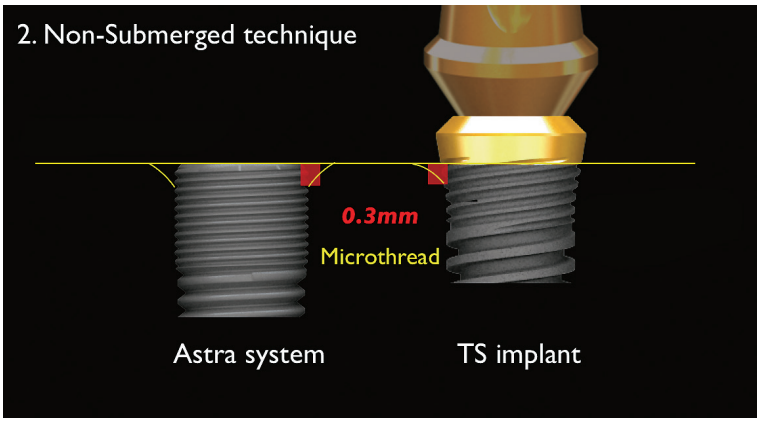


Fig. 33:

For the non-submerged position (1.2mm smooth collar above the bone level), the average marginal bone loss of the ITI system is 0.65mm. The TS system has a micro-thread design similar to the Astra system and is compatible with platform switching abutments. The marginal bone loss may be much less than ITI system and equal to 0.3 mm.

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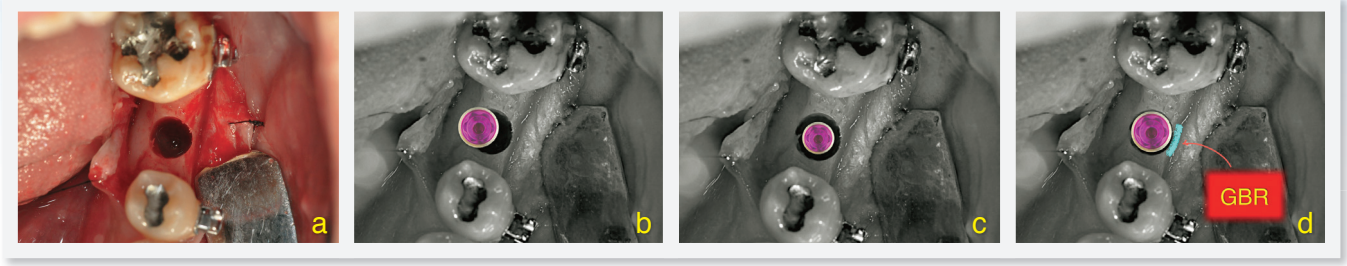

Fig. 34a, b, c, d:

If the buccal bone plate is less than 2mm, we can: 1. place the implant more lingually (b), 2. choose the smaller diameter implant fixture (c), 3. augment buccal bone with GBR procedure, to improve the buccal bone thickness (d).

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IBOI Discrepancy Index Worksheet

TOTAL D.I. SCORE 16

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 = 0

OVERBITE

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

Total = 0

ANTERIOR OPEN BITE

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

Total = 0

LATERAL OPEN BITE

2 pts. per mm. per tooth

Total = 0

CROWDING (only one arch)

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

Total = 0

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. additional _____ pts.

Total = 2

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 1

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 4

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° _____ x 1 pt. = _____

Total = 0

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. =	2
Missing teeth (except 3rd molars)	_____	x 1 pts. =	2
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	2	x 2 pts. =	4

Identify:

Total = 8

IMPLANT SITE

Lip line : Low (0 pt), Medium (1 pt), High (2 pts) = 0

Gingival biotype : Low-scalloped, thick (0 pt), Medium-scalloped, medium-thick (1 pt), High-scalloped, thin (2 pts) = 1

Shape of tooth crowns : Rectangular (0 pt), Triangular (2 pts) = 0

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) = 0

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) = 0

Soft tissue anatomy : Intact (0 pt), Defective (2 pts) = 0

Infection at implant site : None (0 pt), Chronic (1 pt), Acute(2 pts) = 0

Total = 1

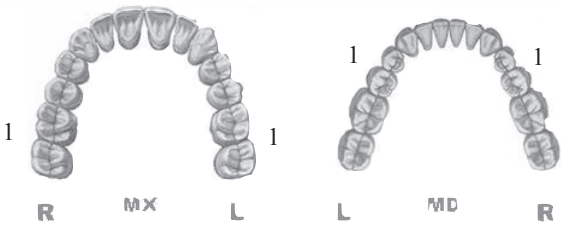
IBOI Cast-Radiograph Evaluation

Case # 1 **Patient**

Total Score: 26

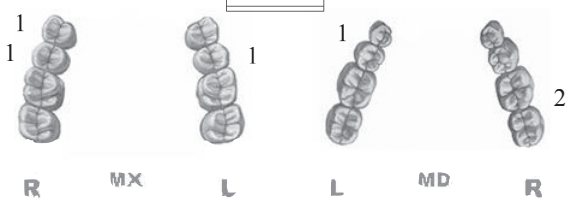
Alignment/Rotations

4



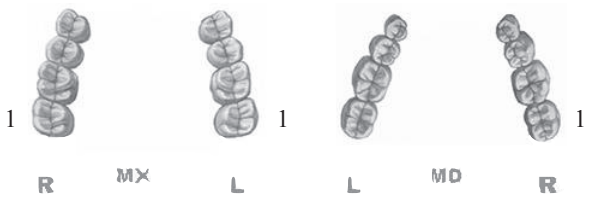
Marginal Ridges

6



Buccolingual Inclination

3

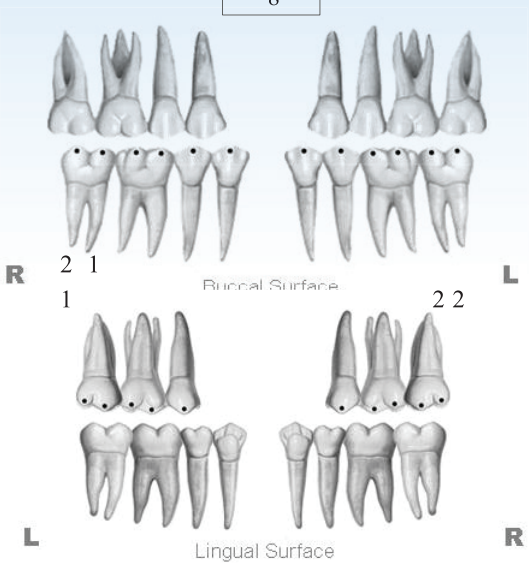


Overjet

0

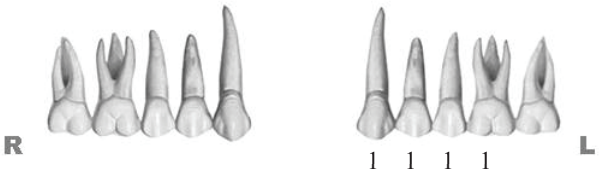
Occlusal Contacts

8



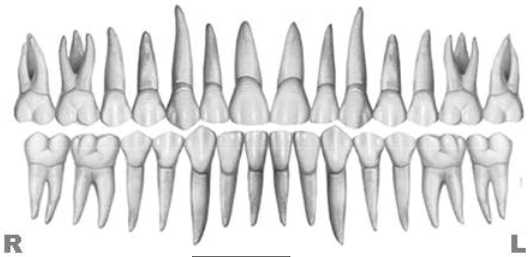
Occlusal Relationships

4

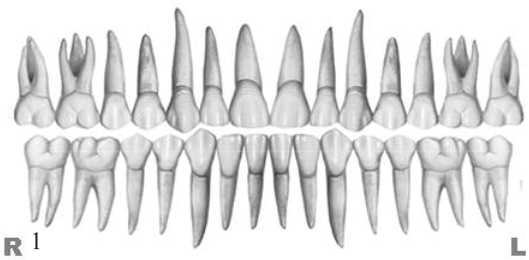


Interproximal Contacts

0



1



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.