

Class II and Labially Impacted Maxillary Canines on Both Sides

History and Etiology

A 12-year-1-month male was referred by his dentist for orthodontic consultation (Fig. 1). His chief concern was delayed eruption of upper canines (Figures 2, 3) and cross bite of the upper left lateral incisor. There was no other contributory medical or dental history. As documented in Figures 4-6, the patient was treated to a near ideal outcome. Before and after treatment radiographic documentation is provided in Figures 7 and 8, as well as in the cephalometrics table.

Panoramic radiography (Fig. 7) revealed that both maxillary canines are impacted, and 3D CT images show that both were labially impacted. The etiology of the malocclusion was deemed to be insufficient space due to a constricted maxilla and the premature loss of the deciduous maxillary canines.

Diagnosis

Skeletal:

Skeletal Class I (SNA 80°, SNB 77°, ANB 3°)

Mandibular plane angle (SN-MP 33°, FMA 24°)

Dental:

Right full cusp Class II molar relationship

Left end-on Class II molar relationship

OJ 1.5mm; OB 1.5mm

UR3 & UL3 are labially impacted

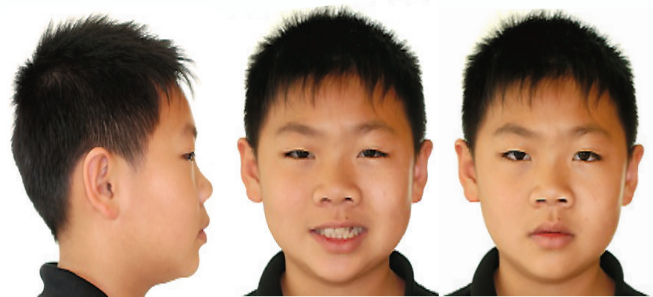


Fig. 1: Pretreatment facial photographs



Fig. 2: Pretreatment intraoral photographs



Fig. 3: Pretreatment study models

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■ Fig.4: Posttreatment facial photographs



■ Fig.5: Posttreatment intraoral photographs



■ Fig.6: Posttreatment study models

UL2 is in anterior cross bite
 UL5 and LL5 are in posterior cross bite
 ABO Discrepancy Index: 19

Facial:

Convex profile within normal limits (WNL)
 Competent lips

Specific Objectives of Treatment

Maxilla (all three planes):

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

Mandible (all three planes):

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

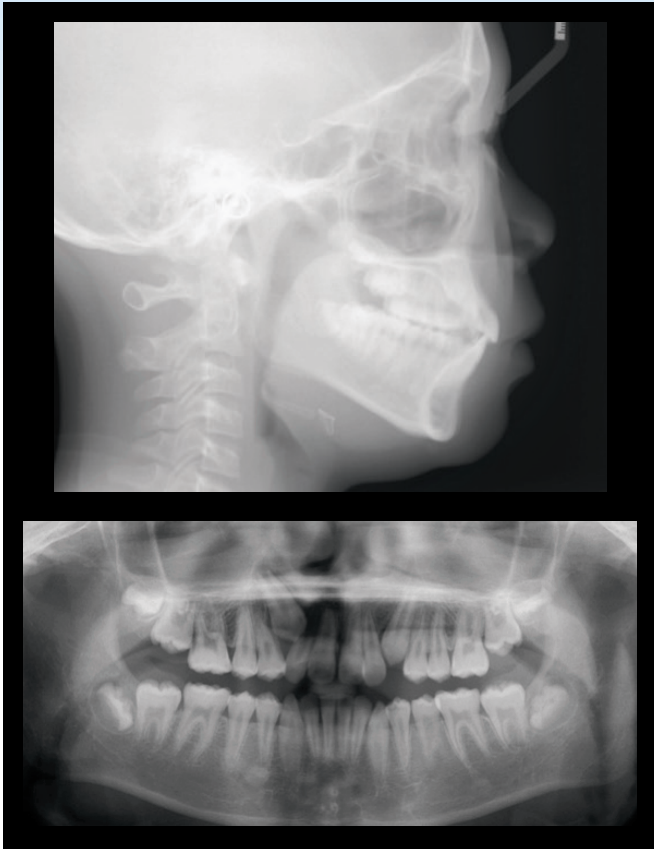
Maxillary Dentition:

- A - P: Correct cross bite of UL2, create space for UL3
- Vertical: Allow for normal extrusion with growth
- Inter-molar: Expansion for impacted UR3 and UL3

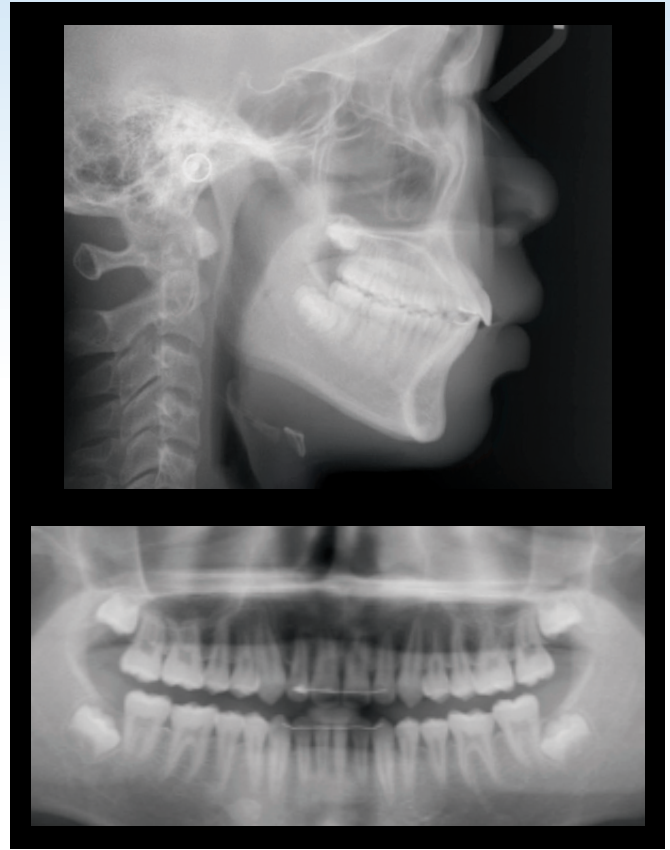
Mandibular Dentition:

- A - P: Retract incisors
- Vertical: Allow for growth-related extrusion
- Inter-molar/Inter-canine Width: Expansion to correct crowding

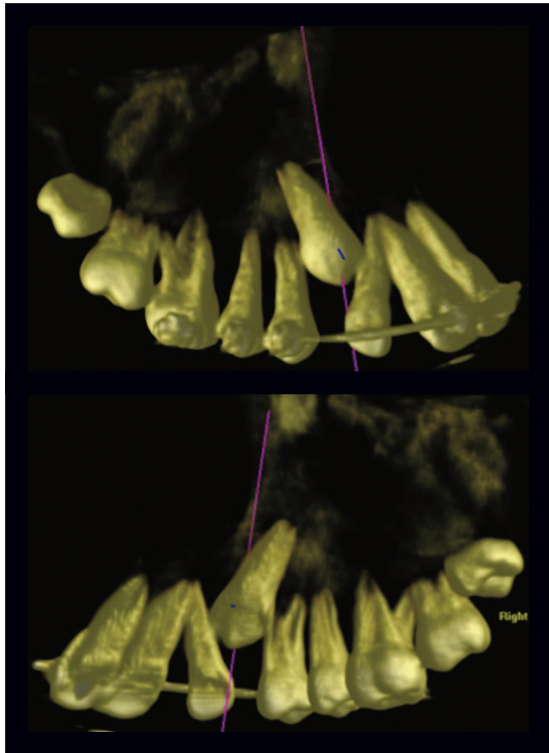
Facial Esthetics: Maintain facial balance



■ Fig.7: Pretreatment pano and ceph radiographs



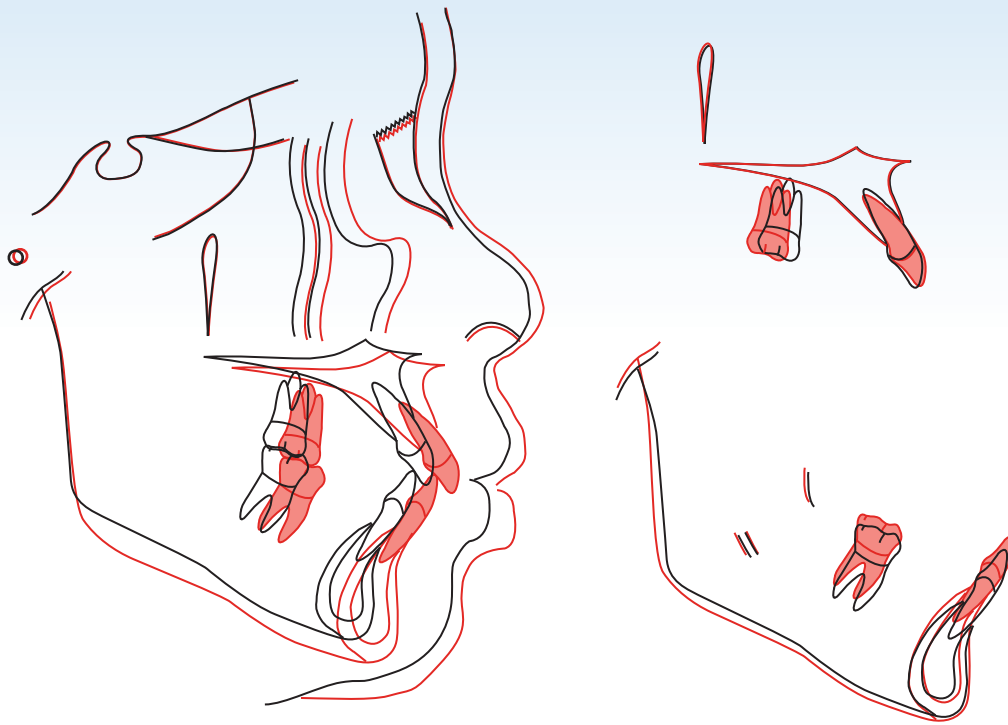
■ Fig. 8: Posttreatment pano and ceph radiographs



■ Fig. 9: 3D images for upper right impacted tooth

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	80°	82°	2°
SNB°	77°	79°	2°
ANB°	3°	3°	0°
SN-MP°	33°	30°	-3°
FMA°	24°	21°	-3°
DENTAL ANALYSIS			
U1 TO NA mm	4.0 mm	3.0 mm	-1.0 mm
U1 TO SN°	116°	113°	-3°
L1 TO NB mm	3.5 mm	4.0 mm	0.5 mm
L1 TO MP°	100°	103°	3°
FACIAL ANALYSIS			
E-LINE (U)	2.0 mm	2.5 mm	0.5 mm
E-LINE (L)	1.5 mm	3.0 mm	1.5 mm

■ Table. Cephalometric summary



■ Fig. 10: Superimposed tracings

Treatment Plan

Considering the patient's normal convexity and age, non-extraction treatment with a full fixed orthodontic appliance was indicated to align and level the dentition. Since this male patient was only 12 years old, there was considerable potential for additional chin projection, as the mandible rotates anteriorly with growth. Extracting permanent teeth may be detrimental to lip protrusion and facial esthetics after growth is completed. Damon D3MX low torque brackets (*Ormco*) with an .022" slot were selected because this self-ligation system can induce light force to increase arch width and create space for crowding and/or unerupted anterior teeth. Correcting crowding and aligning unerupted

anterior teeth, with non-extraction treatment, requires low torque brackets. Low torque brackets help avoid flaring of anterior teeth during leveling. In the initial stage of active treatment, coil springs were used to create space for the impacted canines (*Fig. 11*). A bite turbo was cemented on LL1 to open up the bite to facilitate correction of the crossbites (*Fig. 14*). A .014 CuNiTi wire was used to tip the UL2 to resolve the anterior cross bite. Class II elastics were used to resolve the sagittal occlusion discrepancy. When the fixed appliances were removed and the corrected dentition was retained with fixed anterior retainers in both arches and a clear overlay on the upper arch.

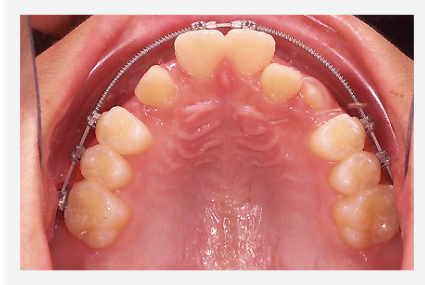
Appliances and Treatment Progress

A .022" slot Damon D3MX low torque brackets (*Ormco*) were bonded on all permanent teeth. Two sections of open coil springs were applied to create space for the impacted maxillary canines. To avoid lateral incisor root resorption, no bracket was bonded on the UR2 initially (*Fig. 11*). Four months later, the upper left canine had spontaneously erupted (*Fig. 12*). In the 16th month, the upper left canine had reached the occlusal plane (*Fig. 13*). In the 25th month, to help correct the cross bite of UL2 and LL1, a composite bite turbo was bonded on the

lower left lateral incisor (*Figures 14, 15*). The cross bite of the lateral incisor was corrected in the 27th month, and the bite turbo was removed. After 29 months, the crown of upper right canine had spontaneously erupted, and then a Damon D3MX bracket (*Ormco*) was bonded on it (*Fig. 16*). After another four months, the upper right canine reached the occlusal plane (*Fig. 17*). Class II elastics (3-3.5 oz) were used for two months to correct the Class II molar relationships. All appliances were removed after 34 months of active treatment.



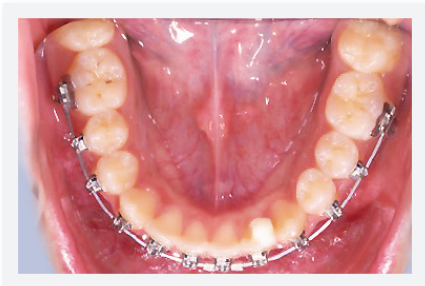
■ Fig. 11:
Open coil springs, one between #5 and #7, the other #10 and #12



■ Fig. 12:
#11 erupted



■ Fig. 13:
#11 completely erupted



■ Fig. 14:
#23 Bite turbo



■ Fig. 15:
Bite turbo on #23 in the 13 completely erupted



■ Fig. 16:
The D3MX bracket was bonded on #6

Results Achieved

Maxilla (all three planes):

- A - P: Optimal growth expression
- Vertical: Optimal growth expression
- Transverse: Maintained

Mandible (all three planes):

- A - P: Optimal growth expression
- Vertical: Optimal growth expression
- Transverse: Maintained

Maxillary Dentition:

- A - P: Increased axial inclination of the incisors
- Vertical: Impacted canines uncovered and optimally aligned
- Inter-molar/Inter-canine Width: Optimal growth expression

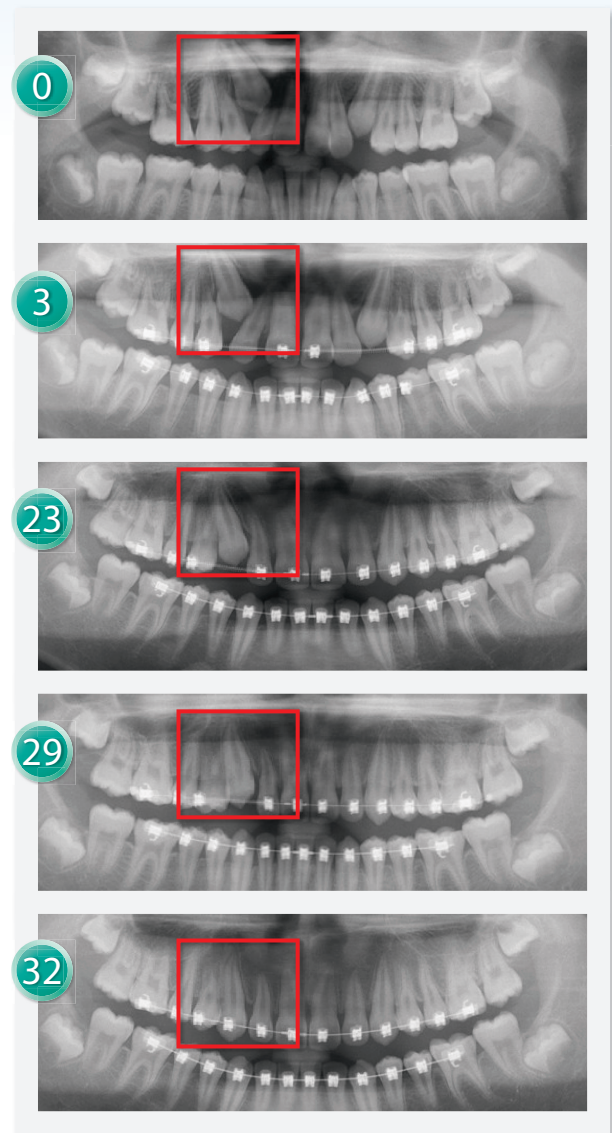
Mandibular Dentition:

- A - P: Retracted
- Vertical: Extruded incisors, molars maintained
- Inter-molar/Inter-canine Width: Optimal growth expression

Facial Esthetics: A pleasing profile with competent lips was achieved

Retention

The upper fixed 2-2 and the lower fixed 3-3 retainers were bonded on every tooth. An upper clear overlay retainer was delivered (Fig. 18). The patient was instructed to wear it full time for the first 6



■ Fig. 17:

X-ray films showed the movement of the upper impacted canines.

months and nights only thereafter. The patient was also informed about proper home hygiene and maintenance of the retainers.



■ Fig. 18: Upper fixed retainer

Final Evaluation of Treatment

The ABO Cast-Radiograph Evaluation was scored at 14 points. The major discrepancies were malalignment (5 points) and uneven marginal ridges (6 points). The IBOI pink and white esthetic score was 6.

The distance from the upper and lower lip to the E-line increased from 2mm to 2.5mm and 1.5mm to 3mm, respectively.

The impacted canines were in optimal alignment after treatment. The gingival esthetics was pleasing. The root prominence was satisfactory. From the radiographs, the root alignment was ideal, and no external root resorption (EARR) was presented.

The molar and canine relationships are both Class I. The over bite and overjet are ideal. Overall, the treatment results were pleasing to the patient and the clinician

Discussion

About one third of impacted maxillary canines are positioned labially or within the alveolus.¹ Labial impaction of a maxillary canine is either due to ectopic migration of the canine crown over the root of the lateral incisor or shifting of the maxillary dental midline, causing insufficient space for the canine to erupt.² Olive³ suggested that opening space for the canine crown with routine orthodontic mechanics may allow for spontaneous eruption of impacted canines. Bishara⁴ claimed that facially impacted canines have the potential to erupt without surgical intervention. In this case, the labially impacted canines spontaneously erupted without any surgery.

For space expansion, Kokich⁵ suggested that brackets are placed on the teeth in the maxillary arch, and coil springs are required to move the first premolar and central incisor apart. It is best not to place brackets on the maxillary lateral incisor initially. If brackets are placed on all maxillary teeth, including the lateral incisor, the root of it may be forced toward the labial side. If the canine crown is occupying this space, root resorption could occur. In the patient, the brackets were bonded on upper left and right lateral incisors in the 12th month. In the 34th month, no root resorption was found in the final radiograph.

Warford et al⁶ mentioned that patients with canine impactions experience longer treatment time than those without, due to displacement of the tooth

from the occlusal plane. Smith⁷ reported that the mean value of the rates of eruption for maxillary canines was .08 mm per week. Prior to emergence the rate of eruption may be quite slow, and it may take 2-4 years for a tooth to reach the oral cavity. Upon entering the oral cavity, however, the rate of movement can be very rapid (1mm per month). Nevertheless, it may take the tooth 1-2 years to fully reach the occlusal plane. The distance from the occlusal plane to the UR3 was more than that to the UL3. It took 32 months for the UR3 to reach the occlusal plane and only 12 months for the UL3.

The space between the UL2 and the UL4 was 5 mm, and there was no space between the UR4 and UR2. In the 16th month the left impacted canine reached the occlusal plane. In the 29th month the right one was also on the occlusal plane. This case demonstrated that the amount of space needed is directly related to treatment time.

The initial molar occlusal relationship was Class II and it was treated to Class I bilaterally. Two mechanical aspects of the treatment process changed the molar relationship: 1. open coil springs 2. Class II elastics. Coil springs enlarged the space and pushed the upper premolars and molars backward. In the 4th month, the molar relationship was corrected to Class I (Fig. 23). The left and right coil springs were removed in the 12th and 29th month respectively. In the 32nd month, Class II elastics were used to adjust the overjet of anterior teeth and maintain the Class I molar relationship.



■ Fig. 23:
Class I molar relationship in the 4th month, left view



■ Fig. 24:
Class I molar relationship in the 4th month, right view

Tooth eruption is defined as the movement of a tooth from its site of development within the alveolar process to its functional position in oral cavity. The eruption process can be divided into two easily definable parts: intraosseous and supraosseous (Weinmann, 1944).⁸ Supraosseous events include the movement of teeth, once part of the crown is above the alveolar crest. In this phase of eruption, teeth move beyond the alveolar crest to its position of occlusal function. There are several possible mechanism of tooth eruption: 1. Root formation 2. Anabolic bone modeling 3. Dental follicle expansion,

4. Periodontal ligament traction. Experimental evidence suggests that changes in alveolar bone adaptation (*bone formation and resorption*), in response to periodontal ligament traction, plays a key role in supraosseous eruption. Histologic work by Magnusson (1968)⁹ gave rise to the hypothesis that changes in permeability of the periapical periodontal ligament vascular bed, i.e., resulting in increased fluid effusion, that contributed to eruptive force. Subsequent studies with intracardially injected 131I-fibrinogen are consistent with this hypothesis.¹⁰ It has been reported that labial displacement of the upper permanent canine is most frequently associated with crowding. A lack of space was diagnosed in 60%–90% of patients with impacted upper canines. Subjects with maxillary canine impactions also may have a transverse maxillary deficiency. About 42% of displaced maxillary canines erupted spontaneously within one-year period after removal of the primary canine and expansion of the dental arch.¹¹ It demonstrated that the space was critical to spontaneous tooth eruption.

For creating space, roots angulation and torque control present significant challenges. Using open coil springs to create space may result in anterior teeth flaring out. The post treatment cephalometric film demonstrated that no excessive flaring was noted. The positive outcome was attributed to the use of low torque brackets on the anterior

teeth. The slots of these low torque brackets were specially angulated, to allow the arch wire to induce low torque and light force on teeth. Hence, the flaring out of the anterior teeth was avoided by light force.

The initial DI^{12,13} score was 19, indicating a moderate malocclusion for an ABO case report. The ABO Cast-Radiograph Evaluation score was 14 points, within the usual acceptable range for a board case. The major discrepancies were 5 points for tooth rotations (*Figures 19-22*) and 6 points for uneven marginal ridges (*Figures 25-27*). A realistic treatment plan should be designed in advance.

Upper and lower lips are slightly protrusive in the finish profile. Since the patient was only 15 years old, his face and jaw bone still had significant growth potential, the profile should be monitored in post-treatment follow up.

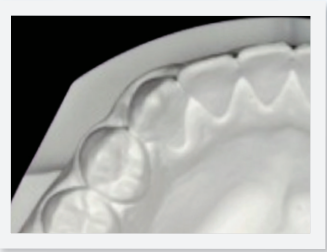
For retention, the upper fixed retainer did not extend to maxillary canines. This approach maintains incisor alignment, but still allows the canines to function independently. The latter is important because previously impacted teeth tend to intrude. If they are tied to incisor with a fixed retainer, the entire maxillary anterior segment could be affected by the canines' tendency to relapse.



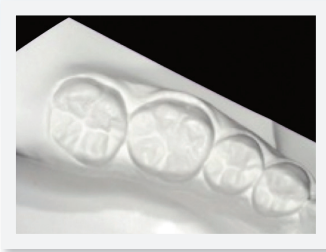
■ Fig. 19:
distal-in upper left 1st molar



■ Fig. 20:
distal-in upper right 1st molar



■ Fig. 21:
distal-in lower left canine



■ Fig. 22:
Mesial-in lower left 2nd molar



■ Fig. 25:
Marginal discrepancy between upper left 1st molar and 2nd molar



■ Fig. 26:
Marginal discrepancy between lower left 1st molar and 2nd molar



■ Fig. 27:
Marginal discrepancy between upper right 1st molar and 2nd molar

Conclusion

This case report demonstrates the eruption potential of labially impacted maxillary canines provided with sufficient space. The impacted canine may be easily treated with fixed orthodontic appliance without surgical treatment. Labially impacted teeth can occur bilaterally in the same maxillary arch. The treatment strategies must consider enough space expansion. Roots resorption of the teeth adjacent to the impacted canine should be avoided. Open coil springs can create space and correct the Class II molar relationship, but flaring out of anterior teeth can be avoided by light force.

Acknowledgment

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References

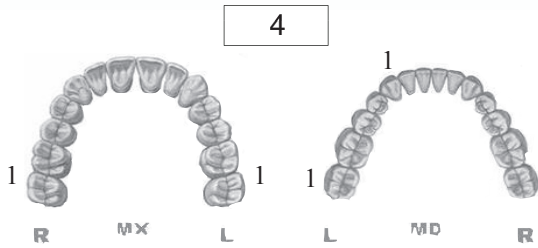
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IBOI Cast-Radiograph Evaluation

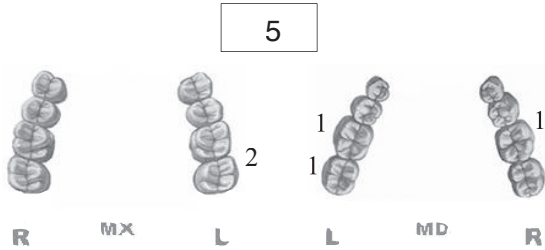
Case # Patient

Total Score: **14**

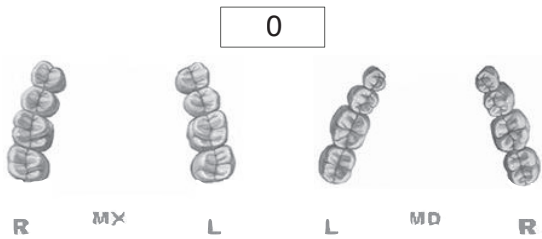
Alignment/Rotations



Marginal Ridges



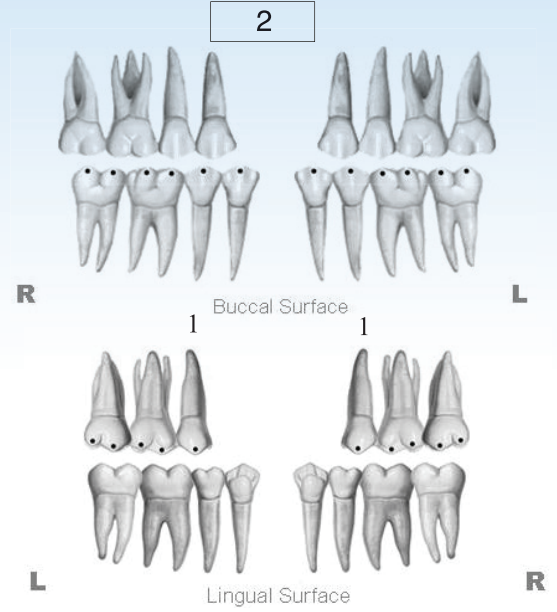
Buccolingual Inclination



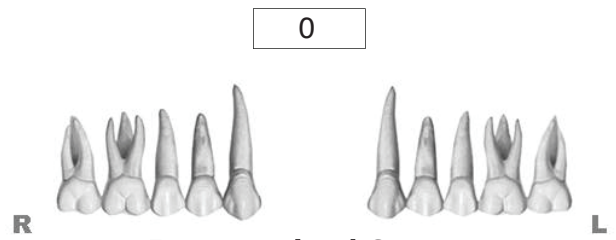
Overjet



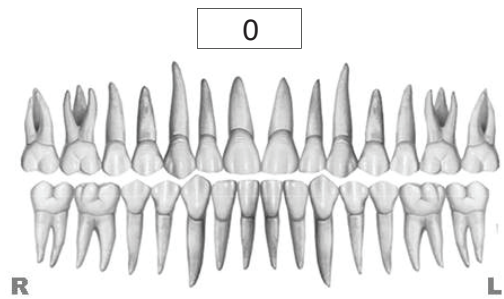
Occlusal Contacts



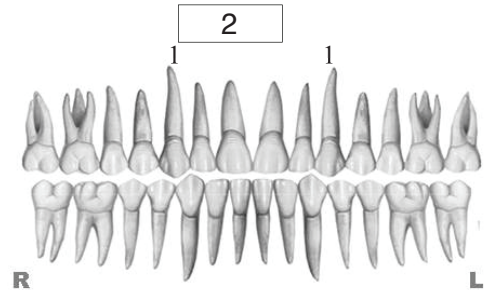
Occlusal Relationships



Interproximal Contacts



Root Angulation



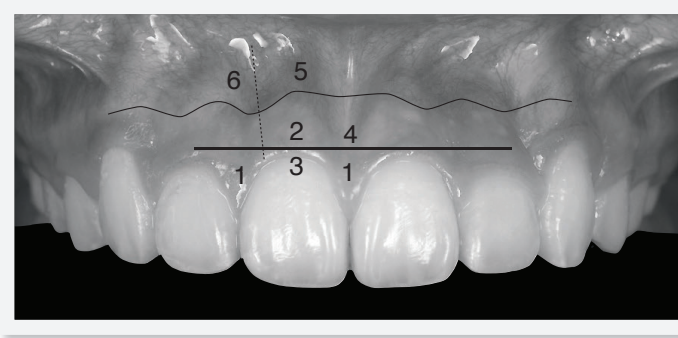
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 6

1. Pink Esthetic Score

Total = 2



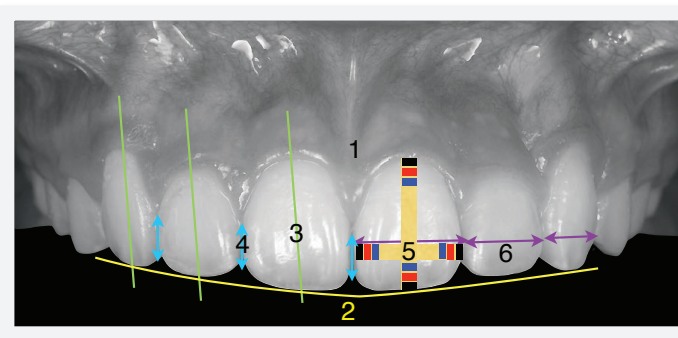
1. Mesial Papilla	0	1	2
2. Distal Papilla	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2



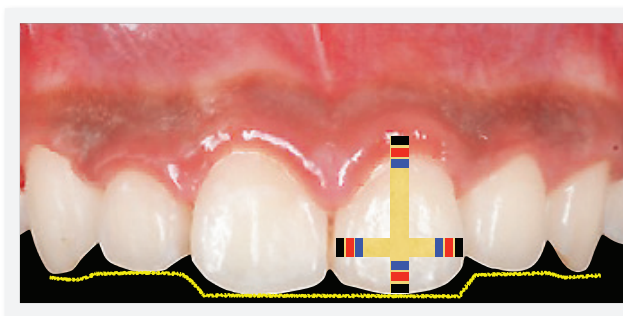
1. M & D Papilla	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

2. White Esthetic Score *(for Micro-esthetics)*

Total = 4



1. Midline	0	1	2
2. Incisor Curve	0	1	2
3. Axial Inclination (5°, 8°, 10°)	0	1	2
4. Contact Area (50%, 40%, 30%)	0	1	2
5. Tooth Proportion (1: 0.8)	0	1	2
6. Tooth to Tooth Proportion	0	1	2



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2. Incisor Curve	0	1	2
3. Axial Inclination (5°, 8°, 10°)	0	1	2
4. Contact Area (50%, 40%, 30%)	0	1	2
5. Tooth Proportion (1: 0.8)	0	1	2
6. Tooth to Tooth Proportion	0	1	2