Class II with a Trans-Alveolar Impaction of a Maxillary Canine

History and Etiology

A 13-year-10-month-old boy was referred by his dentist for orthodontic consultation (*Fig. 1*). His chief concern was a maxillary dental midline discrepancy (*Figures 2, 3*). There was no contributory medical or dental history. Clinical exam indicated that the permanent maxillary left canine was impacted (*Fig. 2*). A specific plan for surgical exposure and orthodontic traction was proposed to guide the impacted canine to an appropriate location in the dental arch. The patient was treated to an acceptable result as documented in Figures 4-9. The details for diagnosis and treatment will be discussed below.

Diagnosis

Cephalometric and panoramic radiographs (*Fig.* 7) document the complexity of the malocclusion. Pretreatment cone beam computed tomography (*CBCT*) scan confirmed that the canine was palatally impacted between the upper left lateral incisor and first premolar. The cusp tip of the impacted canine was oriented toward the palate and the root was toward the labial (*Fig.* 10).

Skeletal:

Skeletal Class II (SNA 80°, SNB 75°, ANB 5°)

Mandibular plane angle (SN-MP 35°, FMA 25°) Dental:

Bilateral Class II malocclusion The overbite and overjet were both 6 mm.



Fig. 1: Pretreatment facial photographs



Fig. 2: Pre-treatment intraoral photographs



Fig. 3: Pretreatment study models

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Severe crowding about 8 mm in upper arch due to left impacted canine, and moderate crowding of about 3mm in the lower arch.

Maxillary dental midline 5 mm left of the facial midline Facial:

Moderately convex profile with acceptable 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: Maintain
- 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: Retract maxillary buccal segments
- 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. 9: Superimposed tracings





Fig. 10:

An impacted canine located between upper left lateral incisor and first premolar with the cusp tip oriented toward palatal side and the root toward labial side.

Treatment Plan

Non-extraction treatment with a full fixed orthodontic appliance was indicated to align and level the dentition. In the initial stage of treatment, space was created between upper left lateral incisor and first premolar for the impacted canine (Fig. 11). An open window surgery was applied to the palatally impacted canine. To tract the first premolar for opening the space of the impacted canine, an extra-alveolar miniscrew (2x12 mm OrthoBoneScrew, Newton's A inc.) was inserted in the infrazygomatic crest as a traction anchorage. As the impaction extruded, there was sufficient crown length to permit bonding of an eyelet with an elastometric chain attached. The maxillary arch was the anchorage to extrude and align the impacted canine.

Anterior bite turbos assisted in overbite and overjet correction. Class II elastics were used to resolve the sagittal occlusal discrepancy, and detailing bends produced the final occlusion. The fixed appliances were removed and the corrected dentition was retained with fixed anterior retainers in both arches: Mx 2-2, Md 3-3.



Fig. 11:

Upper arch was bonded and an open coil spring was placed between left lateral incisor and first premolar.





Appliances and Treatment Progress

A .022" slot Damon D3MX bracket system (*Ormco*) was used. The maxillary arch was bonded with low torque brackets on anteriors, and an open coil spring was placed between left lateral incisor and first premolar to open a pathway for the extrusion of the impacted canine. After five weeks of initial alignment and leveling, surgical exposure of the impacted canine was performed. The covering soft tissue and bone over the impaction was removed (*Fig. 12*) and the wound was covered with surgical dressing. After the surgical exposure, a miniscrew was inserted into the left infrazygomatic crest to serve as anchorage to retract the left maxillary buccal segment (*Fig. 3*).

Six months after the initiation of active treatment, an eyelet was bonded on the buccal surface of the impacted canine and a ligature wire was inserted and tied to the .014x.025 NiTi main arch wire. At the same appointment, the bracket on the left first premolar was debonded and an open coil spring was placed between left lateral incisor and second premolar (Fig. 14). In the 11th month of active treatment, a Diode laser was used to remove excessive buccal gingiva of the impacted canine (Fig. 15). One month later, the impaction was almost aligned. Light round wire .016 NiTi was engaged into the eyelet (Fig. 16). In the 14th month, brackets were placed on the impacted canine (*low torque*) and lower arch (standard torque on lower anteriors) (Fig. 17). Anterior bite turbos were placed on palatal side of upper central incisors with Class II elastics to correct the A-P discrepancy and deep overbite (Fig. 18).

In the 16th month of the treatment, a miniscrew (2x12 *mm OrthoBoneScrew, Newton's A inc.*) was inserted into the right infrazygomatic crest. An elastometric



Fig. 13:

Surgical dressing was covered the wound. A miniscrew was inserted into the IEC.



Fig. 14:

The impacted canine was bonded with an eyelet with ligature wire inserted. The bracket of left first premolar was debonded.



Fig. 15:

Excessive buccal gingiva over the impacted canine was removed by using Diode laser.



 Fig. 16: Buccal view and pano film of active treatment for 12 months. The impacted canine was almost aligned.

chain was attached from upper right canine to the screw and a Class II elastic from lower right first molar to upper right first premolar was used to correct midline discrepancy.

When the impacted canine was aligned in the arch, a panoramic radiograph was exposed to evaluate bracket positions relative to the axial inclinations of all teeth. A torquing spring was placed on the impacted canine to move the root palatally, as the maxillary arch was leveled (*Fig. 19*).

Two weeks prior to the completion of active treatment, the upper archwire was sectioned distal to cuspids. Light up-and-down elastics (2 *oz*) were used posteriorly for final detailing of the buccal segments (*Fig. 20*). The wire sequence was: .014 NiTi, .014x25 NiTi, .017x25 TMA, and .019x25 SS. After



Fig. 17: The impacted canine was bonded (high torque).



Fig. 18.:

Anterior bite turbos were placed on the palatal side of upper central incisors.



 Fig. 19: Use a torquing spring to increase lingual root torque.



Fig. 20:

Light up and down elastics (2 oz) were used posteriorly for final detailing of buccal segments.



Fig. 21: Post-treatment intra-oral frontal photo.

30 months of active treatment, all appliances were removed. Upper clear overlay and fixed anterior (*Mx 2-2, Md 3-3*) retainers were delivered for both arches.

Results Achieved

Maxilla (all three planes):

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

Mandible (all three planes):

- A P: Favorable growth
- Vertical: Favorable growth
- Transverse: Maintained

Maxillary Dentition:

- A P: Slightly flared incisors ~ 2 degrees
- Vertical: Extruded, impacted canine recovered and optimally aligned
- Inter-molar / Inter-canine Width: Retracted Mx molars

Mandibular Dentition:

- A P: Slightly flared incisors ~2 degrees
- Vertical: Maintained
- Inter-molar / Inter-canine Width: Maintained

Facial Esthetics: Maintained

Retention

The fixed retainer was bonded on all maxillary incisors and 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 29 points. The major discrepancies were in the right occlusal relationships, alignment/rotation, and marginal ridges. Upper dental midline shift was decreased to 1.5 mm to the left of facial midline. The impacted canine was well aligned, and the gingiva texture was healthy (*Fig. 21*).

Collectively, flaring of the maxillary and mandibular incisors resulted in regaining of space and the overjet was corrected. The use of Class II elastics to anteriorly position the mandibular dentition was necessary, because there was insufficient anterior growth of the mandible. Overall, this difficult impaction case was treated to an appropriate facial and dental result with no iatrogenic problems.

Discussion

The palatally impacted canine is a difficult clinical problem for orthodontists. The first step in resolving the problem is to locate the impacted tooth and evaluate root resorption of the adjacent teeth. Cone beam computed tomography (CBCT) is particularly advantageous for evaluating impactions and their adjacent teeth. The low distortion, threedimensional data provided by a CBCT allows for the precise location of the impaction relative to the adjacent teeth. A pretreatment CBCT scan offers more detailed information on the impaction than conventional radiography. For the present case, the CBCT imaging showed that the impacted canine was located between the left lateral incisor and first premolar with its cusp tip oriented toward palatal side and the root toward the labial side. The upper left first premolar was in the position of the impacted canine and the upper dental midline was left of the facial midline. After a thorough diagnosis, three treatment modalities are considered:

- 1. Surgical exposure, spontaneous eruption and orthodontic alignment of the impacted canine. The advantage of this approach is visualization of the crown and better control of the direction of tooth movement to avoid roots resorption of adjacent teeth.
- 2. Closed eruption with an auxiliary attachment and orthodontic alignment. Immediate orthodontic traction can be applied to the impaction but this approach is more likely to result in root resorption of adjacent teeth.
- 3. Extraction of the impacted canine usually requires first premolar replacement or restoration of the space with a prosthesis or

implant. The disadvantages of this approach are compromised occlusion, as well as bony defects and damage to adjacent teeth subsequent to extraction of the impacted canine.

The first treatment plan was selected for the present case. Schmidt and Kokich⁶ reported that the open surgical exposure of impacted maxillary canines had minimal effects on the periodontium, and had better overall consequences than the closed exposure and early traction technique. Zasciurinskiene et al⁷ found that the surgical exposure and orthodontic extrusion of palatally impacted, maxillary canines usually resulted in clinically acceptable periodontal condition, but the result depended on the initial vertical and horizontal position of the impaction. The extraction of impacted canines is seldom considered, but may be a viable option for some problems: (1) ankylosed and cannot be transplanted; (2) external or internal root resorption; (3) severely dilacerated root; (4) unfavorable impaction where orthodontic movement will jeopardize the adjacent teeth; (5) acceptable occlusion with the first premolar in the position of the canine; (6) pathological complications; and/or (7) the patient does not desire orthodontic treatment. For the present case, the first premolar was in the position of canine but the molar relation was a full Class II malocclusion; thus, the open exposure surgery and orthodontic alignment with retraction of the left buccal segment was optimal.

According to Samir E. Bishara,⁸ the traction of impacted canines is recommended under the following conditions: (1) sufficient space is available in the arch or can be created for the impaction to maintain; (2) use of light forces (*no more than 2 oz (60 g*) to move the impaction; (3) the arch wire should provide sufficient stiffness to resist deformation by

the forces applied to extrude the impaction; and (4) the direction of the applied force should move the impaction away from the roots of neighboring teeth.

To achieve an optimal result for the present patient, the initial step was alignment of upper teeth and creation of space for the impacted canine. One month after the upper arch was bonded, open surgical exposure of the impacted canine was achieved. After five months of natural eruption, a ligature wire was used to apply light traction with minimal deflection of the maxillary arch wire. To minimize root resorption during traction of the impacted canine, the bracket of the first premolar was removed. After sixteen months of active treatment, the impacted canine was aligned into the arch and a torquing root spring was used. Root angulation and torque control, of transalveolar impacted canines, present significant challenges. Placing the loop of the torquing spring gingivally creates a couple that delivers lingual root torque. Conversely, incisal positioning of the loop results in labial root torque.

A thorough evaluation of the recovery and alignment of an impacted canine requires an assessment of gingival esthetic change after impaction-related surgery and orthodontic traction. (*see the IBOI Pink & White Esthetic Score*). For the present case, the papillae of the impacted canine fill the embrasure. The curvature and level of the gingival margin were also acceptable. With regard to the upper esthetic zone, the maxillary dental midline was 1.5 mm left of the facial midline and the axial inclination of right lateral incisor was too distal. The Pink & White esthetic score worksheet below provides a broad array of clinical parameters for evaluation of patients with impacted teeth and esthetics. The ABO CRE score was 29, with most of the points reflecting problems in left occlusal relationships. If retraction of the left maxillary buccal segment, with extra-alveolar miniscrew anchorage, was used earlier in the treatment sequence to retract the upper dentition, it would have facilitated a more complete correction of the Class II relationship.

Conclusion

Impacted maxillary canine is a common finding in dental treatment. The treatment of these cases is important because upper canines play an important role in esthetics and function. The first step is assessing the position of the impacted canine. Conebeam computed tomography can provide precise information to dentists so that they can use proper surgical and orthodontic techniques to recover impacted canine. In this case, we chose the open exposure technique and allowed the impaction to

CEPHALOMETRIC					
SKELETAL ANAL	YSIS				
	PRE-Tx	POST-Tx	DIFF.		
SNA°	79°	80°	1°		
SNB°	74°	76°	2°		
ANB°	5°	4°	-1°		
SN-MP°	35°	34°	-1°		
FMA°	25°	27°	2°		
DENTAL ANALYSIS					
U1 TO NA mm	2 mm	3 mm	1 mm		
U1 TO SN°	98°	100°	2°		
L1 TO NB mm	5 mm	6 mm	1 mm		
L1 TO MP°	99°	101°	2°		
FACIAL ANALYSIS					
E-LINE UL	1 mm	2 mm	1 mm		
E-LINE LL	2 mm	2 mm	0 mm		

Table. Cephalometric summary

auto-erupt. Remove the bracket on the adjacent tooth during traction of the impaction to avoid root resorption, followed by the use of a torquing auxiliary during the finishing phase. The impaction was well aligned with a healthy periodontium.

This very difficult malocclusion (DI = 31) was treated to an acceptable result (CRE = 29). The occlusal relationship could have been improved by placing the maxillary miniscrews earlier in the treatment sequence. The bilateral full cusp Class II malocclusion could have been completely corrected with about 3 months of continuous retraction of the maxillary buccal segments.

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		51	
<u>DVERJET</u>			
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	
<u>OVERBITE</u>			
0 - 3 mm.	=	0 pts.	
3.1 - 5 mm.	=	2 pts.	
3.1 – 5 mm. 5.1 – 7 mm.	=	2 pts. 3 pts.	
3.1 – 5 mm. 5.1 – 7 mm. Impinging (100%)	= =	2 pts. 3 pts. 5 pts.	
3.1 – 5 mm. 5.1 – 7 mm. Impinging (100%)	= =	2 pts. 3 pts. 5 pts.	

LATERAL OPEN BITE

Total

2 pts. per mm. per tooth

Total



=

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

0

OCCLUSION

Class I to end on	=	0 pts.
End on Class II or III	=	2 pts. per side <u>pts.</u>
Full Class II or III	=	4 pts. per side <u>8 pts.</u>
Beyond Class II or III	=	1 pt. per mm. <u>pts.</u> additional
Total	=	8

LINGUAL POSTERIOR X-BITE

1 pt. per tooth	Total	=		1	
BUCCAL POSTERI	OR X-H	BITE			
2 pts. per tooth	Total	=		0	
CEPHALOMETRIC	C <u>S</u> (Se	ee Instru	ctions)	
ANB $\geq 6^{\circ}$ or $\leq -2^{\circ}$)		=	4 pts.	
Each degree $< -2^{\circ}$		_x 1 pt	. =_		_
Each degree $> 6^{\circ}$		_x 1 pt	:. =_		-
SN-MP $\geq 38^{\circ}$ Each degree $\geq 38^{\circ}$ $\leq 26^{\circ}$		_x 2 p	= ts. =_ =	2 pts.	_
Each degree $< 26^{\circ}$		_x 1 p	t. =_	1 pt.	_
1 to MP \geq 99° Each degree $>$ 99°		_x 1 p	= t. =_	l pt.	-
	Tot	al	=	1	
OTHER (See Instru	ctions)				
Supernumerary teeth Ankylosis of perm. teeth Anomalous morphology Impaction (except 3 rd m Midline discrepancy (\geq Missing teeth (except 3 rd Missing teeth, congenita Spacing (4 or more, per a Spacing (Mx cent. diastema Tooth transposition Skeletal asymmetry (nonsur Addl. treatment complet	n olars) Bmm) molars) nl rch) $rgical tx)xities$	2	_x 1 p _x 2 p @ 2 _x 2 p @ 3 _x 2 p @ 3	bt. =	2
Identify: Trans-alveolar impaction					
IMPLANT SITE Lip line : Low (0 pt), Medium Gingival biotype : Low-s High-scalloped, thin (2 pts) Shape of tooth crowns Bone level at adjacent contact point (1 pt), ≥ 7mm to co Bone anatomy of alveo	Tot n (1 pt), Higl calloped, th : Rectangu teeth : ntact point (olar cres	al (2 pts) ick (0 pt), ilar (0 pt), $\leq 5 \text{ mm to}$ 2 pts) t : H&V	= Mediun Triangu contac sufficier	8 n-scalloped, r ilar (2 pts) t point (0 pt), Defi	= medium-thick (1 pt), = = 5.5 to 6.5 mm to = cicient H, allow
sumutaneous augment (1 pt), Def H&V (3 pts) Soft tissue anatomy : 1 Infection at implant site	ntact (0 pt), None (0 pt)	uire prior Defective , Chronic (gratting (2 pts) 1 pt), Ac	g (2 pts), Defi ute(2 pts)	= =
-	To	otal	=	0	



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

2

Total Score: =





SP 19 CI	
MYYYY	ANY M

Total =	0		
1. Mesial Papilla	0	1	2
2. Distal Papilla	0	1	2
3. Curvature of Gingival Margir	n 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



Total =	2		
1. Tooth Form	0	1	2
2. Mesial & Distal Outline	0	1	2
3. Crown Margin	0	1	2
4. Translucency (Incisal thrid)	0	1	2
5. Hue & Value (Middle third)	0	1	2
6. Tooth Proportion	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 (1: 0.8)	0 1	2
6. Tooth to Tooth Proportion	0 1	2