Trans-Alveolar Uprighting of a Horizontally Impacted Lower Canine with a Mandibular Buccal Shelf Bone Screw

Abstract

A 10yr 6m female presented with an unerupted mandibular left canine and crowding of the maxillary incisors. Cone-beam computer tomography (CBCT) revealed the unerupted cuspid was a deep transalveolar impaction, positioned lingual to the roots of the left mandibular incisors and buccal to the root of the adjacent first premolar. Extraction posed serious surgical risks to the mental nerve, sublingual artery, and periodontium. So a carefully sequenced treatment plan was devised to reverse the etiology of the aberrant development, and recover the cuspid by uprighting it in an oblique plane corresponding to the long axis of the impaction. Two stages of conservative surgery exposed and progressively bonded the impaction as it was uprighted. To help avoid root resorption, the adjacent lateral incisor was not bonded and engaged on the archwire. The precise mechanics to upright the cuspid in the prepared oblique plane was provided by a rectangular lever arm anchored by a mandibular buccal shelf miniscrew (OrthoBoneScrew®). This very difficult malocclusion with a Discrepancy Index (DI) of 30 was treated to an excellent result in 36 months, as documented a Cast-Radiograph Evaluation (CRE) of 20 and Pink & White esthetic score of 2. (Int J Orthod Implantol 2017;46:40-56)

Key words:

Sublingual trans-alveolar impacted cuspid, 3-D lever arm, minimally invasive surgery, progressive bracket bonding, moment to force ratio, buccal shelf screw, horizontal cuspid impaction

History and Etiology

This 10y6m female was in good general health. The initial clinical examination revealed Class I molars and an edge to edge incisal relationship. The mandibular midline was 3mm to the left of the facial and maxillary midlines. The mandibular left canine was unerupted and there was space between the left premolars (*Figs. 1-3*). The apparent etiology for the impaction was an aberrant path of eruption. An innovative treatment plan was devised to reverse the aberrant development by: 1. creating an oblique space in the arch form that corresponded to the plane of the aberrant path of eruption (*long axis of the impaction*), and 2. uprighting the cuspid in the prepared oblique plane with mechanics designed to rotate the tooth at its apex. The patient was treated to an excellent outcome as documented in Figs. 4-6. A pre-treatment cone beam computed tomography (*CBCT*) documented the position of the impacted canine (*Fig. 7*). Panoramic and cephalometric radiographs before and after treatment are illustrated in Figs. 8 and 9, respectively. Superimposed cephalometric tracings are show in Fig. 10.

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Fig. 1: Pre-treatment facial photographs of a 10yr 6mo female

Fig. 4: Post-treatment facial photographs at 13yr 6mo of age

Fig. 2: Pre-treatment intraoral photographs

Fig. 5: Post-treatment intraoral photographs

Fig. 3: Pre-treatment study models (casts)

Fig. 6: Post-treatment study models (casts)

Fig. 7: Pre-treatment CBCT imaging reveals the unfavorable location of the impacted lower left cuspid.

Diagnosis

CBCT imaging (*Fig. 7*) revealed that the trans-alveolar impaction of the left mandibular canine was oriented lingual to the roots of the left lower incisors, and facial to the root of the adjacent first premolar. The cephalometric measurements are presented in Table 1.

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	81°	80°	1°
SNB° (80°)	78°	78°	0°
ANB° (2°)	3°	2°	1°
SN-MP° (32°)	41°	40°	1°
FMA° (25°)	32°	31°	1°
DENTAL ANALYSIS			
U1 TO NA mm *(4 mm)*	3 mm	6 mm	3 mm
U1 TO SN° (104°)	104°	109°	5°
L1 TO NB mm *(4 mm)*	4 mm	7 mm	3 mm
L1 TO MP° (90°)	83°	91°	8°
FACIAL ANALYSIS			
E-LINE UL *(-1 mm)*	0 mm	-1 mm	1 mm
E-LINE LL *(0 mm)*	2 mm	1 mm	1 mm

Table 1: Cephalometric summary

Skeletal:

1. Skeletal Class I (*SNA 81°, SNB 78°, ANB 3°*)
2. High mandibular plane angle (*SN-MP 41°, FMA 32°*)

Dental:

1. Class I occlusal relationships bilaterally
2. Anterior edge to edge occlusion of the incisors
3. 7mm of crowding in the upper anterior region
4. Multiple spaces were noted in the lower arch
5. Impacted lower left canine
6. Lower midline was 3mm left of the facial and maxillary midlines

Facial:

- Orthognathic profile with acceptable nose and lip esthetics

ABO Discrepancy Index (*DI*) was 30 as shown in the subsequent worksheet.

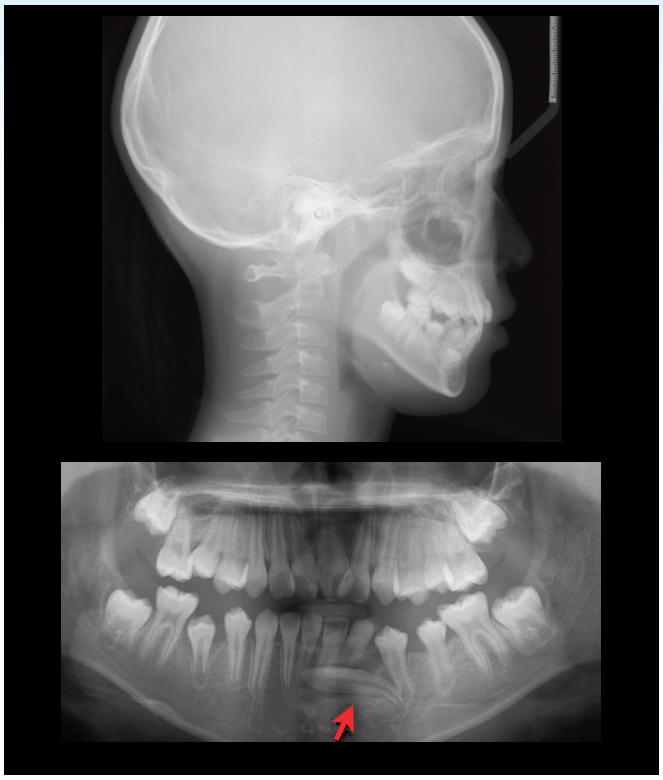


Fig. 8:
Pre-treatment panoramic and cephalometric radiographs showing the impacted lower left canine (red arrow).

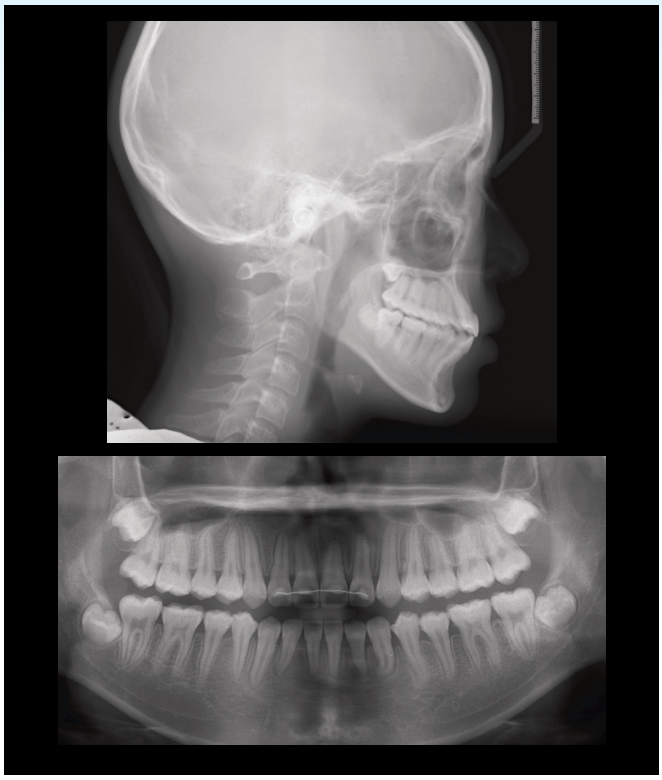


Fig. 9:
Post-treatment panoramic and cephalometric radiographs.

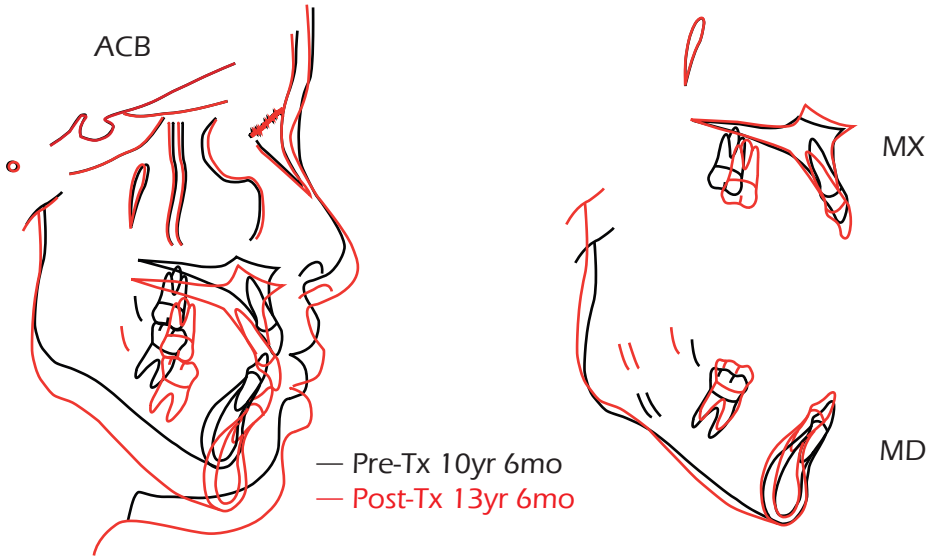


Fig. 10:
Tracings of pre-treatment (Pre-Tx, black) and post-treatment (Post-Tx, red) cephalometric radiographs are superimposed on the anterior cranial base (ACB), maxilla (MX), and mandible (MD).

Specific Objectives of Treatment

Maxilla (*all three planes*):

- A - P: *Allow for normal growth*
- Vertical: *Allow for normal growth*
- Transverse: *Maintain*

Mandible (*all three planes*):

- A - P: *Allow for normal growth*
- Vertical: *Allow for normal growth*
- Transverse: *Maintain*

Maxillary Dentition

- A - P: *Align maxillary incisors*
- Vertical: *Maintain*
- Inter-molar Width: *Maintain*

Mandibular Dentition

- A - P: *Maintain*
- Vertical: *Recover lingually impacted canine on the left side*
- Inter-molar / Inter-canine Width: *Maintain*

Facial Esthetics: Maintain

E-line: Maintain

Treatment Plan

Non-extraction treatment with a full fixed orthodontic appliance was indicated to correct crowding, recover the impaction, level the Curve of Spee, and coordinate the arches. After opening the oblique space, two stages of minimally invasive surgeries were planned to expose and progressively bond attachments on the impaction. Traction was applied, via a lever arm anchored with a left buccal shelf miniscrew, to upright the tooth by rotation at the apex. After the canine was recovered, leveling, aligning and detailing was planned for both arches. After removing the fixed appliances, the retention plan was a fixed retainer bonded to each of the upper incisors, and a clear overlay retainer for the lower arch.

Appliances and Treatment Progress

A 0.022-in slot Damon Q® bracket system (*Ormco Corporation, Glendora, CA*) was selected for both arches. The lower arch was bonded initially with low torque brackets in the anterior segment. Initially, brackets were placed on all erupted mandibular teeth, except for the left lateral incisor (#23). The initial archwire was 0.014-in CuNiTi. An open coil spring was placed between teeth #21 and #24 one month later (*Fig. 11*). The following month, an extra-alveolar (*E-A*) 2x12mm stainless steel (*SS*) miniscrew, with a

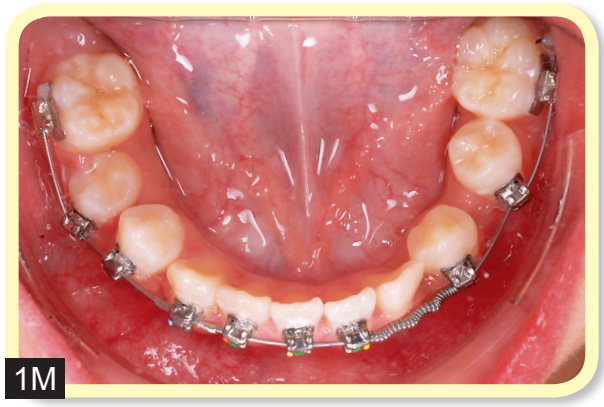


Fig. 11:
At one month (1M) into treatment, the lower arch was bonded and an 0.014-in CuNiTi archwire was placed with a coil spring between teeth #21 and 24 to open space.

0.019x0.025-in auxiliary hole (*OrthoBoneScrew® (OBS) Newton's A Ltd., Hsinchu City, Taiwan*), was inserted in the mandibular buccal shelf, lateral to the mesial root of the lower left first molar (#*19*). An elastomeric power chain, anchored by the OBS, was used to retract tooth #21, to help open space for the impaction (*Fig. 12*).

Three months later, the upper dentition (*except tooth #10*) was bonded with low torque brackets on the anterior teeth. An 0.014-in CuNiTi wire was engaged with an open coil spring between teeth #9 to 11 to open space, and tooth #10, was bonded with a low torque bracket one month later. At the following appointment an 0.014x0.025-in CuNiTi was placed, and in the sixth

Fig. 12:
A 2x12mm OBS with a rectangular hole through the head was inserted in the mandibular left buccal shelf, and a power chain from the OBS was used to retract tooth #21 along the archwire. Note that the lateral incisor (#23) was not bonded and engaged on the archwire, so that it can act as a "free body" to avoid root resorption, as the arch is aligned and space is opened.

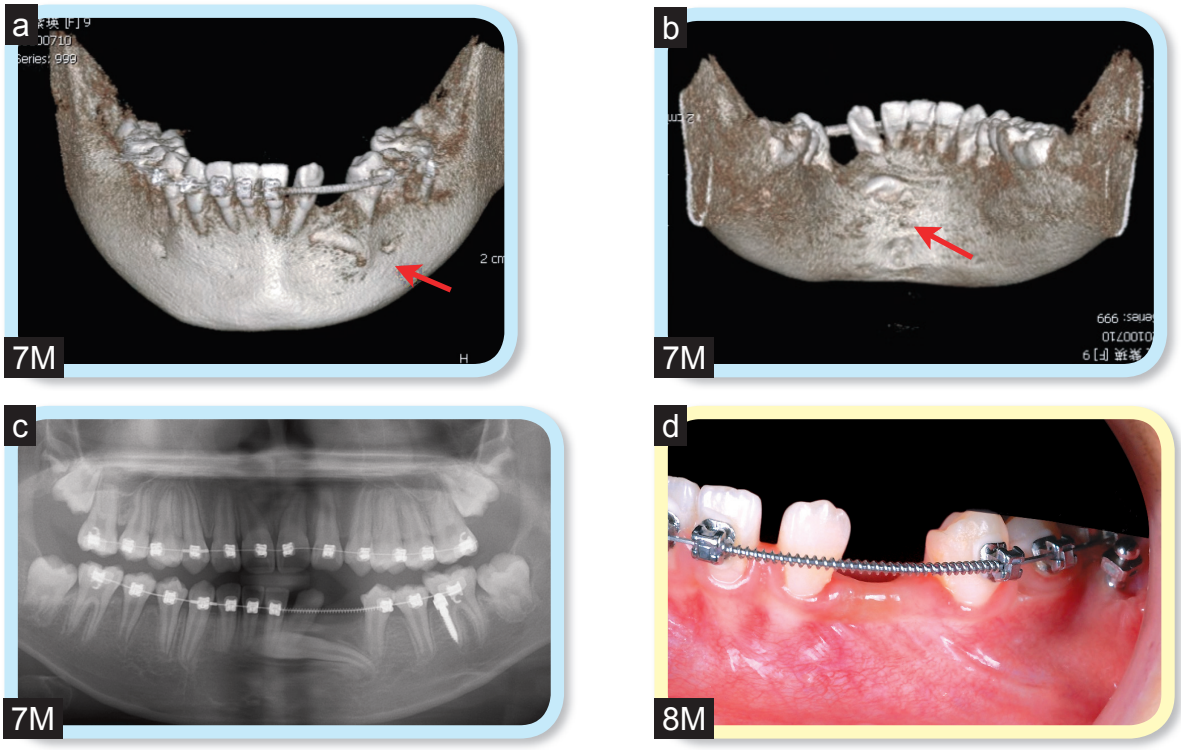


Fig. 13:
In the seventh month (7M), CBCT images from the labial (a) and lingual (b) show the 3D morphology. A 7M panoramic radiograph (c) and eighth month (8M) intraoral photograph (d) show that there is adequate arch length to upright the tooth, but no information is provided on the 3D relationship of tooth roots to the impaction, mental foramen or sublingual area. The CBCT scans (a and b) show that an oblique transalveolar space has been created that corresponds to the long axis of the impaction. NOTE: red arrows mark the structures that present the greatest surgical risk: the mental foramen position (a) and sublingual foramen (b).

month of active treatment, the crowding was relieved in the maxillary arch.

In the seventh month of treatment (*7M*), a panoramic radiograph and CBCT scan demonstrated that an adequate oblique space was successfully created to upright the impacted cuspid (*#22*) (*Fig. 13*). The impacted mandibular cuspid was surgically exposed with a full thickness flap, reflected from the overlying bone on the buccal surface (*Fig. 14*). Bone was carefully removed to expose the root of the impacted canine. The operative field was as superficial as possible on both the labial and lingual surfaces of the impaction. An eyelet was bonded on the upper aspect of the distal surface of the root (*Fig. 15*). To upright the impacted #22, a SS ligature was attached to the eyelet (*Fig. 16*). The traction force was provided by a 3-dimensional lever arm, made of 0.019x0.025-in stainless steel, that was anchored in the square hole of the OBS (*Fig. 17*). The flap was closed and sutured with 5-0 nylon. The lever arm was activated to upright the transalveolar canine in the plane of the oblique space to avoid damaging the roots of adjacent teeth.

In the tenth month, the upper arch wire was changed to 0.014x0.025-in CuNiTi. After two months of traction, the horizontally impacted canine was successfully uprighted with a point of rotation at its apex (*Fig. 18*). Eleven months into treatment a second exposure surgery was performed to change the position of the eyelet from the root to the crown of the impaction (*Fig. 19*), and the flap was closed at its cementoenamel junction (*CEJ*), to induce the attachment of keratinized gingiva in an occlusal position to the previously bonded root area (*Fig. 20*). Fig. 21 is a progressive series of panoramic

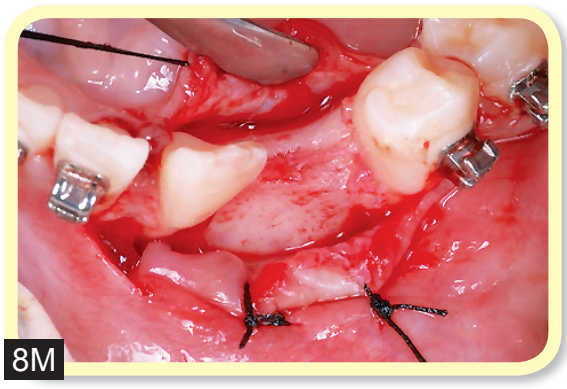


Fig. 14:
At eight months into treatment (8M), the alveolar ridge overlying the impaction was exposed with a full thickness mucoperiosteal flap.

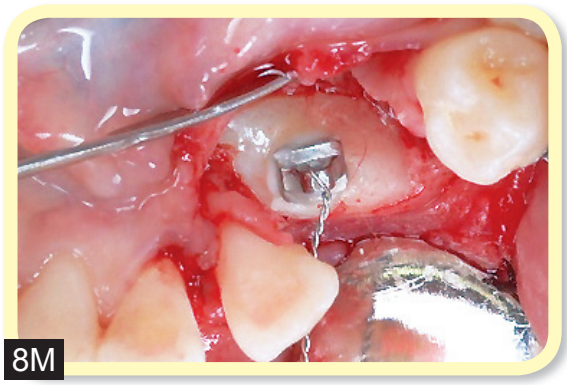


Fig. 15:
Following a careful removal of overlying bone, the upper root of the impaction was exposed lingual to the crest of the alveolar ridge, and an eyelet was direct bonded with light-cured composite resin. A SS ligature wire was attached to the eyelet.

Fig. 16:
With the SS traction wire exiting through the incision, the wound was closed with coronally repositioned flap to prevent gingiva recession of the left lateral incisor of tooth #23. Note that a mattress suture, providing light traction to the attached gingiva, was bonded to the facial surface of tooth #23.

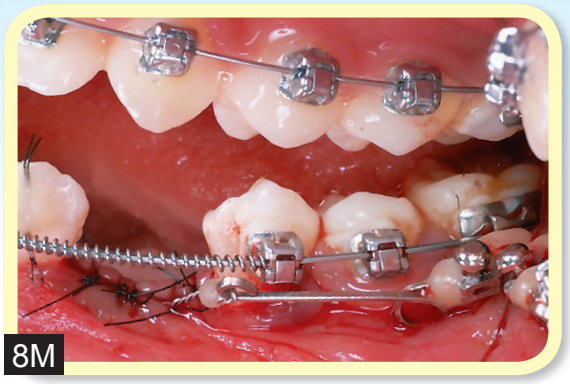


Fig. 17:
The traction ligature was activated in the plane of the oblique space by flexing the 3-dimensional level arm, which was inserted into the rectangular hole in the OBS. To secure the attachment and prevent tissue irritation, a small bead of resin was polymerized where the ligature was tied to the lever arm (lower center). Resin also secured the lever arm to the OBS (lower right).

radiographs documenting the initial uprighting of tooth #22. By progressive adjustment of the lever arm to produce 5 months of traction, the tip of the impacted canine appeared in the oral cavity 13 months into treatment (*Fig. 22*). One month later, the lever arm, bone screw, and eyelet were removed, and teeth #22 and 23 were bonded with brackets and engaged on the 0.014-in CuNiTi lower archwire (*Fig. 22*).

In the sixteenth month, the maxillary arch wire was changed to 0.017x0.025-in TMA, and the mandibular archwire was changed to 0.014x0.025-in CuNiTi. A torquing spring was installed on tooth #22 to torque the root lingually (*Fig. 23*). Twenty months into treatment the lower archwire was changed to 0.017x0.025-in TMA. After all the space in the lower anterior segment was closed, drop-in hooks were fitted in the vertical slots of the lower canine and a figure-eight SS ligature maintained firm contacts between the anterior teeth. Class II elastics (*Fox 1/4" 3.5-oz*) were used bilaterally from the upper

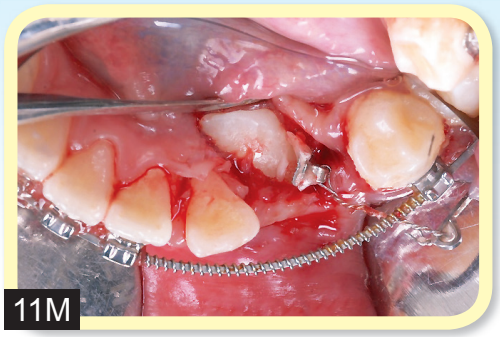


Fig. 18:
After three months of traction, which corresponded to eleven months (11M) into treatment, the cuspid was sufficiently uprighted to expose the crown of the tooth with a second conservative surgical procedure.

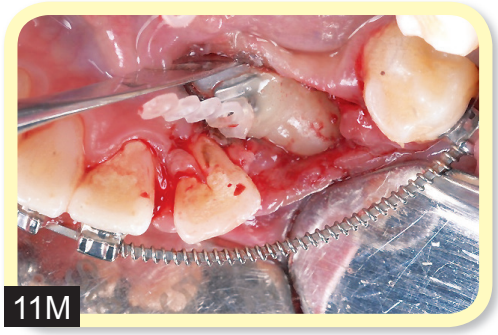


Fig. 19:
After removing the eyelet attached to the root, another attachment was bonded on the crown of the impacted cuspid, and an elastomeric chain was looped through the opening.

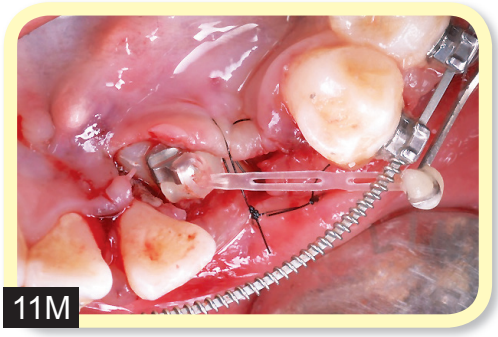
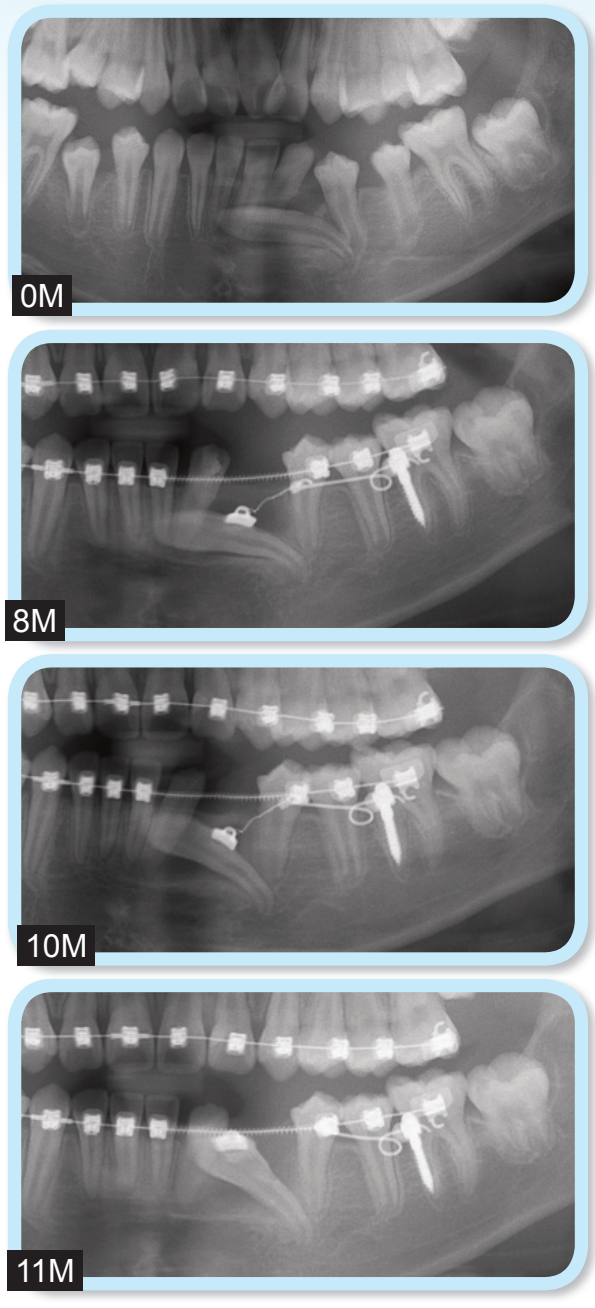


Fig. 20:
The elastomeric chain was loaded in tension by the lever arm from the OBS, and the point of attachment was sealed with polymerized resin. The flap was closed at the CEJ of the lateral incisor (#23).



■ *Fig. 21:*
A progressive series of panoramic x-rays illustrate the uprighting of the impaction over an 11 month period compared to pre-treatment (0M). The first surgery to bond an eyelet was performed at eight months (8M). The eyelet was bonded on the root because the crown was too close to the incisor roots and sublingual artery. The second surgery was performed at eleven months (11M) to reposition the eyelet onto the clinical crown.

canines to the lower first molars to correct the Class II relationship. An open bite in the area of teeth #23 and 24 was noted.

In the twenty-third month, the maxillary arch wire was changed to 0.019x0.025-in SS, the mandibular arch wire was changed to 0.017x0.025-in TMA, and both arches were secured with figure-eight SS ligatures. The patient received myofunctional therapy to correct her tongue-thrust swallowing and interdental soft tissue posturing habits. In the twenty-eighth month of active treatment, progress records were collected, including panoramic and cephalometric radiographs. All teeth judged to have incorrect axial inclinations were rebonded and a more flexible 0.014x0.025-in CuNiTi maxillary archwire was engaged. The mandibular archwire was progressively changed to 0.018-in CuNiTi and 0.017x0.025-in TMA. After 36 months of active treatment, the appliances were removed.

Retention

A fixed retainer was bonded on all maxillary incisors. Clear overlay retainers were delivered for both arches. The patient was instructed to wear them full time for the first 6 months and nights only thereafter. Instructions were provided for home care and maintenance of the retainers.

Final Evaluation of Treatment

The molar and canine relationships were both Class I. The upper incisor to the SN angle

Fig. 22:
A progressive series of intra-oral photographs illustrate the up-righting and alignment of tooth #22 from 11-14 months (11M, 13M, and 14M).

Fig. 23:
At sixteen months (16M) into treatment, a torquing spring was attached to the archwire to apply lingual root torque to tooth #22.

increased from 104° to 109°. The lower incisor to MD plane angle increased from 83° to 91° and the root alignment was nearly ideal. Despite the malocclusion severity and the relatively long treatment time, only modest irregularity in interproximal bone height and papillae were noted in the left mandibular canine and premolar area. However, moderate external apical root resorption was evident on tooth #22. In the pretreatment panoramic radiograph (*Fig. 8*) #22 has an elongated and dilacerated root, but when the tooth was aligned, the root appears shorter than the contralateral canine, but the dilaceration is still present. Overall, it was clear that orthodontic recovery of this severe sublingual, transalveolar impaction was a wise decision for the management of the current patient.

Cephalometric superimpositions revealed a substantial vertical growth spurt[1-3] during the 36 month treatment period. This growth pattern was beneficial for uprighting the horizontally impacted mandibular lower canine, but it aggravated the Class II relationship. Intermaxillary elastics were required to correct the sagittal discrepancy.

The American Board of Orthodontics (*ABO*) Cast-Radiograph Evaluation (*CRE*) score was 20 points as shown in the subsequent worksheet. The major discrepancies were overjet, uneven marginal ridges and occlusal contacts. The International Board of Orthodontics and Implantology (*IBOI*) Pink & White Esthetic score was 3 points. The patient and her parents were well satisfied with the result.

Discussion

Ectopic eruption and impaction of teeth are common problems in orthodontics. The clinical prevalence of impaction is about 1%, and the proportion of maxillary to mandibular occurrence is approximately 4 to 1.[4-6] In general, the recovery of severely impacted teeth is a challenging problem with longterm ramifications.[7-9] Even when an impacted tooth is successfully recovered, there may be discrepancies in occlusion, root resorption and/or gingival compromise.[10,11]

Bishara[12] recommends the following classical mechanics for recovering impacted canines: 1. make space in the arch for the impaction, 2. use of light force of no more than 2-oz (*60 g*) to move the impaction, 3. the archwire should be stiff enough 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 the neighboring teeth. Although these principles are adequate for managing routine impactions, substantial variations were necessary to treat the present malocclusion (*Figs. 1-3 and 8*). Unfortunately, there were no published reports for successfully recovering a deep transalveolar impaction of an mandibular canine. So before committing to a pioneering approach, it was important to consider alternative treatment plans.

Treatment Alternatives: Since the crown of the impacted cuspid was oriented in a lingual direction, three treatment modalities were considered:

- **Extraction**: This is a risky procedure because of the potential for damaging the mental nerve, sublingual artery and adjacent teeth. The extraction would leave a large defect that may heal with osseous and soft tissue deficiencies that would compromise subsequent space closure or prosthetic restoration. Furthermore, orthodontics to close the space or extensive prosthetic procedures may result in compromised occlusion, and/or esthetic asymmetry.

- **One stage closed eruption method**: This is the typical approach for many impactions, but it was contraindicated because of the unfavorable sublingual, transalveolar location of the impaction. It was not possible to expose the crown of the tooth to bond an attachment without risking damage to sublingual artery and adjacent teeth.

- **Two stage exposure and progressive bonding of attachments**: The advantage of this approach is less traumatic surgery, lower risk of damaging adjacent teeth, and more predictable control of the direction of tooth movement. Although this approach was deemed the most challenging, it was clearly indicated because of the obvious advantages over the other options.

Innovative Treatment Plan: The next step was to devise a realistic treatment plan based on basic clinical principles of diagnosis, surgery and biomechanics. A thorough diagnosis includes a careful assessment of the etiology, because it is important to formulate a working hypothesis for

the aberrant development. The most predictable treatment plan may be to reverse the aberrant developmental process. Four key points were proposed for achieving an optimal correction of the malocclusion without assuming unnecessary surgical risk or damaging the adjacent teeth: 1. do not bond a bracket on any teeth with roots near the impaction, 2. create a plane for uprighting the impaction, 3. perform surgery as conservatively as possible, and 4. use precise mechanics to upright the tooth in the prepared plane.[13] Each of these four steps requires a detailed discussion.

Avoid Bonding Adjacent Teeth: Not bonding the incisor adjacent to the impaction (#23) prior to uprighting the cuspid allowed it to act as a free body. This was a very important step for several reasons: 1. leveling #23 with the initial archwire would torque its root into the impaction, probably resulting in severe root resorption, 2. moving the root of #23 over the impaction would have blocked the oblique plane for uprighting #22, and 3. attempting to extrude the impaction with no clear path for uprighting it would probably damage the roots of multiple teeth.

Create an Uprighting Plane: For the present patient (*Figs. 1-3 and 8*), the critical presurgical step was to open an oblique space in the arch that corresponds to the desired plane for uprighting the cuspid (*Fig. 13*). The next consideration was the least invasive surgery for bonding the initial attachment on the impaction. Several factors are important in this decision: 1. proximity of surgical risks such as the mental nerve, sublingual artery and tooth roots, 2. biomechanics for uprighting the impaction in the prepared oblique plane, and 3. trauma to periodontal tissue. Since the crown of the canine was oriented away from the arch form, the goal was to determine an accessible, superficial area on the impaction for bonding the attachment. It was critical for the attachment to be within the oblique plane prepared for the uprighting. The CBCT image (*Fig. 7*) was carefully analyzed to select a convenient point of attachment occlusal to the center of resistance (C_r). The latter is typically about a third of the distance down the root in an apical direction. If the load to upright the impaction is a single force, such as a spring activating a SS ligature, the actual center of rotation (C_{rot}) is apical to the C_r. If the eyelet attachment on the tooth is occlusal to the C_r of the tooth, and within the plane of uprighting, the application of a single force is reasonably predictable for uprighting the tooth in the desired oblique plane. For the present patient the optimal area for bonding the attachment was the upper root area in the plane for impaction uprighting (*Fig. 15*).

Two-Stage Surgical Procedure: Critical surgical and biomechanics considerations dictate appropriate 3D imaging prior to initiating treatment on impactions that are risks to adjacent teeth. CBCT is a relatively low dose method for determining the 3D morphology. For the current patient, CBCT imaging showed that the impacted cuspid was located below the roots of the adjacent incisors and and first premolar (*Figs. 7 and 12*).

The initial surgical exposure required location and

protection of the mental nerve and sublingual area.[14] Damage to the mental nerve may result in permanent facial paresthesia and bleeding from the sublingual artery can cause swelling of the floor of the mouth and tongue. The latter can lead to respiratory obstruction, or a life-threatening hemorrhage.[15]

After the impaction was exposed and bonded, the direction of traction was selected. All bone in the path of enamel (*crown of the impaction*) was removed within the plane of uprighting. The bone covering the root of the impaction should be retained unless it is essential to bond an attachment in the upper root area (*Fig. 15*). The bonding procedure on the root can result in a loss of attachment, unless the attached gingiva is carefully approximated at the CEJ of the cuspid, after the root attachment is removed (*Fig. 20*).

Precise Biomechanics: Typically, there are three sources of anchorage: 1. the main archwire, 2. other teeth, and 3. miniscrews. When attempting to recover an impaction that is near the roots of other teeth (*Fig. 7*), it is important to first open an appropriate space for the uprighting (*Fig. 13*) and then carefully consider the moment(*s*) that will be generated by that line of traction force. If not carefully controlled, the rotation of the impaction as it extrudes can cause severe damage to adjacent teeth.

The line of force from the attachment (*eyelet*) to the activated lever arm determines the path of tooth movement. If the force is applied along the long axis of the impaction (*within the prepared oblique plane*), it will tend to upright the canine by rotating it near its root apex because of the resistance of the root to intrusion (*Fig. 21*). The rotation of the impaction as it extrudes is determined by the applied moment(*s*) generated in all three planes of space. The magnitude, direction and plane of the moment(*s*) depends on the distance from the line of force to the center of resistance (C_r) of the portion of the tooth that is embedded in bone. If the force is not applied in the uprighting plane, moments may be generated that will rotate the impaction as it uprights and cause severe damage to the roots of adjacent teeth.

The 3D lever arm was a 0.019x0.025-in SS wire inserted in the rectangular hole in the head of the OBS. The firm fit of the wire in the OBS provided a stable base for applying the desired force system at any point in the extrusion and alignment of the impacted cuspid. For the present application, the lever arm was used as a spring, carefully configured to activate in the uprighting plane. The 3-D lever arm can either be used as a spring or directly engaged in the bracket.[16] Once the cuspid erupted, the lever arm and OBS were removed, and a low torque bracket was bonded in an ideal position on the crown for final alignment with routine archwires (*Fig. 22*). The final correction was lingual root torque delivered with a torquing auxiliary (*Fig. 23*).

Treating impacted teeth requires an interdisciplinary approach that involves various aspects of periodontal management. Hence, patients with impacted teeth usually require a longer period of treatment and may have a compromised result if

their soft tissue is not carefully managed. There were two surgical keys to the successful management of the present impaction: 1. two stages of minimally invasive procedures to bond attachments, and 2. avoiding vertical incisions that might cut the sublingual artery and/or mental nerve.

Conclusion

Horizontal oblique (*trans-alveolar*) lower cuspid impactions are very difficult to manage because of their proximity to the mental nerve, sub-lingual artery, and roots of adjacent teeth. Surgical removal of the tooth is a risky surgical procedure, that may produce periodontal tissue deficiencies which can limit space closure and restorative options. Orthodontic recovery of transalveolar impactions is an attractive option, but very challenging. The present case report describes the diagnosis and innovative treatment sequence for managing a very difficult impaction to a near ideal result.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 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 = 3

Total = 5

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 = 2

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

Total = 0

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB ≥ 6° or ≤ -2° 3 = 4 pts.

Each degree < -2° _____ x 1 pt. = 0

Each degree > 6° _____ x 1 pt. = 0

SN-MP

≥ 38° 41 = 2 pts.

Each degree > 38° 3 x 2 pts. = 6

≤ 26° = 1 pt.

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

1 to MP ≥ 99° 83 = 1 pt.

Each degree > 99° _____ x 1 pt. = _____

Total = 8

OTHER (See Instructions)

Supernumerary teeth	_____ x 1 pt. =	_____
Ankylosis of perm. teeth	_____ x 2 pts. =	_____
Anomalous morphology	_____ x 2 pts. =	_____
Impaction (except 3rd molars)	1 x 2 pts. =	2
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	3 x 2 pts. =	6

Identify: Trans-alveolar sublingual impacted cuspid is hard to perform surgery & design mechanics.

Total = 8

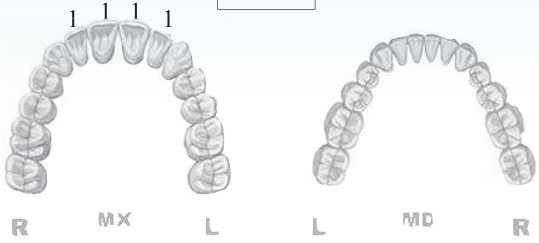
Cast-Radiograph Evaluation

Case # **Patient**

Total Score: 20

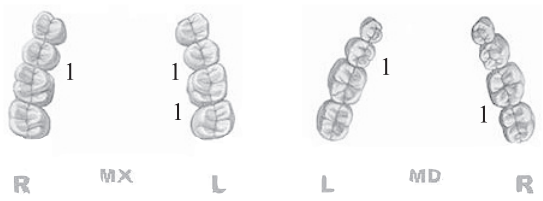
Alignment/Rotations

4



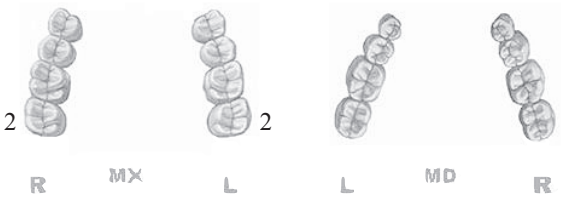
Marginal Ridges

5



Buccolingual Inclination

4

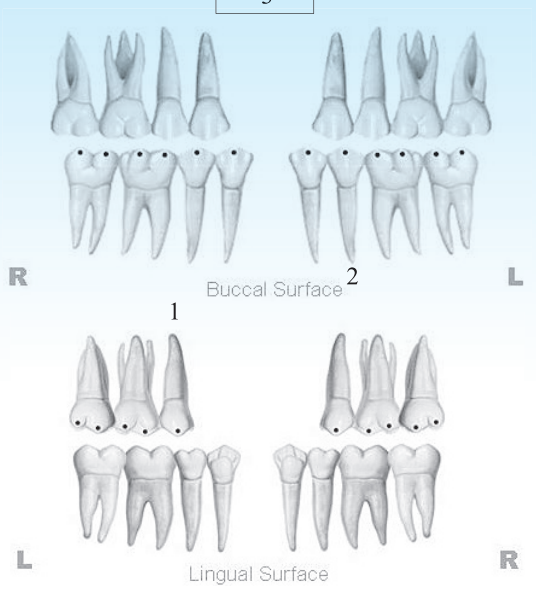


Overjet

3

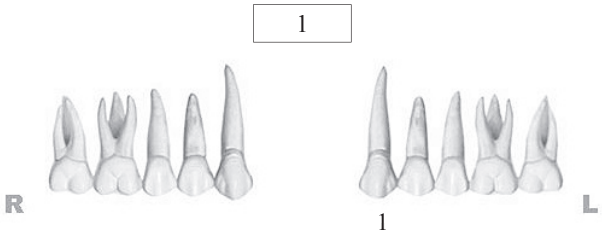
Occlusal Contacts

3



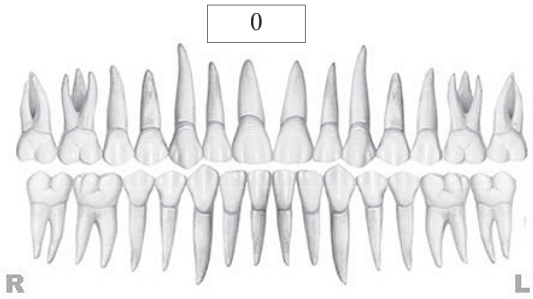
Occlusal Relationships

1



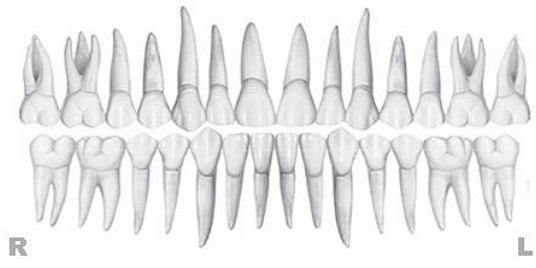
Interproximal Contacts

0



Root Angulation

0



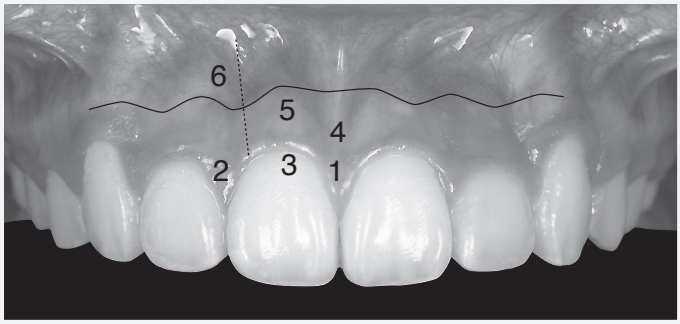
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score (Before Surgical Crown Lengthening)

Total Score: = 2

1. Pink Esthetic Score

Total = 0

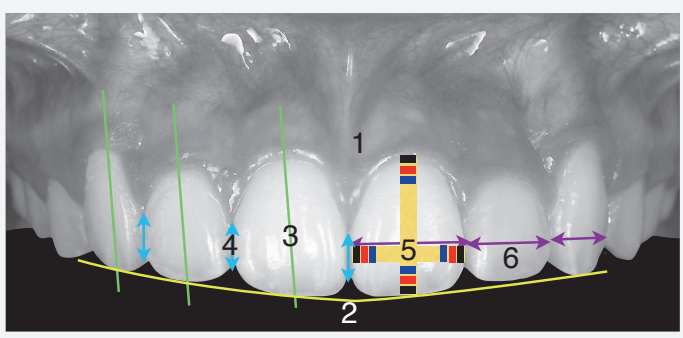


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

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 = 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

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