

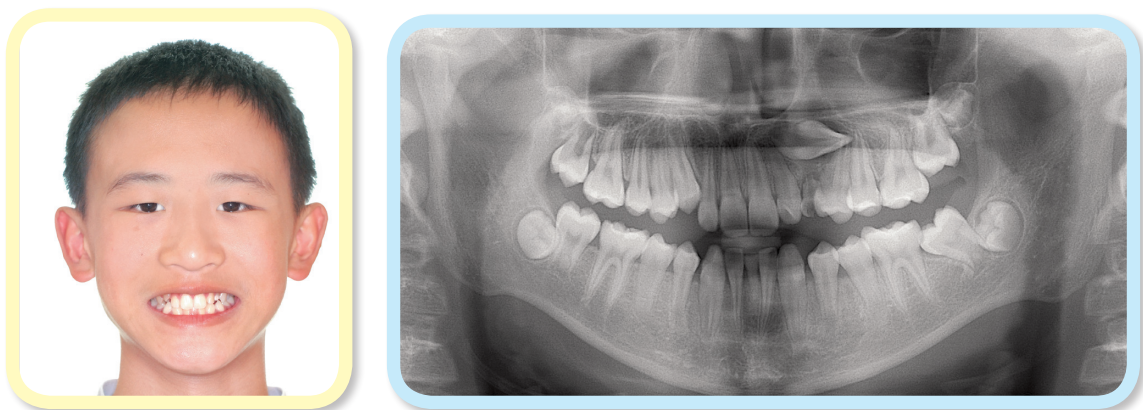
Simplified Open-window Technique for a Horizontally Impacted Maxillary Canine with a Dilacerated Root

Introduction

A left maxillary canine with a dilacerated root is horizontally impacted in the palate. Extraction is undesirable, so the preferred option is efficient surgical exposure and orthodontic alignment.¹ For palatal impactions, the open window technique is a common surgical approach.^{2,3} There are multiple surgical and orthodontic options to customize the process for a specific patient.⁴⁻⁶ This article illustrates the step-by-step surgical procedures as a checklist to assist clinicians in efficiently recovering palatally-impacted maxillary canines.

Case Study

A 12 year 8 month old boy presented for assessment of an unerupted maxillary canine. A panoramic radiograph (Fig. 1) showed an impacted upper left canine associated with a retained deciduous canine on the same side. Intraoral occlusal photographs (Figs. 2 and 3) show modest alignment problems as well as caries in the retained maxillary canine. Three-dimensional (3D) renderings of a cone-beam computed tomography (CBCT) scan⁷ showed that the crown of the impacted canine was oriented distally, near the apices of the

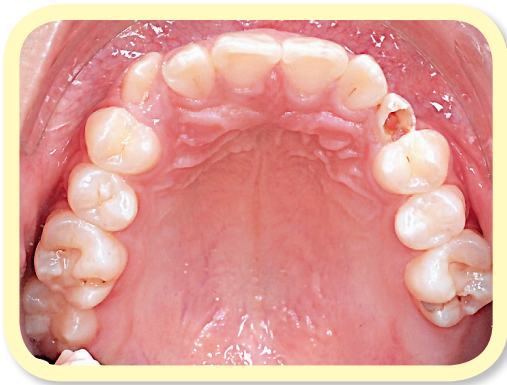


■ Fig. 1: Pre-treatment panoramic radiograph shows the horizontal impaction of the left maxillary canine (#11).

Dr. Ariel Chang,
Instructor, Beethoven Orthodontic Course (Left)

Dr. Chris Chang,
Founder, Beethoven Orthodontic Center
Publisher, International Journal of Orthodontics & Implantology (middle)

W. Eugene Roberts,
Consultant, International Journal of Orthodontics & Implantology (right)



■ **Fig. 2:**
Intraoral occlusal view of the maxillary arch shows no evidence of an impacted tooth.



■ **Fig. 3:**
Intraoral photograph of the occlusal view of the mandibular arch.

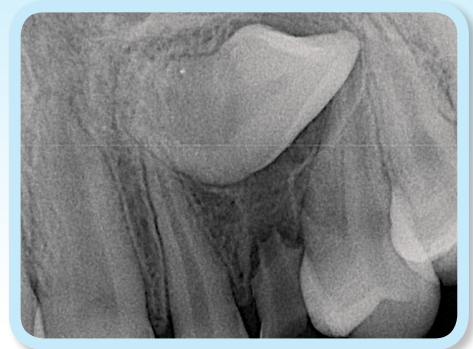
adjacent premolars (Figs. 4 and 5). CBCT slices along the long axis of the tooth, and perpendicular to it, revealed the impaction was completely covered with bone (Figs. 6 and 7). A periapical film demonstrated root dilaceration of the impacted canine, and incomplete apical development (Fig. 8). Radiographic documentation (Figs. 1 and 4-8) provides the precise location of the impacted tooth prior to surgery to uncovering it.⁷ The specialized procedures for surgically exposing this challenging impaction are presented in a checklist.



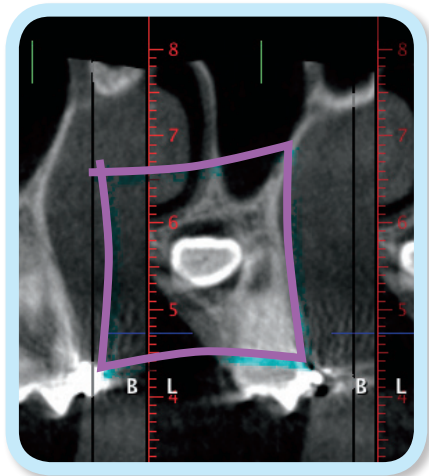
■ **Fig. 4:**
A 3D rendering of the maxillary dentition shows the impacted canine is positioned lingual to the premolar roots.



■ **Fig. 5:**
A 3D rendering of a CBCT scan shows the maxillary dentition from a posterior palatal perspective.



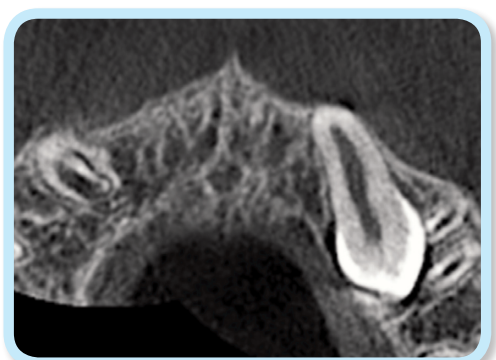
■ **Fig. 8:**
A periapical film demonstrates a dilaceration in the root of the impacted cuspid.



■ **Fig. 6:**
A CBCT slice perpendicular to the long axis of the impacted canine (colored boxes) shows it is located beneath the palatal cortical plate.



■ **Fig. 9:**
The orientation of the impaction and roots of adjacent teeth are visualized on a CBCT image.



■ **Fig. 7:**
An axial slice along the long axis of the impaction shows it is located near the roots of the premolars.

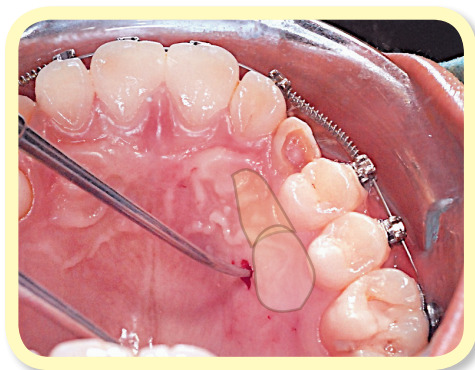
Surgery Procedures

1. Orientation

- *Locate the position of the impacted canine.*
 - » Plane radiographs (*occlusal and periapical films*) may be adequate for localizing and determining the root shape of relatively simple soft tissue impactions, but bony impactions require CBCT imaging for precise localization relative to adjacent teeth (*Fig. 9*).⁷ Slices from the CBCT

imaging are also useful for determining the thickness and density of the bone covering the tooth (Fig. 6). In addition, 3D imaging reveals the root shape (Fig. 7), and any anomalies present that may limit the prognosis for the impaction, even if it is aligned. This is an important aspect of differential diagnosis. It is a waste of time and money to recover an unserviceable tooth.

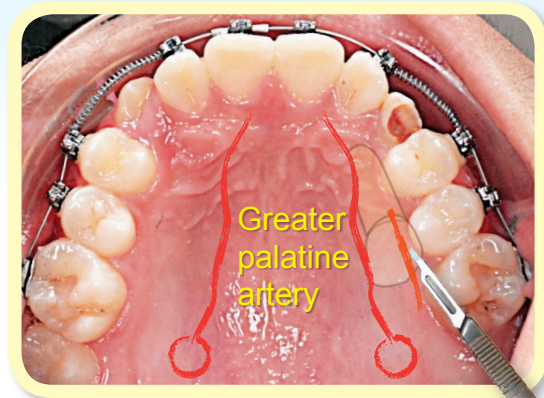
2. Indentation



■ **Fig. 10:**
Mark the location of the underlying crown with a sharp explorer. See text for details.

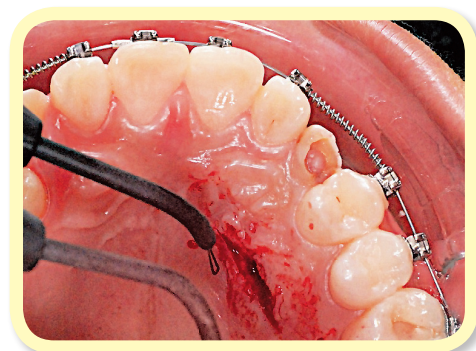
- Apply local anesthesia to the surgical site.
- Mark the location of the crown with a sharp explorer.^{4,5}
 - » The sensation is different when an explorer strikes a tooth rather than bone. Enamel is very rigid and there is no penetration by even a sharp stainless steel (SS) explorer. A tooth root is not as hard as the enamel, but penetration by the explorer tip is quite limited. The explorer will penetrate bone with a crunchy sensation.

3. Flap Reflection

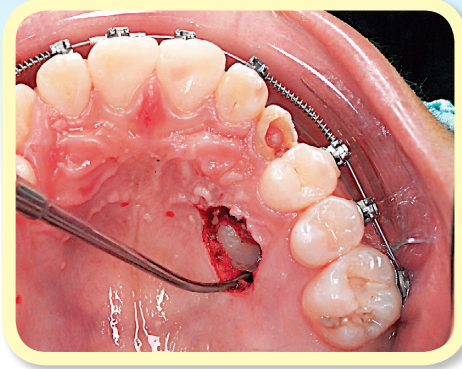


■ **Fig. 11:**
Incise the overlying soft tissue (orange line) along the long axis of the crown and parallel to the greater palatine artery (red lines).

- Incise the soft tissue along the long axis of the crown with a No. 15c surgical scalpel (Fig. 11).²
- Reflect the flap with a surgical curette or periosteal elevator.
- Beware of the greater palatine artery (Fig. 11) which courses through the center of each half of the palate. If possible make incisions parallel to the artery and avoid deep transverse sections that may sever it.

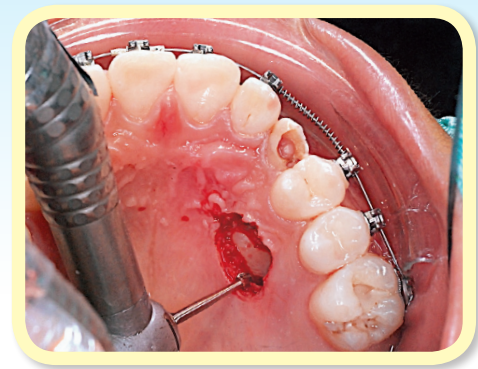


■ **Fig. 12:**
The soft tissue covering the crown of the impacted canine is removed with electrocautery.



■ Fig. 13:

Remove soft tissue to expose the bone covering the crown of the cuspid, and locate the underlying enamel with an explorer.



■ Fig. 14:

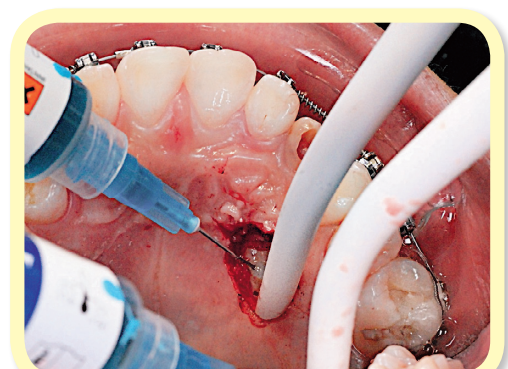
All bone covering the crown of the impaction is carefully removed down to the level of the CEJ. Avoid directly contacting the tooth with the bur.

- Use a dental electrosurgical unit (ESU) to remove the soft tissue covering the crown (Fig. 12).³
 - » ESU controls localized bleeding by cauterizing vessels and coagulating blood. This method prevents blood oozing from the wound, thereby providing good visualization of the surgical field.
- Use an explorer to penetrate overlying bone to determine the position of the cuspid crown (Fig. 13).
 - » Differential sensations when an explorer engages enamel, the root of the tooth or bone is a very effective method for surgically locating the crown of the impaction.

4. Bone Removal

- Use a high speed handpiece with a carbide round bur to remove the overlying bone (Fig. 14).^{2,3}
 - » It is essential to remove all bone covering the crown down to the cemento enamel junction

(CEJ). Spontaneous tooth eruption is facilitated by removing bone apical to the height of curvature of the crown. Be cautious with the bur near the CEJ to avoid injuring the tooth. When the layer of overlying bone is thinned sufficiently, the remnant is easily removed with a hand instrument. Cervical damage to the tooth can subsequently result in external root resorption.⁸



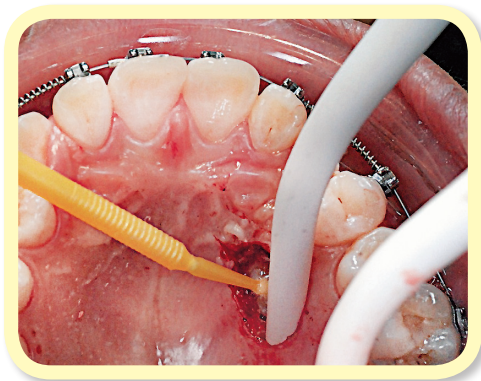
■ Fig. 15:

The etching solution is applied to the enamel surface with a syringe (upper left). Moisture is controlled with surgical suction (grey tube).

5. Etching & Bonding

▪ Etching & Bonding

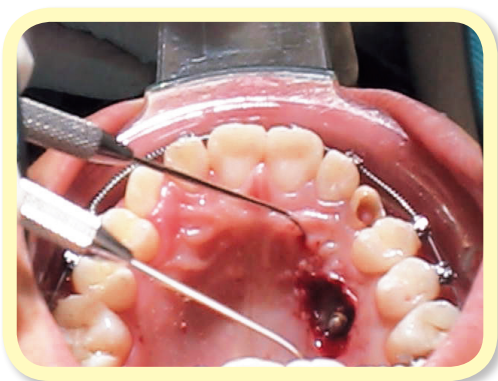
- » Moisture control is very important when etching, sealing and bonding. Bleeding is controlled with electrocautery. Water, saliva and residual blood are removed with high power suction (Figs. 15 and 16).



■ Fig. 16:

After the etched surface is rinsed and dried, the sealant is applied with a yellow brush.

6. Indentation

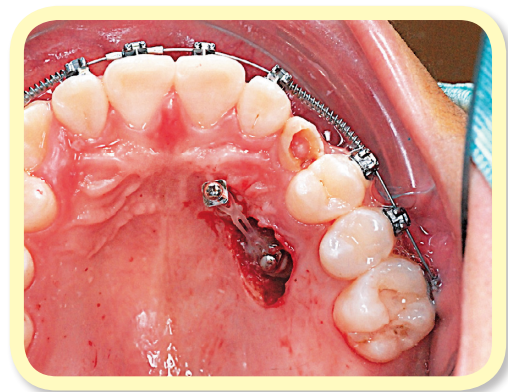


■ Fig. 17:

After the button was bonded on the crown of the impacted canine, the position for the miniscrew was marked by penetrating the soft tissue in the rugae area with an explorer.

- Bond a button on the crown portion of the impacted canine.
- Make an indentation in the rugae area where the miniscrew will be inserted.

7. Screws Insertion



■ Fig. 18:

Traction is applied with a power chain to upright the canine, and a coil spring is used to open space in the arch for the impaction.

- A miniscrew is inserted mesial to the impaction.
- An elastic power chain is attached from the button on the impaction to the miniscrew.
 - » The miniscrew is placed on the mesial surface to upright the impacted canine with an elastic power chain. This force system provides direct traction to upright the impaction without deleterious side effects on the rest of the dentition. It is often necessary to reposition the miniscrew as the tooth is uprighted. Beware of impinging on the roots of teeth and creating occlusal interferences.⁶



■ Fig. 19:

Petroleum jelly is applied to the back of a glove to assist in manipulating the periodontal dressing.

- Spread petroleum jelly on the back of a glove to coat glove fingers to prevent sticking to the periodontal dressing (COE-PAK).^{4,5}

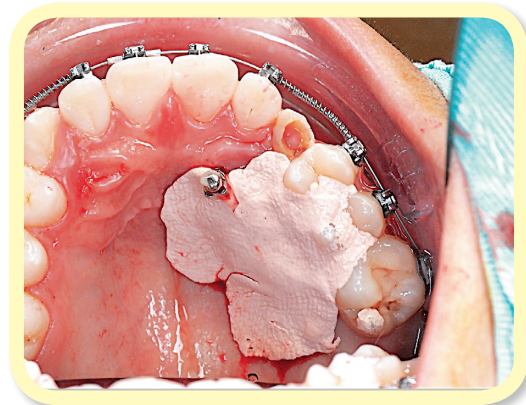
8. COE-PAK Application

- Coat glove finger tips with petroleum jelly from the back of the glove (Fig. 19).
- Cover the wound with periodontal dressing and pack it into the interdental spaces and around the miniscrew.
 - » Packing the dressing into the interdental spaces provides retention.
- Use wet gauze or a cotton swab to press the periodontal dressing into firm contact with the wound.
 - » Periodontal dressing controls bleeding, enhances patient comfort, and most importantly prevents the mucosa from growing over the uncovered impaction (*open window technique*).

» Healing mucosa grows ~1mm/day which is much faster than a tooth erupts. The dressing is essential for maintaining the patency of the window until the tooth erupts through it.

» Periodontal dressing is removed three days after the surgery and the eruption of the impaction is closely monitored for ~3 weeks or until it erupts through the mucosa.

- Extract the primary canine (Figs. 20 and 21).



■ Fig. 20:

Periodontal dressing is covering the wound and the miniscrew, and the carious maxillary left deciduous cuspid is prepared for extraction.

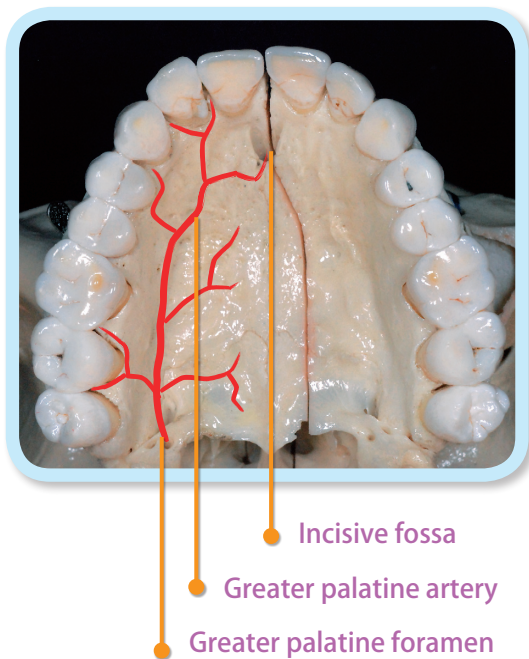


■ Fig. 21:

After extraction the deciduous canine shows both extensive crown and root destruction.

Discussion

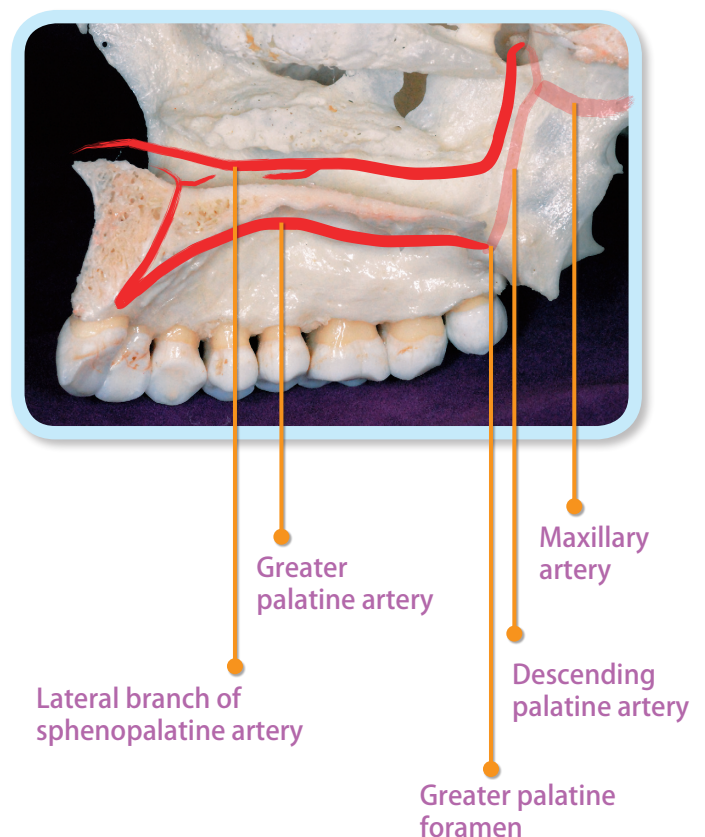
For most palatal impactions, the open window approach allows for spontaneous eruption. However, that approach is less likely to be successful for bony impactions, particularly when horizontal, deep in the alveolar process, with a dilacerated root, in an older patient, or when a miniscrew is required.⁹ Deep bony impactions usually require traction for eruption (Fig. 18). However, the most critical issue in dealing with bony impactions in the posterior palate is avoiding damage to the greater palatine artery (GPA)(Fig. 22);^{2,3} which is the terminal portion of the descending palatine artery, that is derived from the maxillary artery (Fig. 23). The GPA enters the palatal soft tissue through the greater palatine foramen, and provides the blood supply for the gingiva and mucosa of the posterior palate (Fig. 22). It terminates



■ **Fig. 22:**
The arterial supply of the palate is drawn on a dry skull.

through the incisive canal by anastomosing with the sphenopalatine artery to supply the nasal septum (Fig. 23). The GPA is a relatively large artery in the posterior palate that is capable of significant bleeding if severed. The surgeon must avoid any incisions that threaten the GPA. If an impaction is near the GPA, it may be best to reflect the soft tissue of the palate to expose the impaction.

Dilaceration is a developmental disturbance in the shape of a tooth, and it may affect both the deciduous and permanent dentitions.⁹ The term dilaceration refers to a curvature in some aspect of a tooth. It usually involves the cervical region and/



■ **Fig. 23:**
The arterial supply of the internal maxilla is drawn on a midsagittal section of a dry skull.

or the root of a tooth. If the problem is genetic, it usually also affects the same tooth on the opposite side of the arch, because the genome contains genes for only half of the body: the other half is a mirror image.¹⁰ Isolated cases of dilaceration are usually due to trauma during tooth development or the tooth being impeded during eruption. Trauma may displace the formed portion of the tooth germ, so that the rest of the tooth forms at an abnormal angle. Eruption is such that the apical area remains at the same place while the crown moves occlusally, but if eruption is mechanically blocked, the proliferating apical area will move into different direction.⁹ The ensuing distortion of root form is deemed dilaceration.

Conclusion

For many years, extraction was the recommended treatment for a dilacerated impactions, but modern technology offers new options. Conservative surgical exposure and bone screw anchorage facilitates the recovery and alignment of even severely displaced impactions. This article provides a step by step sequence (*checklist*) to assist the clinician in managing palatal impactions in a standardized manner with the open-window technique.

References

1. Kokich VG. Surgical and orthodontic management of impacted maxillary canine. *Am J Orthod Dentofacial Orthop* 2004;126:278-83.
2. Yeh HY, Chang CH, Roberts WE. Step-by-Step on the Open-Window Technique for Upper Palatal Impaction. *Int J Orthod Implantol* 2011;24:40-3.
3. Cheng J, Chang CH. Simplified open-window technique for palatally impacted cuspids. *Int J Orthod Implantol* 2012;25:48-52.
4. Su B, Hsu YL, Chang CH. Soft Tissue Considerations for the Management of Impactions. *News & Trends in Orthodontics* 2011;22:54-9.
5. Su B, Hsu YL, Chang CH, Roberts WE. Soft Tissue Considerations for the Management of Impactions. *Int J Orthod Implantol* 2011;24:50-59.
6. Hsu YL, Chang CH, Roberts WE. OrthoBoneScrew. The dream screw for next generation's orthodontists. *News & Trends in Orthodontics* 2011;23:34-49.
7. Tsuyoshi S, et al. Impacted teeth in the maxilla: usefulness of 3D Dental-CT for preoperative evaluation. *Eur J Radiol* 2003;47:221-6.
8. Discacciati JA, de Souza EL, Costa SC, Sander HH, Barros Vde M, Vasconcellos WA. Invasive cervical resorption: etiology, diagnosis, classification and treatment. *J Contemp Dent Pract* 2012;13(5):723-728.
9. Proffit WR, Fields HW, Sarver DM. *Contemporary Orthodontics* 5th ed. 2012;3:66-91.
10. Roberts WE, Hartsfield Jr JK. Bone development and function: genetic and environmental mechanisms. *Seminars in Orthodontics* 2004;10(2):100-122.

