



# Exposure of Impacted Teeth

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Killian MacCarthy and Tarryn MacCarthy

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## Introduction

Most patients with impacted teeth are referred to the surgical practice by an orthodontist. The surgeon has the opportunity to educate the patient on their clinical options and to develop a team-based approach with the general dentist, the orthodontist, the surgeon, and the autonomy of the patient.

After third molars, maxillary canines are the second most commonly impacted tooth [1]. Following the maxillary canine in prevalence of impaction is the mandibular second premolar followed by the mandibular canine. Treatment plans for either extraction of the impacted tooth or exposure and bonding of the impacted tooth should be discussed with the orthodontist prior to surgery to assess the likelihood of success for dental alignment. This decision is made with the aid of a complete workup and accurate diagnosis.

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## Radiographic Analysis

The workup for surgical management of unerupted teeth requires imaging to guide the consultation. In the past, the buccal shift rule for plain film radiographs (Clarke's rule) was the mainstay for surgical and orthodontic planning of impacted teeth. The SLOB Rule: Same Lingual, Opposite Buccal is a mnemonic device stating that if the X-ray tube shifts and the tooth follows in the same direction as the tube moves in the second image then the impacted tooth is on the lingual. If

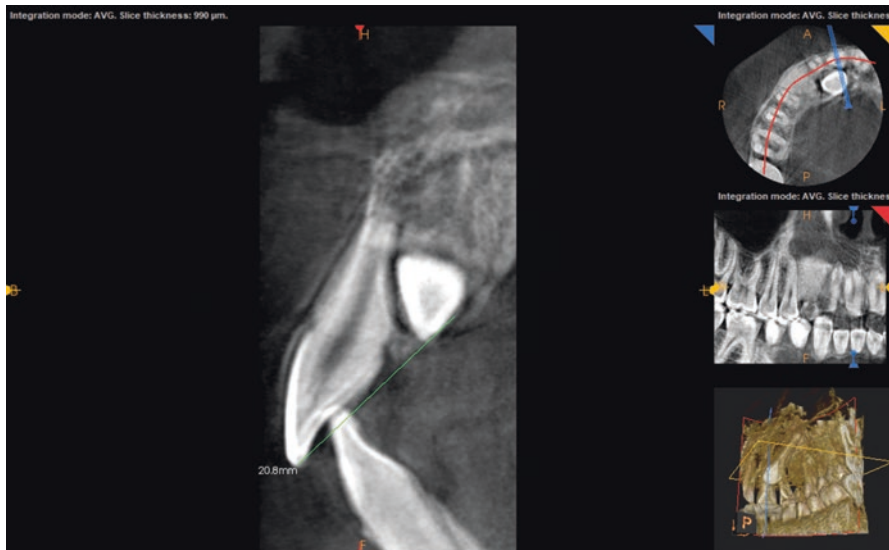
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K. MacCarthy (✉)  
OMS Associates, South Portland, ME, USA  
e-mail: [killian@maineoralsurgery.com](mailto:killian@maineoralsurgery.com)

T. MacCarthy  
Mbrace Orthodontic, Falmouth, ME, USA

the tooth moves in the opposite direction to the direction of the tube shift then the tooth is on the buccal relative to the adjacent teeth. Lingual and buccal in this example refers to the three-dimensional reference of the impacted tooth relative to the adjacent tooth roots. This rule on 2-dimensional radiographs is unreliable in certain situations in which the tooth is positioned almost directly over the middle of the alveolar ridge or when the crown of the tooth is in one plane and the root apex is in another.

Today current 3D computed tomography allows the dentist to determine the exact position and location of the impacted tooth and with specific accuracy as to the position of the crown and the root apex of the impacted tooth. The discrepancy between the crown and root location can have significant effect on the best direction of orthodontic force and the best location for surgical access. 3D computed tomography allows direct measurement that can be translated to the surgical field with ease (see Fig. 12.1). Limited field view radiographs can isolate the alveolus to 3–4 tooth segments. A full skull cone beam CT can be 3–6 times the radiation dose of a panoramic radiograph [2]. Reduced field views also reduces the possible liability for missed pathology in the skull or spine as those structures can be avoided in the imaged field. With 3D computed tomography the oral surgeon and the orthodontist can more accurately assess for damage to the adjacent teeth and if orthodontic forces might cause further resorption. Lastly, the 3D images can evaluate the palatal bone quality and thickness if temporary anchor screws are going to be used.



**Fig. 12.1** Direct measurement of the canine. Computed Cone Beam Tomography allows direct measurement of the position of teeth that then can be translated to the mouth using a surgical caliper. Measuring from the incisal edge is helpful if the impacted tooth is not easily located. In this particular image the canine is 20 mm from the incisor

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## Clinical Examination

The clinical exam can suggest the location of an impacted tooth. 85% of impacted maxillary canines are located on the palate [1, 3]. Clinically one might find a bulge in the mucosa to suggest the location of the crown or possibly the root. This hard bulge can be detected on the palate or on the buccal surface of the alveolus, although it is not always perceptible. Mobility of teeth on the mesial or distal of the impacted tooth might indicate root resorption. Root resorption has typically been diagnosed on 2D radiographs. 3D computer tomography is able to discern root resorption in three dimensions much sooner than is shown on the 2D radiographs which will show resorption only at a more advanced stage. Early diagnosis of root resorption of teeth adjacent to impacted teeth is critical in the long-term treatment planning of the orthodontic management of the case. This knowledge could change the treatment plan from a surgical exposure case to an extraction case [4].

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## Potential Complications

Informed consent is critical. The major and common risks should be reviewed with the patient prior to treatment. The following is a list of the most common (not exhaustive) complications with surgical exposure of impacted teeth:

- Debonding of the bracket can occur for many reasons. If good isolation was not achieved during the surgical exposure or if the bracket was not properly tested for adequate bond strength either situation could result in bracket bond failure. Often bracket bond failure could require a second surgical procedure to reattach the bracket to the tooth.
- The tooth can become nonvital from the exposure procedure requiring root canal therapy. Aggressive exposure of the tooth beyond the CEJ or retractor pressure at or above the CEJ can lead to external resorption of the tooth. High heat or clinical trauma with a high-speed bur to the impacted tooth could also lead to dental devitalization. Surgical limitations for adequate bonding of a bracket to the impacted tooth may require placing a wire ligature around the tooth. This can also lead to external root resorption as the wire is likely to sit at or below the CEJ.
- External root resorption can result from damage to the root during surgery (as described above), as a result of previous trauma to the root of the impacted tooth or to the adjacent teeth (which have stimulated cementoclastic activity), damage to the roots when teeth collide within the bone, and from heavy orthodontic forces.
- Prior to the use of presurgical 3D imaging, there was a higher risk of inadvertently exposing the roots of adjacent teeth during the procedure. It is prudent to still talk about damage to adjacent teeth during the exposure process as this is still a risk.
- Ankylosis of the impacted tooth is also a risk factor. Ankylosis can be a preexisting condition that is better diagnosed with 3D imaging. It is still possible,

however, that ankylosis is not initially diagnosed and only recognized clinically after surgical exposure and once orthodontic forces are applied. Ankylosis can be clinically diagnosed when intrusion or adverse movements of the adjacent teeth occur. It is wise to mention that the impacted tooth might need to be removed if it cannot be moved orthodontically.

- Gingival defects around the impacted tooth subsequent to final orthodontic positioning can later require gingival or connective tissue grafting.

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## Surgical Treatment

Good surgical technique culminates from presurgical and orthodontic treatment planning. The location of the impacted tooth will dictate the surgical approach. The direction of planned orthodontic forces will also dictate the surgical approach. The younger patient might have interceptive Phase 1 orthodontics (removal of primary teeth, palatal expander, Trans Palatal Arch, etc.) to avoid the need for more involved surgical intervention later in life or to avoid impending root resorption of adjacent teeth [4]. Temporary skeletal anchors can allow the orthodontist to intervene sooner with anchorage that TADS offer compared to the mixed dentition. The chain can be attached to the temporary anchorage device or a fixed orthodontic appliance prior to comprehensive orthodontic treatment. In a patient with mixed dentition an open window technique can be used prior to placement of the orthodontic appliances. The majority of patients in the author's office choose to have this procedure done with moderate sedation or general anesthesia. Though it can be comfortably done under local anesthesia, it is recommended in the case of palatal impacted canines the patient should consider a sedation option. As full patient cooperation will support a better surgical outcome.

Methods that can be used for exposing impacted teeth include (1) gingivectomy, (2) apically repositioned flap, (3) closed eruption technique, or (4) open window technique.

1. The gingivectomy procedure removes the tissue that is covering the impacted tooth. This tissue removal can be accomplished with a scalpel, electrocautery, or a laser. At least 3 mm of attached tissue must remain in order to ensure mucogingival health of the tooth. Adequate anesthesia requires infiltration on the buccal and palatal or anesthetic block. Once anesthetized, retraction or gentle pulling of the lips or cheeks allows proper evaluation for the location of the mucogingival junction. Proper identification of the mucogingival junction will allow accurate measurement of the biologically needed 3 mm of attached tissue [5].
2. An apically repositioned flap creates a finger flap that is elevated and placed in an apical direction to better expose the impacted tooth when it is on the buccal aspect of the alveolus. One risk of using this technique is a nonideal esthetic result of the gingiva. This is a significant concern if considering this technique for an impacted central incisor. If the impacted tooth is positioned very high apically compared to the adjacent teeth this technique can lead to mismatch of attached tissue which is especially obvious in the anterior maxilla. This risk is

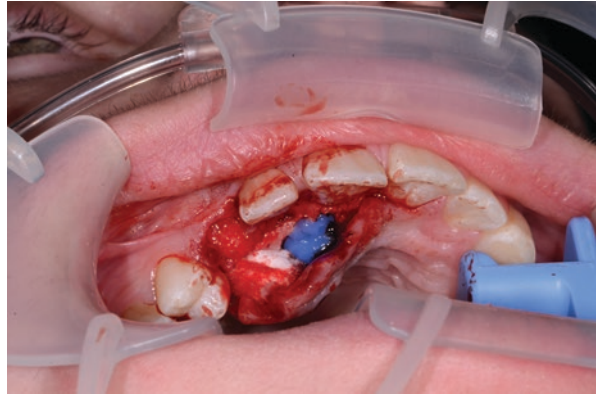
increased when the bulk of the crown is above the mucogingival junction. Uncovering the tooth at this location can require a large amount of bone removal that can lead to unstable bony and gingival support of the tooth. There can also be a concern of partial re-intrusion or relapse of the impacted tooth in the retention phase of orthodontics [6].

The surgical technique for an apically repositioned buccal flap involves parallel vertical incisions over the impacted tooth and a midcrestal incision down to the bone. Next, a full-thickness mucoperiosteal flap is elevated. The flap is stabilized apically with 2–4 sutures to the adjacent tissue. If converging incisions (toward the CEJ) are made it can be difficult to suture the narrower flap tip to the wider apical tissue. The surgical exposure ideally leaves two-thirds or more of the clinical crown exposed.

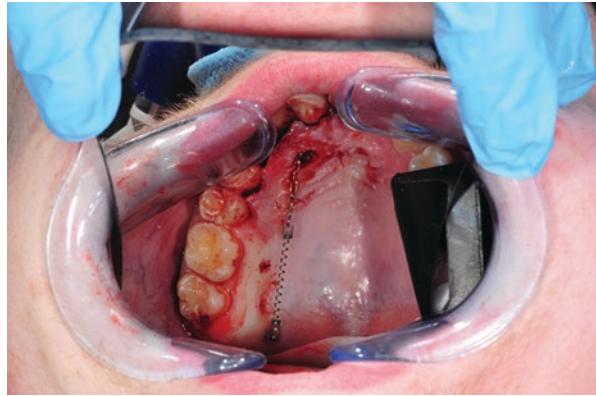
3. For many palatally impacted teeth a closed eruption technique can be used. For access to a palatally impacted canine a neck of tooth incision can be used with release from the 2–3 teeth mesially and distally to the location of the impacted tooth. A full-thickness flap can be elevated. A presurgical 3D radiograph can be used to accurately locate the impacted tooth. Calipers are used to transpose the position of the tooth beneath the bone on the images to the surgical field. A thin shell of bone mostly overlies the impacted tooth and can be easily removed with an elevator or an interproximator elevator (Karl Schumacher New York). If using a handpiece and bur to remove the bone, then judicious bone removal should be employed to ensure only bone is removed and to avoid damage of the impacted tooth and adjacent tooth roots. Once the tooth is located and the covering bone removed, the follicular tissue, which is very vascular, can make bonding of a bracket difficult due to copious oozing. It is wise to remove as much follicular tissue as possible without violating or curetting the CEJ to ensure a drier surgical field to work with, ideally bonding in the first attempt.

A self-retaining cheek retractor can be used to help hold the lips apart, freeing up a retractor hand. Moisture control is paramount to good bond strength. Sterile cotton rolls keep the field dry by cutting them into thirds or quarters so they can fit easily into the wound. The number of control rolls or cotton roll pieces used is marked on the surgical field with a surgical marker. Confirmation that the presurgical and postsurgical cotton roll count is the same is imperative. A remaining cotton roll in the wound can lead to postoperative infection. If there is concern about accurate counts then a small 1 × 1 cm or 1 × 4 radiopaque neuropatty can be used to help keep the field dry. This will allow for intraoperative or postoperative confirmation of retained sponges with a postoperative radiograph. If cotton rolls or neuropatties are to be used they are placed at the apex of the flap wedging it open and absorbing the apical oozing blood (see Fig. 12.2). Holding the neuropatty or cotton roll in a snap instrument using a sweeping blunt dissection motion can help remove oozing follicular tissue. If not using packing material, then consider suturing the tissue edge of the flap to the mouth prop and having your assistant keep the field dry. Be aware that positioning of the suction tip is important so as not to drag the saliva and blood across the tooth surface which will prevent adequate bonding.

**Fig. 12.2** Cotton roll wedge: The cotton roll is being used on the lateral side of the flap as a wedge to hold open the site. Secondly is helping with hemostasis in the field. The blue etchant is being used to prepare the tooth for bonding of a bracket



**Fig. 12.3** Tissue punch window: If the orthodontist wants an open window then once the tooth is located via an envelope flap a large tissue punch can be used to make a window over the tooth. In this particular image a temporary anchor device is being used to bring this tooth into the mouth



4. If the orthodontist requests an open window exposure, then the same type of tooth incision can be used as in the closed approach. A tissue punch can be used to make a gingival window right over the impacted tooth through the elevated flap (see Fig. 12.3). The elevated flap with a tissue punch through the flap is preferred. This is as opposed to using a tissue punch alone, directly over the impacted tooth, with subsequent laser or electrocautery of the adjacent tissue. There tends to be more tissue removal with the direct punch access and bleeding can be challenging to control. The elevated flap technique leaves a less painful, smaller wound for the patient's recovery. If a directly punched tissue window is used it is recommended to place a dressing over the exposed tooth to be left in place to prevent gingival regrowth [6]. Bracket placement with composite will also lessen gingival regrowth over the impacted tooth. If the periodontal dressing comes loose the gingiva can cover over the bracket within a week. Tissue regrowth might necessitate laser or electrocautery removal to help the final eruption of the tooth.



For successful bonding of a bracket the shape of the tooth and the location of the planned bonding have to be considered. Frequently the palatal surface of an impacted maxillary canine is bonded. Accurate relay of the precise location of bracket bonding on the impacted tooth is valuable for the orthodontist in planning his/her directional forces of eruption. There are several bracket and cleat configurations with chain attached that can be used. If the patient has thick palatal tissue using a tall cleat or bracket can slow tooth eruption. If the bracket is to be placed on the buccal surface of the tooth for a buccally impacted tooth then a low profile bracket should be used, especially if they have a thin gingival biotype (see Fig. 12.4). If a bracket debonds during a closed eruption then it can lead to fenestration of the bracket through the gingiva. If this happens mid-treatment it can lead to gingival defects that will likely necessitate grafting [7].

Bonding of the bracket takes an organized team when keeping the field dry. A mid-surgical time-out before etching the tooth will make sure all instruments and materials are ready to go on the field. Any instrument delay might require another attempt at bonding the bracket if the field gets contaminated with blood. Fuji GC glass ionomer premixed ampules are mixed in a triturator. There are many additional cements on the market that will accomplish the bonding. There are different preparations that can be hand mixed instead of triturated. Premixed cements provide a consistent bond success rate. Time-outs should confirm the correct bracket, tooth, etchant ready, rinse ready, light curing gun turned on and ready to go. Any delay can lead to blood oozing over the field leading to weaker bond strength leading to premature failure. Follow the manufacturer's recommendation for etchant, etching times, and rinse amount. Injecting local anesthesia or trading out the cotton roll with one that is soaked in local anesthesia can control apical bleeding. A firm pull on the bracket will ensure a strong bond to the enamel. A photograph prior to closure or note to the orthodontist will be helpful if there is an unusual bracket placement. Miscommunication about the location of the bracket placement on the tooth might hamper the mechanics of the forced chain eruption.

**Fig. 12.4** Low profile buccal bracket: This canine is impacted buccally so a buccal flap is used and too high for an open approach. A flat low profile bracket is being deployed to prevent fenestration through the attached tissue



The chain attached to the bracket or cleat can be tunneled under the mucosal flap to the crest of the ridge. For a palatally impacted canine pass the chain through a small nick made in the palatal mucosa where the tooth is located. This allows the orthodontist to see where the tooth is located and how to direct the orthodontic forces.

The next step will be to attach the chain to the arch wire, TAD, or fixed orthodontic appliance. The orthodontist will instruct how to tie the chain and how much force is to be applied to the chain. The chain can be attached with wire, suture, spring, or elastic thread to the arch wire or orthodontic appliance. This preference is dependent on the orthodontist and should be discussed during the treatment planning stage. If there is misunderstanding as to the orthodontist's preference, passive ligation of the chain to the nearest fixed appliance will suffice. The orthodontist will apply the necessary forces to the impacted tooth and in the direction necessitated by the position of the tooth relative to the dental arch.

Closure of the wound can be achieved with vicryl or chromic suture. Chromic sutures risk early resorption and leave inflamed mobile flap edges that take longer to heal. The excess chain links are removed so as to not dangle and bother the patient. One should be careful cutting the chain links as they can fly away from the site and get dislodged under the flap or in the airway if not properly protected.

If the orthodontist wants to use TADS for anchorage, they can be placed either preoperatively or intraoperatively. Both placement times are aided with 3D images that show bone quality, quantity, and location of adjacent roots. If TADS are placed preoperatively, they can be placed at the consultation appointment under local anesthesia.

Consider palatally impacted canines that need to be distalized away from the incisors prior to bringing them into the arch. Two paramedian TADS parallel to the first molar (if adequate bone height allows) can be used for skeletal anchorage in conjunction with a soldered Trans Palatal Arch (TPA) borne on the first molars and the two TADS. Once the TADS have been placed the orthodontist will scan the TADS with an intraoral scanner and send the STL file to the Orthodontic Lab. The lab fabricates an appliance that attaches to the first molars with bands and caps that seat over the TADS with o-caps (see Fig. 12.5). Once the TPA has been cemented in place the patient returns for the surgical uncovering of the impacted tooth or teeth. After surgical exposure of a palatally impacted tooth the tissue is edematous and raw. The sore tissue complicates an accurate scan of the palate and the newly placed TADS due to the bulk of the scanner wand. It is because of this that the surgery is done in two steps: first, placement of the TADS and second, surgical exposure and bond of the impacted tooth/teeth (see Fig. 12.5). TAD placement can happen at the time the impacted tooth is uncovered if no additional orthodontic appliance needs fabrication to fit over the TADS. Once the impacted tooth is uncovered and bonded with a bracket and chain, it can be attached directly to the lone TAD. Palatal skeletal anchorage allows palatally impacted canines to be guided away from the roots of



**Fig. 12.5** TPA bar with tads: The lab fabricated the TPA bar to attach to the TADS over the comfort caps that sit over the round head of the TAD. The bar does not impede in the surgical exposure



the anterior teeth without the need for buccal fixed orthodontic appliances (braces). This is advantageous for patients who are still in the mixed dentition and are not yet ready for comprehensive orthodontic treatment and for patients who have already experienced root resorption of the anterior teeth. Patients with root resorption will benefit from less time in traditional orthodontic appliances and it is beneficial to remove the assaulting impacted tooth prior to starting comprehensive orthodontics.. Placing two TADs for a TPA allows for a backup should one of the TADs come loose. If you place one TAD and are considering retraction forces directly to the TAD with a nickel-titanium coil spring the TAD location should allow sufficient anterior-posterior distance for the activation of the spring. A nickel titanium spring is attached as close to the bracket as possible along the chain to allow a consistent force on the tooth. The excess gold chain link is removed. The TAD head is protected with a comfort cap that allows the patient's tongue to better tolerate the appliance.

Postsurgical follow-up is scheduled one week to ten days later. This allows for a wound check and removal of the vicryl sutures that might linger for 3–4 weeks more. Coordination with the orthodontist will ensure follow-up with the patient 2–3 weeks after the procedure. The orthodontist will activate or continue the activation of the eruption of the tooth. 6–12 months post-surgery the tooth will erupt into the mouth depending on the age and density of the bone and the position of the canine.

If the surgeon can see the orthodontic issues of treatment, they will have a better understanding of bracket position and the direction of orthodontic forces. Early treatment planning and discussion concerning tissue management can be critical. If the orthodontist understands the issues of incision design, bone quality, and TAD placement he/she will appreciate why, despite previous discussion, the bracket or TAD placement often needs to be decided at the time of surgery. 3D radiographs have taken a lot of the guess work out of the treatments and allow informed discussions between specialists.

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