

Canine Impactions: Incidence and Management



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Impacted teeth present many problems for the orthodontist. They can compromise tooth movement, esthetics, and functional outcomes. The second most commonly impacted tooth, after the maxillary third molar, is the maxillary canine, with an incidence from 1% to 2.5%. Maxillary canines can be impacted facially or palatally and are more common in female patients than in male patients. Therefore, the purpose of this paper is to address the incidence and etiology associated with impacted maxillary canines, the clinical and radiographic evaluation of the situation, and the techniques for managing this problem. Papers related to this topic were identified and reviewed thoroughly. A decision tree involving the various techniques employed to expose impacted canines is presented, together with methods used to identify the location of impacted canines. The impacted canine can be properly managed with proper diagnosis and technique. (Int J Periodontics Restorative Dent 2006;26:483–491.)

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Impacted teeth, especially canines, can cause many problems during orthodontic treatment.¹ They often hinder orthodontic movement and compromise esthetic outcomes. In some situations, impactions may cause resorption of adjacent roots. It has been estimated that 0.71% of children 10 to 13 years old have permanent incisors with root resorption caused by ectopic eruption of maxillary canines.^{2,3} Approximately 80% of teeth with root resorption are lateral incisors.⁴ After impacted teeth are properly positioned and orthodontic treatment is completed, root resorption should cease, and the tooth should remain functional. Proper exposure of impacted canines is essential for complete orthodontic treatment when indicated. The purposes of this paper are to describe the incidence and etiology of impacted canines, to discuss methods used to detect impacted teeth, and to present the techniques that can be employed to expose impacted canines.

Incidence

The maxillary canine is the second most commonly impacted tooth after

the maxillary third molar, with an incidence ranging from 1% to 2.5%.⁵⁻⁹ Often the maxillary canine is palatally impacted, with a ratio of about 2:1.¹⁰ Canine impactions are about twice as common in girls.⁴ In about 8% to 10% of cases, canine impactions occur bilaterally.^{4,11} The incidence of mandibular canine impactions is much lower, at only about 0.35%.⁸ Rarely, a maxillary central incisor can become impacted, but it is often caused by a supernumerary tooth.¹² In the mandibular arch, the second most commonly impacted tooth after the third molar is the second premolar, followed by the second molar.¹³⁻¹⁵

Etiology

Often, teeth that have become impacted are diverted or angled during development. Once the root apex is closed, teeth will lose their potential to erupt.¹³ The maxillary canines have the longest course to travel from their point of formation into the occlusion and have the longest period of development. Causes for ectopic eruption may be either local or general.¹⁶ Generalized causes include systemic diseases such as endocrine deficiencies, febrile diseases, and possibly irradiation.³ The most common causes for canine impactions are local and can include any of the following factors: (1) tooth size/arch length discrepancies, (2) prolonged retention or early loss of the primary canine, (3) abnormal position of the tooth bud, (4) the presence of an alveolar cleft, (5) ankylosis, (6) cystic or neoplastic formation, (7) dilacerations of the root, (8) iatrogenic

origin, and (9) idiopathic condition with no apparent cause.⁴ It has also been reported that one cause of maxillary canine impactions may be missing or peg lateral incisors.¹⁷ An increase by 2.4 times in palatally impacted canines adjacent to missing lateral incisors has been reported.¹⁸ This is believed to be attributable to the "guidance theory," ie, that the lateral root serves as a guide along which the canine erupts, and when it is not present or malformed, the canine fails to erupt.¹⁹

Diagnosis of impacted canines

Clinical evaluation

Clinical evaluation includes palpating for the canine bulge above the primary canine. Possible clinical signs of canine impactions include: retention of the primary canine beyond 14 to 15 years of age, absence of a normal labial canine bulge, asymmetry in the canine bulge, presence of a palatal bulge, delayed eruption, distal tipping, or migration of the lateral incisor.⁴

Radiographic evaluation

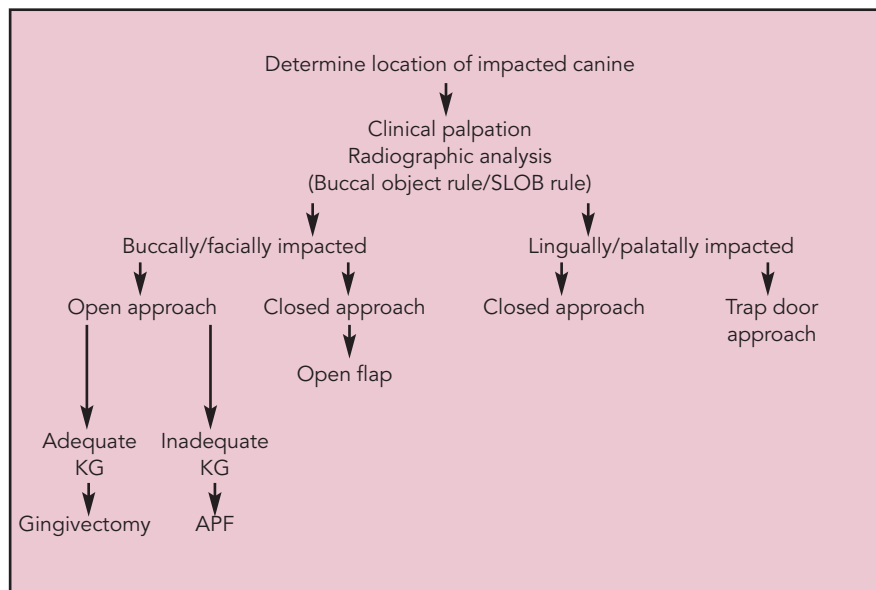
It has been reported that 29% of the time canines were not palpable at 10 years of age, 5% were not palpable at 11 years, and 3% were not palpable thereafter.² For this reason, radiographic evaluation should be used in combination with the clinical assessment. When a tooth position cannot be determined clinically, radiographic evaluation using the "buccal object

rule" should be used to determine the location of an impacted tooth.^{1,20} With this technique, two radiographs are taken at different horizontal angulations. The *SLOB rule* stands for same lingual opposite buccal: If the object (impacted tooth) moves in the same direction as the movement of the x-ray beam, the tooth is located on the *lingual*; if the impacted tooth moves *opposite* of the x-ray beam, the tooth is located on the *buccal*. Thus, a proper diagnosis of the tooth's position can be confirmed radiographically.

Palatal versus facial canine impactions

Approximately 85% of palatally impacted maxillary canines have sufficient space for eruption into the dental arch, but only 17% of facially impacted maxillary canines have sufficient space for eruption.²¹ Therefore, arch length deficiency is thought to be a primary etiologic factor for facially impacted canines.²¹ Facial impactions are more likely to have a favorable vertical angulation, and palatal impactions are more inclined to be in a horizontal angulation.^{6,22} Facially impacted canines have the potential to erupt without surgical intervention. Nevertheless, palatally impacted canines seldom erupt without surgical treatment. This may be because of an increased thickness of the cortical bone on the palate and the thick palatal tissue.⁴

Fig 1 Decision tree to assist in choosing the appropriate technique to correct an impacted canine.



Techniques and surgical cases

Figure 1 presents a decision tree to help clinicians choose the proper surgical technique to be used based on certain clinical conditions.

Presurgical orthodontic treatment

For the impacted maxillary canine, the entire maxillary arch should be bracketed to allow proper positioning of the canine and avoid tipping of the occlusal plane.¹³ Bracketing the entire arch will provide adequate anchorage for extrusion of the impacted canine.¹³ One other option is to use a microimplant or mini-implant as anchorage to move the impacted canine, instead of

bracketing the entire arch.²³ Use of a mini-implant will allow the proper force to be placed on the canine for forced eruption. After the treatment is completed, implants can then easily be removed. However, before any surgical intervention, adequate space must be created to facilitate movement of the impacted tooth. The average width of a maxillary canine is generally about 7.5 to 8 mm. If the contralateral canine is present, it should be measured and used as a guide for the amount of space needed. First premolars can also be used to estimate the width of the canine, since permanent canines are generally about 1 to 1.5 mm wider than first premolars. Presurgical orthodontic treatment should be performed until adequate space is made for the canine (usually 2 to 4 months).¹³

Techniques for facially impacted canines

Gingivectomy

The gingivectomy technique can be used for facial canine impactions when the tip of the canine cusp is located coronal to the cemento-enamel junction (CEJ) of the adjacent lateral incisor. An adequate amount of keratinized gingiva (KG) needs to be present, so that a minimum of 3 mm of KG will be left following gingivectomy.^{4,13,24} This procedure can be done with a Kirkland gingivectomy knife or a round diamond bur. Approximately one half to two thirds of the crown must be uncovered to ensure stable bracketing.^{4,13,24} Often a dressing can be placed over the exposed enamel to prevent gingival overgrowth. A bracket can be placed at the time of surgery to help



Fig 2a (left) View before APF surgery (the impacted canine was noted between the right lateral incisor and first premolar).



Fig 2b (right) During APF surgery, the canine is exposed from the facial aspect and a pedicle flap is apically positioned.

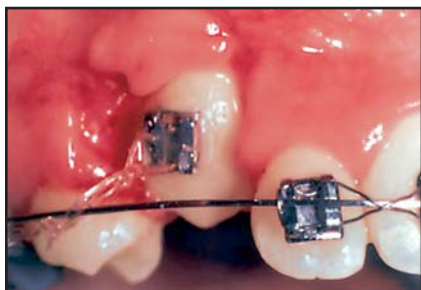


Fig 2c (left) View at 1 week postoperative (note the KG present apical to the canine).



Fig 2d (right) Final position of canine, with the KG maintained.

stabilize the dressing, or it can be placed 2 to 3 weeks later. Tooth movement should be initiated at about 2 to 3 weeks after exposure.¹³

- Advantages: It is the simplest and least traumatic technique.
- Disadvantages: It can be used in only a few instances, attached gingiva is lost, and damage to the attachment apparatus is possible.^{25,26} Tissue may regrow over the surgical area if the gingivectomy is too conservative.

Apically positioned flap

An apically positioned flap (APF) should be used for labial canine impactions when an inadequate amount of KG is present (Figs 2a to 2d). A minimum of 3 mm of KG is often considered physiologically ade-

quate.²⁴ If a minimum of 3 mm of attached tissue could not be preserved after gingivectomy, then an APF technique should be used.²⁶ For APF, an incision is made on the crest of the edentulous ridge with the intent to preserve as much KG as possible.²⁵ The incisions are then extended vertically into the vestibule, raising a split-thickness flap. Often a thin shell of bone will cover the tooth. This bony cover can be removed with a curette or a round bur. About two thirds of the crown should be exposed and the dental follicle removed by a curette.¹³ Only the coronal two thirds of the crown should be exposed so that the CEJ and attachment apparatus are not encroached upon, which would cause future problems such as attachment loss following eruption. The bracket can be bonded at the time of surgery

or at 2 to 3 weeks postoperatively. The pedicle flap is then apically positioned and sutured to the periosteum so that 2 to 3 mm of the crown is covered.²⁶ A minimum of one half to two thirds of the crown should be left exposed in the oral cavity.²⁶ After 2 to 3 weeks, orthodontic treatment should be initiated. When the canine impaction is lateral to the edentulous area, a pedicle flap from another area may be necessary. Kokich and Mathews¹³ recommended that in such cases a minimum of 6 mm of KG should be initially present. A collar of 2 to 3 mm should be left around the donor site and 3 mm should be incorporated into the pedicle flap to be apically positioned.¹³ Improper management of facial canine impactions may lead to mucogingival recession, gingival inflammation, and loss of alveolar bone.^{25,26}

- Advantages: This is the most commonly used technique for facial impactions. Keratinized gingiva is preserved, leading to fewer post-operative problems.^{13,27}
- Disadvantages: Accessory frena can be created and cause orthodontic relapse. There is a greater risk of recession and uneven gingival margins. Considerable labial bone may need to be removed, and impactions near the nasal spine cannot be left uncovered.^{13,15,28,29}

Closed technique

When the maxillary impacted canine is located more apically in the vestibule, near the nasal spine or in the middle of the alveolar bone, the closed eruption technique is the treatment of choice.^{15,28-31} Because of the need to remove bone to adequately expose the crown, an APF would be impossible to use in these situations owing to the apical position of the impacted canine. Thus, a closed approach is preferred. For the closed technique, a flap is raised using a crestal incision, and enough bone is removed around the tooth so a bracket or eyelet can be placed at the time of surgery on the impacted canine.^{13,27} The use of a wire lasso around the impacted tooth is unacceptable, as it may increase the incidence of external root resorption and unnecessarily increase the amount of bone to be removed.⁴ The field must be kept completely dry for proper bracket attachment. The bracket/eyelet is then attached to the archwire with a wire or chain that passes under the flap and through the incision. If the bonded bracket/eyelet becomes loose or the bond breaks, it

should be remade. Before flap closure, the tooth should be gently luxated with a small straight elevator or periosteal elevator to ensure that it is not ankylosed. The flap is then sutured back into its original position and orthodontic force is activated in 1 week.¹³

- Advantages: A closed flap usually produces the best gingival esthetics and increased ease of tooth movement.^{13,26,27}
- Disadvantages: More discomfort is noted with this technique. If debonding of the bracket occurs, a second surgery is required. Mucogingival problems can be created by improper orthodontic mechanics and cause the tooth to erupt through the mucosa.^{13,15,26}

Techniques for palatally impacted canines

Often the primary canine is still present with palatally impacted permanent canines.³² Although controversial, it has been suggested that extraction of the primary canine be delayed because of the following possible benefits: It holds space for the permanent canine, it maintains the width of the alveolar ridge, and it avoids the need for an additional procedure since the primary canine can be removed during the uncovering procedure.¹³ Two techniques are generally employed in exposing the impacted palatal canine: the *closed flap technique* and the *trap door open technique*.

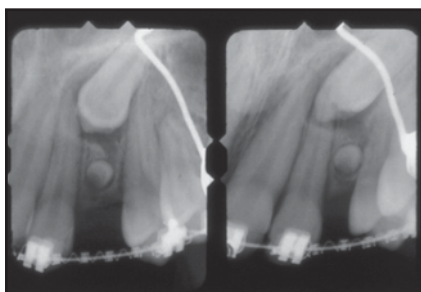


Fig 3a (left) Preoperative radiographs, taken using the standard parallel cone technique (left) and in a mesial angulation (right). Using the SLOB rule, the tooth was found to be located palatally.



Fig 3b (right) Preoperative clinical view; the impacted canine is between the left lateral incisor and the left first premolar.



Fig 3c (left) Closed technique surgery for exposure of the palatal canine in the left maxilla, with a vertical releasing incision for proper access.

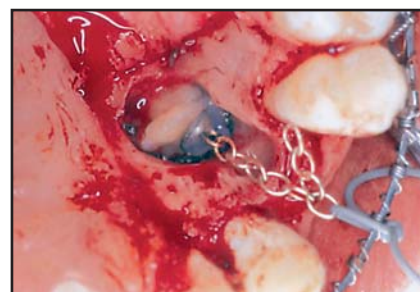


Fig 3d (right) Closed technique bracketing for palate. All bony covering is removed from the canine, and the follicle is removed before the bracket is placed.



Fig 3e Closed technique suturing for palate. Note that the chain goes through the crestal incision line and is connected to the archwire.



Fig 3f View at 2 weeks after the closed technique to treat the palatally impacted canine.



Fig 3g Postoperative view of the closed technique, with the canine in its final position.

Closed flap technique

Most palatally impacted canines are located near the lateral and central incisors, horizontally positioned, and higher in the roof of the mouth.¹³ The surgical technique for palatal exposures requires that a full-thickness flap be raised from the premolar to the midline (Figs 3a to 3g). Again, a curette or a surgical round bur is used to remove the thin shell of bone around the impacted tooth, the follicle is removed, and the

tooth is gently luxated. The field is then isolated, bracketed, and returned to its original position, as described earlier for facial impactions in the closed technique. For the closed flap technique, the flap is completely closed (no window is made) and the chain is placed through the incision line.

Trap door open technique

In the trap door technique, a full-thickness flap is raised, as in the closed

technique, and then the tooth with the bracket/eyelet is palpated through the flap to locate the bracket/eyelet. The area is then fenestrated with a blade or round bur to create a window (the "trap door") to expose the bracket through the flap. The flap is then sutured and a wire or gold chain is attached from the bracket/eyelet to the arch outside of the flap. After 1 to 2 weeks, orthodontic force is initiated.¹³

Postoperative care (maintenance of newly established position)

Following surgery, chlorhexidine or a saltwater mouth rinse is recommended for a period of 2 weeks.³³ Once the canine is present extraorally, regular oral hygiene modalities should be initiated to care for the newly erupting tooth. This should reduce potential mucogingival and periodontal problems while the tooth is being erupted orthodontically.

Complications

Lack of movement

One problem that may occur is no movement on the tooth once orthodontic forces have been initiated. This occurs more often in palatal impactions. Four possible etiologies may contribute to this¹³:

1. Not enough bone was removed around the crown of the impacted tooth. Hence, there is no biologic mechanism for the enamel of the crown to resorb the surrounding bone.
2. Inappropriate orthodontic mechanics. Often a tooth will resist lateral tooth movement because of its angulation. Therefore the tooth should be erupted into the oral cavity and then repositioned.
3. Ankylosis. If a tooth is found to be ankylosed during the surgery, forces should be placed on the tooth immediately. In some cases the tooth will not move and will need to be extracted.

4. Improper bonding. The orthodontic bracket is bonded to bone rather than the impacted canine.

Extraction of impacted canines

Extraction of the canine is seldom a treatment option, as it may severely compromise a patient's functional occlusion. However, if the impacted canine is malformed, ankylosed, unable to move after a period of orthodontic activation, or if it has a severely dilacerated root, internal or external root resorption, or pathologic changes, extraction of the impacted tooth may be unavoidable.^{4,13}

Conclusions

When dealing with maxillary canine impactions, a proper diagnosis is critical for the success of the surgical treatment. Proper clinical and radiographic evaluation will help the clinician decide whether a canine is impacted palatally or facially. The decision tree presented here can aid in selection of the appropriate surgical treatment. The correct surgical treatment will lead to improved esthetics, orthodontic movement, and functional results.

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