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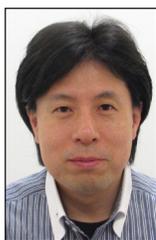
# Impacted Maxillary Canines: Diagnosis and Management



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An impacted maxillary canine is usually diagnosed during a routine dental examination. Disturbance in the eruption of permanent maxillary canines can cause problems in the dental arch and adjacent teeth, which require special care and attention. Therefore, clinicians should be capable of dealing with this clinical situation in order to deliver optimal treatment.

Clinicians have various definitions of “impaction.” Canine impaction can be defined as an unerupted tooth after its root development is complete; or a tooth still unerupted when the corresponding tooth on the other side of the arch has been erupted for at least 6 months and has a complete root formation; or a condition in which a tooth is embedded in the alveolus and is locked in by bone, adjacent teeth, or other obstacles and cannot properly erupt into the oral cavity.<sup>1-5</sup> This includes teeth in which eruption is significantly delayed and there is no clinical or radiographic evidence that further eruption is likely to happen.<sup>1-5</sup>

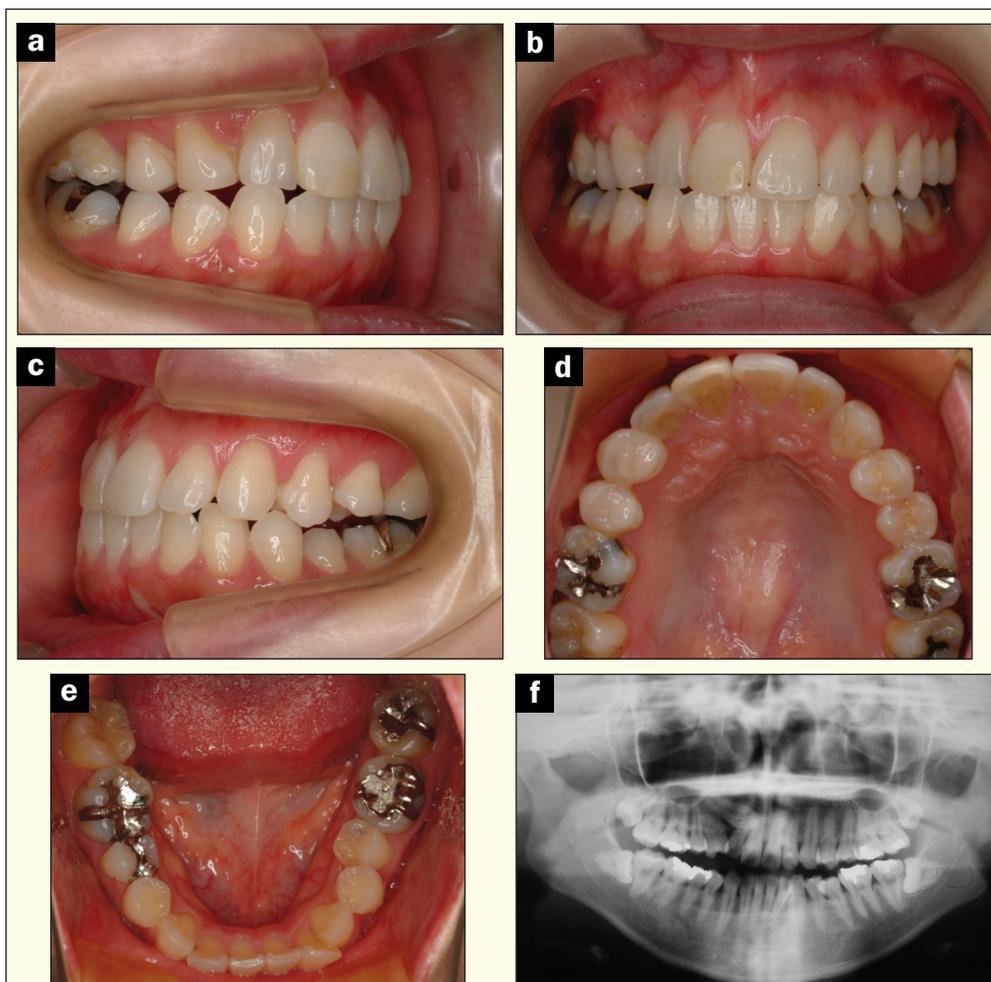
Maxillary canines are among the last teeth to develop and have the longest period of development. They also have the longest and most devious path of eruption from the formation point lateral of the pisi-form fossa to the final position in the dental arch.<sup>1-5</sup> Therefore, there is an increased potential for mechanical disturbances resulting in displacement and impaction.

*Maxillary canines are among the last teeth to develop and have the longest period of development.*

This article discusses the etiology, diagnosis, and clinical management of impacted maxillary canine teeth.

## PREVALENCE AND ETIOLOGY

Permanent maxillary canine impaction has been reported in about 1% to 2% of the population.<sup>1-5</sup> This makes the maxillary canine



Figures 1a to 1f. Pretreatment intraoral photographs and a panoramic radiograph showing the impacted maxillary right canine.

the second most commonly impacted tooth, after third molars.<sup>1-7</sup> Research indicates that women are twice as likely as men to have impacted maxillary canines.<sup>1-11</sup> The prevalence of impacted maxillary canines is between 0.9% and 2%.<sup>1-5,11-13</sup> It has been found that maxillary impacted canines occur palatally 85% of the time while only 15% of impactions occur labially.<sup>1-5,14</sup> According to Al-Nimri and Gharaibeh,<sup>15</sup> palatal canine impaction occurred most frequently in subjects with a Class II division 2 malocclusion. Among all patients with impacted canines, it was found that unilateral impaction is much more common than

bilateral impaction.<sup>1-5,16</sup> Maxillary canine impactions appear to be 10 to 20 times more frequent than those in the mandible.<sup>1-5,17</sup>

While the etiology of impacted maxillary canines is thought to be multifactorial, they are not likely to originate from modified conditions in modern civilization such as food texture or eating behavior;<sup>18</sup> however, the exact etiology is still unclear.<sup>5,11</sup> Possible causes for impacted canines may include one or more of the following local factors: inadequate space for eruption or early loss of primary canines; abnormal position of the tooth bud; the

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## Impacted Maxillary Canines...

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presence of an alveolar cleft, a cystic lesion or neoplasm; ankylosis; dilacerations of the root; an iatrogenic origin; and an idiopathic condition for no apparent reason.<sup>1-5</sup> Systemic conditions such as endocrine deficiencies, malnutrition, febrile disease, or irradiation can also account for impacted canines.<sup>1-5</sup>

Currently, there are 2 major theories that have been used to explain the cause of maxillary canine impaction: the guidance theory and the genetic theory. The guidance theory states that excess space in the canine area of the dental arch during development and eruption owing to an absent or malformed lateral incisor root causes the canine to lose its way and erupt improperly, because a permanent canine tooth needs the distal aspect of a lateral incisor's root to guide it downward to the occlusion.<sup>19-22</sup> The genetic theory claims that palatally impacted canines are the result of a combination of multiple gene expressions which cause dental anomalies such as congenitally missing or peg-shaped lateral incisors due to a developmental disturbance of the dental lamina.<sup>23-25</sup>

*Lateral cephalometric radiographs can help determine the position of impacted canines relative to other structures.*

### CLINICAL DIAGNOSIS

Impacted canine teeth can be detected as early as age 8 years.<sup>13,26</sup> Clinical examination includes overall arch inspection, palpation of canine bulges, mobility of primary canines, and a review of the patient's chronological age and history of eruption/exfoliation patterns of the dentition. Clinicians should be aware that there is a possibility of canine impaction in the absence of canine bulges, abnormality in shape, missing lateral incisors, or less mobility of primary canines. Unusual movement of lateral or central incisors can also be a sign of root resorption due to pressure from malposed canines. When there is the clinical presence of any of these signs, radiographic examination should be performed to confirm the diagnosis.<sup>1-5</sup>

### RADIOGRAPHIC DIAGNOSIS

Radiographic examination should be initiated with routine periapical radi-

ographs. However, when clinical signs lead to a possibility of canine impaction, radiographic evaluation is immediately needed to confirm the diagnosis and assist in developing an appropriate treatment plan. There are various radiographic methods that can be used to obtain needed information.

Periapical radiographs can be helpful by using at least 2 radiographs at different angles to determine the buccolingual position of a particular tooth. There are 2 methods that are widely used: Clark's rule and the buccal object rule. Both use the different angulation of the x-ray beam to locate objects in different directions. These methods, also known as same lingual-opposite-buccal rule, will make the objects on the lingual side move to the

same direction as the x-ray tube and objects on the buccal side move in the opposite direction.<sup>2,27</sup>

Panoramic radiographs are also widely used to locate the position of impacted canines. They are part of the fundamental imaging taken for dental records and treatment planning. They provide an overall look of the entire dentition including the temporomandibular joints (TMJs). Many prediction values proposed in the literature come from this type of radiograph.

Occlusal radiographs can identify the position of impacted maxillary canines accurately in conjunction with routine periapical radiographs. When properly obtained, they provide information about the buccolingual direction of the crown and root of the canine. They also provide information related to the distance between the midline and the position of the canines. The disadvantage of this radiograph is that it cannot provide

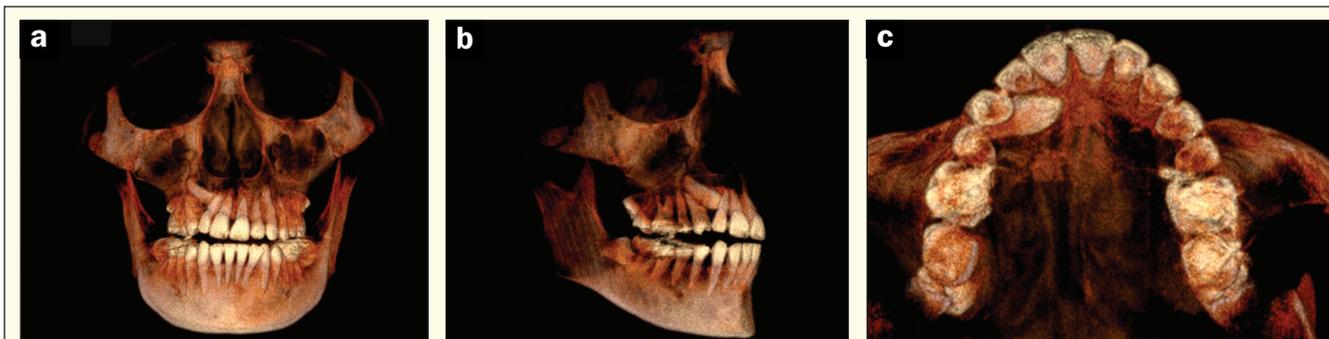
any information about the vertical position of the canines.

Lateral cephalometric radiographs can help determine the position of impacted canines relative to other structures. They are helpful because they are some of the fundamental radiographs that all patients have taken prior to the beginning of orthodontic treatment. Maxillary canines can be located easily on this radiograph as early as age 8 or 9 years. Their inclination should be parallel to the maxillary incisors.<sup>5</sup>

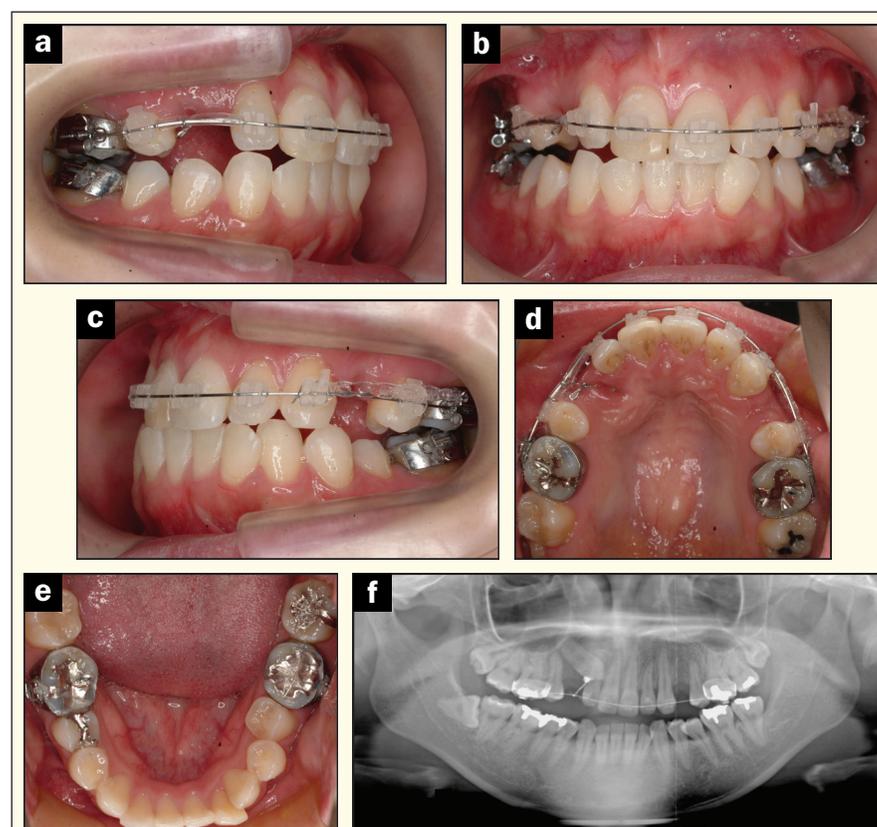
Posterior-anterior radiographs are also useful. Normal canines in this type of radiograph should angle medially, and crowns should be lower than the apex of the lateral incisors and the lateral border of the nasal cavity.<sup>8</sup> However, this method still provides only 2-dimensional images with some degree of superimposition. Nevertheless, this type of radiograph is not usually taken unless there are skeletal asymmetry

and/or transverse width issues. If there is any concern of impaction with other anomalies, it might be better to utilize cone beam computed tomography (CBCT) instead.

CBCT has the great advantage of showing hard-tissue reconstruction in the area of interest in 3 dimensions, presenting a view without any superimposition,<sup>28</sup> and also providing a 1:1 magnification which can be used to reproduce panoramic or cephalometric images.<sup>6</sup> Its use in orthodontics includes impacted teeth and TMJ evaluations, 3-dimensional views of upper airways, assessment of maxillofacial growth, and development and dental age estimation.<sup>29</sup> CBCT scans are far better than conventional panoramic radiographs in verifying the orientation and location of the impacted canine and its relationship to neighboring structures.<sup>6,30,31</sup> This technique makes identification of the



Figures 2a to 2c. Pretreatment 3-dimensional volume rendering showing the location of the impacted maxillary right canine. The crown was located palatally and the root was located buccally.



Figures 3a to 3f. Intraoral treatment progress views and a panoramic radiograph.

exact position and shape of impacted canines possible, which is crucial in treatment planning. Furthermore, it is very helpful in evaluating damage to adjacent teeth and the amount of surrounding bone.<sup>32</sup> The major disadvantage of CBCT is the increased amount of radiation exposure, which is at least 4 times higher than with ordinary panoramic radiograms.<sup>6,29,33,34</sup> Therefore, orthodontists should consider cost-benefit outcomes before ordering this radiograph.

**PREDICTION OF MAXILLARY IMPACTION**

There are many predictive values and measurements proposed in the literature to help determine the chance of an eventual impacted canine. Ericson and Kuroi<sup>35</sup> proposed predicting canine impaction using the angulation, distance, and sector of the canines from a panoramic radiograph to determine the chance of an impacted canine. That is, the deeper the cusp tip from the occlusal plane, the more perpendicular to the midline, and the closer to the midline, the greater the chance that tooth impaction will occur and the longer the duration of treatment.<sup>36</sup> Many studies have shown that the mesiodistal position gives the best prediction value, while angulation and vertical position showed no statistical significance.<sup>8,37-40</sup> Furthermore, an impacted canine which is closer to the midline, or whose

cusp tip is mesial to the midline of the lateral incisor, is more likely to be palatally impacted, and root resorptions are also more frequent.<sup>41</sup>

**MANAGEMENT OF CANINE IMPACTION**

Maxillary canine impaction usually needs multidisciplinary care, which involves oral surgery and periodontics along with orthodontic treatment. It is essential that the various clinicians working on the case have good communication to provide optimal care for the patient.<sup>2</sup> The management of impacted canines can be divided into 2 treatment categories: interceptive treatment and corrective treatment.

**Interceptive Treatment**

Preventive modalities should be performed in cases that have a strong possibility of canine impaction. The elimination of obstacles to the path of eruption and the provision of sufficient room for underlying canines are essential. Therefore, extraction of the primary canine is thought to be a proper interceptive treatment. Many claim that this is the best treatment and it provides the most stable results.<sup>1-5</sup> When appropriate, interceptive treatment is the most advantageous in terms of cost-benefit as compared to other more aggressive methods.<sup>11</sup>

However, there are many factors to be considered before interceptive

treatment can be done. A classic study from Ericson and Kuroi<sup>35</sup> showed that extraction of the primary canines between the ages of 10 and 13 years will obtain a favorable result with most palatally erupted canines. If the cusp tip of a permanent maxillary canine in the panoramic radiograph does not exceed the midline of the lateral incisor, the chance of the canine erupting normally is 91%; if the cusp tip does exceed the midline of the lateral incisor, the chance for normally erupting drops to 64%.<sup>35</sup>

Many modifications have been added to the extraction of primary canines to improve the results, including the use of cervical pull headgear,<sup>42</sup> double extraction of the primary canine and the primary first molar,<sup>43,44</sup>

situations where orthodontists cannot render preventive or interceptive treatment for some reason, or patients present beyond the point of prevention. There should be an attempt to bring impacted maxillary canines down to occlusion if possible, because permanent canines are important for both functional and aesthetic reasons. Treatment can be divided into 2 types, labial or palatal, depending on the position of the ectopic canines.

Three techniques have been proposed by Kokich<sup>47</sup> for uncovering a labially unerupted maxillary canine (gingivectomy, apically positioned flap, and closed eruption technique). He also suggested that orthodontists should evaluate 4 criteria to determine the correct method for uncover-

*The management of impacted canines can be divided into 2 treatment categories....*

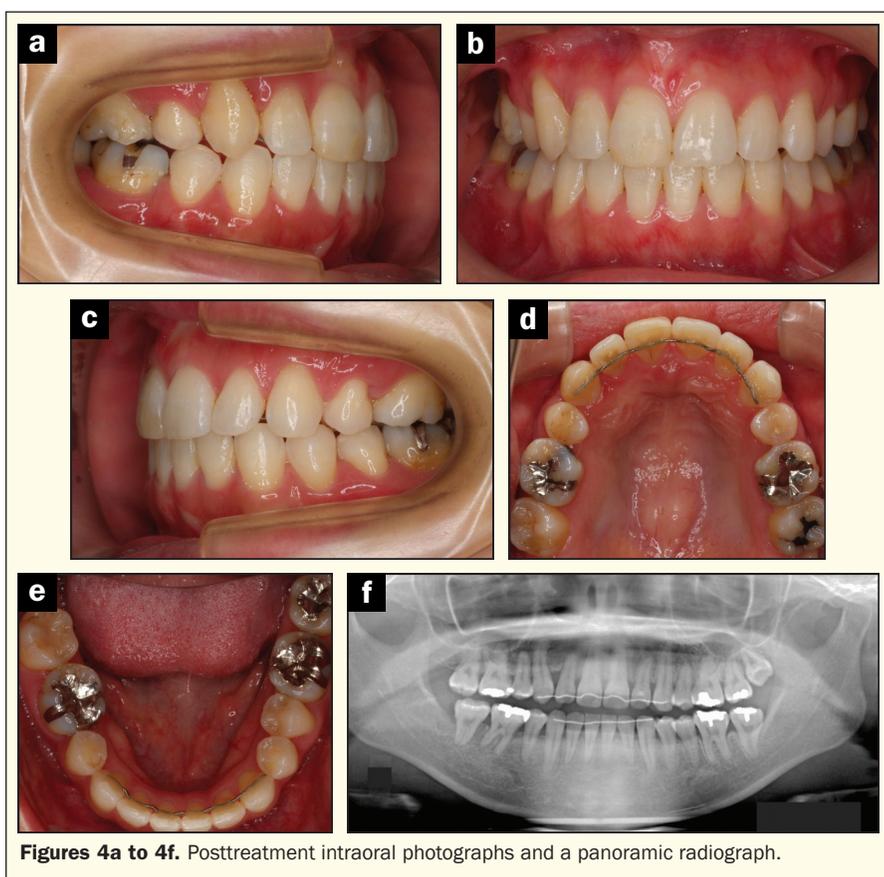
the use of a transpalatal arch (TPA),<sup>45</sup> and the use of a rapid maxillary expansion in combination with a TPA.<sup>46</sup> All of these show favorable results as compared to the extraction of primary canines alone. The selection of these modifications should be based on individual clinical presentations.

**Corrective Treatment**

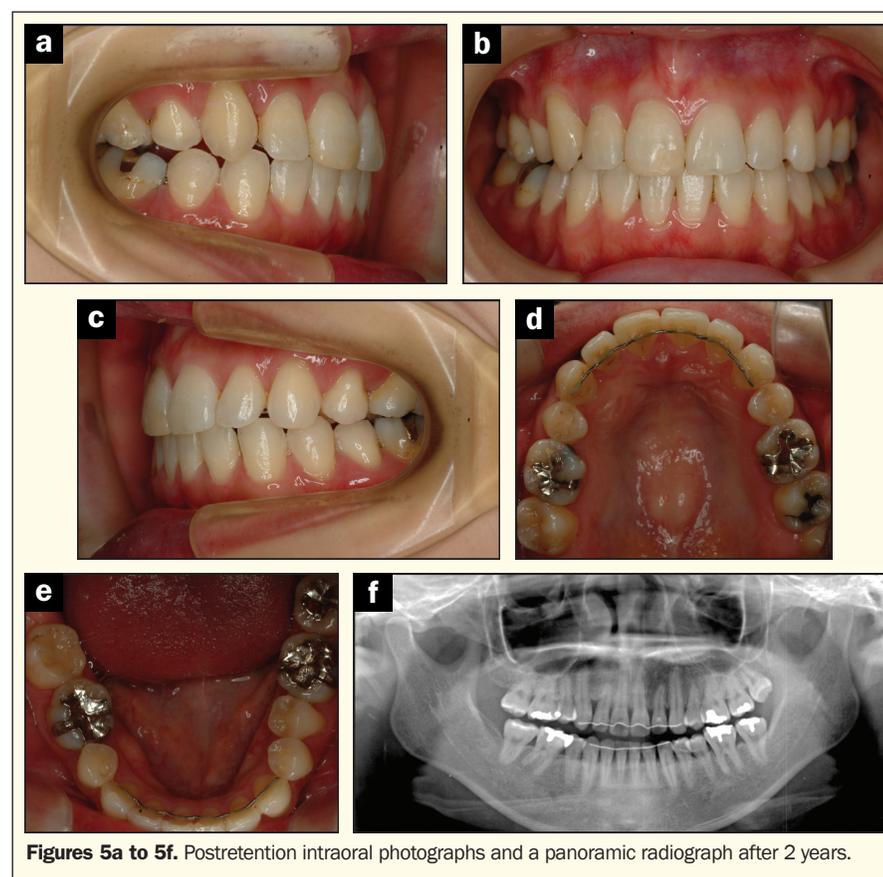
Corrective treatment is performed in

ing the tooth so the outcome achieves the optimum periodontal health.<sup>47</sup> These criteria include the distance between the canine cusp and the mucogingival junction; the labiolingual position; the mesiodistal position; and the amount of gingiva in the area of the impacted canine.

In palatally impacted canines, the concern about the lack of keratinized gingiva disappears because palatal tis-



Figures 4a to 4f. Posttreatment intraoral photographs and a panoramic radiograph.



Figures 5a to 5f. Postretention intraoral photographs and a panoramic radiograph after 2 years.

sue is a dense connective tissue. Bishara<sup>2</sup> suggested 2 surgical methods for exposing the impacted canines: surgical exposure followed by allowing spontaneous eruption; and surgical exposure with auxiliary attachment for further orthodontic treatment.

The first method is useful when the canine has a correct axial inclination and needs no upright correction during its eruption, but this method may increase treatment time and be unable to control the path of eruption.<sup>2</sup> Kokich<sup>47</sup> suggested performing this method before the beginning of orthodontic treatment or during the late mixed dentition because the tooth will erupt in a more favorable

*A good understanding by the clinician of the situation and treatment options can have a significant impact....*

location, which will facilitate orthodontic movement without dragging the crown through the palatal gingiva. Schmidt and Kokich<sup>48</sup> also reported that this technique had minimal effects on the periodontium and that the overall effects on the impacted canine appeared better than those from the closed exposure and early traction techniques.

The second method is used when there is no eruption force left or the tooth does not lie in a favorable direction and orthodontic force is required to move the impacted tooth away from the roots of the adjacent teeth and bring it to the proper position. After sufficient space has been created, surgical exposure is performed and the attachment is placed. Light orthodontic force (not to exceed 60 g or 2 oz) is then applied to move the tooth to the desired position by various orthodontic techniques (Figures 1a to 5f).<sup>2,5</sup>

Removal of an impacted canine is one approach that is rarely used but might need to be considered if the impacted canine is ankylosed, has internal or external root resorption, severe dilaceration, or the position is undesirable and it is impossible to bring it to the occlusion.<sup>2,5</sup> Wriedt et al<sup>30</sup> suggested that if the inclination of impacted canines in panoramic radiographs is more than 45°, they will more likely require surgical removal. If this is the final decision, the ortho-

dentist must consider alternative treatments to substitute for the missing canine. The options can be pre-molar substitution, autotransplantation, or prosthetic substitution by working together with other specialties. The patient should be informed of all these treatment outcome possibilities before beginning the treatment.<sup>5</sup>

### SUMMARY

Canine impaction is a relatively frequent clinical presentation in dentistry, with challenges that should be resolved. A good understanding by the clinician of the situation and treatment options can have a significant impact on the treatment outcome. Therefore, clinicians should be competent to perform the proper investigation, provide a correct diagnosis, develop an optimum treatment plan, and render appropriate treatment for each individual patient so each patient realizes the best outcome possible. ♦

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The following 16 questions were derived from the article *Impacted Maxillary Canines: Diagnosis and Management* by Jae Hyun Park, DMD, MSD, MS, PhD et al on pages 62 to 66.

### Learning Objectives

**After reading this article, the individual will learn:**

- Basic concepts of impacted maxillary canines and evaluations of potentially impacted canines in individuals.
- How to make treatment decisions for impacted maxillary canines in various clinical scenarios and time points.

**1. Which tooth has the longest and most tortuous eruption path in the mouth?**

- Mandibular third molar.
- Maxillary canine.
- Maxillary first premolar.
- Maxillary second premolar.

**2. Which tooth is the most frequently impacted in the oral cavity?**

- Maxillary canine.
- Mandibular second premolar.
- Maxillary lateral incisor.
- Mandibular third molar.

**3. Which criterion (criteria) is (are) used to determine the proper access for uncovering impacted maxillary canines?**

- The distance between the canine cusp and the mucogingival junction.
- The labiolingual position of the canine cusp.
- The mesiodistal position of the canine cusp.
- All of the above.

**4. Which one of the following is NOT considered a local etiological factor of impacted canines?**

- Vitamin D deficiency.
- Dentigerous cyst.
- Cleft palate.
- Missing permanent maxillary lateral incisors.

**5. Which of the following is (are) clinical sign(s) of impacted maxillary canines?**

- Absence of a labial bulge.
- Peg shaped lateral incisor.
- Retained primary canine.
- All of the above.

**6. When moving the x-ray tube in a mesial direction to localize the palatally impacted maxillary canine:**

- The tooth moves mesially.
- The tooth moves distally.
- There is no change.
- None of the above.

**7. Which radiographic method is the best to locate the position of impacted maxillary canines?**

- Periapical radiograph.
- Lateral cephalogram.
- Panoramic radiograph.
- Cone beam computed tomography (CBCT).

**8. What is the advantage of CBCT?**

- Gives a 3-dimensional view.
- Free of superimposition.
- 1:1 magnification.
- All of the above.

**9. To predict impacted maxillary canines, which of the following could be used?**

- Canine angulation.
- Vertical distance of canine cusp from occlusal plane.
- Mesiodistal position of the canine cusp.
- All of the above.

**10. One of the most negative consequences of impacted canines is:**

- Decreased arch length.
- Transposition of adjacent teeth.
- Increased risk of cystic formation.
- Causes root resorption of adjacent teeth.

**11. Which of the following is the interceptive treatment modality for impacted maxillary canines?**

- Extraction of primary canine.
- Extraction of primary canine in combination with cervical pull headgear.
- Extraction of primary canine in combination with transpalatal arch.
- All of the above.

**12. According to the study from Ericson and Kurol, with extraction of the primary canine at age 11 years when the cusp tip of the permanent maxillary canine is between the central and the lateral incisors, the chance that this canine will erupt normally is:**

- 91%.
- 75%.
- 64%.
- 50%.

**13. Which of the following is NOT a surgical exposure technique for labially impacted canines?**

- Gingivectomy.
- Coronally positioned flap.
- Closed eruption technique.
- Apically positioned flap.

**14. Which surgical technique is NOT performed in the case of a palatally impacted canine?**

- Open eruption.
- Close flap with auxiliary attachment.
- Apically positioned flap.
- None of the above.

**15. The appropriate amount of force used to orthodontically move an impacted canine is:**

- 30 g.
- 45 g.
- 60 g.
- 90 g.

**16. When an impacted canine has to be removed, which of the following is a restorative treatment option?**

- Tooth autotransplantation.
- Premolar substitution.
- Prosthetic substitution.
- All of the above.

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