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Review Article

DIAGNOSIS AND MANAGEMENT OF IMPACTED MAXILLARY CANINES

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Maxillary canines play an important role in facial esthetics, since the canine eminence can support the alar and the upper lip. Impacted maxillary canines is a common problem which requires multidisciplinary diagnosis and treatment in dental clinic. The aim of this review is to integrate the studies that include clinical diagnosis and guidelines for management of canine impaction. (Taiwanese Journal of Orthodontics. 31(1): 04-11, 2019)

Keywords: canine impaction; surgical exposure; orthodontic biomechanics.

INCIDENCE OF CANINE IMPACTION

The incidence of maxillary canine impaction was reported as second to the third molar. The incidence was reported varies, from 0.92% to 2.2%, higher in some races. Dachi and Howell reported an incidence of 0.92%, while Thilander and Myrberg reported 2.2% in 7-13 years of age. Ericson and Kurol also reported an incidence of 1.7%, more common in women (1.17%) than in men (0.51%) as a ratio about 2:1.

Bilateral impactions present in about 8% of people with maxillary impacted canines. Palatally impacted canine occurs more than labially impacted canine by the ratio of 2:1 to 3:1. Jacoby believed that most labial impactions could erupt to a relatively labial and superior position. He declared that 85% of palatally impacted canines have enough space for eruption, whereas only 17% of labially impacted canines have enough space. There were 83% of labially impacted canines cases who had arch length deficiency, a primary etiologic factor for labially impacted canines. However, palatally impacted canines seldom erupt without surgical or orthodontic intervention due to the thick cortical bone and dense palatal mucosa. Moreover, palatally impacted canines are often in a horizontal or oblique direction.

The prevalence of impacted maxillary canines in Chinese people was different from Caucasians. The ratio of labially and palatally impacted canines is 2.1: 1, and the ratio of male to female having maxillary canine impactions is 1.8:1.

ETIOLOGY AND DEVELOPMENTAL CONSIDERATION

Maxillary canines take the longest period to develop and the longest course to travel into dental occlusion. During the development, the crowns of canines are close to the roots of lateral incisors. Early correction of the root
position in maxillary lateral incisor with distal tipping and flaring might either cause the impaction of canines or root resorption of lateral incisors.\textsuperscript{9}

The etiology of maxillary canine impaction may be genetic, generalized or localized (Table 1). The labial impaction is often the result of crowding or shifting of the maxillary dental midline,\textsuperscript{10} whereas the etiology of palatal impaction is hypothesized to be multifactorial and genetic.\textsuperscript{11}

Two main theories have been proposed to explain the presence of palatally impacted canines: the guidance theory and the genetic theory.\textsuperscript{1} The guidance theory suggested that the length and timing of root formation of the lateral incisors is crucial for guiding the mesially erupting canine to a more favorably distal and incisal direction.\textsuperscript{12} Becker et al. reported an increase of 2.4 times of incidence of palatally impacted canines if absence of lateral incisors.\textsuperscript{13} The genetic theory suggested that the genetic factors are primary origin of palatally displaced maxillary canines, resulting in the familial and bilateral occurrence as well as gender preference.\textsuperscript{14}

### SEQUELAE OF IMPACATION

According to the study of Shafer et al., there are some following sequelae of canine impaction:\textsuperscript{15}

- Labial or lingual malpositioning of the impacted tooth
- Migration of the neighboring teeth and loss of arch length
- Internal resorption
- Dentigerous cyst formation
- External root resorption of the impaction or the neighboring teeth
- Infection particularly with partial eruption
- Referred pain

#### Table 1. The etiologic factors of canine impaction.\textsuperscript{45,46}

<table>
<thead>
<tr>
<th>Genetic</th>
<th>Generalized</th>
<th>Localized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heredity</td>
<td>Endocrine deficiencies</td>
<td>Tooth size-arch length discrepancy</td>
</tr>
<tr>
<td></td>
<td>Febrile diseases</td>
<td>Prolonged retention or early loss of primary canine</td>
</tr>
<tr>
<td></td>
<td>Irradiation</td>
<td>Abnormal position of the tooth bud</td>
</tr>
<tr>
<td></td>
<td>Nutritional deficiency</td>
<td>The presence of an alveolar cleft</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ankyloses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cystic or neoplasm formation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dilacerations of the root</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trauma</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iatrogenic origin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Idiopathic conditions including primary failure of eruption</td>
</tr>
</tbody>
</table>
The diagnosis and localization of impacted maxillary canine should be based on clinical and radiographic evaluation.

Clinical Evaluation
The amount of space for eruption, the morphology and position of the adjacent teeth, the contour of the bone, the mobility of teeth should be considered through clinical evaluation. Clinical signs of canine impaction are listed as followings:26

1. Delayed eruption of the permanent canine or prolonged retention of the primary canine
2. Absence of a normal labial canine bulge
   On the other hand, the absence of the canine bulge at earlier ages should not be considered as an only indicator of canine impaction. According to study of Ericson and Kurol, 29% of children had nonpalpable canines at age of 10; but only 5% at age of 11, and only 3% at later ages.17
3. Presence of a palatal bulge
4. Delayed eruption, distal tipping, or migration of the lateral incisor

Radiographic Evaluation
Radiographic evaluation includes periapical radiographs, occlusal films, panoramic radiographs, lateral cephalograms and cone-beam computed tomography (CBCT).18

1. Periapical films: A second periapical film is required.
   The lingual object moves in the same direction of the cone; the buccal object moves in the direction opposite to the direction of the cone, as “same-lingual, opposite-buccal (SLOB)” rule.19
   (1) Tube-shift technique or Clark’s rule
      Two films are taken at different horizontal angulation of the cone.
   (2) Buccal-object rule
      Two films are taken at different vertical angulation of the cone.

2. Occlusal films can also help to determine the buccolingual position of the impacted canine.20

3. Panoramic films
   Katsnelson et al. revealed 26.6 times of chances for labially impacted canine if the angulation of the impaction and the horizontal reference line is more than 65°.21

4. Frontal/lateral cephalograms can sometimes be used to determine the position of the impacted canine in relation to adjacent structures such as the maxillary sinus and the floor of the nose.

5. CT/CBCT is an accurate technique for identifying and locating the position of the impacted canine, and assessing if any damage to the roots of adjacent teeth and the amount of bone surrounding the teeth, yet increasing the costs, time and radiation exposure.22,23

CONSIDERATION OF TREATMENT PLANNING
A number of factors can affect the prognosis and should be considered before making the treatment decision, including the patient’s age and cooperation, general and dental health, skeletal variation and dental spacing or crowding (Table 2).

Treatment options
Various treatment options are available including:24

1. No treatment
   No active treatment is recommended when:25
   • the patient does not request treatment
   • there is no sign of resorption or other pathology of the adjacent teeth
   • the canine is severely displaced with no evidence of pathology
   • the canine is remote from the dentition with a good contact between lateral incisor and first premolar
   • the primary canine provides good esthetics/prognosis
In this case, periodical monitoring is suggested in the cases of cystic degeneration, root resorption and the other possible complications. In most cases, the root of primary canine will eventually resorb and need extraction.\textsuperscript{24}

2. Interceptive treatment

The primary canine is usually extracted to facilitate the eruption of the permanent canine or to let the permanent canine move to a favorable position; it avoids excessive duration, expense, and complex treatment.

Williams suggested extraction of the primary canines at the age of 8 or 9 in Class I uncrowded cases for self-correction of a labial or intra-alveolar canine impaction.\textsuperscript{26} Ericson and Kurol suggested that extraction of the primary canine before the age of 11 will normalized the position of the canines in 91\% of the cases if the crown tip is distal to the midline of the lateral incisor, while only 64\% of the cases can be normalized if the crown tip is mesial to the midline of the lateral incisor.\textsuperscript{27} Baccetti et al. declared that the extraction of the primary canine is an effective way to normalize the eruption of maxillary canine by 2 times the possibility than in untreated cases.\textsuperscript{28}

Therefore, extraction of the primary canine before the age of 11 as an interceptive approach to prevent canine impaction can be concluded. Then clinical and radiographic re-evaluation should be taken at 6-month intervals. If there is no improvement within 12 months, an alternative treatment is indicated.\textsuperscript{27}

\begin{table}[h]
\centering
\caption{Factors influencing the treatment decision of an impacted maxillary canine.\textsuperscript{47}}
\begin{tabular}{l}
\hline
Factors influencing the treatment decision of an impacted maxillary canine \\
\hline
Age \\
General and dental health \\
Patient motivation \\
Adequate space in the dental arch \\
Suitability of the first premolar to replace a canine \\
Position of the canine \\
\hspace{1cm} Vertical height of the canine crown \\
\hspace{1cm} Anteroposterior position of the canine root apex \\
\hspace{1cm} Labiopalatal position of the canine \\
\hspace{1cm} Canine angulations to the midline \\
\hspace{1cm} Overlap and root resorption of the adjacent incisor \\
Adequate width of the attached gingiva \\
\hline
\end{tabular}
\end{table}
3. Extraction

The extraction of the impacted canine is seldom considered for the functional occlusion might be compromised, yet it might be an alternative, only if:

- it is ankylosed and cannot be transplanted
- it is undergoing external or internal root resorption
- its root is severely dilacerated
- the impaction is severe
- the occlusion is acceptable, with the first premolar in the position of the canine and well-aligned
- there are pathologic changes
- the patient does not desire for orthodontic treatment

If the impacted canine is going to be extracted, then the decision should be made whether to replace the canine with first premolar or to restore the canine space with prosthesis.

If the canine space is going to be replaced with the first premolar by orthodontic protraction, several factors should be taken into consideration; such as the lingual cusp interference of premolar, tooth size discrepancy, the unilateral mechanics, the smile esthetics. For orthodontic alignment, it may need to intrude the first premolar and restoring the premolars with composite resin or porcelain prosthesis, or to apply negative crown torque and mesiopalatal rotation to imitate the appearance of a canine. The canine guidance can be replaced by premolar guidance or group function.

4. Autotransplantation

The ideal stage for autotransplantation is at 50-75 % of the root formation. The prognosis of transplantation of the impacted canine in adult is poor, most of them need endodontic treatment.

5. Surgical exposure and orthodontic treatment

Considerations for exposing the impacted canine should be emphasized, including surgical technique, marginal gingival placement, control of inflammation, magnitude of force, atraumatic surgery, and proper gingival attachment.

Three main techniques may be performed:

1. Excisional uncovering (gingivectomy)
2. Apically positioned flap (APF)
3. Closed technique: Including vestibular incision subperiosteal tunnel access (VISTA) technique

Kokich had proposed 4 criteria for surgical exposure:

1. Labiolingual position of the crown
   If the canine is impacted labially, then the 3 techniques are viable; if the canine is impacted at the center of the alveolus, then APF and gingivectomy might not be feasible for the extensive bone removal.

2. Vertical position of the tooth relative to the mucogingival junction (MGJ)
   If the crown is positioned apically to MGJ, then closed technique is the most appropriate approach.
   If the crown is slightly apical positioned, then APF is used.
   If the crown is positioned coronally to MGJ, then any of the 3 techniques can be used.

3. Amount of attached gingiva
   The amount of 2-3 mm of attached gingiva should be sufficient after eruption. If there is no sufficient attached gingiva, APF could bring out to preserve the attached gingiva for periodontal health.

4. Mesiodistal position of the crown
   If the crown is positioned mesially, APF is recommended for it could be difficult to move the tooth through the alveolus unless complete exposure.

Orthodontic considerations

Which biomechanics to be used depends on several factors, such as the location and the angulation of the canine relative to the dental arch, the adjacent teeth and the occlusal plane.

The appliances such as ligature wires, brackets, buttons or eyelets may be used to attach onto impacted tooth. Various traction methods has been proposed, including light wires, auxiliary springs or arms from main the archwire or transpalatal arch, mousetrap loops,
K-9 spring, ballista loops and Kilroy I, II springs.\(^{33,37,38}\) Also, temporary anchorage devices (TADs) can be reliable and then brackets bonding can be delayed until canine eruption.\(^{39}\) Hawley type removable appliances can be used as anchorage unit; however, the need for patients’ cooperation, limited control of tooth movement and the inability to treat complex malocclusions are the disadvantages.\(^{24}\)

Initially, the arch should be leveled and aligned until a rigid rectangular wire is placed. Then enough space is required before the surgical exposure. Whatever materials are used, the direction of the force applied on the impacted tooth should first move the impaction away from the root of the adjacent tooth. The force should be light, no more than 2 oz (60 g).\(^{24}\)

When a palatally impacted canine is encountered, the tooth surface available for bonding is often on the palatal side. However, Becker reckoned that the palatal surface is an undesirable site for applying traction force from main archwire, for it could embed the buccal surface of the crown and produce periodontal problems and make it harder to move the canine to a better position and angulation.\(^{40}\) Therefore, it would be better to let the canine erupt vertically until the buccal surface could be bonded.\(^{41}\) As for the labially impacted canines, periodontal conditions such as bony dehiscence and recession of labial gingival margin should be prevented by guide the impacted tooth to erupt between the alveolar cortical plates.\(^{42}\)

**CONCLUSION**

Impacted maxillary canine is the second most frequent impaction, early diagnosis and intervention make the best solution. The keys to treat the impacted canines successfully include accurate localization, use of appropriate surgical procedure and orthodontic biomechanics.

**REFERENCES**