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## Orthodontic management of impacted canine: A review

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### Abstract

Permanent canines play a fundamental role in facial appearance, dental aesthetics, arch development, and functional occlusion. The process of eruption of the permanent canines leading to their final positioning in the oral cavity is complex and the longest of all the permanent teeth making it more prone to impaction. There is a need for its impaction to be properly diagnosed and managed. The orthodontists have played an important role and are proved successful in treating them. This article reviews classification, complications, diagnosis, and treatment modalities in the management of impacted maxillary canines.

**Keywords:** Canine impaction, management, diagnosis, treatment, orthodontics

### Introduction

Impacted teeth are a common finding among patients seen in dental practice. Maxillary canine is the second most commonly impacted tooth, after the mandibular third molar <sup>[1]</sup>. The permanent maxillary canine may be considered as impacted when the eruption of the tooth lags behind as compared to the eruption sequences of other teeth in the dentition. Diagnosis of maxillary canine impaction may be made by clinical examination and by radiography.

The normal path through which maxillary canines erupt may be altered due to changes in the eruption sequence in the maxilla, and also by space limitations due to crowding <sup>[3]</sup>. The impaction can lead to reduced bone dimensions, or affect dental angulations of the nearby teeth. There are a few studies <sup>[11]</sup> comparing specifically the impacted area with the area that had adequate canine eruption in the same individual. These results indicate the consequences generated by the impaction of a canine <sup>[4]</sup>. Kanavakis *et al.* concluded that the root of lateral incisors adjacent to palatal impacted canines is angulated more mesially compared to that of lateral incisors adjacent to normally erupted canines.

It is essential to diagnose and treat this condition early, to prevent the development of complications. An ideal management protocol for impacted permanent maxillary canines should involve an interdisciplinary approach linking the specialties of orthodontics, oral and maxillofacial surgery and periodontology.

### Prevalence and incidence

The incidence of impacted teeth varies considerably in their findings, probably due to regional, genetic differences, public dental health assessed, and interpretation of what impaction constitutes. Aside from third molars, maxillary canines are the most commonly impacted teeth <sup>[6, 7]</sup>. The incidence among females over males is 2:1 and the likelihood of palatal versus labial impaction is 2 to 3 times higher <sup>[8]</sup>. In different populations the incidence of maxillary impaction has been reported to be between 1% and 5%. There was a lower frequency among Blacks and Asians <sup>[9]</sup> and higher occurrence in Greeks and Turks, with European Caucasians somewhere in between. Reports of rates as high as 23.5% may occur in individual orthodontic practices <sup>[5, 3]</sup>. Even if we assume a 1% to 2% incidence, the number of patients affected is huge. As pointed out by Dewel <sup>[9]</sup>, the canine has the longest, most complex eruption path as well as the slowest development time. Perhaps it will come as no surprise that it is often impacted. The etiology of impacted canines, especially palatally displaced teeth, is speculative.

The prevalence of maxillary canine impaction reaches 1% to 5% [6]. Impacted canine in the palatal position occurs 3 to 6 times more often than buccal position. Impacted canines are twice as common in women as in men, and the incidence in the maxilla is more than double compared to the lower jaw [7, 8]. However, contrary reports show that maxillary canine impaction occurs 2–3 times higher on the buccal side compared with the palatal side in East Asians. These reports suggest that the side of impaction varies depending on the ethnic population [9-12].

### The order of frequency of impacted teeth

1. Maxillary third molars
2. Mandibular third molars
3. Maxillary cuspids
4. Mandibular bicuspid
5. Mandibular cuspids
6. Maxillary bicuspid
7. Maxillary central incisors
8. Maxillary lateral incisors

### Reason for canine impaction:

#### 1. Becker Concept

Becker (1984) hypothesized two processes in the palatal impaction of the maxillary canine: Absence of initial early guidance from an anomalous lateral incisor, and later failure of buccal movement of the canine at an unspecified age {9 years}.

#### 2. Moyers Concept: Summarized by Bishara

##### A) Primary cause

1. Trauma to deciduous tooth bud.
2. Rate of resorption of deciduous tooth.
3. Availability of space in the arch.
4. Disturbance in tooth Eruption Sequence
5. Rotation of tooth buds
6. Canine Erupt in Cleft are in Person with Cleft Area
7. Premature root Closure

##### B) Secondary cause

Abnormal muscle pressure  
 Febrile diseases  
 Endocrine disturbances  
 Vitamin D deficiency

#### 3. MC Bridge Concept

Canine formed at high in the anterior wall at antrum, below the floor of orbit, long tortuous path of eruption.

#### 4. Vonder Heydt Concept

Total arch length of permanent teeth is initially established very early in life at the time of eruption of first permanent molars. Canine is larger and later erupting and considering like a musical chair situation it may get impacted. Reason for eruption of canine labially in arch length deficient.

#### 5. Guidance Theory-Miller

Normal Eruption: Canine usually have a more mesial development path, which is guided downwards apparently along the distal and aspect of the lateral incisor roots.

First stage Impaction: If there is a loss of guidances due to missing lateral incisors or late developing laterals, canine will have mesial and palatal path of eruption. In this event there is no vertical movement of canine into the alveolar process, results in more horizontal impaction.

**First stage impaction and secondary correction:** Once it reached the palatal alveolar process, canine is redirected to more favorable path of eruption.

**Second stage Impaction:** Self correction is prevented by, late developing lateral incisors (peg laterals) which reflect the tooth further palatally.

Second stage Impaction and secondary correction: Extraction of deciduous canine or even extraction of lateral incisors leads to spontaneous eruption of the impacted tooth.

### Diagnosis

#### Clinical evaluation

1. Prolonged retention or deciduous canine
2. Delayed eruption of permanent canine
3. Presence of palatal bulge
4. Absence of labial canine bulge
5. Delayed eruption, persistent of distal tipping, migration of lateral incisors

#### Radiographic evaluation:

##### Intra-Oral Radiograph

**1) IOPA:** The first, simplest and most informative X-ray film is the periapical view.

##### Advantages

- Root development, pattern and integrity
- Crown resorption
- Root resorption of adjacent tooth
- Minimum of surrounding tissue is exposed which increase accuracy and resolution.
- Minimal radiation exposure

##### Disadvantage

- Periapical film is a two-dimensional representation which gives no information regarding buccal lingual plane.
- Overlapping structures cannot be differentiated as to which is lingual and which is buccal.

#### 2) Tube shift technique or Clarke technique (Parallax Method)

This is based on binocular principle where two periapical views of same object are taken at different angles will depict the position of tooth in buccolingual position.

**Procedure:** The first film was taken in one angulation. Second film is placed in identical position but X-ray tube is shifted mesially or distally around the arch, but held at the same angle at the horizontal plane and directed at the mesially or distally adjacent tooth

1. If the object is moves in the same directions, it is linguallly positioned.
2. If the object moves in opposite direction, it buccally located.

**Disadvantage:** In cases when canine is highly placed, and periapical film shows no superimposition of canine with the roots of erupted tooth or when superimposition is only in the periapical region the result may be misleading.

#### 3) Buccal object rule technique

If the vertical angulation of cone is changed approximately 20° in two successive films. The result will buccal will move in the direction opposite to the source of radiation. Lingual object will move in the same direction as source of radiation.

**4) Occlusal radiograph (true occlusal or vertex occlusal)**

In this view the central ray of X-ray beam runs parallel to long axis of central incisors. Exposure is done through the vertex i.e 110° to the occlusal plane. When the radiograph is viewed the anteriors are seen as small tiny concentric circles. If the impacted tooth is not parallel to neighbouring tooth, depend on angulation of long axis of the tooth it will be elliptical or oblique in cross section. If tooth is horizontal its full length will be seen. Buccolingual posterior of impacted canine can be seen, bonded the image of impacted canine not superimposed or other teeth.

**Extraoral radiograph**

- 1. Lateral cephalograph:** This represents a true lateral view of the skull which defines the anteroposterior i.e mesiodistal position and vertical position of the tooth.
- 2. Poster anterior view:** This represents the vertical position of the tooth. The buccolingual tilt of the tooth is also clearly visible. This view also shows whether the root apex is in line of arch and how far the crown is deflected in palatal direction.  
Using all these information, it is easy to build up a three dimensional picture of the exact position and angulation of the impacted tooth and to define type of tooth movement to bring the tooth in to alignment.
- 3. CT Scanning:** Charles and Frank in 2003, showed all the above-mentioned methods are 2 dimensional, so it is difficult to appreciate the position of canine. So a 3-dimensional image like CT should be used. CT Scanning is a method in which clear radiograph taken at graduated depth in any part of the human body. By viewing serial radiograph slices of the maxilla, the relationship of the impacted tooth to adjacent teeth in all the three planes of space can be accurately assessed.

**Disadvantage:** Expensive.

**Treatment options**

One of the primary functions of orthodontic treatment preparatory to the treatment of impacted canine is the creation of space in the dental arch for the impacted tooth.

**A) Existing incisor space:** Becker showed Incisor spacing was due to failure of completion of ugly duckling stage of development. During final stage of anterior space closure these existing spaces will be closed by mesial movement of lateral incisor.

**B) Maintaining the Existing space:** Headgear is recommended to prevent the mesial movement of molar and to utilize leeway space. Even correcting the rotation of molar and premolar will also add space.

**C) Improving Archform:** The achievement of good archform is an important initial goal in the maxillary arch in non extraction cases. Maxillary canine erupts more buccally to deciduous canine and slightly buccally to premolar and lateral incisors. So improving archform after extraction of deciduous canine will add 2-3 mm of space.

**D) Increasing Arch Length:** In mild crowding cases distalization of molar is recommended. But in some cases this space is not sufficient to guide permanent canine in to occlusion. In these cases extraction is necessary.

**E) Extraction as a means of prevention (Mixed dentition period)****Deciduous Canine**

Usually canine with a mild palatal displacement will undergo spontaneous eruption and alignment despite first stage displacement. But Erickson and Kuroi concluded that patient with age of 10-13 years preferably with delayed dental age, palatal displacement of canine with apex conformed in line of arch requires extraction of deciduous canine for good prognosis for eruption of permanent canine.

**First premolar**

1. Crowding of maxillary arch
2. Bimaxillary Protrusion
3. Class II Relation

**Lateral incisor**

Peg shaped or severely malformed lateral incisor (Dens invaginatus) can be extracted instead of healthy premolars. These are the various methods in which space for impacted canine is provided.

**Attachments for canine****a) Ligature wire:** Johnston

Poor control over direction of extrusion  
Poor control over type of tooth movement  
Risk of external root resorption near CEJ

**b) Bands:** Von der Heydt

Requires extensive bone removal

**c) Cast canine caps:** Lewis, Dewel

Requires extensive crown preparation

**d) Perforation of canine tips:** Fournier

Chances for non vitality of the tooth  
Needs restoration of the tooth at the end of treatment

**e) Direct Bonding:** Jacoby, Nielson

Easy to perform  
More reliable method

**Methodology of approach:****A) Early extraction of deciduous tooth:**

When early extraction was performed, the immature tooth bud will be deep in the bone and unready for eruption. After healing permanent tooth fell difficulty in penetrating thickened mucosa.

Treatment: Removing fibrous mucosal covering apically repositioned flap was done and resutured tooth will erupt spontaneously.

**B) Retained deciduous tooth:**

Retained deciduous teeth is defined as tooth which is retained even after the permanent successors have reached the stage of development.

Treatment: Extraction of deciduous tooth Usually permanent successors are low in the alveolus, so after exposing the crown a periodontal pack is placed for 2-3 weeks. This will encourage epithelization down the socket and generally prevent the reformation of bone over the unerupted tooth.

**C) Highly buccally impacted canine**

These teeth are usually ankylosed and difficult to respond to

orthodontic traction.

Treatment: Tooth should be luxated with extraction forceps such that it is not removed from the socket nor to tear the periodontal fibers. Accordingly this approach will be quite successful only if a continuous force is applied to the tooth from the time of subluxation. If the range of force is small and loses its potency between visit of adjustments, reankylosis will result.

#### D) Retained deciduous tooth with deep infraosseus impacted canine

These condition are difficult to manipulate. usually tooth will be placed more than 17mm above the occlusal plane. So tooth have to take a long journey to come to occlusion.

**Treatment:** CRESCINI approached a method called as Tunnel Traction.

- a. Extract deciduous canine.
- b. Full thickness mucoperiosteal flap is elevated to expose the cortical plate.
- c. Bur drilled until exposing crown of canine
- d. Tooth was bonded and ligature wire tied
- e. Traction force given after 1 week of surgery

#### Advantage

1. No buccal or palatal access
2. No loss of supporting tissue

**Disadvantage:** Post operative discomfort will be more.

Thus tooth can be guided in normal physiological eruption pattern through the crest of the ridge.

#### E) Palatally impacted canine

When crown of canine is more palatally displaced, surgery on the buccal side needs to become more radical, rendering a palatal; approach preferable.

Usually palatally impacted tooth is guided to occlusion in two stages.

1. Guiding tooth to oral environment
2. Guiding tooth to line of arch

#### Guiding tooth to oral environment

##### Auxiliary springs for canine movement

1. **Ballista Spring (Jacoby 1979):** It is made of rectangular wires. It proceeds forwarded until it is opposite to canine space and bent vertically downwards and terminate into a small loop. With slight finger pressure spring is it is tied to pigtail ligature. by this it provide an extrusive force for the canine to erupt. If the impacted tooth is resistant to movement or if the distance for the tooth to move is more it will leads to lingual molar root torque leads to loss of anchorage. To overcome this feature TPA is used.
2. **Active palatal arch (Becker 1978):** It consist of fine 0.020 inch removable palatal arch wire carrying an omega loop on each side. End of the wire is doubled for Frictionless fit in lingual sheath. It is activated by elevating downward activated palatal arch wire and hooking the pigtail ligature around it.
3. **Light Auxiliary Labial Arch (Kornhauser 1996):** It is made up of 0.014 inch round SS wire with vertical loops in the area of impacted canine on both sides. This loop has a small helix. This is tied with the basal arch wire in piggyback fashion. If basal arch wire is not used it will leads to extrusion of adjacent tooth and cause alteration of occlusal plane.

4. **Mandibular removable appliance (Orton 1996):** It consist of clasps through which elastic is applied from clasp to the pigtail ligature wire. This provide the necessary extrusive force for the eruption of canine For all the aforementioned methods the position of the attachment is immaterial and bonding is done on the most convenient surface available because no adverse rotation of tooth will occur while it is moving vertically downwards.

#### Guiding tooth to line of arch

Once the tooth is moved to the oral environment, bonding attachment is placed on the midbuccal aspect to prevent iatrogenic rotation of canine and guided to the line of arch.

- a. If the root apex of canine is close to the line of arch and canine related to the roots of incisors, pure buccal tipping will bring the crown to desirable position and inclination.
- b. If the root apex is distant to the line of arch and crown not related to the roots of the incisors, usually it will be impacted deep and may crosses the mid palatal suture. These tooth can be directly guided to occlusion through labial arch wire since there is no interference of roots of incisors.
- c. If there is an horizontal impaction, downward tipping should be cautiously applied. Force application should be like the fulcrum of the canine to be at the root end, so that root apex don't alter following the canine tipping movement. Unfortunately, fulcrum is usually located short away from the apical portion of the root, leads to concomitant palatal displacement of root apex of canine. This requires buccal root torquing after alignment of canine in the arch.
- d. If the root apex mesial to lateral incisor or distal to premolar, tooth is considered as transposed.
  1. **Incomplete transposition:** Roots will be in line of arch in its position and crown tipped due to path of eruption (up righting of tooth will align the tooth in arch).
  2. **Complete transposition:** Both crown and root together will be completely interchanged. In these situation its better to align tooth to their respective position, i.e canine between premolars or mesial to lateral incisors depends on type of transposition. If we tried to align this tooth their respective position,
    - If canine is palatal to line of arch, secondary effect of root contact will rotate the root apex both mesially and palatally across the palate in a wide sweeping motion. the tooth will be laid down beneath the periosteum with huge dehiscence.
    - If canine is buccal to the line of arch, secondary effect of root contact will cause further buccal displacement of root with gross dehiscence of buccal periodontium.
- e. If canine is erupting in line of arch and in place of lateral incisors and resorbing the roots, canine should be guided in distal tipping without extrusion in horizontal plane in a direct line towards the maxillary molars. Once the tooth is exposed to the oral environment buccal tipping of arch wire is done and aligned to the arch. If canine is moved away from the lateral incisor root the resorption process stops completely.

#### Surgical exposure of impacted tooth

- a) **Circular incision or open approach:** This is done over

the crown to expose the bony crypt which lodging the impacted tooth.

#### Advantages

- Easy to perform.
- Suitable access can be provided for bonding of the attachment.
- Reduction of impaction is rapid.

#### Disadvantages

- Tooth will be invested on labial side with thin oral mucosa rather than attached gingiva.
- Typical soft tissue contour aggravates Plaque accumulation which leads to gingivitis. Inflammation will prevent regeneration of the Periodontal ligament which leads to apical movement of the epithelial attachment.

#### Function of attached gingiva

1. To provide attachment between tooth and bone to prevent the muscle of face from detailing the marginal periodontal tissue from the tooth
2. Prevents gingival recession and marginal bone loss.

**b) Apically Repositioned Flap:** This method was proposed by Vanarsdall and corn in 1977.

Procedure: In cases without deciduous canine, Mucoperiosteal flap is elevated from the crest of the ridge that includes attached gingiva.

In cases with deciduous canine, tooth was extracted and the flap was designed to include the entire area of buccal gingival that invest it.

In either cases Split thickness Flap is elevated by incision made vertically into the vestibule someway up into the sulcus, to expose the canine 2/3<sup>rd</sup> of bone covering was removed. Connective tissue follicle was curreted from periphery of the exposed portion of the crown. This Flap is then sutured to the labial side of the crown of the permanent canine, to cover the denuded periosteum and overlying cervical portion of the crown. while remainder portion of the crown is exposed. Surgical dressing is placed on enamel to prevent overgrowth of adjacent tissue. Dressing is removed 1 week post operatively. After 2 weeks, orthodontic traction can be started.

#### Advantages:

- Maintain the width of attached gingiva.
- Easy access for bonding of the attachment
- Tooth can be visualized from the time of exposure still it come to occlusion.

#### Disadvantages:

- Uneven and unesthetic gingival margin
- Increased Clinical crown length
- Some degree of attachment loss and bone loss on the labial surface, which was considered as possibly related to an increased potential for plaque acclumation
- Vertical orthodontic relapse

**Full Flap Exposure:** This method was proposed by MCBride in 1979. This method is more effective for buccal and palatally impacted tooth.

Procedure: A full buccal surgical flap is raised to expose the canine. An attachment is bonded to the tooth and the flap is sutured back to its former place itself. Then a Twisted thread is tied to the bonded tooth and then drawn inferiorly and

through the sutured ends of the replaced flap, or through the crest of the ridge or through the socket vacated by the extracted deciduous canine.

#### Advantages

- Tooth can be erupted towards and through the attached gingiva which maintains the width of the attached gingiva.
- No gingival scarring and good periodontal attachment is established no vertical relapse.
- Conservative bone removal.
- Immediate traction possible
- Less discomfort and good post operative Haemostasis

#### Disadvantage

- Placement of the bonding attachment is necessary at the time of exposure
- If there is a bond failure it needs re-exposure
- Difficulty in gaining dry field
- Button holing

**Dentigerous Cyst:** Dentigerous cyst is a well defined radiolucent lesion of alveolar bone in preadolescents and inhibit the eruption of the involved tooth.

Treatment: Marsupialization is the procedure consists of fenestrating the outer wall of the cyst, and relieving the intracystic pressure. With this early decompression, the size of the cavity slowly decreases, enabling the surrounding bone to regenerate around the impacted tooth, which eventually will erupt into the dental arch.

**Impacted tooth and Periodontium:** Becker 1984, Exposure of the crown should be sufficient to bond attachment rather than exposing upto CEJ. Previously for placing bands surgeons Deliberately and completely remove the follicle surrounding the tooth. When these tooth erupt in to occlusion, these tooth will have longer clinical crown and reduced alveolar height. Kokich and Mathew showed that bone removal shouldnot be more than 2/3<sup>rd</sup> of the impacted tooth crown

Light orthodontic movement like tipping, extrusion, and rotation have less periodontal breakdown than Heavy orthodontic movement like root up righting and to rquing.

#### Retention

1. Rotation and spacing occurs in 17.4%. So fibrectomy and fixed bonded retainer is used.
2. Clark 1985 showed Lingual drift can be prevented by removal of half moon shaped wedge of tissue from lingual aspect of canine which further improves retention

#### Time to extract canine

1. Ankylosed and cant be transplanted.
2. External and internal root resorption
3. Dilacerated root
4. If impaction is severe such that canine lodges between the roots of central and lateral incisors and the orthodontic movement will jeopardizes these teeth.
5. Occlusion is acceptable with 1<sup>st</sup> premolar in canine place.
6. If any severe pathologic changes {Cyst, Infection}
7. If patient does not desire orthodontic

#### Conclusion

Management of the impacted canine is one of the greatest challenge for orthodontist. Success of the treatment depends

upon patient cooperation, Age of patient, Proper diagnosis, Level of canine impaction, Inclination and Depth of impaction, Amount of root formation, Type of exposure of tooth, Amount of bone removal, Type of attachment, Orthodontic traction. All these parameter plays important role when managing impacted canines to achieve good canine alignment in the arch with canine guided occlusion, Gingival level, and Integrity of periodontium.

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