Aberrant position of canine

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Normal development of canine:

The development of the maxillary canine commences around 4–5 months of age, high in the maxilla. Crown calcification is complete around 6–7 years of age. The permanent canine then migrates forwards and downwards to lie buccal and mesial to the apex of the deciduous canine before erupting down the distal aspect of the root of the upper lateral incisor. Pressure from the unerupted canine on the root of the lateral incisor, leads to flaring of the incisor crowns, which resolves as the canine erupts. In normal development, the maxillary canines should be palpable in the labial sulcus by age 11 years. The upper canines erupt, on average, at 11–12 years of age. The lower canines erupt, on average, at 10–11 years of age.

In a Caucasian population, congenital absence of upper canines represented 0.3%, whereas congenital absence of lower canines was about 0.1%. Impaction of upper canines could be found in 1–2%, of which, 8% are bilateral, however, the impaction of lower canines was about 0.35%. Resorption of upper incisors due to impacted canine could be 0.7% of 10–13-year-olds, whereas the prevalence of transposition was 0.33%.

Aetiology of maxillary canine displacement

Canine displacement is generally classified into buccal or palatal displacement. However, more rarely, canines can be found lying horizontally above the apices of the teeth of the upper arch or displaced high adjacent to the nose (Fig. 1).

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Fig. 1: High upper right canine displacement

The aetiology of canine displacement is still not fully understood, however, the following have been suggested as possible causative factors:

• *Displacement of the crypt.*

• *Long path of eruption.*

• *Short-rooted or absent upper lateral incisor*. A 2.4-fold increase in the incidence of palatally displaced canines in patients with absent or short-rooted lateral incisors has been reported (Fig. 1). It has been suggested that a lack of guidance during eruption is the reason behind this association.

• *Crowding.* About 85% of buccally displaced canines were associated with crowding, whereas 83% of palatal displacements had sufficient space for eruption. If the upper arch is crowded, this often manifests as insufficient space for the canine, which is the last tooth anterior to the molar to erupt.

• *Retention of the primary deciduous canine*. This usually results in mild displacement of the permanent tooth buccally. However, if the permanent canine itself is displaced, normal resorption of the deciduous canine will not occur. In this situation, the retained deciduous tooth is an indicator, rather than the cause, of displacement.

• *Genetic factors.* It has been suggested that palatal displacement of the maxillary canine is an inherited trait with a pattern that suggests polygenic inheritance. The evidence cited for this includes:

(a) The prevalence varies in different populations with a greater prevalence in Europeans than other racial groups.

(b) Affects females more commonly than males.

(c) Familial occurrence.

(d) Occurs bilaterally with a greater than expected frequency.

(e) Occurs in association with other dental anomalies.

Interception of displaced canines

Because management of ectopic canines is difficult and early detection of an abnormal eruption path gives the opportunity, if appropriate, for interceptive measures, it is essential to routinely palpate for unerupted canines when examining any child aged 10 years and older. It is also important to locate the position of the canines before undertaking the extraction of other permanent teeth.

Canines, which are palpable in the normal developmental position (buccal and slightly distal to the upper lateral incisor root), have a good prognosis for eruption. Clinically, if a definite hollow, or asymmetry, or both are found on palpation, further investigation is warranted. On occasion, routine panoramic radiographic examination may demonstrate asymmetry in the position and development of the canines.

Number of studies have investigated the widely held belief that extraction of the deciduous canine may facilitate an improvement in the position of a palatally displaced canine (Fig. 2) where the unerupted tooth is not markedly ectopic. Clinical experience suggests that interceptive measures are more successful between the developmental ages of 10–13 years and when there is space available for the unerupted canine, therefore space maintenance or even space creation should be considered in crowded dentitions if this approach is being contemplated.

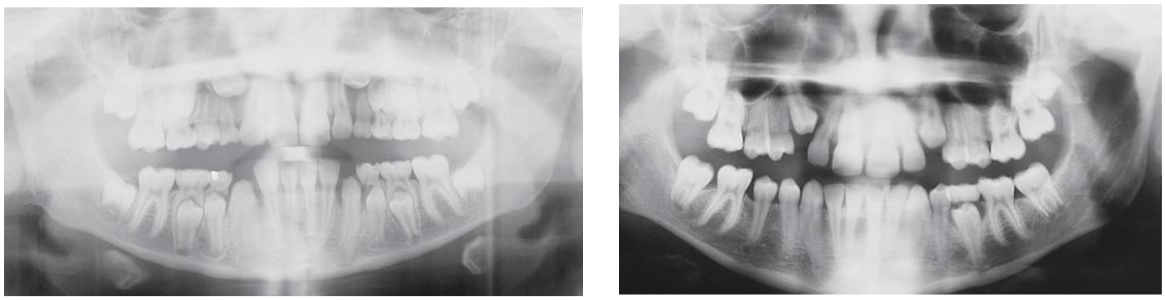


Fig. 2: Extraction of the deciduous canine may facilitate an improvement in the position of a palatally displaced canine Assessing maxillary canine position

The position of an unerupted canine should initially be assessed clinically, followed by radiographic examination if displacement is suspected.

Clinically

It is usually possible to obtain a good estimate of the likely location of an unerupted maxillary canine by palpation (in the buccal sulcus and palatally) and by the inclination of the lateral incisor (Fig. 3).

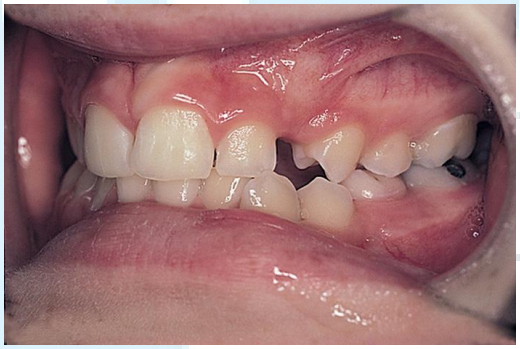


Fig. 3: Bucally positioned canine

Radiographically

The views commonly used for assessing ectopic canines. The radiographic assessment of a displaced canine should include the following**:**

- Location of the position of both the canine crown and the root apex relative to adjacent teeth and the arch.
- Prognosis of adjacent teeth and the deciduous canine, if present.
- Presence of resorption, particularly of the adjacent central and/or lateral incisors.

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The radiographic assessment includes the followings techniques:

• *Dental panoramic tomogram* (OPT, OPG, or DPT). This film gives a good overall assessment of the development of the dentition and canine position. However, this view suggests that the canine relation to midline or its inclination. This view should be supplemented with an intra-oral view.

• *Periapical***.** This view is useful for assessing the prognosis of a retained deciduous canine and for detecting resorption. The principle of parallax can be used to determine the position of an unerupted tooth relative to its neighbours. To use parallax, two radiographs are required with a change in the position of the X-ray tube between them. The object furthest away from the X-ray beam will appear to move in the same direction as the tube shift. Therefore (Fig. 4).

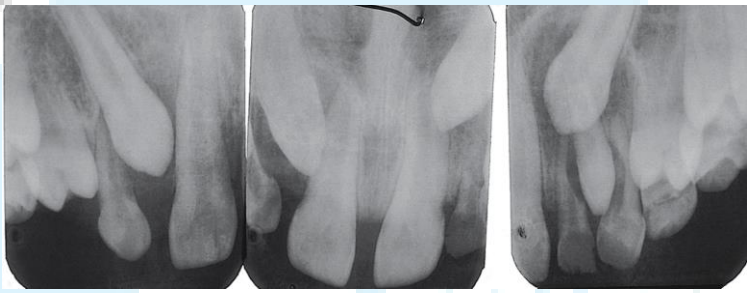


Fig. 4: Horizontal parallax technique

• *Upper anterior occlusal.* To facilitate the use of vertical parallax in conjunction with an OPT radiograph, the angle of the tube should be increased to 70–75° (rather than the customary 60–65°).

• *Lateral cephalometric***.** For accurate localization, this view should be combined with an anteroposterior view (e.g. an OPT).

• *Cone beam computed tomography (CBCT).* Although there is an increased radiographic dose with this view, the three-dimensional (3D) images produced provide useful information on the exact position of the impacted tooth, especially in relation to other teeth and whether there is any associated root resorption. However, clinicians need to be able to justify the increased dosage and follow CBCT guidelines when using this type of investigation.

Management of buccal displacement

Buccal displacement is usually associated with crowding, and therefore *relief of crowding* prior to eruption of the canine will usually effect some ***spontaneous improvement*** (Fig. 4).



Fig. 4: Spontaneous canine eruption and improvement after extraction of first premolar

Buccal displacements are more likely to erupt than palatal displacements because of the thinner buccal mucosa and bone. Erupted, buccally displaced canines are managed by *relief of crowding*, if indicated, and ***alignment***, usually with a fixed appliance.

In severely crowded cases where the upper lateral incisor and first premolar are in contact and no additional space exists to accommodate the wider canine tooth, ***extraction of the canine*** itself may be indicated. In some patients, the canine is so severely displaced that a good result is unlikely, necessitating removal of the canine tooth and the use of fixed appliances to close any residual spacing.

More rarely, a buccally displaced *canine tooth does not erupt* or its eruption is so *delayed* that treatment. In these situations, ***exposure of the impacted tooth*** may be indicated. If the crown is located below the mucogingival junction, an open procedure to expose the crown is sufficient (Fig. 5).



Fig. 5: Window exposure of canine

However, if the crown is above the mucogingival junction, then a different approach is required. To ensure an adequate width of attached gingiva either an apically repositioned or, preferably, a replaced flap should be used. In the latter case, in order to be able to apply traction to align the canine, an attachment can be bonded to the tooth at the time of surgery (Fig. 6). A gold chain or a stainless steel ligature can be attached to the bond and used to apply traction.



Fig. 6: exposure of bucally impacted canine using flap and attachment.

Management of palatal displacement

There are some factors that affect the treatment decision. These include:

- Patient's opinion of appearance and motivation towards orthodontic treatment.
- Malocclusion.
- Position of displaced canine: is it within range of orthodontic alignment?
- Presence of spacing/crowding.
- Condition of retained deciduous canine, if present.
- Condition of adjacent teeth.

The treatment options available are as follows:

1. **Surgical removal of canine**

This situation occurs in the following conditions:

- The retained deciduous canine has an acceptable appearance and the patient is happy with the aesthetics and/or reluctant to embark on more complicated treatment (Fig. 7). The clinician must ensure that the patient understands that the primary canine will be lost eventually and a prosthetic replacement required. However, if the occlusion is unfavourable, for example, a deep and increased overbite is present, this may affect the feasibility of bridgework later, necessitating the exploration of alternative options.



Fig. 7: Preservation of aesthetically acceptable deciduous canine.

• The upper arch is very crowded and the upper first premolar is adjacent to the upper lateral incisor. Provided that the first premolar is not mesiopalatally rotated, the aesthetic result can be acceptable.

• The canine is severely displaced. Depending upon the presence of crowding and the patient's wishes, either any residual spacing can be closed by forward movement of the upper buccal segments with fixed appliances, or a prosthetic replacement can be considered.

2. Leave in situ:

If space closure is not planned, it may be preferable to keep the unerupted canine under biannual radiographic observation until the fate of the third molars is decided. However, if any pathology, for example, resorption of adjacent teeth or cyst formation, intervenes, removal should be arranged as soon as possible.

3. Surgical exposure and orthodontic alignment

Indications are as followed:
• Well-motivated patient
• Well-cared-for dentition
• Favorable canine position
• Space available (or can be created).

Whether orthodontic alignment is feasible or not depends upon the 3D position of the unerupted canine:

• **Height:** the higher a canine is positioned relative to the occlusal plane, the poorer the prognosis. In addition, the access for surgical exposure will be more restricted. If the crown tip is at or above the apical third of the incisor roots, orthodontic alignment will be very difficult.

• **Anteroposterior position:** the nearer the canine crown is to the midline, the more difficult alignment will be. Most operators regard canines which are more than halfway across the upper central incisor to be outside the limits of orthodontics.

• **Position of the apex:** the further away the canine apex is from normal, the poorer the prognosis for successful alignment. If it is distal to the second premolar, other options should be considered.

• **Inclination:** the smaller the angle with the occlusal plane, the greater the need for traction.

If these factors are favorable, the usual sequence of treatment is as follows:
1. Make space available (although some operators are reluctant to embark on permanent extractions until after the tooth has been exposed and traction successfully started).
2. Arrange exposure.
3. Allow the tooth to erupt for 2–3 months.
4. Commence traction.

An attachment plus the means of traction (e.g. a wire ligature or gold chain) can be bonded to the tooth at the time of exposure or about 2 days after pack removal. Traction can be applied using either a removable appliance (Fig. 8) or a fixed appliance.



Fig. 8: Traction of palatally displaced canine

4. Transplantation

Transplantation should be carried out when the canine root is two-thirds to three-quarters of its final length; unfortunately, by the time most ectopic canines are diagnosed, root development is further advanced. If transplantation is to be attempted, it must be possible to remove the canine intact and there must be space available to accommodate the canine within

the arch and occlusion. In some cases, this will mean that some orthodontic treatment will be required prior to transplantation.

The main causes of failure of transplanted canines are *replacement resorption* and *inflammatory resorption*.

- Replacement resorption, or ankylosis, occurs when the root surface is damaged during the surgical procedure and is promoted by rigid splinting of the transplanted tooth, which encourages healing by bony rather than fibrous union. Therefore, a careful surgical technique is essential to prevent damage to the root surface and the transplanted canine should be positioned out of occlusion and splinted with a sectional archwire for 6 weeks.
- Inflammatory resorption follows death of the pulpal tissues, and therefore the vitality of the transplanted tooth must be carefully monitored.

Generally speaking, this approach is usually ***one of last resort***.

Resorption:

Unerupted and impacted canines can cause resorption of adjacent lateral incisor roots and may sometimes progress to cause resorption of the central incisor. About two-thirds of upper lateral incisors associated with ectopic canines showed signs of resorption. This sequela is more common in females than males. Extraction of the canine may be necessary to halt the resorption. However, if the resorption is severe, it may be wiser to extract the affected incisor(s), and if appropriate, exposure and traction to bring the canine into the arch (Fig. 9).

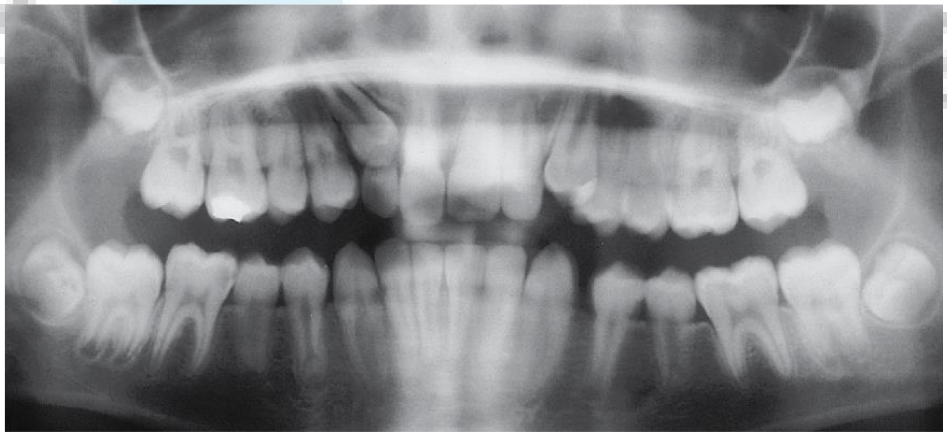


Fig. 9: severe resoption of lateral incisor necessitate its extraction

Transposition

Transposition is the term used to describe interchange in the position of two teeth. This anomaly is comparatively rare, but almost always affects the canine tooth. It affects males and females equally and is more common in the maxilla. In the upper arch, the canine and the first premolar are most commonly involved; however, transposition of the canine and lateral incisor occurs.



In the mandible, the canine and lateral incisor appear to be almost exclusively affected. The aetiology of this condition is not understood. The management depends upon whether the transposition is complete (i.e. the apices of the affected teeth are transposed), or partial; the malocclusion; and the presence or absence of crowding. Possible treatment options include ***acceptance*** (particularly if transposition is complete), ***extraction*** of the most displaced tooth if the arch is crowded, or orthodontic ***alignment***. In the last case, the relative positions of the root apices will be a major factor in deciding whether the affected teeth are corrected or aligned in their transposed arrangement.

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