CASE REPORT

Early Detection and Interceptive Orthodontic Treatment of Impacted Canine: A Case Report

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Abstract

Aim and background: Upper canines are the second most common teeth involved in impaction after the third mandibular molar. Accurate diagnosis at an appropriate age is important to reduce complications of the impacted tooth and its adjacent teeth. We present a case of early detection of an impacted left maxillary canine, which allowed spontaneous eruption through arch expansion.

Case description: An 11-year-old patient was referred for monitoring of an unerupted left maxillary canine. The tooth was palpable labially, but there was a lack of space for an eruption for the tooth, with 2 mm of discrepancy as assessed using the Tanaka and Johnston space analysis method. The patient had generalized gingivitis, multiple carious teeth, and dens evaginatus of upper incisors. An orthopantomogram (OPG) confirmed the clinical findings and impaction of the tooth. Localization of the tooth was done using the parallax technique with the addition of an intraoral periapical radiograph (IOPA). The tooth was in line with the arch. Due to this favorable position, an upper removable appliance (URA) with an acrylic plate, metal clasps on the upper first molars and premolars, and an expansion screw in the midline was constructed for the patient. The patient activated the screw with a weekly quarter turn. Preventive and caries management strategies were done simultaneously. The impacted left maxillary canine erupted after 10 months of using the URA.

Conclusion: Due to the high plasticity of bone structures in a growing child, interceptive orthodontic treatment using removable appliances works well. The impacted left maxillary canine erupted in place after 10 months of using the URA without the need for surgical or fixed orthodontic treatment.

Clinical significance: Early detection of impacted teeth in a growing child is important in order for us to intervene in the problem at an earlier stage to avoid further complications.

Keywords: Case report, Impacted canine, Interceptive orthodontic treatment, Removable appliance.

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Introduction

The maxillary canine plays a vital role in the functional aspect of the occlusion. It is frequently referred to as the maxillary arch's cornerstone because of its large root and strong bone support. A missing or impacted canine will affect the function and esthetic appearance of the smile.[1]

Impacted teeth are defined as teeth that are prevented from erupting into the arch within the specified time due to some physical barrier in their path.[1,2] The prevalence of maxillary canine impaction is between 0.8 and 5.2%, and it is the second most common tooth involved in impaction after the mandibular third molars.[1,3] Impacted maxillary canines are frequently displaced palatally at 61.4%, followed by 34.1% in line with the arch, and the remaining 4.5% on the buccal side.[4]

Tooth-arch length discrepancy is often mentioned as an etiologic factor for crowding and impactions.[2] Other factors that contribute to the impaction of canines include general factors such as endocrine disorders, a history of long-term chemotherapy, nutritional deficiency, and localized factors such as the presence of supernumerary teeth, injury to the primary tooth, premature loss of the primary tooth, and lack of resorption of the primary tooth.[2]

The erupting maxillary canine should be palpable in the buccal sulcus from the age of 10–11 years.[5] Eruption of maxillary canines after 12.3 years of age in girls and 13.1 years of age in boys may be considered late.[1] Accurate diagnosis at an appropriate age is important to reduce complications of the impacted tooth and its adjacent teeth. With canine impactions, the possible complications include—(1) external root resorption of the impacted tooth, as well as the neighboring teeth, (2) labial or lingual malpositioning of the impacted tooth, (3) migration of the neighboring teeth and loss of arch length, (4) internal resorption, (5) dentigerous cyst formation, (6) infection, and (7) referred pain.[6]

The impaction of maxillary canines can directly affect overall treatment planning and timing of treatment for patients. Treatment of impacted maxillary canines is challenging and may require extensive measures such as orthodontic and/or surgical intervention. Hence, early diagnosis is crucial to avoid any surgical intervention at a later stage. In this report, we present a case of

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early detection of an impacted left maxillary canine, which allowed spontaneous eruption through arch expansion.

Case Description

An 11-year-old patient was referred for an oral hygiene review and monitoring of permanent teeth eruption following a previous intervention. The patient had been previously seen by a pediatric dentist but was referred to us because the patient's family had moved. The patient denied any medical history. The gestation and delivery history of the patient were unremarkable. The patient presented with a Frankl behavior scale of 3 at the initial presentation.

Past dental experience showed that at 7 years and 8 months, the patient had a history of fixed orthodontic treatment (molar bands on upper first molars and orthodontic brackets on teeth 11 and 21) to close the median diastema of 6 mm between teeth 11 and 21. At 9 years and 5 months, extraction of the upper left primary canine under physical restraint was performed to allow spontaneous eruption of the permanent left canine (tooth 23). The transpalatal arch (TPA) was cemented on the upper first molars to avoid the mesial drifting of these teeth.

Upon clinical examination, the patient had poor oral hygiene, with an oral hygiene index-simplified (OHI-S) score of 2.7. The TPA was intact. Tooth 23 was unerupted but palpable labially, with minimal space for eruption measuring 3.5 mm. Caries were present involving teeth 65, 84, and 85, with both lower deciduous molars exhibiting grade II mobility. Dens evaginatus was noted on teeth 12, 11, 21, and 22, present as a 2 mm projection from the cingulum of the respective teeth. These projections, however, did not cause any occlusal interference or premature contact upon biting (Fig. 1).

An orthopantomograph (OPG) was taken to assess the patient's dentition (Fig. 2). All permanent tooth buds were accounted for. The presence of caries and the TPA were consistent with the intraoral findings. The impacted tooth 23 was confirmed. An intraoral periapical (IOPA) radiograph (Fig. 3) was taken to assess the exact position of tooth 23 using the vertical parallax technique, and it was concluded that tooth 23 was in line with the arch.

Space analysis was done using the Tanaka and Johnston equation method.[7]

$$\text{Space analysis of maxillary canine to second premolar} = \frac{\text{Mesiodistal width of mandibular lower incisors (mm)}}{2} + 11 \text{ mm}$$

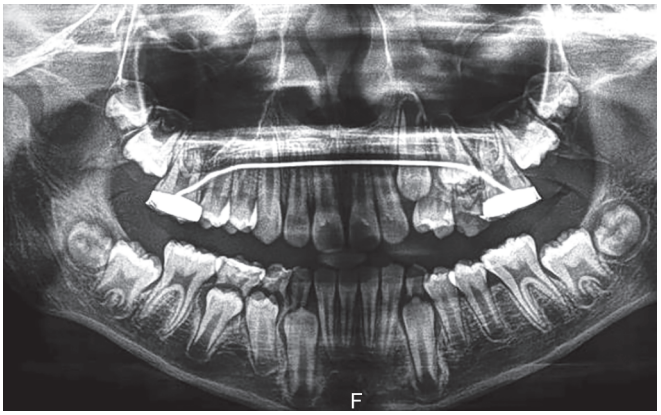
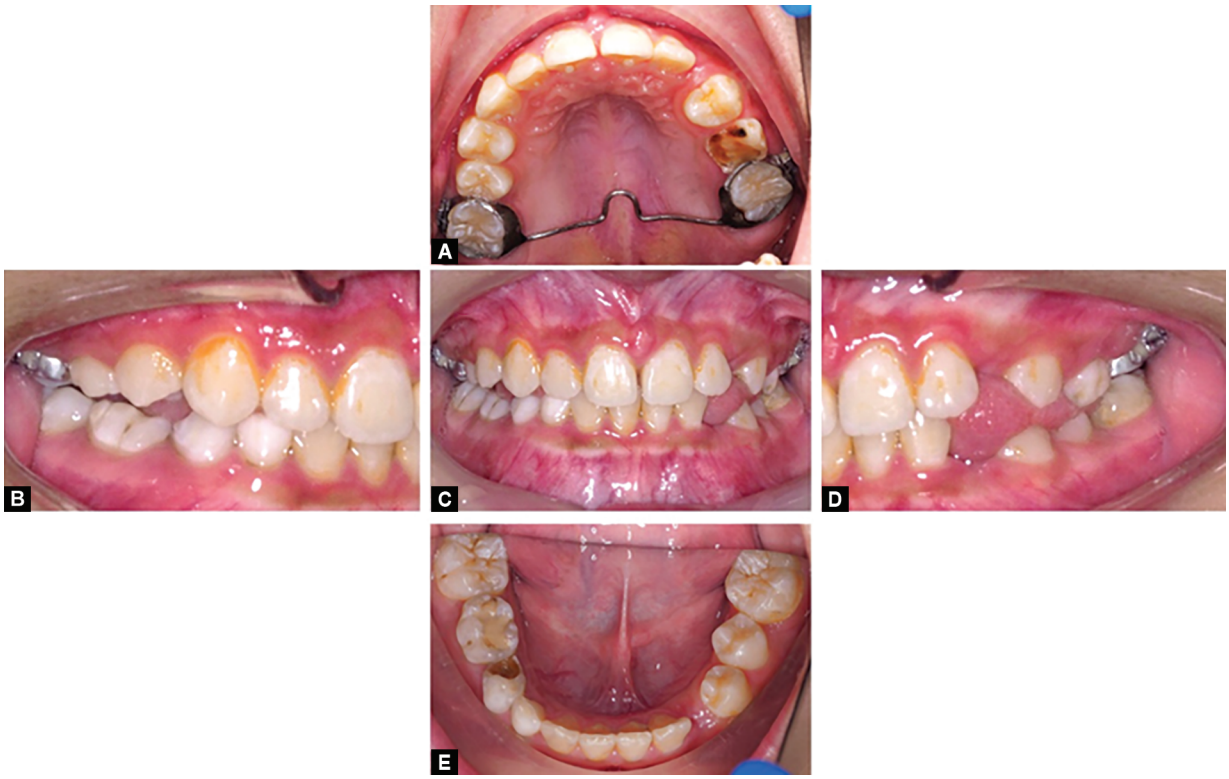


Fig. 2: Orthopantomograph of patient



Figs 1A to E: Initial clinical presentation. (A) Upper occlusal view; (B) Right side view; (C) Front view; (D) Left side view; (E) Lower occlusal view

Fig. 3: Intraoral periapical radiograph of a patient

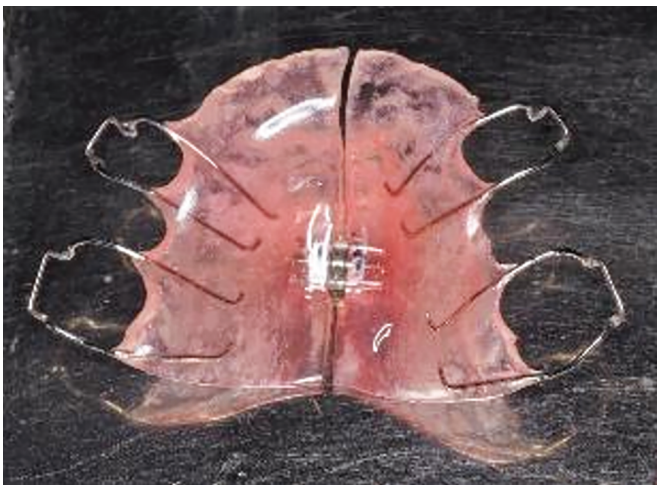


Fig. 4: Upper removable appliance with acrylic plate, metal clasp, and expansion screw

Table 1: Treatment plan for the patient

No.	*Issue*	*Treatment plan*
1.	Poor oral hygiene	For oral hygiene instruction To demonstrate toothbrushing technique to the patient followed by the use of disclosing agent
2.	Caries on primary dentition	To conduct caries risk assessment To monitor the patient's diet chart For extraction of 65 under nitrous oxide sedation To stabilize caries and allow normal exfoliation of teeth 84 and 85 For 3 monthly fluoride varnish application For fissure sealant on permanent first molars
3.	Dens evaginatus on 12, 11, 21, and 22	For fissure sealant on dens evaginatus and continuous monitoring of the vitality of the teeth
4.	Impacted left permanent canine	For URA with an expansion screw to allow transverse expansion of the maxilla

The mesiodistal width of the lower incisor was 24 mm. Using the equation by Tanaka and Johnston, the space needed from the permanent canine to the permanent second premolar is 23 mm. However, only 21 mm of space was available, suggesting a 2 mm discrepancy.

Based on both clinical and radiographic examination, the following diagnoses have been made—generalized gingivitis, multiple caries on deciduous teeth, dens evaginatus on teeth 12, 11, 21, and 22, and impacted left permanent maxillary canine secondary to tooth-arch length discrepancy.

We discussed with both parents and the patient the treatment options for each dental issue the patient had. The nature of the procedure, risks, and complications of each treatment option were explained. After much deliberation, a treatment plan was laid out, as shown in Table 1.

The treatments were done concurrently. Preventive treatment encompassed improving the patient's brushing efficacy, diet intervention, 3-monthly topical fluoride application, and fissure sealants on all permanent molars. Tooth 65 was extracted under inhalation sedation, while caries on teeth 84 and 85 were stabilized with glass ionomer cement (GIC) and left for self-exfoliation. For the impacted maxillary left permanent canine, the treatment objective was to create enough space for the tooth to erupt spontaneously and guide the tooth gradually to the appropriate position to obtain pleasant esthetics. We constructed an upper removable appliance (URA) using an acrylic plate with metal clasps surrounding the molars and first premolars and an expansion screw in the midline, placed on the palate (Fig. 4). This URA acts as a slow maxillary expansion (SME) and indirect space maintainer that kept the 6s in position. The TPA was removed prior to the delivery of the URA. The patient was instructed to use the appliance 24 hours a day except during eating and tooth brushing. The patient activated the screw with a weekly quarter turn. The patient was reviewed every 6 weeks to monitor the eruption of teeth 23 and 25 while addressing other treatment needs. The palatal surface of the upper incisors with dens evaginatus was fissure sealed. Tooth 25 erupted after 3 months. At 5 months, the patient complained of an ill-fitting URA. A new URA was constructed for the patient. Tooth 23 erupted after 10 months from the first activation of the expansion screw. The clinical photo of the completion of treatment is seen in Figure 5.

Discussion

Despite the patient's high orthodontic treatment need, the prevention and management of dental caries should not be overlooked. Patient education and improvement in the efficacy of oral hygiene care are particularly important, especially as the patient embarks on the phase of orthodontic treatment, which may predispose the patient to a higher caries risk.[8] Fissure sealant of the permanent molars has been shown to reduce the incidence of caries involving posterior teeth.[9]

Figs 5A to E: Clinical presentation after completion of treatment. (A) Upper occlusal view; (B) Right side view; (C) Front view; (D) Left side view; (E) Lower occlusal view

Tooth 65 was deemed unrestorable; thus, we decided to extract the tooth under inhalation sedation, given the fact that the patient had a traumatic experience of tooth extraction under physical restraint before. The use of inhalation sedation provides better anxiety control for the patient.[10] In contrast, teeth 84 and 85 were near exfoliation with grade II mobility; hence, we decided to stabilize caries by restoring both teeth with GIC, providing a cleansable surface while waiting for the teeth to self-exfoliate.

The enamel projection from dens evaginatus contains pulp tissue underneath the thin enamel layer, and fracture of the projection may lead to pulp exposure and pulpal symptoms.[11] Therefore, protection of the projection from fracture has been suggested. In the present case, the projection was considered minimal and did not cause any occlusal interference but can act as a potential plaque retentive area. Thus, the decision to fissure seal the structure was made. All of the affected teeth are still vital and free from symptoms.

Although the prevalence of impacted canines is only about 0.8–5.2%, the fact that about 61% of these teeth are impacted palatally indicates that it will take a longer time, effort, and expense to retrieve the tooth and subsequently align it.[3,4] Hence, early diagnosis and any interceptive procedure that could provide early intervention would be beneficial for the patient. Successful early orthodontic intervention would reduce the treatment complexity and possibly avoid any surgical procedure, which in turn minimizes the cost and time of treatment.

Clinical and radiographic examinations should be carried out to diagnose an impacted canine tooth. Clinically, palpation at the buccal surface of the alveolar process distal to the lateral incisor should be carried out from 8 years of age; however, lack of positive palpation is only considered abnormal at the age of 10 years plus.[5] The clinician should inspect for gross soft tissue pathology, scars, swellings, and fibrous or dense frenal attachments. Careful observation and palpation of the alveolar ridges buccally and lingually usually show the characteristic bulge of a tooth in the process of eruption. Palpation-producing pain, crackling, or other symptoms should be further evaluated for pathology.[2] At age 10 and above, a radiographic examination may be necessary when the canines cannot be palpated in the normal position or when the lateral incisor is late erupting or shows a pronounced buccal displacement or proclination. Radiographic examination is also needed where there is asymmetry on palpation or a difference in the eruption of canines between the left and right side is noted.[12] Using the parallax technique principle, two radiographs are often taken to localize the site of an impacted canine.[3] In our case, even though the tooth was palpable when the patient was 11 years old, the patient was deemed for a radiographic examination due to a discrepancy in the eruption of the canine between the right and left side. We used a vertical parallax technique where we took an OPG and an IOPA radiograph to assess the location of the impacted tooth. Based on these two radiographs, the canine was impacted in line with the maxillary arch.

Radiographs also allow us to determine if the tooth is in a favorable position for spontaneous eruption using interceptive management. This is based on the assessment of the canine position.[12] Four aspects of the canine position should be assessed—(1) amount of canine crown horizontally overlaps with the adjacent incisor, (2) the vertical height of the canine crown, (3) the canine angulation to the midline, and (4) position of the canine root apex in the horizontal plane. The prognosis of these four factors is shown in

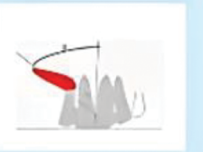
Category	Good prognosis	Average	Poor
Overlap of incisor	No horizontal overlap 	Up to half root width 	Complete overlap 
Vertical height	CEJ–halfway up root 	>half <full root length 	>full root length 
Angulation	0–15° 	16–30° 	>30° 
Position of apex	Above canine position 	Above 1st premolar 	Above 2nd premolar 

Fig. 6: Prognosis of realignment depending on assessment of various categories. Green, good prognosis; red, poor prognosis; yellow, average prognosis[8]

Figure 6. In the present case, the crown of the impacted left canine had no horizontal overlap with the neighboring lateral incisor, the crown was at the cervical third of the lateral incisor root, the tooth was angulated at 0°, and the position of the apex of the impacted canine was above the canine position. Based on all four criteria, the impacted canine was regarded to be in a favorable position for a spontaneous eruption with arch expansion.

We carried out a space analysis for mixed dentition. In this case, we used the Tanaka and Johnston equation method to predict the space needed.[7] This method of space analysis is known to be the quickest and easiest method available.[13] The mesiodistal width of the four lower incisors was measured using a caliper and then divided in two. To predict the widths of canine and premolars in the maxilla, this value is added by 11 mm.[7] The mesiodistal width of the lower incisor for this patient was 24 mm. By using this equation, we needed a space of 23 mm (24/2 + 11 mm). However, the space available from canine to second premolar on the left side was only 21 mm, suggesting an arch length discrepancy of 2 mm on the left side.

Once we completed the clinical and radiographic examination and space analysis, we planned out the treatment plan for the patient. A few treatment modalities are available for the management of impacted canines. Among those are no active treatments where we leave the tooth *in situ* and monitor annually radiographically for any cyst formation, interceptive treatment, surgical exposure and orthodontic alignment, and lastly, extraction of the tooth.[6] Since the impacted canine was in a favorable position and the problem was arch length discrepancy, both parents and patient agreed to an interceptive treatment of maxillary expansion. Maxillary expansion can be done for cases of skeletal problems of the upper jaw.[14] It opens the palatal suture to increase the transverse width of the maxilla.[15] Maxillary expansion can be achieved by means of different expansion rates and forces. There is either SME or rapid maxillary expansion (RME). Both SME and RME have shown a significant increase in the short-term maxillary dentoalveolar transversal dimensions.[11] However, patients treated with SME reported lower levels of pain and discomfort, fewer chewing and swallowing difficulties, and less pressure on soft tissues than those treated with RME.[16] Due to the patient's previous history of extraction under physical restraint, we opted for SME to gain the patient's cooperation. Treatment time took about 10 months for the tooth to erupt in position, and the patient was fully compliant throughout the treatment.

With the weekly quarter-turn expansion of the expansion screw, we managed to gain 2.5 mm of space, sufficient for the spontaneous eruption of the impacted tooth 23 in 10 months. In the event that expansion was not done, the tooth might have erupted buccally in an ectopic position, necessitating fixed orthodontic treatment later on, or if the tooth did not erupt, the patient may require surgical and orthodontic treatment of expose and bond followed

by tracking down the tooth. Combined surgical and orthodontic therapy requires longer treatment time, and it involves greater complications such as ankylosis, root resorption, bone loss, and periodontal issues.[17]

Conclusion

Due to the high plasticity of bone structures in a growing child, interceptive orthodontic treatment using removable appliances works well. The impacted canine has erupted in place after 10 months of using URA with an expansion screw. No surgical nor fixed orthodontic treatment was required for this patient.

Clinical Significance

Tooth impaction, especially at the anterior region, is esthetically compromising. Early detection of impacted teeth in a growing child is important so that we can intervene in the problem at an earlier stage to avoid further complications.

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