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Case Report

Successful treatment of an impacted maxillary canine using closed surgical exposure: A case report

Perla Tazi[1]*

[1]*Private Practitioner, North Holland, Netherlands*

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ABSTRACT

Impaction of a maxillary canine is a common tooth transposition, being the second most frequently impacted tooth after third molars. Management of such cases typically require a multidisciplinary approach, combining surgery with orthodontics. Presented is a case involving a 12-year 7-month-old male patient with an impacted right maxillary canine, premature loss of the second deciduous right maxillary molar, and hypoplasia of the maxilla. Treatment included extraction of the premolars with surgical exposure and subsequent guided eruption of the impacted canine into the tooth arch.

1. Introduction

Impaction of a maxillary canine is a relatively common tooth transposition, ranking as the second most impacted tooth, with a prevalence ranging from 0.8 to 5.3%.[1] Canine impaction occurs twice as frequently in females than in males and twice as often in the maxilla compared to the mandible. Approximately one third of impacted maxillary canines are located labially or within the alveolus, and two-thirds are positioned palatally.[2]

Usually, the etiology behind canine impaction is localized and often multifactorial.[3] The predominant localized causes are tooth size-arche discrepancies, prolonged retention or early loss of the deciduous canine, abnormal position of the tooth bud, the presence of an alveolar cleft, ankylosis, cystic or neoplastic formation, dilaceration of the root, iatrogenic origin, trauma to the early mixed dentition, and idiopathic conditions. Generalized causes include endocrine deficiencies, febrile disease, and irradiation. Patients affected by impacted canines, especially combined with maxillary hypoplasia, present a challenge, often requiring a multidisciplinary approach, combining oral surgery and orthodontics.

2. Informed Consent

Informed consent has been obtained. The patient as well as their parent are well-informed about the usage of their medical and dental details and have given their permission to publish this information.

3. History

A 12-year 7-month-old caucasian male patient, presented with the request for regular orthodontic treatment in Amsterdam, The Netherlands. The patient's medical history revealed no noteworthy conditions and there is no medication usage. Furthermore, no family history of dental impactions is known and the patient and parents did not have any recollection of dental trauma. It's important to note that the patient exhibited suboptimal oral hygiene during the assessment.

* *Corresponding author*.
E-mail address: perla.tazi@hotmail.com (P. Tazi).

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4. Assessment

4.1. Extra-oral

The patient demonstrated a mildly concave facial profile characterized by a skeletal class I to class III tendency. Furthermore, a constriction of the premaxilla was identified, enhancing the anterior crossbite. This anatomical observation was shared by the patient's father, who also exhibited a facial deformity in the lower third of the face.

Additionally, a protrusion of the lower lip was noted, accompanied by a negative lip relation. A line drawn from the pronasal to the pogonion point is tangent to the upper lip, while intersecting the lower lip. Notably, the nasolabial angle does not show any abnormalities.

4.2. Intra-oral

The intra-oral examination revealed a retained deciduous upper right canine (tooth 53) and teeth 13, 23, 43, and 33 remained unerupted, due to lack of space within the tooth arches. A left $\frac{1}{4}$ cusp class II and right $\frac{3}{4}$ cusp class II malocclusion was noted as well, caused by the premature loss of tooth 55 due to decay. An anterior crossbite was seen, with teeth 31 and 41 positioned buccally to teeth 21 and 11, respectively. Other characteristics include a negative overjet of 2 mm and an overbite of nearly 4 mm. Severe crowding in the lower arch and diastemas in the upper arch were apparent. These temporary diastemas are likely the result of the pressure exerted by the canine crowns on the apexes of the lateral incisors. An upper midline deviation of 1.5 mm towards the right with respect to the lower midline was seen. Teeth 12 and 22 exhibited distobuccal rotation, and tooth 34 displayed mesiobuccal rotation. Periodontal biotype and bone morphology showed no abnormalities (Figure 1).

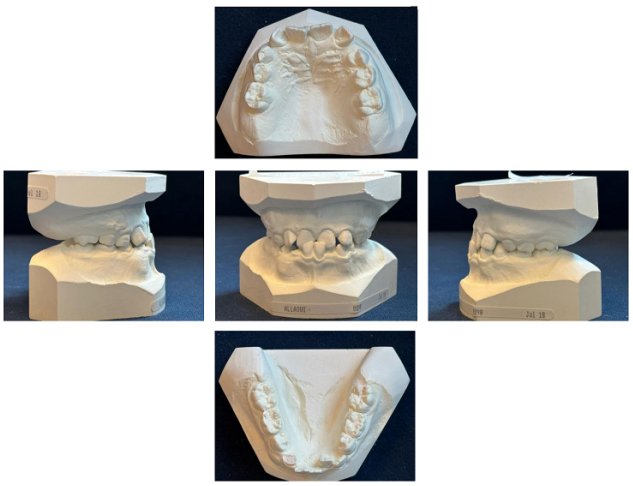

Figure 1: Initial case study models Note: These case models were made at time of orthodontic assessment

5. Radiographic

The initial panoramic radiograph had been taken 1 year prior, due to financial reasoning this was not remade at time of the intra-oral inspection. The radiograph disclosed the presence of all permanent teeth and revealed calcifications of all four third molars (Figure 2). The roots of the second premolars were formed for two-thirds.

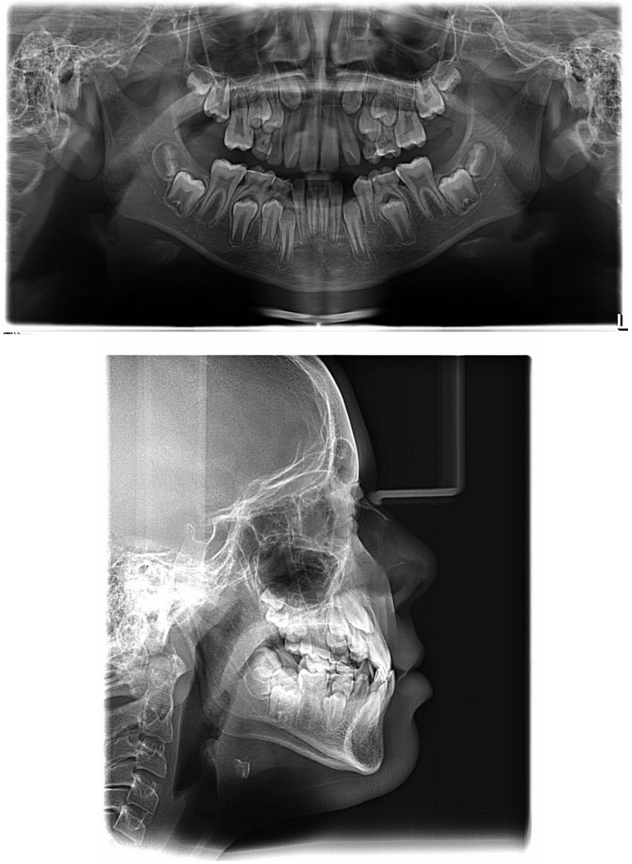

Figure 2: Initial panoramic radiograph and lateral cephalograph Note: These radiographs were made 1 year prior to orthodontic assessment

No signs of infections, bone defects, or other pathologies were apparent. An impaction of the maxillary right canine was noticeable, with the crown of the 13 positioned centrally in relation to the apex of the tooth 12. The crown of tooth 23 is positioned laterally in relation to the apex of tooth 22. Due to the positioning of the upper canines, a distoversion of teeth 12 and 22 was evident.

The lateral radiograph unveiled a skeletal class I relation, with a tendency to class III (Figure 2). A hyperdivergent grow pattern was seen, attributed to maxillary hypoplasia. A protrusion of the lower lip is visible here as well. Furthermore, minor retrusion of the upper incisors was noted, due to the more vestibularly positioned lower incisors. These lower incisors maintained a normal inclination with respect to the mandible.

6. Treatment

6.1. Aim

The primary aim of the treatment was to achieve a class I occlusion, to advance the eruption of the premolars and canines, and to correct the anterior crossbite. The secondary aim was to correct crowding in both arches, to correct the midline deviation, and to close the diastemas of the upper anterior teeth.

6.2. Treatment plan

The proposed course of action involved conventional fixed multibracket treatment for both the upper and lower jaws, with bands on the first molars. Furthermore, the treatment plan entailed removal of teeth 14, 24, 34, and 45. Removal of tooth 45 was deemed more appropriate than the removal of tooth 44, primarily to improve the correction of the asymmetrical occlusion discrepancy between the right and left sides. This asymmetry most likely arose from the premature loss of tooth 55. Additionally, tooth 53 would be removed to facilitate the advancement of the eruption of tooth 13. The progression of the eruption trajectory of tooth 13 will be carefully monitored, with a potential surgical exposure and bonding procedure planned if necessary. Upon achieving the desired result, fixed retainers will be applied.

6.3. Treatment progress

Due to the patient's personal circumstances and insurance matters, the treatment began 1 year later. Fixed appliances in both the upper and lower jaws were placed, with brackets bonded on all teeth except tooth 53, accompanied by bands on the first molars. The alignment was initiated with a 012 NiTi wire. After 1 month, extractions of teeth 14, 24, 34, 45, and 53 were performed. After 7.5 months, tooth 23 was in the process of erupting into the tooth arch. A new panoramic radiograph (Figure 3) unveiled the impaction of tooth 13 due to the position of the root of tooth 12. Considerable resorption of the root of tooth 12 was observed, as a result of the central position of tooth 13 with respect to tooth 12.

It was decided, based on the new panoramic radiograph, that tooth 13 had no chance of spontaneous eruption. Tooth 13 was then surgically exposed utilizing a mucosal L flap and by removing a small amount of buccal cortical bone that covered the canine (Figure 4).

Bleeding was reduced by applying a hemostatic paste. The surface of the tooth was etched with 35% fosforic acid and a bracket was then securely bonded to the buccal surface, followed by the attachment of a steel ligature to the bracket. This steel ligature was subsequently attached to a second (016) NiTi wire, intended to facilitate vertical and caudal traction, while refraining from exerting any secondary forces on the primary wire. The second wire was then freely ligated, extending from the brackets of teeth 12-11 in a mesial direction and 15-16 in a distal direction. This configuration enabled a sliding movement along the main wire, whilst allowing the canine to move towards the occlusal plane. This approach is crucial to prevent tipping of teeth 12 and 15 towards the space designated for the canine, a scenario that could obstruct the planned movement. A closed eruption technique was selected, suturing the surgical wound using five stitches.

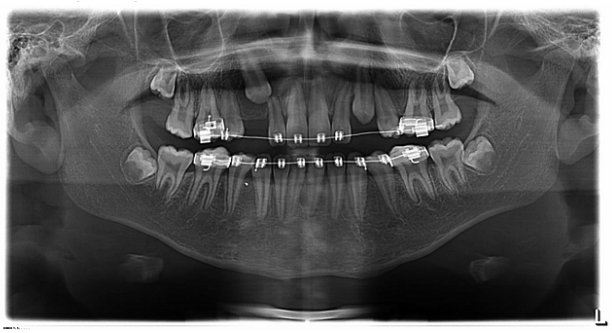

Figure 3: Panoramic radiograph during treatment Note: This panoramic radiograph was made 7.5 months after commencement of orthodontic treatment

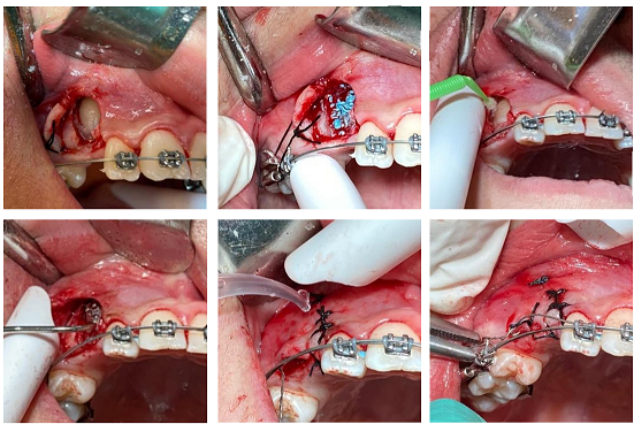

Figure 4: Surgical exposure procedure of the impacted canine Note: These clinical photos show the 1: Mucosal L Flap, 2: Application of a hemostatic paste; 3: Etch and bonding procedure; 4: Placement of the bracket; 5: Rinsing with chlorexidine 0.2%; 6: Attachment of the ligature to the secondary arch wire

During the surgery, continuous rinsing with Chlorexidine 0.2% was performed, and the patient was instructed to rinse twice daily for a span of seven days post-surgery as well.

One month later, well healed soft tissue was observed. After 3 months, tooth 13 had begun erupting and the bonding procedure was repeated. Subsequently after 1 month, tooth 13 achieved complete eruption and was then successfully incorporated into the straight wire configuration. Tooth 23 completed its eruption as well and underwent the bonding process. Four months thereafter, tooth 13 attained full occlusion and only tooth 41 still

exhibited a slight degree of rotation. Due to personal circumstances affecting the patient, a return visit took place after 4.5 months. During this visit, the fixed appliances in both the upper and lower jaws were removed and fixed retainers were applied. Total active treatment time was 2 years and 2 months.

7. Result

The anterior crossbite was corrected, as evidenced in Figures 5 and 6. Majority of the crowding in the lower jaw was corrected and the diastemas in the upper jaw were effectively closed. Tooth 13 was successfully guided into its designated position within the tooth arch, coming into a full occlusion. Furthermore, the midline deviation was corrected. A class I occlusion was achieved in both the molar and canine regions, signifying the accomplishment of the intended treatment objectives.

Figure 5: Post-treatment case study model Note: These case models were made after debonding and application of fixed retainers

The panoramic radiograph showed parallel and evenly spread roots (Figure 7). The lip relation has also been restored.

8. Discussion

Due to the apical positioning of the canine crown in relation to the mucogingival junction, a closed eruption technique was selected, as recommended by research (Kokich, 2004).[4] This exposure technique may lead to an adequate gingiva contour after treatment.[5] Research has shown that the closed eruption technique often leads to more favorable esthetic results when compared to the apically positioned flap procedure, as the teeth exposed with the closed technique exhibit similar crown lengths as the contralateral nonimpacted teeth.[6] However, when looking at the final clinical photos, a gingival recession of 2 mm of tooth 13

Figure 6: Post-treatment clinical photos Note: These clinical photos were made after debonding and application of fixed retainers

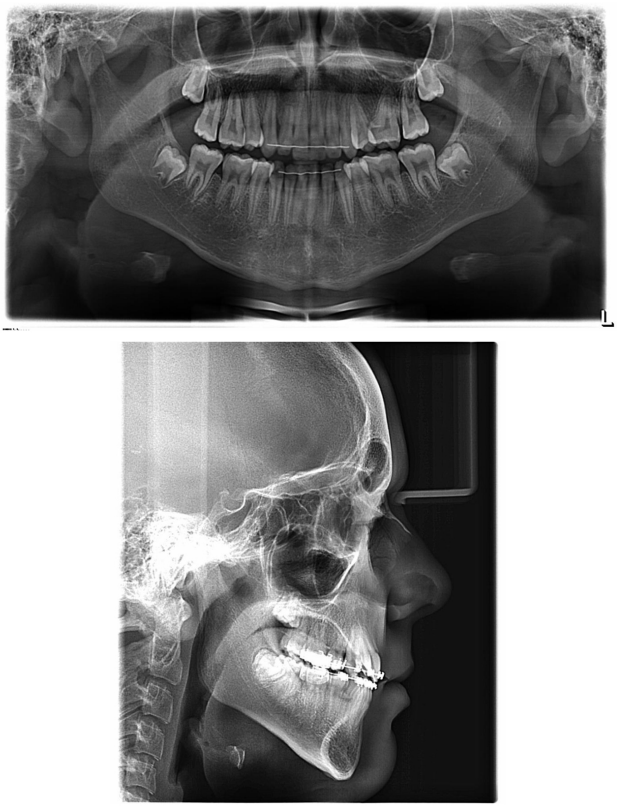

Figure 7: Post-treatment panoramic radiograph and lateral cephalograph

can be observed. The research of Lee et al. (2018) found that orthodontically treated impacted maxillary canines showed significantly more crown length when compared to the contralateral canines in the same mouth. Additionally, a higher development of the roots and mesially angulated deeply impacted maxillary canines may negatively influence the periodontal conditions.[7]

The post-treatment panoramic radiograph reveals bone resorption mesial to tooth 13. This could most likely be attributed to the physiological process of apposition and resorption, a phenomenon associated with orthodontic movement. Research has found that there is significantly less bone support with impacted canines compared to the contralateral nonimpacted canines (Lee et al., 2018). The bone level should be monitored through periodontal exams and periodic x-rays.[7]

In addition, considerable resorption of the root of tooth 12 is exhibited on the OPT during treatment as well as on the final OPT. Research has found that resorption of the root of the lateral incisor adjacent to the ectopically erupting canine occurred in 38% of patients with impacted maxillary canines (Ericson & Kurol, 2000).[8] Among these resorptions, 9% were moderate and 60% were severe with pulp involvement. The etiology of lateral incisor root resorption remains unclear; However, early intervention in case of tooth impaction is crucial to prevent any untreatable pathology.[9] Due to the patient seeking orthodontic treatment at almost 13 years old, interceptive treatment was not indicated anymore. Ericson and Kurol (1988) found that predisposing factors to resorption of lateral incisors adjacent to ectopic eruption of maxillary canines include a well-developed canine root, a canine cusp position medially to the midline of the lateral incisor, and the canine being in a mesial angle of eruption exceeding 25 degrees.[10] Ongoing monitoring is planned, and at time of writing this case report, the tooth remains responding vital.

Furthermore, there exists a slight residual crowding of the lower incisors, partly attributed to the lack of space resulting from maxillary hypoplasia and the correction of the anterior crossbite. IPR of the lower incisors would have been an option to create some space in order to correct the residual crowding.

Additionally, mesial tipping of tooth 15 and distal tipping of tooth 25 is seen, resulting in incomplete occlusion of both premolars. Tipping of the premolars could have been avoided by obtaining a panoramic radiograph prior to removal of the appliance and by prolonging the treatment to facilitate their uprighting. However, the patient's insurance and the budget were not allowing any extra expenses and these factors should be taken into consideration while treating a patient. Compliance with honoring scheduled appointments and with maintaining oral hygiene were also factors that needed to be considered while treating this patient.

An alternative to this treatment was considered, being the placement TADs in the upper jaw in order to distalize the upper first molars and premolars. This strategy would have aimed to create space and to avoid extraction of the premolars. However, this treatment strategy may have extended the treatment time, possibly increasing the risk of more root resorption of the right upper lateral incisor. In addition, the placing of TADs was not indicated with this specific patient, due to their suboptimal compliance in oral hygiene. The decision to extract the premolars was made to create immediate distal space for the eruption of the canine, facilitating the possibility of spontaneous movement without the need of surgical exposure. In this case, surgical exposure ultimately became imperative as the canine failed to erupt spontaneously.

9. Conclusion

In conclusion, the primary aims of this treatment have been realized, being achieving a class I occlusion, advancing the eruption of the canine, and correcting the anterior crossbite. When coming across a patient that shows predisposing factors of an impacted canine, interceptive treatment is ultimately recommended. However, in cases where this is not possible, exposure will most probably be necessary to guide the tooth to the correct position. It is imperative to select the right exposure technique, based on the clinical situation, to achieve the best gingival results. Furthermore, the physician should be aware of possible root resorption of the adjacent lateral incisor and bone loss around the canine, and this should be carefully monitored throughout treatment.

10. Source of Funding

None.

11. Conflict of Interest

None.

12. Acknowledgement

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Author biography

Perla Tazi, Orthodontics https://orcid.org/0009-0000-6346-111X

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