ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 9, Issue – 4, July – 2026, Page No. : 90 – 97

Disimpacting Palatally Positioned Canine with Asymmetrical Extraction: A Case Report

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Citation of this Article: Dr. Amit Maheshwari, Dr. Shrushti Dhuldhar, Dr. Suyash Patil, "Disimpacting Palatally Positioned Canine with Asymmetrical Extraction: A Case Report", IJDSIR – July – 2026, Volume – 9, Issue – 4, P. No. 90 – 97.

Type of Publication: Case Report

Conflicts of Interest: Nil

Abstract

This case report describes the treatment of a 15-year-old boy who had palatally impacted maxillary left canine demanding complex biomechanics for orthodontic traction of the tooth in the arch. The impacted canine possessed both functional and aesthetic challenges requiring early diagnosis and intervention. The case report presents the management of a palatally impacted maxillary canine using a mini-implant for uprighting and a ballista spring for a controlled and efficient traction of tooth. The case highlights the ballista spring as a simple and efficient auxiliary for management of palatally impacted maxillary canines.

Keywords: Canine impaction, Ballista spring, Infrazygomatic implant, Distalization, Asymmetric extraction

Introduction

Maxillary canines occupy a strategic position within the dental arch and contribute significantly to esthetics, function, and occlusal stability. Canine plays a prominent role in the dental arch due to its location in a transition zone between the anterior and posterior teeth.[1]

From an esthetic perspective, maxillary canines influence the harmony of the smile arc, buccal corridor width, and anterior dental symmetry. Their characteristic crown morphology, light-reflecting properties, and prominence at the canine eminence contribute to facial and dental esthetics and thus are referred to as corner stones.

Beside esthetic concern, owing to their long root length and robust periodontal support, canines play a key role in maintaining arch form and transferring occlusal loads during mastication. Their position at the corner of the dental arch allows them to guide mandibular movements

and facilitate canine guidance during lateral excursions, thereby reducing load on the posterior dentition and protecting temporomandibular structures.[2]

According to the literature and studies till date, permanent maxillary canine is reported to be the 2nd most frequently impacted teeth after the 3rd molar with the incidence rate of 0.8% to 3.5%.

Amongst the impacted maxillary canine, the prevalence of palatal impaction is more in comparison to labial. The etiological factors for the palatal impaction of maxillary canine are multiple including genetic, environmental and local mechanical influences. According to *Adrian Becker*, the most common cause for the impaction of maxillary canine is usually localised and are combination of many factors such as- tooth size arch length discrepancy, prolonged retention of deciduous canine and not to forget the abnormal path of eruption of tooth. [3,4]

The impaction of maxillary canines presents with adverse sequelae such as root resorption of adjacent incisor, loss of the arch symmetry, midline deviations, cystic changes and many more including compromised dental and facial esthetics.[5]

Treatment of palatally impacted canines typically involves surgical exposure followed by controlled orthodontic traction to guide the tooth into the dental arch. The biomechanics of canine traction can be complex, as vertical, labial, and rotational components must be coordinated while minimizing undesirable reciprocal forces.[6]

In the past few years, several auxiliaries including piggyback wires, cantilevers, power chains, TAD-supported traction, and various spring designs have been reported to be successful in traction of impacted maxillary canine.

Amongst these auxiliaries, a spring introduced by Jacoby.i.e., Ballista Spring is the most recognized method for delivering light continuous force to the canine for its movement both labial and extrusive in the initial phase of eruption. Many a times the palatally impacted canine presents with a unfavourable position and poor prognosis for orthodontic traction. Such cases demands complex biomechanics for their traction & eruption in the arch with proper levelling and alignment as the canine demands 3-dimensional positional correction.[7]

This case report presents successful management of unilateral palatally impacted maxillary canine with TAD-supported uprighting followed by orthodontic traction with Ballista spring to achieve successful alignment of the impacted canine while maintaining the arch symmetry and anchorage control and also correcting the loss of arch length via unilateral distalization with an IZC implant that has occurred as an adverse sequel of impacted canine.

Case Report

A 15-year-old boy reported the Department of Orthodontics and Dentofacial Orthopaedics at ACPM Dental college, Dhule with the chief complaint of missing teeth in the upper front region of jaw. On extraoral examination, the patient exhibited a convex profile with competent lips. Intraorally, the patient had Class II (end on) molar relationship bilaterally and class II canine relationship on right side with over-retained deciduous maxillary left canine, minimal mandibular crowding and anterior deep bite. With respect to the the facial midline, the upper dental midline was deviated to left by 1.5mm.(fig.1)

Figure 1: Pretreatment intraoral and extraoral photographs

The panoramic radiograph depicted impaction of maxillary left canine, mesially inclined towards midline with average angulation of over 45 degrees. The canine tip was lying approximately between the mesial aspect of lateral incisor and long axis of central incisor i.e., Sector IV canine impaction as per Erickson & Kurol. (FIG.2A)

On CBCT evaluation, the coronal section of CBCT image showed that the canine is obliquely placed and extends from the second premolar to the central incisor whereas the sagittal section showed the location of cusp tip of canine palatal to the root of central incisor and the canine is seen to be inclined 30 degrees to the occlusal plane i.e., Class II impaction as per Archer's classification. (fig.2B)

Table 1: Pre-treatment and post-treatment cephalometric values

Parameters	Pre-treatment	Post-treatment
SNA	82^0	82^0
SNB	77^0	78^0
FACIAL ANGLE	83^0	81^0
ANB	5^0	4^0
Y AXIS	65^0	64^0
SN-GO-GN	25^0	31^0
OCCLUSAL PLANE TO SN ANGLE	15^0	16^0
INTERINCISAL ANGLE	130^0	120^0
NASOLABIAL ANGLE	104^0	110^0
UPPER INCISOR TO NA	22^0	24^0
LOWER INCISOR TO NB	25^0	31^0
UPPER INCISOR TO SN ANGLE	98^0	107^0
LOWER INCISOR TO MANDIBULAR PLANE	104^0	104^0
E LINE UPPER LIP	+2mm	+2mm
E LINE LOWER LIP	+3mm	+2mm

The lateral cephalogram analysis and readings showed a class I skeletal pattern with orthognathic position of both maxilla &mandible.

The values being SNA-82 degrees and SNB-77 degrees respectively and average horizontal growth pattern. (fig.2.C & table1)

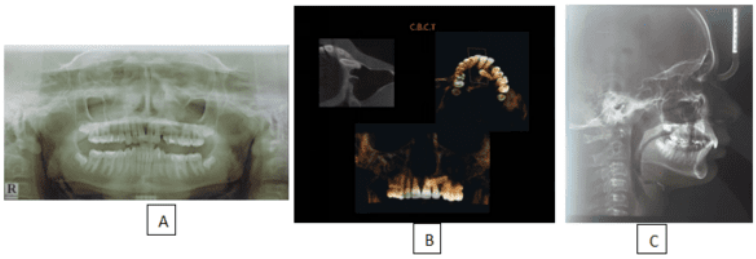

Figure 2: Pretreatment radiographs. A.OPG; B. Maxillary arch CBCT; C. Lateral cephalogram

A. Etiology & Diagnosis

According to *Adrian Becker*, the most common cause for canine impactions is usually localized and are the result of any one or a combination of many factors.

In the above case, the etiological factors for impaction of canine can be as listed below-

- Tooth size arch length discrepancy.
- Prolonged retention of deciduous maxillary left canine.
- Abnormal path of eruption of maxillary left permanent canine.

The case was diagnosed as-

- Skeletal class I with average horizontal growth pattern.
- Class II molar (end on) relationship bilaterally with palatally impacted maxillary left canine & anterior deep bite.

B. Treatment Objectives

- Proper levelling & alignment of the teeth in both maxillary and mandibular arch.
- Bringing the impacted canine to a proper alignment in the arch.
- Achieving class I canine bilaterally.
- Ideal overjet & overbite.
- Coincident midlines.
- A concordant smile, as well as optimal facial esthetics and balance were desired.

C. Treatment Plan

Due to unfavourable position and critical prognosis of impacted canine, it was planned to initially upright the canine with a palatally placed TAD and further orthodontic traction with a BALLISTA spring.

Due to arch length discrepancy in the maxillary arch and insufficient space for orthodontic traction & positioning of maxillary left canine in the arch, it was planned to extract the maxillary left permanent 1st premolar. In order to achieve a full cusp class I molar relationship on right side along with class I canine relationship and to address the shifted maxillary midline on left side, unilateral distalization was planned in the first quadrant with an IZC implant.

D. Treatment Progress

Initially both the upper and lower arch were bonded with 0.022*0.028 MBT brackets and a wire sequence of 0.014 niti, 0.016 niti, 0.017*0.025-inch niti wires and finally 0.019*0.025-inch SS wire was followed.

Along with levelling and alignment the palatally impacted maxillary left canine was exposed surgically. A palatal TAD (1.5*9mm) was placed between the 2nd premolar and 1st molar. Following this, a button was bonded on the palatal surface of exposed canine and traction was applied to it from the palatal tad with a echain for uprighting.(fig.3A)

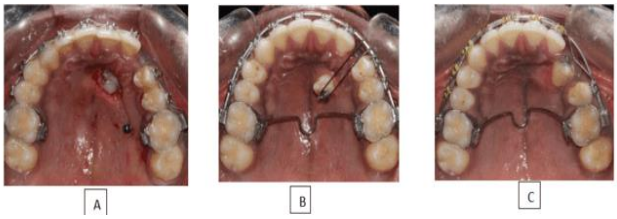

Figure 3: Canine traction progress A. Surgical exposure of palatally impacted maxillary left canine followed by traction with a palatal mini-implant; B. Incorporation of Ballista spring for canine traction; C. Piggy back technique for canine traction.

After a period of 6 weeks, when subsequent canine uprighting was achieved, Ballista spring was employed for further canine traction. The ballista spring was constructed using 0.016 round Australian Wilcock wire, was twisted and hooked onto the impacted canine. (fig.3B)

After a period of 4.5 months, when both buccal and extrusive movement of the canine was achieved with a ballista spring to an extent, the ballista spring was removed and piggy was employed with the 0.019*0.025-inch SS wire in place in maxillary arch and an overlay 0.014-inch niti archwire. During this phase, due to the arch length discrepancy and insufficient space for maxillary left canine in the arch, therapeutic extraction with the maxillary left 1st premolar was undergone. (fig.3C)

Subsequently, an IZC implant(2*12mm) was placed in the maxillary right quadrant and unilateral distalization was started. (fig.4) After a period of 4 months, both an optimal position of canine in the arch and distalization in the maxillary right quadrant were achieved. Remaining spaces in the maxillary left quadrant were closed and class I molar relation on the right side and class II molar relation on left side with class I canine relationship bilaterally was achieved. Further the patient was shifted to settling and finishing stage(fig.5). After a period of settling the case was debonded and fixed lingual retainer placed in the maxillary arch along with essix retainer.

Figure 4: Adeqaute positioning of the maxillary left canine and unilateral distalization on the maxillary right side with an IZC implant

Figure 5: Settling elastics over 0.014 niti archwires in both maxillary & mandibular arch

E. Treatment Results

At the end of the treatment the arches were well aligned and coordinated with the proper alignment of impacted maxillary left canine in the arch, and adequate overjet and overbite. The maxillary and mandibular midlines were coincident with each other and also facial midline and the patient had a concordant smile. (fig6.)

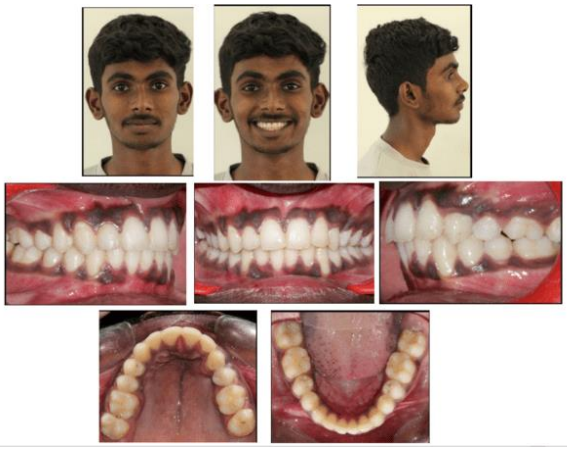

Figure 6: Post treatment extraoral & intraoral photographs

The OPG depicted adequate root parallelism with no signs of resorption and the lateral cephalogram depicted a good profile maintenance (fig.7A & 7B)

Figure 7: Post treatment radiographs. A.OPG; B. Lateral Cephalogram

Discussion

As the incidence of maxillary canine impaction ranges from 0.8-3.5, the exact etiology still remains ambiguous.[8] Although several factors have been stated to be a potential cause, the long eruptive course and the increased duration of its development remains the most significant factor[9]. In our present case long, standing deciduous canine plays a major role in aetiology for palatal impaction of the canine.

The uneruption or impaction of tooth especially in the anterior region affects the esthetics and function to a major extent and such cases demand prime alignment of the tooth in the arch.[10]

In past literature, many treatments options have been presented for the successful orthodontic traction of impacted canines, but our case of palatal impaction was a sector IV impaction according to Erickson & Kurol and was difficult to treat maintaining the periodontal conditions.[11] The impactions of canine depending upon their severity and difficulty index demands for surgical intervention followed by orthodontic traction.

In our case, as the Archers [12] classification according to CBCT view presented Class II canine impaction, the palatal impaction of canine presented a challenging orthodontic scenario requiring complex biomechanics. Therefore, integrating biomechanics smartly in our case, we planned initial uprighting of the canine assisted by mini-implant followed by orthodontic traction with a Ballista spring. Due to the unfavourable position of canine, a palatal mini-implant was employed to enhance anchorage. This advanced anchorage mechanism allowed for precise uprighting of canine. The article by Park et al describes the potential of micro-implant anchoring in the uprighting of teeth orthodontically [13]. Further the use of Ballista Spring, introduced by Jacoby[7] in 1979, provided a conservative and controlled method for vertical and buccal traction of impacted canine. The ballista spring presents an advantage of being used before and also after levelling and aligning the arches. The ballista spring was constructed with a 0.016'' round Australian Wilcock wire. The spring acts by storing its energy when twisted along the long axis. Thus, the spring helped in both buccal and vertical traction of the palatally impacted canine.

As the canine was being tractioned into the arch, an arch length discrepancy was evident and thus therapeutic extraction of the maxillary left first premolar was planned. According to the past literature, therapeutic extractions in order to create adequate space for the impacted teeth, is a firmly set protocol for management of impacted canines.[14] In order to correct upper dental midline deviation, unilateral distalization was attempted in the maxillary right quadrant, successfully achieving a full cusp class I molar and Class I canine relationship on the right side with coincident maxillary and mandibular dental midline. A recent study evaluating the efficiency of infrazygomatic crest screws, proved the IZC screws to be effectively used as an absolute anchorage for distalization.[15]

A study by Erickson & Kurol on incisor resorption caused by cuspid impaction presented that long standing impaction of canine presented incisor root resorption in

many patients, thus demanding early diagnosis and intervention.[16]

The permanent canine is of atmost importance in two perspectives- one for the esthetic reasons and the other being a functional occlusion, and thus is also named as- Corner stone of the dentition. The canine not only balances an esthetic smile but also helps prevent the collapse of arch by maintaining the intercanine width. Post-treatment although the case ended up in class II subdivision, class I canine relationship was achieved bilaterally thus guiding functional occlusion and also a balanced concordant smile was attained.

Conclusion

The esthetic and functional importance of the canine demands early diagnosis and intervention in order to achieve optimal position of the canine in the arch. The treatment when planned individually for a patient according to the needs combining various orthodontic biomechanics helps achieving successful treatment results in a complex challenging orthodontic case scenario.

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