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Ballista Spring - A Conservative Method for Repositioning Palatally Impacted Canine - Clinical Case Report

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Abstract

Maxillary canine impaction is one of the most frequently encountered condition in orthodontic practice. Many factors are responsible for the development of canine impaction. Early diagnosis and interception can provide prudent clinical management of impacted canine with minimal or no iatrogenic effects. The Ballista spring system is a simple, less traumatic system for treating impacted canines. The impacted teeth is retracted by a spring that accumulates light continuous force from being twisted on its long axis. This article illustrates a case in which impacted maxillary canine was surgically exposed, attachment bonded, vertical and labial traction given with Ballista spring and ideally positioned with fixed orthodontic mechanotherapy.

Keywords: Cuspid, Impaction, Ballista Spring

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Introduction

Maxillary canine impaction is the most prevalent form of tooth impaction next to third molars. Hard tissue bodies, soft tissue lesions, and developing pathologic entities that alter the environment of the unerupted maxillary canine may cause the tooth to become impacted, whereas its removal frequently results in partial or complete resolution. Creating space via anteroposterior or lateral expansion, tooth extraction, and premolar or incisor root uprighting, on the other hand, is helpful in positively reversing the eruption course of an errant canine. Creating space via anteroposterior or lateral expansion, tooth extraction, and premolar or incisor root uprighting, on the other hand, is helpful in positively reversing the eruption course of an errant canine.[1]

The incidence of maxillary canine impaction reported by Dachi and Howell is 0.92%.[2] According to Thilander and Myrberg, the cumulative prevalence of canine impaction in 7-13 years old children to be 2.2%.[3] Impactions are twice more prevalent in females(1.17%) than in males (0.51%).[4] Of all patients with maxillary canine impaction, it is estimated that 8%have bilateral impactions. The incidence of mandibular canine impaction is 0.35%.[2]

Dewel stated thatmaxillary canines have the longest period of development as well as longest and more tortuous course to travel from its developmental site, lateral to pirifom fossa, to reach their final functional position.[5] The etiology of maxillary canine impaction may be either generalized or localized. Generalized causes include endocrine deficiencies, febrile illness and irradiation. The most common causes for canine impaction are localized factors such as arch length-tooth size 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, idiopathic condition with no apparent cause.[6]

The maxillary lateral incisor guides the mesially erupting canine in a more favorable distal and incisal direction. The absence of maxillary lateral incisor, variation in the root size of the tooth, variation in the timing of root formation have been implicated as an important etiologic factors associated with canine impaction. Becker *et al*., reported an increase of 2.4 times in the incidence of palatally impacted canines adjacent to missing lateral incisor as compared with general population.[7]

Early diagnosis and timely interception provide conservative clinical management of impacted canine with minimal or no side effects. The proper localization of the impacted canine plays a crucial role in determining the feasibility as well as proper access for surgical approach and proper direction for the application of orthodontic forces. Of all the radiographic techniques and analysis, cone beam computed tomography imaging technique gives us a clear and precise position of palatally impacted canine in both linear and angular positions.[8]

Two most commonly used methods for exposing impacted canines are surgical exposure allowing natural eruption and surgical exposure with placement of an auxiliary attachment. Several methods are used for applying traction to the impacted canine which includes elastic traction, lasso wires, Kilroy spring by Bowmanand Carano, K9 spring by Kalra, Australian helical archwire by Christine Hausen, active palatal arch by Becker, Ballista spring by Jacoby.

Spring Design

Ballista spring exerts a light continuous force from being twisted on its long axis. The ballista spring is a 0.014, 0.016, 0.018 inch round AJ wilcock wire. The spring has horizontal and vertical parts. The horizontal part of the wire accumulates the energy. This part of

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the wire is attached by ligature on the first premolar, which allows it to rotate in the slot of the bracket as a hinge axis. The part of the spring is bent down vertically at 90 degrees and ends in a loop shape to which a ligature elastomeric thread can be attached. When the vertical portion of the spring is raised towards the impacted tooth, the horizontal part accumulates the energy into the twisted metal. When the vertical section is released, it bumps down like a "ballista."[9] The length of the vertical arm is kept 2 mm short from maxillary permanent canine to direct an occlusal force palatally and horizontally.[10]

The force of the spring is proportional to the diameter of the wire and to the length of the horizontal and vertical parts of the spring. A 0.016 inch spring of average size provides a force of 60–100 g; a 0.018 inch spring of average size provides a force of 120-150 grams. For a normal case, it is advisable to start with a 0.016 inch wire and to change it to a 0.018 inch after a month.[9] This case report illustrates the effects of Ballista spring in orthodontic repositioning of palatally impacted canine.

Case Report

A 26-year-old male patient reported to the department with the chief complaint of spacing in the upper front tooth region. Patient presented with impaired esthetics. On clinical examination, he showed apparently symmetrical**,** mesoprosopic facial form and straight profile. He is also having an average nasolabial angle with competent lips [Figure 1].

On intraoral examination, he presented with spacing of upper anteriors, mild crowding of lower anteriors, overjet of 2 mm, overbite of 3 mm, class I molar relation bilaterally, class I canine relation on the left side, and unerupted right permanent maxillary canine [Figure 2]. Radiographic examination revealed that the maxillary right permanent canine was palatally impacted. Cephalometric analysis revealed orthognathic maxilla, orthognathic mandible, class I skeletal base, average growth pattern, normally placed upper and lower incisor, normal upper and lower lips [Figure 3].

Treatment Plan

Based on the final diagnosis, patient planned for non-extraction treatment with surgical exposure of impacted canine followed by orthodontic traction using Ballista spring and alignment of canine.

Treatment Progress

Patient was treated with.022 MBT preadjusted edgewise appliance system. Initial leveling and aligning were done with0.016, 0.018, 16×22, 17×25 NiTiwires. After 8 months of initial leveling and aligning, 17×25 SS base archwire was inserted following which surgical exposure of impacted canine was done on the palatal side. The attachment was bonded on the palatal surface with all the necessary precaution taken to prevent moisture contamination. The Ballista spring fabricated using 0.016 SS as an auxiliary was placed for forced eruption of permanent canine. After 7 months of forced traction with ballista spring, the right maxillary impacted canine had erupted sufficiently to the oral cavity. Rotation correction of canine done followed by space closure. Finishing and detailing were carried out for about 6 months [Figure 4].

Treatment Results

A good class I molar and canine relationship with adequate occlusion and esthetically pleasing profile was achieved at the end of 20 months of treatment [Figure 5]. Pre-and Post-treatment cephalometric values are shown in Table 1. Fixed retainer was placed in the upper and lower arch.

Discussion

Maxillary canines are the cornerstone of the dental arch and play a very vital role in maintaining a functional occlusion and smile esthetics. Each patient with an impacted canine must undergo a comprehensive evaluation of malocclusion. In cases where patient does not desire treatment, the clinician should periodically evaluate the impacted tooth for any pathologic changes. Treatment options are autotransplantation of the canine, extraction of the impacted canine and movement of a first premolar in its position, extraction of the canine and posterior segmental osteotomy to move the buccal segments mesially to close the residual space, prosthetic replacement of canine. The most appropriate treatment approach is the surgical exposure of the canine and orthodontic treatment to bring the tooth into the line of occlusion.

Surgical exposure with the placement of an auxiliary attachment is particularly recommended for palatally impacted canines. The attachment is placed on the tooth at the time of surgical exposure. The tissues over the attachment should be excised, and a periodontal pack should be placed. The pack will minimize patient discomfort and prevent granulation tissues

Figure 1: Pre-treatment extra oral photographs

Figure 2: Pre-treatment intra oral photographs

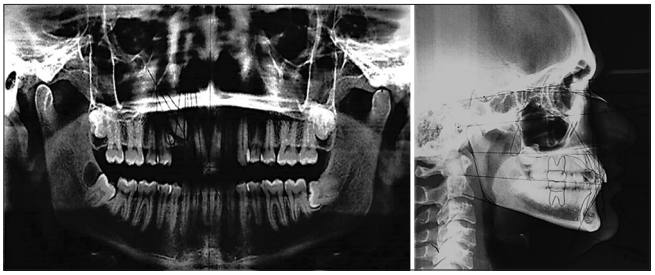

Figure 3: Pre-treatment orthopantomogramand lateral cephalogram revealing impacted maxillary right canine

Figure 4: Surgical exposure of impacted canine and mid treatment ballista spring

Table 1: Pre and post treatment cephalometric values

S. No	*Parameter*	*Standard value*	*Pre treatment*	*Post treatment*
1.	SNA	82±2°	84°	83°
2.	SNB	80±2°	82°	80°
3.	ANB	2±2°	2°	3°
4.	SN-Go Gn	31°±2°	30°	30°
5.	SN-OP	14°±8°	14°	14°
6.	SN-PP	8°±6°	10°	9°
7.	U1-NA(°)	22°	20°	21°
8.	U1-NA(mm)	4 mm	2 mm	4 mm
9.	L1-NB(°)	25°	30°	28°
10.	L1-NB(mm)	4 mm	5 mm	4 mm
11.	Interincisal angle	131°	129	130°
12.	UL-S line	2 mm	1 mm	2 mm
13.	LL-S line	2 mm	1 mm	2 mm
14.	Bjork sum	396±3°	395°	395°
15.	IMPA	90°	95°	93°
16.	Nasolabial angle	102±8°	95°	96°
17.	Upper lip thickness	15 mm	15 mm	15 mm
18.	Lip strain	14–16 mm	14 mm	15 mm
19.	Lower lip to E line	–2 mm±2 mm	3 mm	2 mm

from covering the attachment before the clinician is ready to apply traction force on the impacted tooth. The advantage of this approach is that when the force is applied to the impacted tooth, the clinician is able to visualize the crown of the tooth and have a better control over the direction of tooth movement. This will avoid moving the impacted tooth into the roots of the neighbouring teeth.[6]

The Ballista spring system used in this patient has advantages over other systems. Most impacted tooth are in close proximity to the roots of adjacent teeth. A simple straight traction between impacted tooth and the edgewise vestibular arch wire may result in compression of impacted tooth against roots of adjacent teeth with failure in treatment.

In 1992, Bishara states that the use of a circumferential, dead soft, ligature wire (lasso) as an attachment around the cervical area of the tooth should be discouraged, since too much bone has to be removed so that the wire can be placed around the tooth circumference. This heavy exposure increases the risk of injuring the neighboring teeth. An increased incidence of ankylosis was also reported during orthodontic treatment of these teeth. The ankylosis was associated with the external root resorption, and the teeth were found to be nonrestorable and had to be extracted. Therefore it is strongly recommended that the surgical exposure of the impacted tooth be conservativeto allow for the placement of a bonded bracket or button.[6]

The Ballista spring creates a vertical traction on the impacted tooth towards the middle of the palate and separates the tooth from roots of the adjacent teeth. By modifying the vertical part of the spring, one can control the direction of eruption of impacted tooth. This approach has been successfully used in many cases for treating impacted maxillary canines by several authors.[9,10] It can be easily inserted and ligated and is independent of other parts of the appliance. It provides a continuous force that is well controlled and easily modified. If the spring is inclined forward or backwards. it adds these components to the vertical traction. By lengthening the vertical part of the spring, it adds a force towards the midline of the palate and by shortening it adds force towards the dental arch. Once the ballista spring is attached to the hook. it becomes

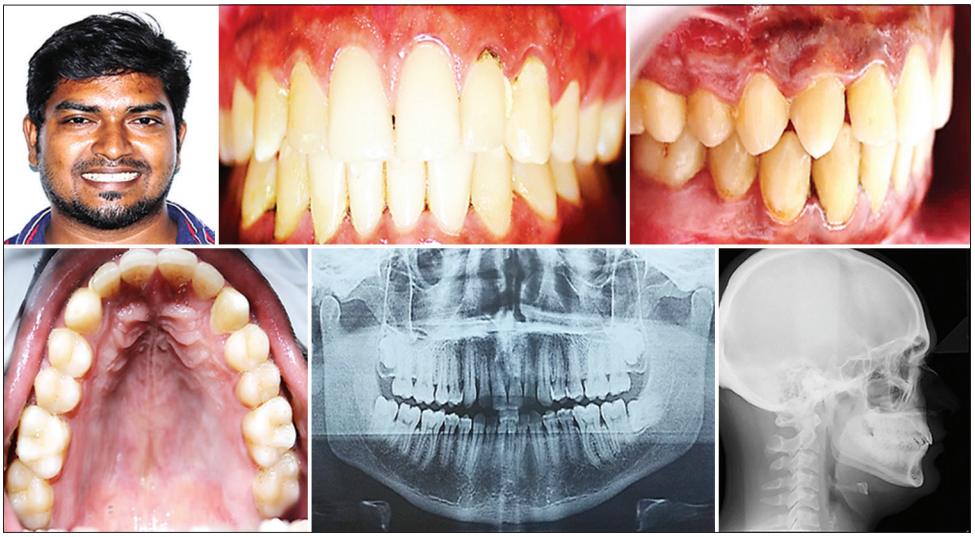

Figure 5: Post treatment extra, intraoral photographs, orthopantamogram and lateral cephalogram

tangent to the oral mucosa and it does not disturb the patient. The system does not require any banding of front teeth and therefore does not pose any potential esthetic problems in adults.[9]

The ballista spring can also be used to retract impacted upper incisors, impacted upper and lower vestibular canines, and impacted premolars. In all these cases, the principal is the same, with small modification of the anchorage or the spring. The surgical procedure for the impacted tooth in this system is less traumatic in comparison to other systems. The flap is very limited and can heal rapidly. The closed flap technique used in this patient enables a good periodontal health of the impacted teeth. The width of the attached gingiva following reposition was almost same as physiologically erupted teeth on the left side.

Conclusion

The management of the severely impacted canine is often a complex undertaking and often requires proper diagnosis and intervention at the earliest. Relevant and planned orthodontic mechanotherapy helps in reducing the duration of treatment and detrimental effects to the adjacent structures. The limited surgical procedure, the control of orthodontic forces, the simplicity of the appliance, the comfort of the patient, and lack of esthetic problems during treatment give great advantages to the Ballista spring system over most other systems used in the management of impacted teeth.

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