Case Report

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BALLISTA - S: A MODIFIED BALLISTA SPRING FOR DISIMPACTION OF MAXILLARY CANINE

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ABSTRACT:

The aim of the paper is to bring to light a simple modification of the ballista spring for disimpaction of the palatally impacted maxillary canine. A simple yet effective modification of the Ballista spring is done by shortening the active arm of the spring. DISCUSSION: The biomechanical advantage of the new clinical innovation is highlighted with two treated clinical cases.

Key Words: Palatal Canine Impaction, Ballista Spring

INTRODUCTION:

Impacted teeth are defined as those that are prevented from erupting by some physical barrier in their eruptive path[1]. Impacted maxillary canines have a prevalence of 3% in the general population, and is the second most common; the first being mandibular third molar [1]. Females have more propensity for impacted maxillary canines than male with the palatal impaction almost twice as common as the buccal impaction in the ratio of 2:1 to 9:1 [2].

Impacted maxillary canines can be labial, palatal or vertically in the arch. The etiology for palatal impaction, otherwise called the palatally displaced canines may be anamolous or absent lateral incisor, over-retained deciduous tooth with unresorbed root or genetic [3]. Impacted canine if left untreated may lead to untoward sequelae like cystic change in follicle, resorption of root of permanent lateral incisor, loss of arch length, internal resorption etc. Difficulty in resolving an impacted canine orthodontically depends on many factors such as labiopalatal position of the canine crown and root, canine angulation to the midline, vertical crown height, canine overlap of the adjacent lateral incisor root.

Palatally impacted canines are better managed orthodontically because the attached gingiva is adequate in the palatal aspect whereas if the canine is in the buccal side there is risk of development of fenestration due to paucity of attached gingiva in the buccal aspect [4]. An impacted maxillary canine can be resolved orthodontically by applying traction force from the same arch or opposite arch. Forces applied from the same arch can be in the form of ligatures, springs and auxiliaries, mini –implants etc. Forces from the opposite arch can be through

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elastics from the mandibular appliances or magnets.

CASE DETAILS:

CASE REPORT 1:

Pt M aged 18 years had the chief complaint of irregularly arranged teeth. On examination, she was diagnosed to have Angle's Class I malocclusion with crowding and missing maxillary left canine and retained deciduous maxillary left canine. The following clinical signs were indicative of palatally impacted canine: delayed eruption of permanent canine, prolonged retention of deciduous canine, presence of an abnormal bulge in the palatal aspect or absence of normal canine bulge in the labial aspect [5]. OPG revealed the presence of impacted maxillary left canine (fig 1). The presence of the palatal bulge and the OPG findings were correlated with the magnification technique to localize the maxillary canine. The maxillary left canine was more magnified than its counterpart. It was concluded from the clinical findings and radiographic examination that it was palatally impacted.

The impacted canine's position and angulation were determined by using OPG (fig 2) as advocated by Stivaros and Mendall [6].

1. Canine's angulation to the midline was 35˚
2. It was located in sector IV of Lindeur's modification of Erickson and Kurol's sectors which means that the cusp tip of the canine is mesial to the mesial incline of lateral incisor root and crown.
3. Canine crown was located above the half of lateral incisor root length.
4. There was no apparent resorption of lateral or central incisor roots.

Though deciduous canine was present during initial examination, tunnel traction of the permanent canine as advocated by Crescini et al was not performed because of patient apprehension for the procedure [7]. It was decided to use the open eruption technique. According to Fleming et al the advantage of the open eruption method over closed eruption is that there is adequate visualization of the impacted teeth during bonding of the attachment so that incorrect positioning of attachments is avoided[8]. The palatal flap is elevated; bone removed to expose the canine crown, attachment bonded to the canine crown and the flap is closed after marking the canine position. The canine crown with the attachment was exposed through a window incision of 6mm diameter.

It was decided to use the Ballista spring to erupt the surgically exposed canine because the spring fulfilled the criteria suggested by Bishara for canine resolution [9].

1. Direction of applied force should move the canine away from roots of neighboring teeth.

2. Traction force applied should be very light and continuous- about 60g.

SPRING DESIGN:

Ballista spring was given by Jacoby in 1979[10]. It was so named because its mode

of action is similar to that of a roman ballista. Jacoby advocated the use of 0.014", 0.016" or 0.018" stainless steel wire. 0.016" ss wire was used for fabricating the spring to keep forces at an optimum. The force delivered is proportional to the diameter and inversely proportional the length of the vertical and horizontal component of the spring. A spring fabricated with 0.016" ss wire delivers a force of 60-100g. The spring has a vertical and horizontal component. The vertical component ends in a loop which is attached to the canine by means of a ligature or elastic thread (fig 3).

Horizontal component of the spring is inserted into the headgear tube and main arch wire slot of the molar tube and anterior end of the horizontal arm is engaged in both the premolars. The horizontal component is ligated to the buccal tube to prevent its rotation during activation. The horizontal component accumulates energy when the vertical arm is raised to engage the exposed canine due to the twist force. There was no reactionary force in the premolar region. The base arch wire used was also round stainless steel- 0.018".

The vertical arm is perpendicular to the horizontal arm and in the passive state extends vertically in the canine space. The position of the vertical arm is critical. The vertical arm should be positioned in such a way that it erupts the canine in the middle of the edentulous span.

According to Jacoby, the length of the vertical arm is decided by the direction of tooth movement [10]. If the canine is to be moved away from the roots of the adjacent teeth then the length of the vertical arm should be till the impacted canine. The line of action of the spring is along the arc of a segment of a circle.

By virtue of its biomechanics, the ballista spring with the long vertical arm erupts the canine in the same position i.e. in the centre of the palate. Once it has erupted in the middle of the palate, it is difficult to bring the tooth into the arch. It is also embarrassing to the patient to have a tooth erupting in the middle of the palate. If the canine should be moved towards the dental arch, Jacoby suggests reducing the length of the vertical arm.

Ballista spring can be fabricated with a short vertical arm for all the cases. The length is calculated by measuring the distance between the main archwire and the attachment bonded to the canine's lingual surface and dividing it by two. The initial action of moving the canine away from the roots of the adjacent teeth is performed by ligating the vertical arm passively to the impacted canine but not activating it. This modified short vertical arm initially helps to erupt the canine away from the roots of the adjacent teeth(fig 4) Once the canine is erupted so that sufficient enamel surface is seen, then the ligature attached to the vertical arm can be activated to provide traction force towards the arch.

The angulation of the vertical arm is such that it is angulated away from the impacted tooth, ie, if the canine crown is mesial to the lateral incisor, then the vertical arm is distally angulated to facilitate its eruption away from the roots of the neighbouring tooth and vice versa. The stages of canine eruption are depicted in the figures 5 and 6. Intraoral photographs in fig 7 reveal erupted and aligned maxillary canine. OPG reveals the erupted maxillary left canine (fig 8).

CASE REPORT 2:

A 16 year old patient Mr. V came to the hospital with the chief complaints of retained milk tooth and spacing in the upper front teeth region. He was diagnosed to have Angle's Class I malocclusion with generalized spacing in the upper arch with retained right deciduous canine and palatally impacted permanent canine on a horizontal growth pattern. On palpation the canine could be felt on the palatal aspect of right upper lateral incisor. The tube shift technique revealed a palatally placed maxillary canine.

OPG revealed mesioangular impaction of right maxillary canine (fig 9). In OPG analysis it was found out that the impacted canine was angulated at 35°, the tip of the canine was 8mm from the occlusal plane and at the level of the cervical third of the root. The tip of the canine was in sector III (between the long axis and mesial margin of the root of lateral incisor). There was no resorption of root of lateral incisor. All these findings suggest that the canine was favorably positioned and can be disimpacted effectively.

The deciduous canine was extracted. The impacted canine was exposed by elevating a flap and an attachment was bonded to the tooth. The canine with the bonded attachment was exposed by means of a window incision on the palatal gingiva. Ballista S spring fabricated from 0.017 x 0.025 " TMA wire was engaged to the canine to apply traction force. Fig 10, 11 reveal stages of disimpaction of canine. Fig 12 and 13 reveal the well aligned and torqued canine in the arch.

DISCUSSION:

This small modification makes the spring exceedingly efficient with its occlusal and later buccal force to erupt impacted canines. AJ Wilcock round wire was used in the first patient instead of rectangular stainless steel as the resiliency of round stainless steel wire would enable easier resolution [11]. Another advantage of using round wire is that there is no reactionary torque in the premolar region. Ballista can also be fabricated using Titanium Molybdenum alloy as advocated by Kalra [11]. The following are advantages of using Ballista spring as given by Jacoby [10],

1. Continuous well controlled force.
2. Initial vertical traction towards the palate away from the roots of the adjacent teeth, later horizontal traction towards the arch.
3. Independent from other parts of the fixed appliance; the entire dental arch

need not be included in the fixed orthodontic treatment; segmental treatment is possible, hence esthetic.
4. The spring is easy to insert and ligate.
5. It can be used to resolve buccal impaction also.
6. The spring can be incorporated at any stage of the fixed appliance treatment.
7. Extremely cost effective and economical.

Fleming et al have discussed the influence of position of impacted canine on duration of orthodontic treatment[8]. The conclusion is that mesiodistal position of the impacted canine is the only factor that is related to the duration of treatment. Zuccati et al suggest that patient aged 25 years or more require longer treatment, canine cusp tip farther from the occlusal plane require longer time i.e. one additional visit if the distance increased by 0.63mm on OPG[2]. Canine with cusp tip mesial to lateral incisor required 10 more visits than distally located canines. Inclination of the canine was an important criteria – less inclined canines required longer treatment time.

Resolution of impacted canine in both the patients took 3 months. Though the canine's position was favorable, it is the low continuous force of the ballista spring system that has helped in speedy resolution of the impacted canine to its position in the arch. 0.018" stainless steel base archwire was used during canine disimpaction. The canine was torqued later by incorporating reverse torque in the stainless steel archwire.

CONCLUSION:

Ballista spring is a valuable auxiliary to resolve impacted maxillary canines. It is clinically efficient, effective, and economical and can be incorporated at any point during the fixed appliance therapy. Ballista S with short vertical arm of the spring is a biomechanically valid modification.

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FIGURES:

Fig 1: Extraoral photograph and OPG. OPG reveals impacted maxillary left canine

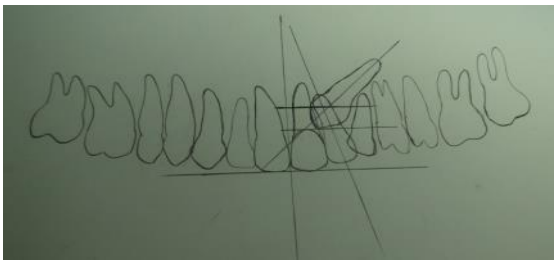

Fig 2 OPG analysis reveals angulation of the canine to the midline.

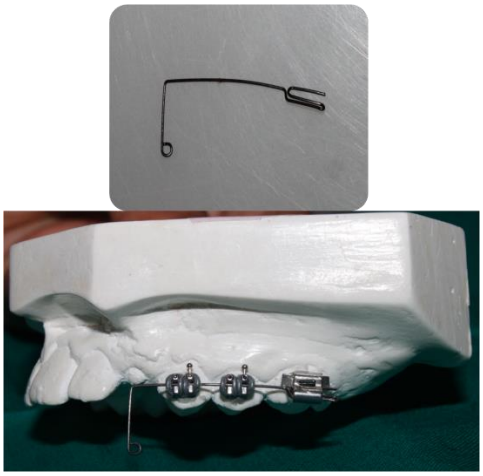

Fig 3: Ballista spring with vertical ,hortizontal arm and recurved molar insert. Ballista spring inserted in the premolar brackets and molar buccal tube.

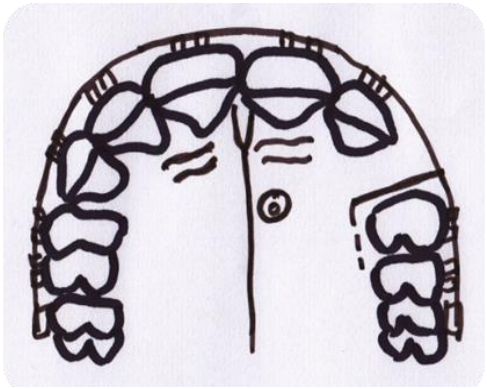

Fig 4: Method of calculating the length of vertical arm. Position of the impacted canine is depicted by the circle, the length of the vertical arm should be half the distance from the arch to the impacted canine.

Fig 5 Stages of eruption of canine depicted by occlusal stage photographs

Fig 6. Stages of canine eruption depicted by intraoral photographs

Fig 7 Intra oral photos after disimpaction and alignment of canine.

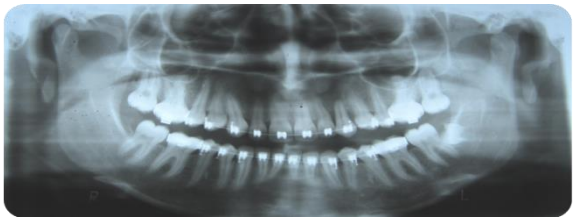

Fig 8 OPG after the eruption of canine.

Fig 9 Extraoral photograph and OPG. OPG reveals impacted right maxillary canine.

Fig 10 Occlusal photographs depicting stages of canine eruption.

Fig 11 Intraoral photographs show alignment of impacted maxillary right canine.

Fig 12 Intra oral photographs at the end of treatment

Fig 13 OPG reveals aligned right maxillary canine in the arch