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Orthodontic Traction Of An Impacted Upper Canine Using The Ballista Spring Loop: A Case Report

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Abstract
Background. *Impacted canines are one of the most common challenges in orthodontic practice. Interdisciplinary work is required for an adequate diagnosis and treatment plan. A timely approach and a case management with controlled biomechanics will be ideal for the success of the orthodontic treatment. Among the different biomechanical options that we have to treat the retained dental organs is the ballistic loop spring, which has proven to be an effective and safe tool for orthodontic traction of impacted canines. In the following clinical case report, a canine traction was performed with a ballistic loop spring which showed satisfactory results.*
Case Report. *A 21-year-old female patient presented an impacted superior right canine, a bilateral class I molar relationship, an undetermined canine relationship on both sides, both upper left temporary canines were still present, an overbite of 50% and an overjet with a 3mm values, proclined lower incisors, the patient presented a neutral growth pattern and a convex profile. An open exposure approach was selected and performed by a periodontist to band a surgical button and in addition to the ballistic loop spring to help the eruption of the impacted tooth.*
Discussion. *There are many options to help the impacted canines to erupt and be included in the dental arch, such as the double arch and mini screws, we opted for the ballistic spring loop, which helps on a vertical traction along the long axis of the tooth and at the same time providing a continuous orthodontic light force.*
Results. *A class I canine relationship was achieved on both sides, a class I molar relationship was maintained, the mandibular incisors ended up with a better inclination in relation with its bone base and a facial harmony was maintained.*
Conclusion. *In this clinical case report, the ballistic spring loop proved to be an efficient way to help the eruption of the impacted canine.*
Keyword: *Orthodontics, Impacted canine, Ballistic loop spring, Forced Eruption.*

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I. Introduction

Maxillary canines play a very important role in smile esthetics and function, they also have the longest development period and the longest eruption path and the crowns are intimately related with the lateral incisors' roots. Following the third molar, the maxillary canine is the most frequently impacted tooth. When teeth remain completely or incompletely embedded in the jawbone due to malposition or lack of space is called impaction. Extraction of impacted canines should be the last treatment option. There are many factors that may cause a change in position and subsequent deviation from the normal path of eruption; it could be an early loss of primary teeth, a retained primary cuspid, dental ankylosis, among other factors that can result as a dental impaction. (1,2,3,4,5)

A considerable range of surgical and orthodontic techniques have been used along the years, a popular approach has been the ballistic loop spring, described for first time by Harry Jacoby in 1979 and popularized by Kokich, which was originally designed for impacted canines, but can be use for any other impactation. (6,7)

The ballistic loop spring is usually made with 0.014, 0.016, or 0.018 inch round stainless steel Australian wire (Jacoby) or with 0.018 inch round stainless steel wire (Kokich), in this clinical case report we opted for a 0.018 inch round stainless steel Australian wire, which accumulates its energy by being twisted on its long axis when activated or engaged to the impacted tooth. The arch is engaged in the molar vestibular tube of the first and/or the second maxillary molar. When the vertical portion of the spring is engaged to the impacted tooth, the horizontal part of the arch wire is twisted and then liberates the accumulated energy performing like a "ballista".

This method has proven to be an effective and safe tool for impacted tooth traction, applying vertical movement along the long axis of the tooth and light continuous force. (6, 7, 8, 9, 10, 11)

II. Material And Methods: Case Report

The following patient is a 21-years-old female without any medical issues or allergic data, who attended to the Orthodontics program clinic of the Autonomous University of Baja California. The extraoral clinical analysis showed a mesomorph patient, with mild facial asymmetry, mild asymmetric smile, and a mesofacial biotype and convex profile. The patient presents a full lip profile, a nasolabial angle under normal values, and competent lips. (Figure 1)

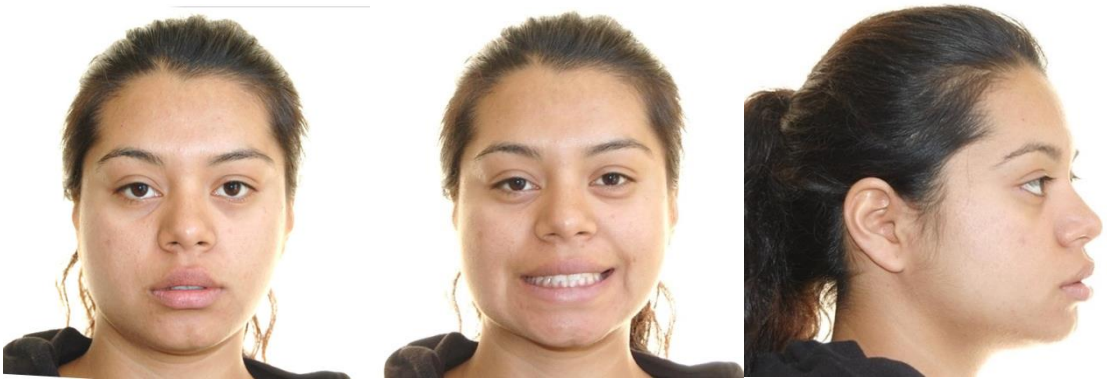

Figure 1. Facial photographs.

Intraoral photographs and study models showed an ovoid-shaped upper and lower arches, both upper temporary canines were still present, thick periodontal biotype, mismatched dental midlines, moderate upper and lower dental crowding, bilateral class I molar relationship, a bilateral undetermined canine class relationship, moderate deep bite and a 3mm overjet. (Figure 2)

Figure 2. Intraoral photographs.

According to the cephalometric analysis, the patient presented a class I skeletal relationship, an horizontal growth pattern, as well as mildly proclined lower and upper incisors. (Table 1, Figure 3).

Table 1. Lateral cephalometric analysis summary.

	Norm	Initial
SNA	82	87
SNB	80.9	83
ANB	2	3.5
SND	80	80.5
Segment SL	51mm	58.6mm
Segment SE	22mm	22.9mm
ANG Go-Gn/SN	32.9	26
Occ Plane/SN	14.4	17.5

Ang 1s/NA	22.8	18.9
Distance 1s/NA	4.3mm	4.9mm
1s/ENA-ENP	113	115
Ang 1s/SN	103.8	105.9
Ang 1i/NB	25.3	23.8
Distance 1i/NB	4mm	5.3mm
1i/Go-Gn	90	95
Interincisal angle	124	128.8
Overbite	2.8mm	3.1mm
Overjet	2.5mm	3mm

The panoramic x ray revealed 27 erupted permanent teeth. In addition, the patient presented both upper temporary canines with delayed exfoliation. The upper right permanent canine was impacted, with an alpha's angle of 60°. We can also observe the presence of the the upper and lower germs of the third molars in development on both sides. The height of both mandibular ramus are symmetrical but with a mildly asymmetric condyle anatomy, and a uniform bone density with a crown root ratio 1:2, and no other apparent pathologies (Figure 4).

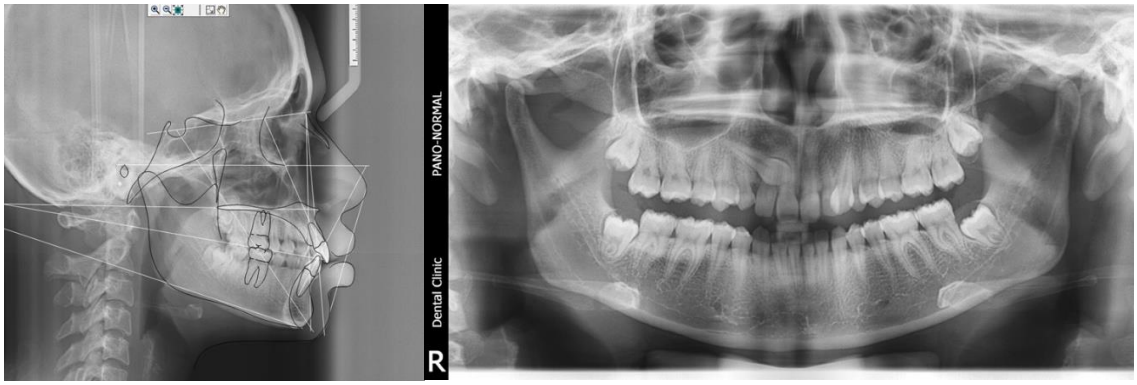

Figure 4. Initial panoramic X-ray.

Treatment Plan

- Extraction of the temporary upper canines on both sides.
- Bonding of upper fixed appliances (Roth Slot 0.018" x 0.022").
- Removable lower bite plane appliance.
- Dental alignment and leveling.
- Periodontal surgery for exposure of the upper right permanent canine.
- Ballista spring mechanic.
- Once both canines are incorporated to the dental arch, lower fixed appliance (Roth Slot 0.018" x 0.022").
- Coordination of dental arches.
- Root torque.
- Retention with upper and lower removable appliances (Hawley retainer).

Treatment Objectives

Maintain the class I molar relationship on both sides, achieve class I canine relationships on both sides, create an ideal overbite and overjet, dental arch coordination, obtain functional occlusion and periodontal health.

Case evolution

The orthodontic treatment was initiated with the placement of fixed appliances on the upper dental arch (Roth Slot 0.018" x 0.022") with fixed orthodontic bands on the upper first molars, after that, we proceeded with the alignment and leveling which were carried out with a sequence of NiTi archwires ranging from 0.014", 0.016", 0.018". After that, we proceeded with the extraction of the upper left temporary canine, followed by the placement of an inferior bite plane with occlusal coverage to eliminate any occlusal interferences while the canine is moved into place to the dental arch. We proceeded with the orthodontic traction of the upper left permanent canine to the arch with an elastomeric chain, with a stainless steel (ss) 0.016"x0.016" archwire. (Fig. 5)

We proceeded with the dental extraction of the upper right temporary canine, and at the same time, the exposure of the upper right permanent canine was performed with the immediate placement of a surgical button with the metallic chain passively attached to the ss 0.016" x 0.022" archwire, open coil between the 12 and the

14 was placed to maintain the space in the dental arch for the impacted canine. In the next appointment we placed the ballista spring loop made with an australian stainless steel 0.018" archwire to start the orthodontic traction of the 13. (Fig. 6)

Once the crown of the upper right permanent canine was erupted, due to the ballista spring mechanic, we started with a cuple force, using the ballista loop attached to the palatal surface of the 13 and an elastomeric chain attached to the buccal face of the tooth in question (Fig. 7). When the crown was almost aligned, the ballista spring was removed, and using elastomeric chain we approached the canine to the dental arch, and at the same time the patient continued using the inferior bite plane with a full compliance protocol.

Once the 13 was included to the dental arch, we proceed to bond the inferior fixed appliances, and starting the leveling stage with a NiTi 0.016" archwire. We continued with the alignment and leveling of the lower arch, with the following archwire sequence: Niti 0.016," 0.018", 0.016"x0.016", 0.016"x0.022", SS 0.016"x0.022". Once we were on heavy archwires, we opted for anterior retraction using laceback mechanic, at the same time, the patient used a class II mechanic with a 3/16" diameter 3.5oz of force elastics, with a 24 hour compliance protocol. (Fig. 8)

A continuous elastomeric chain was used for final space closure and contention. A final 0.016"x0.022" stainless steel archwire was used on the upper and lower arches. After we obtained our final orthodontic objectives, the fixed appliances were removed, and the retention stage was initiated with upper and lower removable appliances using Hawley type retainers. (Figure 9, 10.)

Figure 5. Inferior bite plane, 23 traction
Figure 6. Ballista spring
Figure 7. Ballista spring, cupla
Figure 8. Closing loops.

III. Results

The final clinical results showed that we maintained the class I molar relationship on both sides as well as a class I canine relationships on both sides. The overjet was reduced from 3mm to 2mm and the overbite was also reduced from 50% to 35% coverage. The shape of the lower and upper arches was more uniform and coordinated between each other and the dental crowding was alleviated. (Fig. 9). The inclination of the mandibular incisors showed a significant improvement. An acceptable soft-tissue profile and facial harmony were achieved (Table 2, figure 11 and 12).

Figure 9. Intraoral final photographs.

IV. Discussion

There are many mechanics for the traction of impacted canines. The clinician would have to choose the one that's best for the individual case. In this clinical case report we opted for the ballista spring mechanic using a 0.018 inch round stainless steel Australian wire, but it also could be made using 0.018 inch round stainless steel wire as Kokich did. Jnaneshwar *et al*, in 2016 used a similar mechanic but using a 0.016 inch round stainless steel wire, wich also showed good clinical results. They also claim on their publication that the length of the vertical arm is decided by the direction of tooth movement. If we want to move the canine away from the roots of the adjacent teeth, then the length of the vertical arm must be till the impacted tooth. (12)

Raghav *et al* opted for a same bilateral mechanic using a 0.014 inch round stainless steel wire, this for both maxillary impacted canines. At the surgical approach they used an open window technique with electrocautery for the exposure of the palatally impacted canine, we opted for a closed exposure technique, were a flap is raised to expose the canine and after the attachment is bonded to the tooth, tha flap is closed fully and only the ligature wire is passed through the gingiva. (13, 14)

In case of ankylosed impacted canines, it's important to opt for a different treatment protocol. Many clinicians opt for a piezo ostectomy along the crown axis of the canine to stimulate the tooth movement, but in these cases the teeth extraction most of the times is the most viable treatment. (14)

V. Conclusion

The orthodontic therapy with a ballista spring loop, performed in this case, proved to be an efficient way to help the eruption of impacted canines and provide a correct occlusion at the end of the orthodontic treatment. It's an option that provides the advantage of a vertical traction along the long axis of the tooth and at the same time applying light continuous force, this helps the impacted tooth to erupt vertically and then continue with the orthodontic movements to approach it to the dental arch. In this clinical case report we obtained satisfactory results with no signs of periodontal defects or gingival recessions.

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