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Palatally Impacted Canines: Methods of Achieving Their Desire Position in the Arch

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Abstract:
Proper development of the maxillary canine teeth plays a major role in esthetics as well as in establishing proper dental arch form. Hence, they are known as the corner stone of the mouth . When canines are impacted, they can present significant functional and esthetic dilemmas to the patient and clinician. Therefore, proper management of canine disimpaction is important to achieve long-term success, functionally and esthetically. The aim of this review is to integrate the studies that include different treatment modalities in the management of palatally impacted maxillary canines.

***Key Word**: Canine, Impaction, Alignment, Spring, Module, Magnets, Auxillary*

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I. Introduction

Palatally impacted canines are those that may have completed root development, but unaided eruption from the palate is not expected to occur.[1] It is thought that the impaction of canines depends on genetic factors,[2,3]as well as environmental influences in the form of unfavourable guidance provided by the maxillary lateral incisor.[4] Early diagnosis and timely interception provide conservative clinical management of impacted canine with minimal or no adverse side effects.

Orthodontic management of impacted canine is frequently carried out and a variety of techniques have been introduced the same . The surgical orthodontic treatment of impacted canines is aimed at bringing the tooth into its correct position in the dental arch without causing periodontal damage. The teeth are surgically exposed and moved towards the arch wire after the maxillary arch is stabilized by progressing to a rigid wire.

Several methods have been used for applying traction to the impacted canine and getting the canine tooth into proper occlusion helps to establish a perfect canine guided occlusion. (Kesling1971) which includes, elastic traction, lasso wires, and Kilroy spring designed by Bowman and Carano[5] for guiding the eruption of permanent canine, K-9 spring for alignment of impacted canine by Kalra,[6] eruption of impacted canine with an Australian helical archwire by Christine Hausen,[7] active palatal arch by Becker,[8] etc., Ballista spring designed by Jacoby.[9] The springs exert a light continuous force from being twisted on its long axis. The availability of newer materials has stimulated the development of numerous kinds of appliance designs for alignment of these canines. Superelastic wires, elastic threads, and chain elastic have made preadjusted edgewise technique more efficient.

The force needed to extrude an impacted tooth often produces side effects such as intrusion of the adjacent teeth or even canting of the occlusal plane.[10] Stable anchorage is essential to minimize these effects.In recent years, skeletal anchorage with mini-implants have become increasingly popular because of its versatility, minimal invasiveness, and low cost.[11-14]

II . Mechanics for eruption of palatal canines

Initial eruption can be achieved in many ways; however, to align the canine within the arch sufficient space must be available, which normally necessitates comprehensive fixed appliance therapy. Sufficient space to fully align the canine may be generated by distal molar movement, extraction of permanent teeth, use of complete fixed appliances to consolidate space in the incisor region or by advancement of the upper labial segment using 'push-pull' mechanics.

Surgical exposure

Some research and much debate have surrounded the merits of open versus closed eruption techniques[15]. Overall, there appear to be minor differences between the two methods in relation to treatment duration and periodontal health.[16] Careless surgery, with exposure of the cemento-enamel junction, will have deleterious periodontal consequences; however often the choice between using an open or a closed procedure is based on individual preference.

Open procedure

Where the canine is not deeply impacted, wide, open exposures have the obvious advantage of allowing complete visualization of the crown permitting accurate bond placement. In general, the authors favour open surgical exposure where permissible. This technique enhances control and may allow spontaneous improvement without resorting to active forces.

Closed procedure

Deep infraosseous location of the impacted canine. The location of the impacted canine was assessed on the panoramic image.(figure:1)

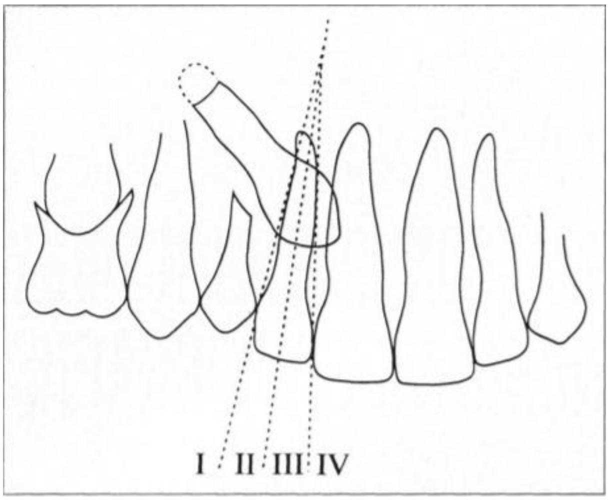

Figure:1 sector analysis

Modification of Ericson and Kurol's definition of sectors used in this study:
sector I is located distal to a tangent to the distal crown and root of the lateral incisor; sector II includes the area from the tangent on the distal surface to a midline bisector of the lateral incisor tooth; sector III includes the area from the midline bisector to a tangent to the mesial surface of the lateral incisor crown and root; sector IV includes all areas mesial to sector III.

With deep impactions, closed exposures are usually favoured. The tunnel traction technique introduced by Crescini et al. (1994)[17] describes a surgical approach for the orthodontic treatment of deep infraosseous impacted canines.

Orthodontic springs used to manage impacted canines are following:
Ballista spring

Ballista spring was Introduced by Harry Jacobay in 1979. Term Ballista was given by one of his patient as it reminded him of Roman Ballista. Made up of 0.014, 0.016 and 0.018 inch round SS wire and preventing it to rotate in the tube giving a bi-dimensional stability. When the vertical section is released, it bumps down like a ballista".0.016 inch wire provides an average force of 60-100 grams whereas 0.018 inch provides an average force of 120-150 grams for disimpaction.[18]

Figure:2 The ballista spring, its anchorage and action. The ballista spring before activation. It is inserted in the molar tube and ligated in the first premolar bracket.

When the vertical portion of the spring is raised towards the impacted tooth, the horizontal part accumulates the energy into the twisted metal.

The ballista spring system is a simplified orthodontic system for treating impacted teeth. The impacted tooth is retracted by a spring that accumulates a continuous force from being twisted on its long axis. The force exerted on the tooth is vertical, without compressing the impacted tooth toward the adjacent roots and well controlled and easily modified. By the lack of appliance on the front teeth during a great part of the treatment, the esthetic side of the treatment is respected. However, The necessary operation on the impacted tooth is traumatic.

Trans-palatal arch (TPA) with stainless steel auxiliary

The use of auxiliary stainless steel projections (0.6– 0.7 mm stainless steel) connected to a TPA has been described previously. Typically, it is used early in treatment; it may also be integrated with comprehensive fixed appliance therapy for final alignment of the canine (Figure 3).

Figure:3

It has an excellent aesthetics and hidden from view. It maintains the transverse dimension and may reinforce vertical anchorage and limit mesial tipping and rotation of first permanent molars, although anchorage loss is still likely to occur. It is versatile may be adjusted to permit posterior, occlusal or buccal movements as required. There is little impediment to oral cleansing. Although, it was prone to breakage and may be difficult to adjust.

Magnets

Magnetic forces[18] have been used in dentistry for very long time and Sandler and colleagues[19] have reported use of magnets in the eruption of an impacted tooth. Darendeliler et al. (1994) used magnets in conjugation with fixed appliance therapy for canine disimpaction. After the permanent canine has been exposed after surgery a small magnet is bonded to the palatal surface of the canine, and the mucosal flap is sutured so that it completely covers the impacted tooth and the magnet. The patient is given a passive removable anterior plate to wear while the tissue healing takes place. Six days after surgery a samarium cobalt magnet 3mm×4mm×6mm is mounted on the removable plate 6.5 mm away from the bonded magnet. The initial force of the magnetic attraction is 10 grams. To free the path of eruption of the impacted tooth, a 9mm hole is cut in the acrylic. As the canine moves, the hole is enlarged. When the impacted canine and magnets can be seen directly under the palatal mucosa, the removable appliance is discontinued.

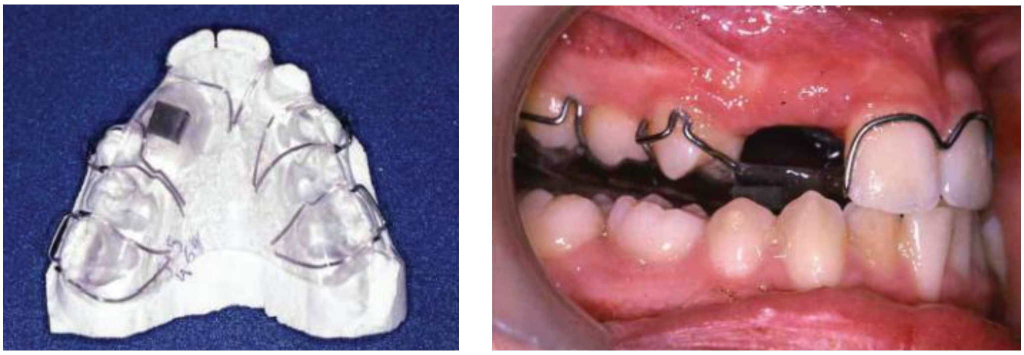

Figure:4 Magnets were used in conjunction with an upper removable appliance to mechanically erupt palatal canines;

Magnets is versatile and needs minimal wire manipulation. It applies a low continuous force increasing over time. It has facility for directional control. The inverse square law applies to magnetic fields, i.e. force decreases with increasing distance. Consequently, more than 3 to 4 mm space between Neodynium–Boron magnets produces insufficient force to affect tooth movement though it is bulky and prone to corrosion;

Elastomeric traction to fixed appliance

Elastomeric traction is useful to initiate eruption in conjunction with fixed appliances and stainless steel arch wires. Rigid stainless steel base archwires, e.g. 0.018-inch or 0.019*0.025-inch SSW, are desirable to minimize reactionary forces reinforcing vertical anchorage in particular.[21]

Figure:5 Movement was initiated with elastomeric traction

Forces applied by elastics leads to decay rapidly with force loss of up to 50% developing within 24 h necessitating regular reactivation.[22] Precise directional control[23] is often difficult by elastomeric traction but may be improved with archwire adjustments or auxiliaries to centre force application, e.g. passive coil-spring (Figure 5).

Piggyback NiTi archwires

Auxiliary NiTi archwires provide inherent flexibility to continue the eruptive process.[24,25] Again rigid stainless steel base archwires with significantly higher elastic modulus, e.g. 0.018-inch or 0.019*0.025-inch SSW, are preferred to limit unwanted effects on anchor units (Figure 6).

Figure:6 'Piggyback' NiTi archwires were used to continue alignment of the displaced canine.

NiTi wires are considered ideal as they provide a relatively constant, light force with high flexibility and range[26] allowing engagement of significantly displaced teeth. Although NITI wire has limited range of action particularly when applied to gold chain. The amount of space opened for the canine may be controlled by using round archwires, therefore the possibility of inadvertent torquing of adjacent roots into the impacted tooth may be avoided. But there is inability to apply a precise directional force.

Stainless steel archwire auxiliary

The application of buccal auxiliary wires for correction of palatal canine position has been introduced by Becker et al.[27] The auxiliary spring is formed in 0.014- or 0.016-inch SSW with a vertical loop having a helix at its extremity (Figure 7).

Figure:7 (0.014-inch SSW auxiliary used to continue vertical movement of UL3; the 0.018-inch stainless steel base archwire minimized reciprocal effects.)

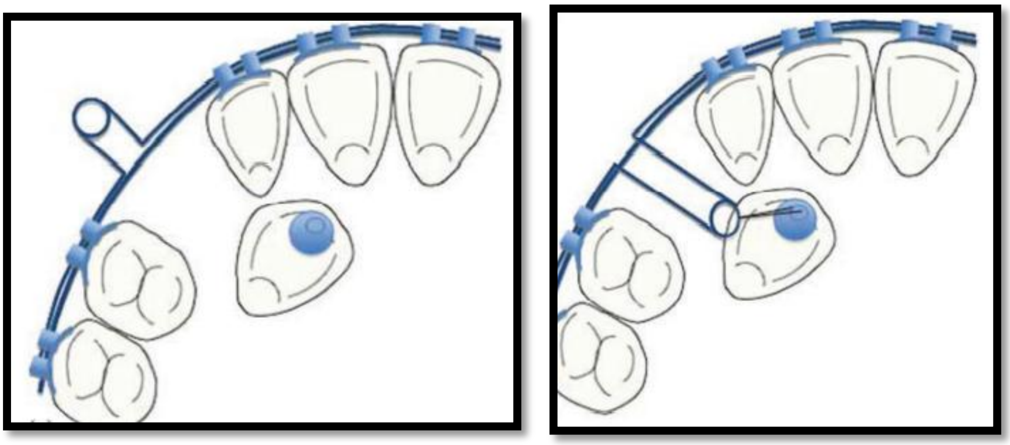

Figure: 8

In the passive position, the loop points vertically downward towards the mandibular dentition; the loop is activated by ligating the helix to an attachment on the canine with a steel ligature generating an extrusive force.(figure 8)

It gives a directional force and wire may be fashioned to produce precise movements. It has long range of activation. It allows vertical movement which may not be achievable with nickel–titanium auxiliary wires following initial vertical movements.The forces generated by spring are controlled and measurable. However there is requirement for wire bending and the risk of appliance breakages.

Removable appliances

Removable appliances may be used in either the upper[28] or lower[29] arch to apply traction to the palatal canine. Placement of elastics may be simplified with pre-formed adjuncts, e.g. monkey hooks or fabricated at the chairside.

Figure: 9(Inter-arch traction to erupt a maxillary canine combined with class II correction using a modified twin block appliance)

It has Excellent anchorage, resisting unwanted reciprocal forces in the maxillary arch. However, elastics to a lower removable will tend to dislodge the appliance and hence the effectiveness is questionable. Ability to achieve other tooth movements concurrently, e.g. overbite reduction, class II correction (Figure 9). Incorporation of an anterior bite plane eliminating occlusal interferences that may otherwise mechanically impede lateral movement of the canine. while upper removable appliances are retentive, they may not offer sufficient flexibility in directional force application. lower removable appliances are less retentive as extrusive forces may unseat the appliance. however, force vectors are ideal for canine; eruption being inferiorly directed and distally directed if required[29] and Depend on excellent patient compliance.

Nickel titanium closed coil spring

Loring Ross (1999)[30] introduced the concept of attaching nickel titanium closed coil spring without end loops to be effective in patient with impacted canines. The eruptive force can be directly attached from the main archwire to a button or chain bonded to the impacted tooth. Activate the spring and wrap several links around a stable rectangular archwire with an occlusal step. Be sure to leave a tail of chain for reactivation. A 0.009×0.041” spring provides 80 grams force when stretched to twice its resting length. Unlike elastic thread showing a rapid decay, the nickel titanium spring delivers a light continuous force over a longer period of time. An impacted canine can be extruded enough to bond an attachment within six weeks.

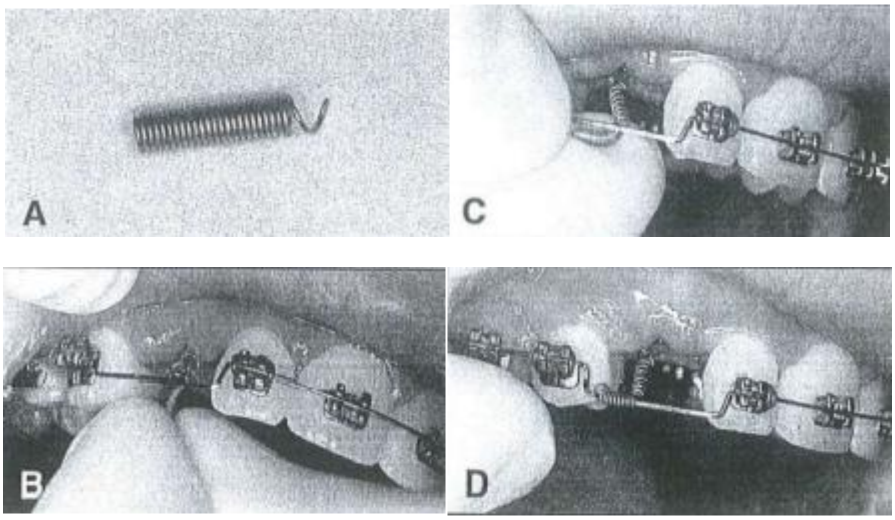

Figure:10 (Nickel titanium closed coil spring for extrusion of impacted canine)

K-9 spring

K-9 sring introduced by Varun Kalra (1995)[6] is made up of 0.017* 0.025 TMA wire, which can be activated twice as far as stainless steel before it undergoes permanent deformation, while producing less than half the force. The horizontal arm of the spring is inserted into the first molar buccal tube and the premolar brackets. About 7 mm mesial to the first premolar bracket, the horizontal arm is bent 90^0 downmard to form a vertical arm, which is about 11 mm long and ends in a helix. While the spring is held with a plier just diatal to the vertical arm, the vertical arm is bent about 200 inwards, towards the plate. To activate the spring the vertical arm is swung upwards and ligated to the bonded attachment on the impacted canine. This provides a gentle extrusive force on the canine; the spring also has a buccal component of force due to its arcial pattern of activation and deactivation. The force needed to distalize the canine is achieved by cinching the spring back about 2 mm after it has been ligated to the canine. The K-9 spring is simple in design, low in cost and easy to fabricate. It also is comfortable for the patient requiring no special cooperation.

Figure: 11 (k-9 spring)

Monkey hook

Given by Bowman et al. in 2002,[31] is a simple auxillary with an open loop on each end for the attachment of intraoral elastics or elastomeric chains, or for connecting to a bondable loop button. Its S shaped design was inspired by the children’s game, “barrel of monkeys”, since more than one monkey hook can be linked together to form a chain. The hook can be closed with a plier to prevent disengagement. A combination of monkey hooks and bondable loop buttons allows the production of a variety of different directional forces to assist in the correction of impacted, rotated or displaced teeth. Apart from canine disimpaction monkey hooks can also be used for derotation and retraction.

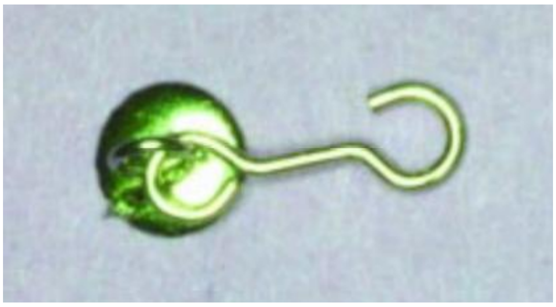

Figure: 12 (Monkey Hook is S-shaped wire linked to bondable “loop-button”.)

Figure: 13 (Monkey Hooks linked together into chain.)

After surgical exposure of canines and direct bonding of loop buttons, Monkey Hooks and elastomeric chains were attached to produce lateral "slingshot" forces supported by continuous stainless steel archwire. Coil springs were used to create and maintain space for canines. Third Monkey Hook on each side was used for attachment of intermaxillary elastics to produce vertical eruptive forces, with anchorage from mandibular arch.

Figure: 14 (monkey hook attachment for eruption of palatally impacted canine)

Kilroy spring

Kilroy spring is a constant force module introduced by Bowman et al. (2003),[5] which is slid onto a rectangular archwire over the site of an impacted tooth. The configuration of Kilroy reminded the designers of the popular "Kilroy was here" graffiti of 1940. In the passive state, the vertical loop of the Kilroy spring extends perpendicularly from the occlusal plane. To activate the spring, a stainless steel ligature wire is guided through the helix at the apex of the vertical loop, and the loop is directed towards the impacted tooth. The ligature is then tied to an attachment that has been direct-bonded to the surgically exposed tooth. A Kilroy spring can be tied to a loop button, monkey hook or a gold chain. Support for the activated Kilroy spring is derived from the continuous rectangular archwire and reciprocal forces from the incisal third of the adjacent teeth, which are contacted by the lateral extensions of the spring. The kilroy spring may need to be periodically retied to maintain a constant force as the teeth erupts.

Figure: 15(Kilroy Spring)

Figure: 16 (When passive, vertical loop of Kilroy Spring is perpendicular to plane of occlusion.)

Figure: 17 (For activation, stainless steel ligature is passed through helix at end of vertical loop and ligated to bonded loop-button on impacted tooth.)

Kilroy II spring was designed to produce more vertical than lateral eruptive forces for the eruption of buccaly impacted teeth. Its multiple helices increases its flexibility, but also increases the likelihood of impingement on the adjacent soft tissue. Modified Kilroy spring was introduced by Sharma et al. (2015),[32] which could be applied without removal of the deciduous canine, thus improving the patient esthetic appearance and helping to maintain the canine space. The base width of the vertical loop is determined by the width of the deciduous canine where the loop clears the deciduous canine in palatal direction.

Figure: 18 (killory II spring)

Temporary anchorage devices (TADs)

TADs have gained widespread popularity being used to produce a variety of tooth movements.[33,34] however, their application to address impacted canines has received little attention.

Giancotti et al.[35] reported a case incorporating an osseointegrated mid-palatal implant to erupt bilaterally impacted canines using the implant for indirect anchorage.

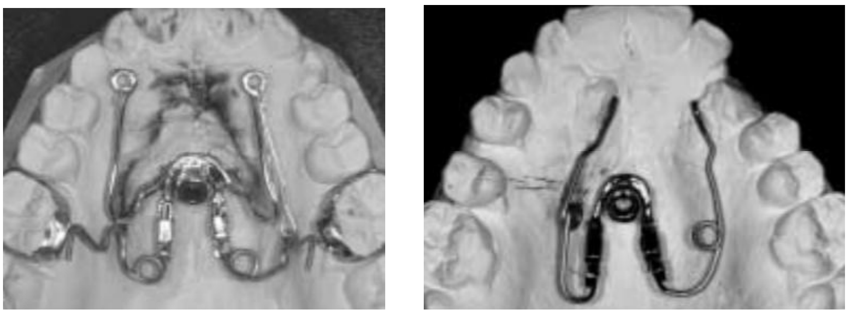

Figure: 19 (Implant-Supported Deimpactor System (ISDS). A. Type 1. B. Type 2)

Mini implant had potentially excellent anchorage which is particularly useful in a compromised dentition (such as hypodontia) with little facility to retain fixed or removable appliances (Figure 20)

Figure: 20 (Temporary anchorage device in the mandibular parasymphysis used to apply elastomeric traction to a maxillary canine in a compromised maxillary arch subsequent to hemi-maxillectomy. Both buccal and palatal attachments were placed to maintain correct canine inclination)

Easy-Way-Coil (EWC) system

The EWC system introduced by Schubert (2008)[36] consists of a Remanium closed-coil stainless steel spring, 0.010" ligature wire and a bondable lingual button. The spring has an outer diameter of .047" and an inner diameter of .030". Each 1mm of activation generates an average force of .158N or 16.1gms. To assemble the system, cut a 1" length of spring with a ligature cutter. At one end, carefully bend the last few coils of the spring at a 45° angle to make an eyelet about 1mm in length. Attach the eyelet to the lingual button with the .010" ligature wire. After twisting and trimming the ligature wire to a length of 1.5mm, firmly press the end against the stem of the button with a band adapter. It is important to ensure that the attachment can still be turned for subsequent activation. The spring should be reactivated at four week intervals to maintain a constant force. After the crown will has emerged enough to remove the lingual button and place a bracket on the tooth. Further alignment can be accomplished with a “piggyback” arch segment. The EWC system allows the constant application of force throughout the eruption of impacted teeth. It can be applied either unilaterally or bilaterally, with secure anchorage and no undesirable side effects.

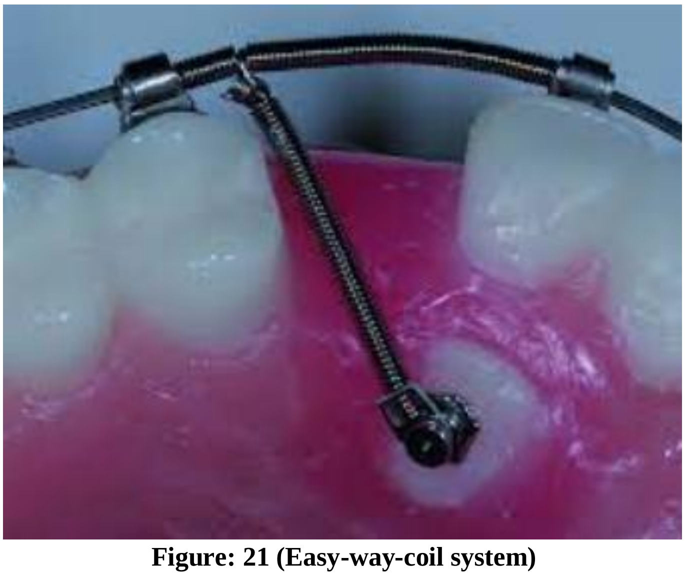

Figure: 21 (Easy-way-coil system)

III. Conclusion

As canines are known as corner stones of mouth, it is important to align them properly in the arch to improve aesthetics as well as function. Success of the treatment depends upon type of exposure of tooth, amount of bone removal, type of attachment, orthodontic traction. All these parameter plays important role when managing impacted teeth to achieve good alignment in the arch, gingival level, and integrity of periodontium. Hence, this article highlights most of the common treatment options which can be used for alignment of canines. Careful selection of surgical and orthodontic techniques is essential for the successful alignment of impacted canines.

References

[1]. Becker A, Chaushu S. Success rate and duration of orthodontic treatment for adult patients with palatally impacted maxillary canines. American Journal of Orthodontics and Dentofacial Orthopedics. 2003 Nov 1;124(5):509-14.
[2]. Mossey PA. The heritability of malocclusion: part 2. The influence of genetics in malocclusion. British journal of orthodontics. 1999 Aug;26(3):195-203.
[3]. Peck S, Peck L, Kataja M. The palatally displaced canine as a dental anomaly of genetic origin. The Angle Orthodontist. 1994 Aug;64(4):250-6.
[4]. Becker A. In defense of the guidance theory of palatal canine displacement. The Angle Orthodontist. 1995 Jan 1;65(2):95-8.
[5]. Bowman SJ, Carano A. The Kilroy spring for impacted teeth. Journal of Clinical Orthodontics. 2003 Dec 1;37(12):683-8.
[6]. Kalra V. The K-9 spring for alignment of impacted canines. Journal of clinical orthodontics: JCO. 2000 Oct;34(10):606-10.
[7]. Hauser C, Lai YH, Karamaliki E. Eruption of impacted canines with an Australian helical archwire. Journal of clinical orthodontics: JCO. 2000 Sep;34(9):538-41.
[8]. Becker A. The orthodontic treatment of impacted teeth, 2nd edt. London: Informa Healtcare UK Ltd. 2007.
[9]. Jacoby H. The etiology of maxillary canine impactions. American journal of orthodontics. 1983 Aug 1;84(2):125-32.
[10]. Kokich VG, Mathews DP. Surgical and orthodontic management of impacted teeth. Dental Clinics of North America. 1993 Apr 1;37(2):181-204.
[11]. Costa A, Raffainl M, Melsen B. Miniscrews as orthodontic anchorage: a preliminary report. The International journal of adult orthodontics and orthognathic surgery. 1998 Jan 1;13(3):201-9.
[12]. Wilmes B. Fields of application of mini-implants. Ludwig B, Baumgaertel S, Bowman SJ. Mini-Implants in Orthodontics: Innovative Anchorage Concepts.
[13]. Kanomi R. Mini-implant for orthodontic anchorage. J. clin. Orthod.. 1997;31:763-7.
[14]. Wilmes B, Drescher D. Vertical periodontal ligament distraction–a new method for aligning ankylosed and displaced canines. Journal of Orofacial Orthopedics/Fortschritte der Kieferorthopädie. 2009 May 1;70(3):213-23.
[15]. Burden DJ, Mullally BH, Robinson SN. Palatally ectopic canines: closed eruption versus open eruption. American Journal of Orthodontics and Dentofacial Orthopedics. 1999 Jun 1;115(6):640-4.
[16]. Parkin N, Benson PE, Thind B, Shah A, Khalil I, Ghafoor S. Open versus closed surgical exposure of canine teeth that are displaced in the roof of the mouth. Cochrane Database of Systematic Reviews. 2017(8).
[17]. Crescini A, Clauser C, Giorgetti R, Cortellini P, Prato GP. Tunnel traction of infraosseous impacted maxillary canines. A three-year periodontal follow-up. American Journal of Orthodontics and Dentofacial Orthopedics. 1994 Jan 1;105(1):61-72.
[18]. Davies S, Gray RMJ. 2001. What is cclusion? British Dental Journal, 191: 5,235-45.
[19]. Blechman AM. Magnetic force systems in orthodontics: clinical results of a pilot study. American Journal of Orthodontics. 1985 Mar 1;87(3):201-10.
[20]. Darendeliler MA, Joho JP. Class II bimaxillary protrusion treated with magnetic forces. Journal of clinical orthodontics: JCO. 1992 Jun 1;26(6):361-8.
[21]. Usiskin LA. Management of the palatal ectopic and unerupted maxillary canine. Br J Orthod 1991; 18: 339–46.
[22]. Baty DL, Storie DJ, Joseph A. Synthetic elastomeric chains: a literature review. American Journal of Orthodontics and Dentofacial Orthopedics. 1994 Jun 1;105(6):536-42.
[23]. Dowling PA, Jones WB, Lagerstrom L, Sandham JA. An investigation into the behavioural characteristics of orthodontic elastomeric modules. British journal of orthodontics. 1998 Aug;25(3):197-202.
[24]. Samuels RH, Rudge SJ. Two-archwire technique for alignment of impacted teeth. Journal of clinical orthodontics: JCO. 1997 Mar 1;31(3):183-7.
[25]. Sandler PJ, Murray AM, Biase DD. Piggyback archwires. Clinical orthodontics and research. 1999 May;2(2):99-104.
[26]. Kusy RP. A review of contemporary archwires: their properties and characteristics. The Angle Orthodontist. 1997 Jun;67(3):197-207.
[27]. Kornhauser S, Abed Y, Harari D, Becker A. The resolution of palatally impacted canines using palatal-occlusal force from a buccal auxiliary. American journal of orthodontics and dentofacial orthopedics. 1996 Nov 1;110(5):528-34.
[28]. Grande T, Stolze A, Goldbecher H. Management of an extremely displaced maxillary canine. Journal of Orofacial Orthopedics/Fortschritte der Kieferorthopädie. 2005 Jul 1;66(4):319-25.
[29]. Orton HS, Garvey MT, Pearson MH. Extrusion of the ectopic maxillary canine using a lower removable appliance. American Journal of Orthodontics and Dentofacial Orthopedics. 1995 Apr 1;107(4):349-59.
[30]. Ross LL. Technique Clinic-Nickel Titanium Closed-Coil Spring for Extrusion of Impacted Canines-A Jones Jig spring is used for de-impaction. Journal of Clinical Orthodontics. 1999;33(2):99-100.
[31]. Bowman SJ, Carano A. The monkey hook: an auxiliary for impacted, rotated, and displaced teeth. Journal of clinical orthodontics: JCO. 2002 Jul 1;36(7):375-8.
[32]. Sharma VI, Nagar AM, Tandon PR. A Modified Kilroy Spring for Eruption of Palatally Impacted Canines. Journal of clinical orthodontics: JCO. 2015 Jan 1;49(1):46-8.
[33]. Papadopoulos MA, Papageorgiou SN, Zogakis IP. Clinical effectiveness of orthodontic miniscrew implants: a meta-analysis. Journal of dental research. 2011 Aug;90(8):969-76.
[34]. Prabhu J, Cousley RR. Current products and practice: bone anchorage devices in orthodontics. Journal of Orthodontics. 2006 Dec;33(4):288-307.
[35]. Giancotti A, Greco M, Mampieri G, Arcuri C. Treatment of ectopic maxillary canines using a palatal implant for anchorage.
[36]. Schubert M. A new technique for forced eruption of impacted teeth. Journal of clinical orthodontics: JCO. 2008 Mar;42(3):175-9.