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Maxillary Canine Impaction: Etiology and Treatment Modalities - A Review.

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Introduction

Impaction is retardation or halt in the normal process of tooth eruption. A canine is considered as impacted, if it is interrupted after the complete root development or contralateral tooth is erupted for at least six months with complete root formation. According to WHO an impacted tooth is any tooth that is prevented from reaching its normal position in the mouth by tissue, bone or another tooth. The ectopic eruption and impaction of maxillary permanent canines is a frequently encountered clinical problem. The diagnosis and treatment of this problem requires the involvement of expertise and cooperation of the general practitioner, the pediatric dentist, the oral surgeon, and the periodontist, as well as the orthodontist[1].

With early detection, timely interception and well managed surgical and orthodontic treatment allows the impacted maxillary canines to erupt in an appropriate location in the dental arch. The maxillary permanent canines develop deep in the maxilla, complete their development late, and emerge into the oral cavity after the neighboring teeth at mean ages of 10 to 12 years for girls and 11 to 13 years for boys[2].

Impaction of permanent maxillary canines are common because they develop deep within the maxilla and have the longest and tortuous course of path to travel compared with any other tooth in the oral cavity. Canines play a vital role in facial appearance, dental esthetics, arch development and functional occlusion. As a result, orthodontists should know the significance of retaining impacted maxillary canines and have proposed various techniques to effectively and efficiently recover these teeth. In orthodontics and dentistry in general, canine impaction is considered as a dental anomaly that occurs frequently and clinicians must be prepared to manage it.

Prevalence and Etiology of Impacted Canine

Maxillary canines are the most commonly impacted teeth, second only to third molars. Maxillary canine impaction occurs in approximately 2 percent of the population and is twice more common in females than in males. The incidence of canine impaction in the maxilla is twice than that in the mandible. Of all patients with maxillary

impacted canines, 8 percent have bilateral impactions. Approximately one third of impacted maxillary canines are located labially, and two thirds are located palatally[3]. Canine impaction can be caused by various factors. The exact etiological factor of palatally displaced maxillary canines is unknown. The results of Jacoby's study showed that 85 percent of palatally impacted canines had sufficient space for eruption, whereas only 17 percent of labially impacted canines had sufficient space. Therefore, arch length discrepancy is thought to be a primary etiologic factor for labially impacted canines[4]. Several etiologic factors for canine impactions have been proposed, they are localized, systemic and genetic.

The localized factors include, tooth size arch length discrepancies, failure of the primary canine root to resorb, prolonged retention or early loss of the primary canine, ankylosis of the permanent canine, cyst or neoplasm, dilaceration of the root, absence of the maxillary lateral incisor, variation in root size of the lateral incisor (peg-shaped lateral incisor), variation in timing of lateral incisor root formation iatrogenic factors and idiopathic factors. Systemic conditions like endocrine deficiencies, febrile diseases and irradiation are found to be associated with impacted canine. Genetic reasons include heredity, malposed tooth germ and presence of an alveolar cleft[2].

Two major theories associated with palatally displaced maxillary canines are the Guidance theory and Genetic theory. The Guidance theory proposes that the canine erupts along the root of the lateral incisor, which serves as a guide, and if the root of the lateral incisor is absent or malformed, the canine will not erupt[5]. The Genetic theory points to genetic factors as a primary origin of palatally displaced maxillary canines and include other possibly associated dental anomalies, such as missing or small lateral incisors. Baccetti reported that palatally impacted maxillary canines are genetically reciprocally associated with anomalies such as enamel hypoplasia, infraocclusion of primary molars, aplasia of second premolars and small maxillary lateral incisors[6]. Peck and colleagues stressed that the high probability of additional dental abnormalities occurring in combination with a palatally displaced canine such as congenital tooth absence and delayed eruption should alert clinicians to be circumspect when planning treatment[7]. Becker reported that an increase of 2.4 times in the incidence of palatally impacted canines adjacent to the sites of missing lateral incisors compared with palatally impacted canines in the general population. It remains uncertain, however, whether an anomalous lateral incisor is a local factor for palatally displaced canines or the displaced canines are the result of an associated genetic developmental influence.

Frequencyof Impaction

Moyers noted that any tooth can be impacted, but the teeth most frequently involved are mentioned below in the following order Mandibular 3rd molar, maxillary 3rd molar, Maxillary canine, mandibular bicuspid, mandibular cuspid, Maxillary bicuspid, maxillary central incisor and maxillary lateral incisor

Sequelae of Maxillary Canine Impaction

Impacted canines usually are asymptomatic. Therefore the patient usually becomes unaware of the impacted canines existence. General practitioners and orthodontists usually discovered the impacted teeth during initial radiographic examinations. Sequelae of abnormal eruption paths of the impacted canine within the dentoalveolar process can have serious clinical ramifications. For example, palatally or labially impacted teeth cause migration of the neighboring teeth and loss of arch length. In addition to this unerupted canines may increase the risk of development of cystic lesion, infection and root resorption of the nearby lateral incisors and jeopardize the longevity of lateral incisors. The potential complications emphasize the need for dentists to examine the development and eruption of

impacted canines during the routine dental examinations of growing children[8].

Clinical Diagnosis

Various clinical signs of canine impaction are documented in the dental literature. These signs include delayed eruption of the permanent canine, overretention of the primary canine, absence of a labial bulge, presence of a palatal bulge and distal crown tipping of the lateral incisor. Ericson and Kurol suggested that absence of the "canine bulge" when the child is around years of age is not an indication of canine impaction. However, they suggested palpation of the buccal surface of the alveolar process distal to the lateral incisor to help determine the position of the maxillary canine before its emergence. If a labial bulge is absent in a 9- or 10-year-old patient, eruption disturbance of the permanent canine should be suspected and a radiograph obtained to confirm the diagnosis[9].

Radiographic Diagnosis

Radiographs are indicated in individual with unerupted and non-palpable canines after the age of 11 years. Several methods have been used to radiographically evaluate impacted maxillary canines. These methods are intraoral techniques (Occlusal and Periapical projections) and extraoral techniques (Panoramic, Posteroanterior or Lateral cephalometric radiographs). Digital imaging technique like CT and CBCT can also be used for radiographic diagnosis of impacted canine.

The most practical method of obtaining an Occlusal radiograph is by positioning the x-ray tube directly over the bridge of the nose, at a 60-degree angle to the occlusal plane. This method has been used to find out the buccolingual position of impacted teeth. However, the traditional method of locating impacted teeth specifically, maxillary canines has been the use of a two-dimensional technique with periapical radiographs, known as the Buccal object rule. This technique consists of taking two periapical radiographs at different mesiodistal angulations and using the same-lingual-opposite buccal (SLOB) rule to evaluate the tooth's buccolingual position. The radiographic interpretation of the SLOB rule is if, when obtaining the second radiograph, the clinician moves the x-ray tube in a distal direction, and on the radiograph the tooth in question also moves distally, then the tooth is located on the lingual or palatal side.

Accordingly, if the impacted canine is located buccally, the crown of the tooth moves mesially.

Assessing the position of the impacted canine is key to determining the feasibility of and proper access for a surgical procedure, as well as the best direction for application of orthodontic forces. Visualizing and assessing the root of the lateral incisor is suggested, as 80 percent of these teeth can resorb owing to ectopically erupting canines. The crown of the ectopically erupting canine may put pressure on the lateral incisor root, causing it to resorb. Clinicians can localize canines by using advanced three-dimensional imaging techniques. Cone-beam computed tomography (CBCT) can identify and locate the position of impacted canines accurately. By using this imaging technique, dentists can also assess any damage to the roots of adjacent teeth and the amount of bone surrounding each tooth[13].

Determination of The Prognosis[11]

According to McSherry, the prognosis for alignment of an impacted maxillary canine is affected by several factors[10]

1. Patient co-operation: Factors such as missed appointments and poor oral hygiene influence treatment duration.

2. Age of patient: The age of a patient at the start of treatment has been found to affect treatment time and, since this may be lengthy, older patients may find it to be unacceptable. The upper age limits suggested for successful alignment of an ectopic canine include 16-20years

3. Presence of spacing or crowding: In 85 per cent of subjects with palatal displacement of a canine there is adequate space in the arch, while in crowded arches the canine is more likely to erupt in a buccal position.

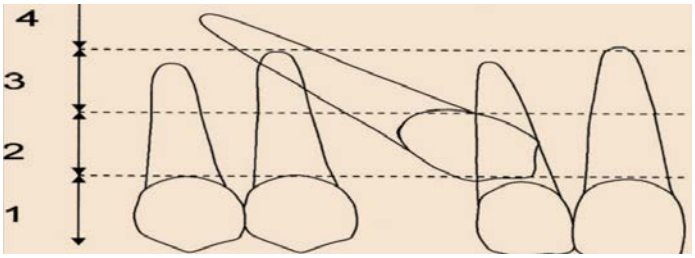
4. Position of canine: The angulation of the tooth, as well as the bucco-palatal, vertical and horizontal position, all influence treatment difficulty.

Canine Angulation to Midline

If the canine angulation is less than 30 degrees, then the prognosis is good. If it is between 30–45 degrees, then the prognosis is fair. If it is Over 45 degree, the prognosis will be poor.

Vertical Height of Impacted Canine

A good prognosis can be expected if the canine cusp tip is at the level of the cement enamel junction of the adjacent incisor. A fair prognosis would be predicted for a canine with its cusp tip at a level of half the root length of the adjacent incisor. A poor prognosis for alignment would be one where the cusp tips lie against the apical third of the adjacent incisor root.



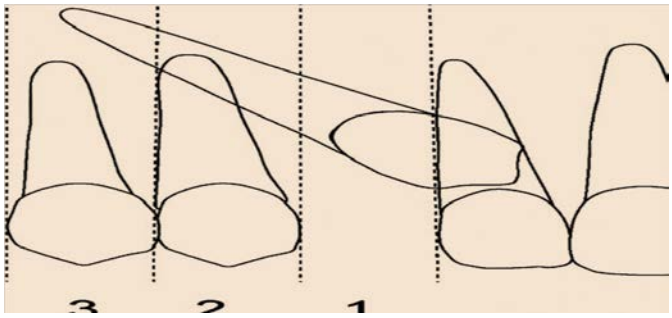
Position of the Canine Apex Relative to the Adjacent Teeth

Grade 1 Canine overlapping up to half the width of the lateral incisor

Grade 2 Canine overlapping over half the width of the lateral incisor

Grade 3 Canine completely overlapping the lateral incisor

Grade 4 Canine overlapping up to half the width of the central incisor



The Management of Maxillary Impacted Canines

Each patient with an impacted canine must undergo a comprehensive evaluation of the malocclusion. The clinician should consider the various treatment options available for the patient, these include No treatment, Interceptive treatment, surgical exposure of labial and palatal Impaction impaction. Auto-transplantation of impacted canine and Extraction of impacted canine.

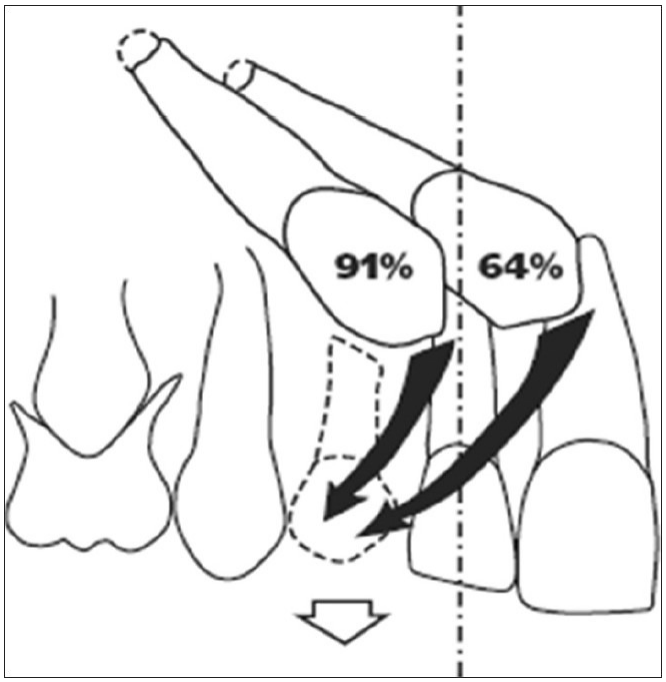
No Treatment

If the patient does not desire it, the clinician should periodically evaluate the impacted tooth for any pathologic changes. It should be remembered that the long-term prognosis for retaining the deciduous canine is poor, regardless of its present root length and the esthetic acceptability of its crown. This is because, in most cases, the root will eventually resorb and the deciduous canine will have to be extracted.[12]

Interceptive Treatment

Preventing maxillary canine impaction is the ideal form of treatment and provides the best long term results. The

success of early interceptive treatment for impacted maxillary canines is influenced by the degree of impaction and the patient's age at the time of diagnosis. Using Panoramic techniques, Ericson and Kurol found that early extraction of primary maxillary canines may result in normal eruption of ectopically displaced permanent maxillary canines. They proposed that extracting the primary canine before the patient is 11 years of age would normalize the erupting position of the permanent canine in 91 percent of the cases if the crown were distal to the midline of the later incisor root. However, the success rate decreases to 64 percent if the permanent canine crown is mesial to the midline of the lateral incisor root. The probability of successful eruption of an impacted canine after extraction of the primary canine decreases as the horizontal angulation increases[13, 14].



Schematic illustration showing the normalization rates of the maxillary canine after extraction of the primary canine when the permanent maxillary canine is located mesially and distally to the midline of the lateral incisor

Power and Short discovered that when the vertical angulation exceeds, the chance of normal eruption after extraction significantly decreases. Prognosis, however, is influenced more by the degree of canine overlap with the lateral incisor than by its angulation. Ericson and Kurol found that lateral incisor root resorption increases when the canine cusp tip is positioned more mesially on the lateral root[15].

Surgical Techniques for Exposing Impacted Maxillary Canines

Labial Impaction

If the canine cusp is coronal to mucogingival junction, adequate amount of keratinized gingival is present and the canine is not coverd by the bone, then the gingivectomy can be performed. The orthodontic traction is not necessary because the tooth tends to erupt normally. Advantages of gingivectomy are that it is easy to perform and less traumatic. The disadvantages are loss of attached gingiva and potential gingival overgrowth at surgical site[16].

If canine crown is apical to mucogingival junction and the amount of attached gingiva is minimal, apically positioned flap is indicated. The initiation of the orthodontic therapy can be started 2-3 weeks after surgery. The advantages are there will be conservation of keratinized gingiva. The disadvantage is increased risk of gingival irritation[17].

If the tooth is in the center of alveolus and crown is significantly apical to mucogingival junction, the closed eruption technique is indicated. The initiation of orthodontic therapy will be done 1-2 weeks after surgery. Advantages are greater esthetics and it has ease of tooth movement. Disadvantages are patient discomfort and possible mucogingival problems.

Palatal Impaction

If the canine is located near the lateral and central incisors, horizontally positioned and higher in the roof of the mouth, the close flap technique is indicated. The initiation of orthodontic therapy can be done 1-2 weeks after surgery. The advantage is that immediate orthodontic traction is possible. The disadvantages are bone necrosis,

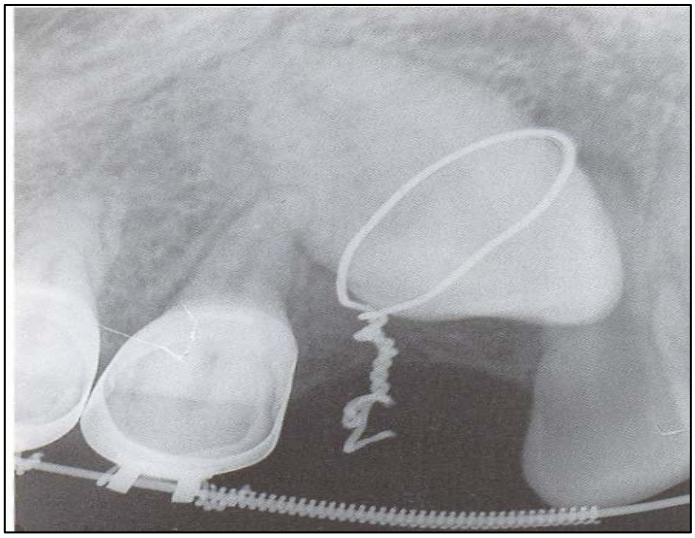
root resorption, longer operation time and bond failure due to blood or saliva. When cusp tip is at the level of the occlusal plane, open technique is indicated. If canine is located near the lateral and central incisors, horizontally positioned and higher in the roof of the mouth, the open window eruption is advised. If the presence of primary canine in the arch is there, tunnel traction is indicated. Initiation of orthodontic therapy can be carried out 10 days after surgery and the traction phase begins. The advantages are visualization of the crown, better control of the direction of tooth movement and avoidance of moving the impacted tooth into the roots of the adjacent teeth. The disadvantages are gingival overgrowth at incision site and chance to infection[17,19,20].

Orthodontic Techniques Used To Treat and Manage Impacted Maxillary Canines

The most common methods used to bring palatally impacted canines into occlusion are surgically exposing the teeth and allowing them to erupt naturally during early or late mixed dentition, surgically exposing the teeth and placing a bonded attachment and using orthodontic forces to move the tooth. Kokichs three methods for uncovering a labially impacted maxillary canine were gingivectomy, creating an apically positioned flap and using closed eruption techniques. Factors influencing surgically exposing a labial or intra-alveolar impaction are labiolingual position of the impacted canine, vertical position of the tooth relative to MGJ amount of gingiva in the area of the impacted canine and mesio distal position of the canine crown. To prevent undesirable periodontal responses, factors that clinicians should consider include impaction depth, anatomy of the edentulous site, speed and direction of the orthodontic force. The results of several studies have shown that surgical exposure and orthodontic eruption of palatally impacted maxillary canines have minor effects on the periodontium[21].

Lasso Wire

Lasso wire twisted lightly around the neck of the canine had been employed widely and was used previously. The disadvantages are irritation of gingiva, prevent reattachment, External resorption and ankylosis in the CEJ area.



Ballista Spring

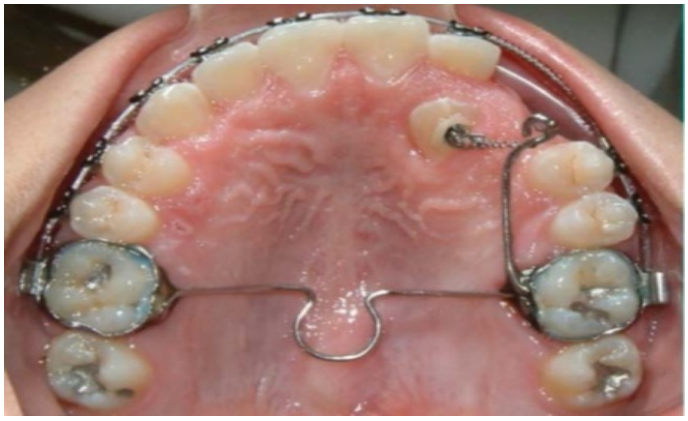
The ballista spring is a 0.014, 0.016, or 0.018 inch round wire, which accumulates its energy by being twisted on its long axis. Its anchorage extremity penetrates in both headgear and edgewise vestibular tubes of the first or second maxillary molar and it is ligated to this tube[20].

Advantages

- The ballista spring system uses a spring which creates a vertical traction on the impacted tooth toward the middle of the palate
- The spring provides a continuous force that is well controlled and easily modified.
- This system does not require any banding of the front teeth
- The surgical procedure for the impacted tooth in this system is less traumatic in comparison to some other systems

Cantilever System

TMA cantilever springs have been used to extrude impacted canines as described by Lindauer and Isaacson. The use of TMA box loops is to produce first and second order correction while continuing vertical eruption. The advantages of this system are predictable tooth movement, low load or deflection and less frequent reactivations[23].



Two Archwire Techniques

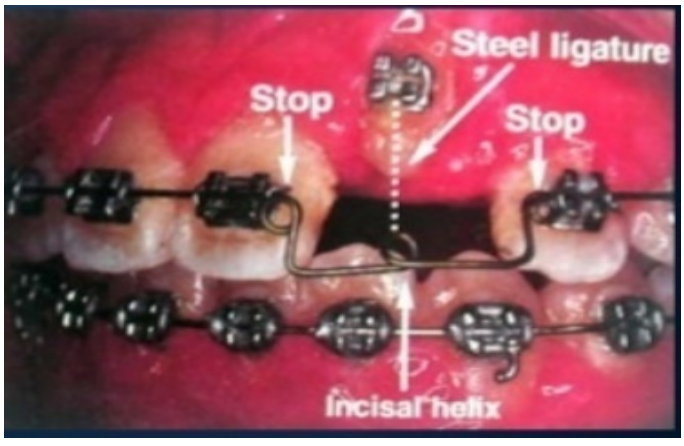
Samuels and Rudge introduced this technique of applying traction system to an impacted tooth using two nickel titanium archwires[24].

Nickeltitanium Closed Coil Spring

Loring Ross introduced the concept of attaching nickel titanium closed coil spring without end loops to be effective in a patient with impacted canine[25].

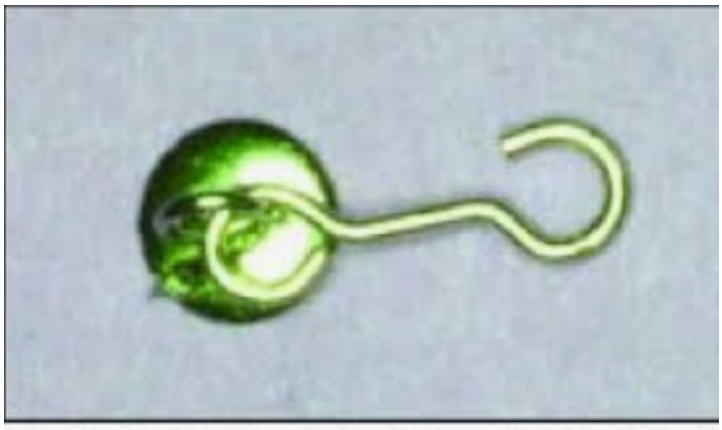
Australian Helical Arch Wire

Australian archwires are made up of austenitic stainless steel that has been heat treated and cold drawn down to the desired diameter to gain exceptional resilience, toughness and tensile strength[26,27].



Monkey Hook

For moving impacted teeth, special plus 0.016" archwire with straight length is preferred over spooled wire because they are more formable and less brittle.



It is a simple auxiliary 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[28].

Kalra- K 9 Springs

K-9 spring introduced by Varun Kalra (1995) 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.The advantages are Simple design, easy to fabricate and gives continuous force[29].

le introduced by Bowman et al. this is slide onto a rectangular archwire over the site of an impacted tooth. 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[15].

When to Extract An Impacted Canine[12]

- Patient declines active treatment.
- There is evidence of early resorption of adjacent teeth.
- The patient is too old for interception.
- There is a good contact for lateral incisors and first premolar.
- If the root of impacted canine is severly dilacerated.
- If the impacted canine is ankylosed and cannot be transplanted.
- If the impaction is severe and the degree of malocclusion is too great for surgical repositioning /transplantation.

Transplantation

Transplantation is the only appropriate option if the position of the canine is such that orthodontic alignment is not possible. Auto-transplantation may be defined as the transplantation of embedded, erupted or impacted teeth from one site to another in the same individual into extraction site or surgically prepared socket. Autogenous transplantation of impacted canines was tried by Widman. Root resorption is often found after autotransplantation surgery. The prevalence of external root resorption is high and it is the most common cause of the eventual failure of the autotransplanted teeth[30].

Conclusion

Various surgical and orthodontics techniques used to recover the impacted maxillary canines. Proper management of these teeth requires the appropriate surgical techniques to apply forces in a favourable direction and to have complete control for efficient correction, thereby avoiding damage to the adjacent teeth[31]. The management of impacted canine is a complex procedure requiring a multidisciplinary approach. The clinician should communicate with each other to provide the patient with an optimal treatment plan based on scientific rationale. When patients are evaluated and treated properly, clinicians can reduce the frequency of ectopic eruption and subsequent impaction of the maxillary canine. The simplest interceptive procedure that can be used to prevent impaction of permanent canines is the timely extraction of the primary canines. Careful selection of surgical and orthodontic techniques is essential for the successful alignment of impacted maxillary canines.

References

1. Lindauer SJ, Rubenstein LK, Hang WM, Andersen WC, Isaacson RJ. Canine impaction identified early with panoramic radiographs. J Am Dent Assoc 1992;123:91-2, 95-7.
2. Power SM, Short MB. An investigation into the response of palatally displaced canines to the removal of deciduous canines and an assessment of factors contributing to a favourable eruption. Br J Orthod. 1993; 20:215–23.
3. Ericson S, Kurol J. Early treatment of palatally erupting maxillary canines by extraction of the primary canines. Eur J Orthod. 1988; 10:283–95.
4. Jacoby H. The etiology of maxillary canine impactions. Am J Orthod. 1983; 84:125–32.
5. Becker A. The orthodontic treatment of impacted teeth. 2nd ed. Abingdon, Oxon, England: Informa Healthcare; 2007. pp. 1–228.
6. Baccetti T. A controlled study of associated dental anomalies. Angle Orthod. 1998; 68:267–74.
7. Peck S, Peck L, Kataja M. The palatally displaced canine as a dental anomaly of genetic origin. Angle Orthod. 1994; 64:249–56.
8. Shafer WG, Hine MK, Levy BM. A textbook of oral pathology. 2nd ed. Philadelphia: WB Saunders; 1963. pp. 2–75.
9. Ericson S. radiographic examination of ectopically erupting maxillary canines. Am J Orthod Dentofacial Orthop. 1987; 91:483–92.
10. Richardson G. A review of impacted permanent maxillary cuspids — diagnosis and prevention. J Can Dent Assoc. 2000;66:497–501.
11. Power SM, Short MB. An investigation into the response of palatally displaced canines to the removal of deciduous canines and an assessment of factors contributing to favourable eruption. Br J Orthod 1993;20:215-23.
12. Samir E. Bishara. Clinical management of impacted maxillary canines . seminars in orthodontics;1998 :4(2); 8-98.
13. Ericsson and kurol. Early management of palatally erupting maxillary canine by extraction off primary canine . EJO 1998:10(4); 283-295.
14. Shapira Y, Kuftinec MM. Early diagnosis and interception of potential maxillary canine impaction. JADA 1998;129(10):1450-1454.
15. Power SM, Short MB. An investigation into the response of palatally displaced canines to the removal of deciduous canines and an assessment of factors contributing to favourable eruption. Br J Orthod 1993; 20:217-23.

16. Bedoya MM, Park JH. A review of the diagnosis and management of impacted maxillary canines. J Am Dent Assoc. 2009;140:1485–93.
17. Vermette ME, Kokich VG , Kennedy DB. Uncovering labially impacted teeth: apically positioned flap and closed-eruption techniques. Angle Orthod 1995;65(1):23–32.
18. Kokich VG, Mathews DA. Impacted teeth: surgical and orthodontic considerations. In: McNamara JA, Brudon WL, Kokich VG, eds. Orthodontics and Dentofacial Orthopedics. Ann Arbor, Mich.: Needham Press; 2001:395-422.
19. Kokich VG. Surgical and orthodontic management of impacted maxillary canines. Am J Orthod Dentofacial Orthop 2004;126(3): 278-283.
20. Schmidt AD, Kokich VG. Periodontal response to early uncovering, autonomous eruption, and orthodontic alignment of palatally impacted maxillary canines. Am J Orthod Dentofacial Orthop 2007; 131(4):449-455.
21. Jacoby H. The “ballista spring” system for impacted teeth. Am J Orthod 1979; 75:143-51.
22. .Fischer TJ, Ziegler F, Lundberg C. Cantilever mechanics for treatment of impacted canines. J Clin Orthod 2000;34(11): 647-650.
23. Samuels RH. Two archwire technique for alignment of impacted teeth. J Clin Orthod 1999;33:12-24.
24. Ross LI.Nickel titanium closed coil spring for extrusion of impacted canine. J Clin Orthod1999;33:74-7.
25. Lindauer SJ, Isaacson RJ. One-couple orthodontic appliance systems. Semin Orthod 1995; 1:12-24. 24.
26. Hauser C, Lai YH, Karamaliki E. Eruption of impacted canines with an Australian helical archwire. J Clin Orthod 2000;34:538-41.
27. Bowman SJ. The monkey hook:An auxillay for impacted, rotated and displaced teeth. J Clin Orthod 2002;36:375-378.
28. Kalra V. the k-9 spring for alignment of impacted canines. J Clin Orthod. 2000; 34:606–10.
29. Peñarrocha M, Peñarrocha M, García-Mira B, Larrazabal C. Extraction of impacted maxillary canines with simultaneous implant placement. J Oral Maxillofac Surg 2007;65(11):2336-2339.
30. Rajanikanth B R, Kavitha Prasad, Vineeth K. Autotransplantation of Teeth Associated with Dentigerous Cyst: A Case Report. J Maxillofac Oral Surg. 2015 Sep; 14(3): 816–820.
31. Brin I, Becker A, Zilberman Y. Resorbed lateral incisors adjacent to impacted canines have normal crown size. Am J Orthod Dentofacial Orthop 1993; 104(1):60-66.