



Orthodontic and Surgical Management of Impacted Maxillary Canines: A Narrative Review

Mimoza E. Selmani¹ Shkelzen B. Duci² Nora Asani Gashi¹ Manushaqe Selmani Bukleta^{3,4}

¹AAB College, Prishtina, Kosovo

²Clinic of Plastic Surgery, University Clinical Center of Kosovo, Prishtina, Kosovo

³College of Medical Science, Faculty of Dentistry, "Rezonanca", Prishtina, Kosovo

⁴Dental Clinic, Mdent Family Dentistry, Prishtina, Kosovo

Address for correspondence Manushaqe Selmani Bukleta, College of Medical Science, Faculty of Dentistry, "Rezonanca" Prishtina, Kosovo Dental Clinic, Mdent Family Dentistry, Eqrem Qabej 74, 10000 Prishtina, Kosovo (e-mail: manushaqeart@gmail.com).

Eur J Gen Dent 2024;13:177–182.

Abstract

Maxillary canine impactions are a significant challenge for orthodontic and oral surgical practices. In this narrative review, we aim to evaluate surgical and orthodontic approaches for treating maxillary canine impactions, evaluate their effectiveness, and compare the two treatment modalities.

We reviewed several studies on databases such as Google Scholar, PUBMED, and MEDLINE to update recent knowledge for canine impactions and their treatment. We reviewed and included studies that matched our research objectives, including orthodontic management, open and closed eruption techniques, and contact and tooth alignment surgery.

Successful treatment results of canine impactions were reported increasingly in literature, and good clinical outcomes were observed in most cases. However, factors such as the severity of the impaction, patient age, and surgical experience were found to influence the choice of surgical technique and success rates. Complications associated with surgical management of maxillary canine impactions were also reported. These complications, which include tooth resorption, postoperative infection, ankylosis, and damage to adjacent structures, are generally rare but emphasize the importance of careful patient selection, surgical planning accuracy, and emphasis on diligent postoperative care.

Findings highlight surgical procedures' effectiveness, outcomes, and challenges to help clinicians make informed decisions and improve patient care. The results underscore the importance of evidence-based decision-making and a multidisciplinary approach for successful clinical outcomes. Future research will focus on long-term stability, patient-reported outcomes, and exploring emerging techniques to further improve the management of maxillary canine impactions.

Keywords

- ▶ eruption
- ▶ impactions
- ▶ maxillary canines
- ▶ orthodontic

article published online
July 15, 2024

DOI <https://doi.org/10.1055/s-0044-1786550>.
ISSN 2320-4753.

© 2024. The Author(s).

This is an open access article published by Thieme under the terms of the Creative Commons Attribution License, permitting unrestricted use, distribution, and reproduction so long as the original work is properly cited. (<https://creativecommons.org/licenses/by/4.0/>)

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

Introduction

Maxillary canine impactions are a common occurrence affecting approximately 2% of the population.^{1,2} The most common cause of canine impactions is the lack of dental arch space. Other factors contributing to canine impaction include crowding, abnormal tooth eruption, and congenital disability.³ The course of treatment takes a long time, and it costs the patient a lot of money. Early discovery, prompt interception, and appropriate treatment approach could help move impacted maxillary canines to a proper position in the dental arch. It is possible to direct impacted canines toward the arch using a variety of surgical and orthodontic procedures. Successful alignment of impacted teeth depends on carefully selecting surgical and orthodontic procedures. Interdisciplinary management of impacted teeth is frequently necessary. So, the periodontist, oral surgeon, and orthodontist must work together effectively for this approach to be successful.⁴

When the canine tooth fails to emerge into its usual place in the oral cavity, it can cause a frequent dental issue known as maxillary canine impaction, as shown in ►Fig. 1. Maxillary canine impactions have complex etiology that may be attributed to regional, inherited, or external factors.⁵ If spare space in the maxillary arch exists, a canine can be palatally impacted, as shown in ►Fig. 2. Peg-shaped lateral incisors, abnormal growth at the bottom of the maxillary bone, or accelerated lateral incisors and the primary premolar emergence can produce this additional space.⁶ The mandibular canine root is flattened and grooved distally, while the maxillary canine



Fig. 1 Maxillary impacted canines in adult patient.



Fig. 2 Palatally impacted canine, retro-alveolar images.

root is the most lengthy and the toughest in the entire mouth.⁷ A comprehensive medical and radiographic investigation is necessary to diagnose maxillary canine impaction. The most used technique is a radiographic examination, which involves assessing panorama images, lateral cephalograms, and cone-beam computed tomography (CBCT) scans. A three-dimensional image of the impacted tooth and its connection to surrounding structures can be obtained using CBCT images.

Canine impactions, if left untreated, can result in a variety of issues, such as aesthetic issues, functional issues like speech and eating difficulties, increased chance of periodontal disease and dental caries, and pathological conditions such as cyst formation.⁸

The current review aims to assess the clinical and practical requirements for managing maxillary canine impaction, the role of orthodontic and surgical management, and provide updated information regarding its management.

Methods

A comprehensive search was conducted on different electronic bases (PUBMED, Scopus, Cochrane) from the year 2015 to 2023. Google databases such as Google Scholar were also searched for relevant articles. We only included articles written in the English language. The keywords we used were “orthodontic management,” “surgical management,” “impaction,” “orthodontic impaction,” “maxillary canine,” “maxillary canine impaction,” and “management maxillary canine.” The introduction and discussion sections of all the articles were analyzed, and references were also interpreted for additional studies. We located 110 studies, of which 80 were assessed as full-text articles. Forty-one articles were included in this review after taking out duplicate reports and those that did not align with our objective.

Prediction of Maxillary Canine Impaction

For the purpose of predicting maxillary canine impaction, numerous prediction techniques, such as radiological evaluation, medical evaluation, and genetic screening, have been

discovered. The classification of maxillary canine impactions from panoramic dental radiography images has also been developed using deep learning models. The tooth arch, the order in which teeth erupt, and the possibility of additional dental anomalies are all evaluated during a medical examination. Another way for predicting maxillary canine impaction has been genetic testing, but its clinical applicability is currently being researched.^{9,10}

Diagnosis of Maxillary Canine Impaction

A thorough clinical and radiographic examination is necessary to diagnose maxillary canine impaction as **Fig. 3** shows a radiological image of maxillary canines. It is essential to assess the impacted tooth's position, the severity of impaction, and the existence of any accompanying dental abnormalities. To get a three-dimensional image of the impacted tooth and its connection to the surrounding structures, CBCT scans are frequently performed,¹¹ as shown in **Fig. 4**. The correct treatment method must be chosen based on the diagnosis of maxillary canine impaction.¹²

Orthodontic Management of Maxillary Canine Impaction

At times orthodontic treatment by itself might be enough to cause the canine to erupt into the proper position. Orthodontic treatment requires creating space in the dental arch and providing traction forces followed by surgical exposure.^{13,14} Early diagnosis and intervention coupled with orthodontic and surgical management have the potential to guide the canines into an appropriate plane of eruption. The role of orthodontists is critical because diagnosing a canine impaction depends on their expertise.¹⁵ Impacted

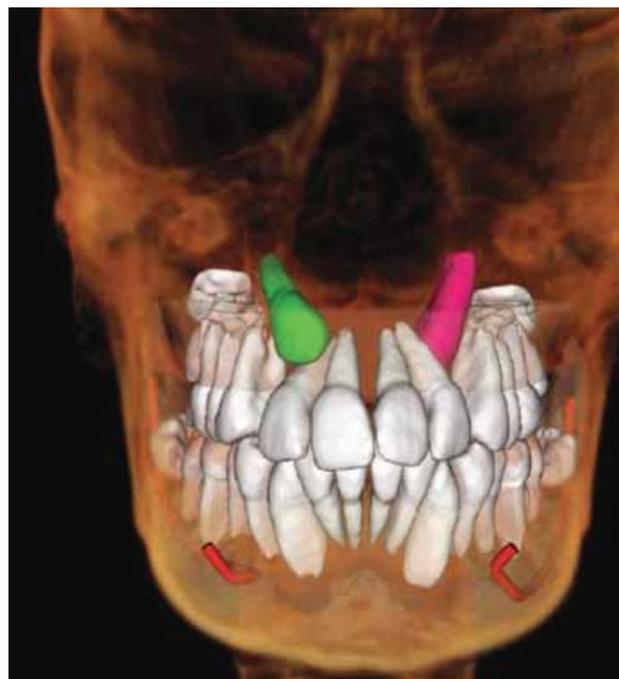


Fig. 4 Cone-beam computed tomography scans for maxillary canines.

maxillary canines are also palpable by the patient. Orthodontists make space analysis diagnoses, and if there is a need for additional space, orthodontists employ methods like maxillary arch expansion, extraction of permanent premolars, or maxillary incisor proclination.¹⁶ Orthodontists also undertake nonextraction treatment plans to achieve a stable profile and treatment outcome, as is evident in a case report by Munaif et al.¹⁶ Impacted maxillary canine requiring surgical exposure must also include the presence of a skilled orthodontist for positive treatment outcome and diagnosis confirmation. *The canine first technique* is an innovative approach through which orthodontists use skeletal anchorage for the disimpaction of canines, as reported in one case study by Bocchino et al.¹⁷ However, this innovative approach could have side effects such as root resorption of the adjacent incisors.¹⁸ Orthodontic mini screws as temporary anchorage devices, along with the hybrid addition of clear aligners, have also been used in the orthodontic management of canine impaction.¹⁹

Orthodontic and Surgical Management of Maxillary Canine Impaction

The proper surgical method must be chosen based on the diagnosis of maxillary canine impaction.⁹ The most extreme situations can present the need for the excision of the affected canine.²⁰ Surgical treatment, if done correctly, for maxillary canine impaction has a high success rate.²¹ One of the treatment options for the impacted maxillary canine is surgical exposure followed by an orthodontic forced eruption. For exposure of the impacted canine, a number of surgical procedures have been described in the literature, which includes apically repositioned flap, window excision of the soft tissue, and closed eruption technique.²² The position of the impacted



Fig. 3 Three-dimensional radiographs and intraoral radiographs.

tooth, the patient's age, and the degree of the impaction all influence the surgical procedure used.²³⁻²⁵ Later, orthodontic techniques are often used with implant surgery to help the tooth fit into its proper position.

The most common approach for surgical exposure of the impacted canines is the vestibular approach.³ In this procedure, the gum tissue next to the front (cheek) of the tooth is incised. The tooth is then exposed and restored with periodontal brackets and wires. Another standard route is the oral route.²⁶ In this procedure, the gum tissue next to the mouth (tongue) of the tooth is incised. The tooth is then exposed and restored with periodontal brackets and wires. In some cases, a combination of the vestibular and palatal approaches may be necessary. This is often the case for canines impacted in the labial and palatal directions.²⁷

A combined forced eruption treatment method for managing impacted maxillary canines was presented in a case report by two authors. The strategy involved surgically exposing the affected teeth, anchoring preparation, and orthodontic traction. The authors claimed that this strategy had positive results.^{22,28} A proposed clinical classification offers an organized course of action for therapy based on the position of the impacted tooth and anatomical considerations.²² The classification contains recommendations for choosing the best surgical strategy. Based on the most recent research, the epidemiology of canine impaction, diagnostics, and surgical alternatives for the exposure of an impacted maxillary canine are described. The correlation between the canine's starting location and treatment outcome was assessed in a systematic review.²⁹ A number of treatments for impacted maxillary canines were identified in the analysis, including interceptive methods, surgical exposure, and orthodontic traction. The study stated that the initial

positioning of the injured canine may have an impact on how well it responds to treatment.

Four other researchers conducted a comprehensive review that contrasted clinical and scientific information about the management of significantly impacted maxillary canines.³⁰ The research found a number of treatment possibilities, including early interceptive treatment, surgical exposure, and alignment of the affected tooth with or without orthodontic traction. They believed that the scientific evidence for the treatment of significantly damaged maxillary canines is scarce.

Preserving the canines is the best course of action to retain functional and aesthetically pleasing results. An interceptive treatment strategy can be employed, which requires extraction of the primary canine and letting the impacted canine take its natural eruptive path.^{2,31,32} The treatment of impacted maxillary canines is a difficult task that needs to be approached from a variety of angles. For successful results, administering orthodontic traction pressures and accurately defining the access for the surgical approach is essential.³³

Surgery to expose the canine is always followed by orthodontic treatment to reposition the tooth into the dental arch, especially in palatal displacement situations.³⁴ The two most popular surgical exposure treatment modalities are closed and open exposure.³⁵ In the closed approach, the tooth is exposed without removing any bone by creating a tiny hole in the soft tissue above it. In the open method, a flap of bone and soft tissue is mirrored to reveal the tooth, as shown in **Fig. 5**.

The management of impacted maxillary canines is a significant challenge that necessitates a multidisciplinary approach. Effectively identifying how to access surgery techniques and implementing orthodontic traction techniques are essential for effective results.



Fig. 5 Surgical exposure of canines, open space with coil spring, traction of canines, align.

The Outcomes and Complications of Surgical and Orthodontic Treatment for Maxillary Canine Impactions

Surgical exposure followed by orthodontic forced eruption is an effective treatment approach for impacted maxillary canines.³⁶ A combination forced eruption treatment method described in a case report for managing impacted maxillary canines has shown positive treatment results.²⁸ Complications have a high risk of arising as the age of the patient increases. It was also identified that the closed eruption technique could produce dental ankylosis.³⁷ To prevent this complication, opting for maxillary expansion in children as the first treatment choice for impacted canines is advised. This can lead to the spontaneous eruption of the impacted maxillary canine.^{2,31} Apart from this, a complication seen with orthodontic traction is root resorption of adjacent teeth. However, two studies investigated that this rarely happens.^{38,39} A realistic approach, the patient's age, good oral hygiene, and appropriate expertise can help prevent a number of possible complications.⁴⁰

Conclusion

In conclusion, this review provides a brief overview of the best treatment approaches for the management of maxillary canine impactions. We have highlighted the importance of evidence-based decision-making when choosing treatment options for the management of maxillary canine impaction. The successful eruption of canines requires good cooperation between oral surgeons and orthodontists. By reviewing the available literature, major insights and findings on the effectiveness, outcomes, and complications of these techniques have emerged. The choice of approach should be tailored to patient-specific characteristics, including severity, age, and physical factors.

Findings suggest that overall success rates are promising for the orthodontic and surgical management of maxillary canine impactions, with most studies reporting high success rates and good clinical outcomes. Still, it should be noted that success rates can vary depending on factors such as expertise, patient compliance, postoperative care, treatment planning, and follow-up.

The reviewed studies also highlighted the difficulties associated with the management of maxillary canine impactions. These complications include resorption, postoperative infection, and damage to adjacent structures. However, it should be noted that complications are generally low, primarily when a multidisciplinary team provides treatment and appropriate precautions are taken.

With rapid advances in technology, emerging techniques are also promising for the management of maxillary canine impaction. These new techniques, such as mini-screw use, computer-assisted surgery, and guided blast, can improve clinical outcomes and significantly reduce complications.

Funding
None.

Conflicts of Interest
None declared.

References

- Bishara SE. Impacted maxillary canines: a review. *Am J Orthod Dentofacial Orthop* 1992;101(02):159–171
- Ericson S, Kuroi J. Early treatment of palatally erupting maxillary canines by extraction of the primary canines. *Eur J Orthod* 1988; 10(04):283–295
- Cooke J, Wang H-L. Canine impactions: incidence and management. *Int J Periodontics Restorative Dent* 2006;26(05):483–491
- Jahanbin A, Shahabi M, Rangrazi A, Namdar P, Lal Alizadeh F. Surgical management of various types of maxillary canine impaction: a narrative review. *Reviews in Clinical Medicine* 2019;6(01):29–32
- Sherwood K. Evidence-based surgical-orthodontic management of impacted teeth. *Atlas Oral Maxillofac Surg Clin North Am* 2013; 21(02):199–210
- Becker A, Chaushu S. Etiology of maxillary canine impaction: a review. *Am J Orthod Dentofacial Orthop* 2015;148(04):557–567
- Beadnell SW. Management of the Impacted Canine. In *Current Therapy in Oral and Maxillofac Surg*. Elsevier Inc.; 2012:135–145. Doi: 10.1016/B978-1-4160-2527-6.00016-5
- Ahmed Z, Awaisi ZH, Ahmed Z. Etiology of midline diastema in patients presenting to Nishtar Institute of Dentistry, Multan. *Khyber Medical University Journal*. 2022;14:169–172
- Jiménez-Silva A, Carnevali-Arellano R, Vivanco-Coke S, Tobar-Reyes J, Araya-Díaz P, Palomino-Montenegro H. Prediction methods of maxillary canine impaction: a systematic review. *Acta Odontol Scand* 2022;80(01):51–64
- Aljabri M, Aljameel SS, Min-Allah N, et al. Canine impaction classification from panoramic dental radiographic images using deep learning models. *Inform Med Unlocked* 2022;30:100918
- MacDonald D, Alebrahim S, Yen E, Aleksejuniene J. CBCT reconstructions in the evaluation of maxillary impacted canines. *Imaging Sci Dent* 2023;53:145–151
- Varghese G. Management of Impacted Canines. *Oral and Maxillofacial Surgery for the Clinician*. SpringerSingapore2021:329–347. Doi: 10.1007/978-981-15-1346-6_15
- Bedoya MM, Park JH. A review of the diagnosis and management of impacted maxillary canines. *J Am Dent Assoc* 2009;140(12): 1485–1493
- Jacoby H. The 'ballista spring' system for impacted teeth. *Am J Orthod* 1979;75(02):143–151
- Bourzgui F, Diouny S, Khazana MM, Serhier Z, Othman MB. The prognosis of impacted maxillary canines and orthodontic management. *Int J Med Rev Case Rep*. 2021;5(03):1–7
- Munaif V, Jyothikiran H, Raghunath N. Non extraction orthodontic management of class I malocclusion with ectopically placed canine: a case report. *Int. J. Appl. Dent. Sci*. 2020;6(01):112–115
- Bocchino T, Perrotta S, Martina S, D'Antoè V, Valletta R. Canine first technique, an innovative approach in maxillary impacted canines: a case report. *Open Dent J* 2022;16(2209140):1–7
- Wang H, Li T, Lv C, et al. Risk factors for maxillary impacted canine-linked severe lateral incisor root resorption: a cone-beam computed tomography study. *Am J Orthod Dentofacial Orthop* 2020;158(03):410–419
- Greco M, Machoy M. Impacted canine management using aligners supported by orthodontic temporary anchorage devices. *Int J Environ Res Public Health* 2022;20(01):1–15
- Kokich VG. Surgical and orthodontic management of impacted maxillary canines. *Am J Orthod Dentofacial Orthop* 2004;126 (03):278–283
- Al-Zoubi H, Alharbi AA, Ferguson DJ, Zafar MS. Frequency of impacted teeth and categorization of impacted canines: a retrospective radiographic study using orthopantomograms. *Eur J Dent* 2017;11(01): 117–121

- 22 Chapokas AR, Almas K, Schincaglia GP. The impacted maxillary canine: a proposed classification for surgical exposure. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2012;113(02):222–228
- 23 Shahid F, Alam MK, Khamis MF. A new formula to predict mesiodistal width of maxillary canines: a digital model study. *Orthod Waves* 2017;76(01):18–25
- 24 Shahid F, Alam MK, Khamis MF. New prediction equations for the estimation of maxillary mandibular canine and premolar widths from mandibular incisors and mandibular first permanent molar widths: a digital model study. *Korean J Orthod* 2016;46(03):171–179
- 25 Alam MK. Management of bilateral impacted maxillary canines (BIMC): open surgical exposure and orthodontic traction. *Bangladesh J Med Sci.* 2020;19(01):169–173
- 26 Upadhyaya JD, Bhattacharyya I, Fitzpatrick SG, Cohen DM, Islam MN. Peripheral ameloblastoma: a study of 18 cases and usage of Ber-EP4 immunohistochemistry to rule out a diagnosis of intraoral basal cell carcinoma. *J Oral Maxillofac Surg* 2018;76(05):996–1004
- 27 Leandro L, Dolci G, Prabhu S, Corkill R. Bilateral traumatic Caroticocavernous fistulas: a case report and review of the literature. *J Oral Maxillofac Surg* 2018;76(04):826–830
- 28 Premkumar S, Sfs S, Tovani-Palone MR. Management of impacted maxillary canines: a case report. *Electron J Gen Med* 2019;16:1–10
- 29 Grisar K, Luyten J, Preda F, et al. Interventions for impacted maxillary canines: a systematic review of the relationship between initial canine position and treatment outcome. *Orthod Craniofac Res* 2021;24(02):180–193
- 30 Grisar K, Denoiseux B, Martin C, et al. Treatment for critically impacted maxillary canines: clinical versus scientific evidence – a systematic review. *J Stomatol Oral Maxillofac Surg* 2022;123(03):e12–e19
- 31 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(03):215–223
- 32 Baccetti T, Mucedero M, Leonardi M, Cozza P. Interceptive treatment of palatal impaction of maxillary canines with rapid maxillary expansion: a randomized clinical trial. *Am J Orthod Dentofacial Orthop* 2009;136(05):657–661
- 33 Varghese SC, Preethi G, Balaji K, Anison JJ, Rajesh R, Mahalakshmi K. Unveiling the impacted canine–Eyelet chain guide: concepts and clinical application. *Contemp Clin Dent* 2020;11(04):403–407
- 34 Izadikhah I, Cao D, Zhao Z, Yan B. Different management approaches in impacted maxillary canines: an overview on current trends and literature. *J Contemp Dent Pract* 2020;21(03):326–336
- 35 Bjerklind K. Orthodontic management of impacted maxillary canines. *APOS Trends Orthod* 2020;10:64–71
- 36 Sajnani AK, King NM. Complications associated with the occurrence and treatment of impacted maxillary canines. *Singapore Dent J* 2014;35:53–57
- 37 Koutzoglou SI, Kostaki A. Effect of surgical exposure technique, age, and grade of impaction on ankylosis of an impacted canine, and the effect of rapid palatal expansion on eruption: a prospective clinical study. *Am J Orthod Dentofacial Orthop* 2013;143(03):342–352
- 38 Lempesi E, Pandis N, Fleming PS, Mavragani M. A comparison of apical root resorption after orthodontic treatment with surgical exposure and traction of maxillary impacted canines versus that without impactions. *Eur J Orthod* 2014;36(06):690–697
- 39 Brusveen EM, Brudvik P, Bøe OE, Mavragani M. Apical root resorption of incisors after orthodontic treatment of impacted maxillary canines: a radiographic study. *Am J Orthod Dentofacial Orthop* 2012;141(04):427–435
- 40 Grybienė V, Juozėnaitė D, Kubiliūtė K. Diagnostic methods and treatment strategies of impacted maxillary canines: a literature review. *Stomatologija* 2019;21(01):3–12