PROGNOSTIC FACTORS IN CANINE IMPACTION: IMPLICATIONS FOR CLINICAL PRACTICE: A REVIEW

Alassfar,A. Benmohimd,H. Zaoui,F

Abstract

Introduction: Maxillary canine impaction is a frequent clinical issue with significant esthetic and functional implications. Understanding its etiologies, diagnostic tools, and prognostic indicators is key for optimal treatment planning.

Materials and Methods: A narrative review was conducted using PubMed (MEDLINE), Web Of Science, Google Scholar, Cochrane Library, Scopus with keywords: "impacted canine," "prognosis," "surgical traction," and "orthodontic treatment." Only English and French articles were included, selected based on titles, abstracts, and full-text relevance.

Discussion: Prognostic factors include patient age, angulation, root development, and cooperation. Early diagnosis and intervention increase treatment success. CBCT imaging provides detailed assessment. Treatment options range from interceptive techniques to surgical-orthodontic approaches depending on prognosis.

Conclusion: A better understanding of prognosis indicators guides clinicians toward tailored and effective treatment strategies.

Keywords: Impacted canine, Prognosis, Surgical traction, Orthodontic treatment

INTRODUCTION

Among impacted teeth, maxillary canines represent a frequent clinical concern, second only to third molars in prevalence [1]. A canine is classified as impacted if it fails to erupt or align properly within its expected developmental period [1]. Untreated impacted canines can cause both functional and esthetic complications, such as displacement of adjacent teeth, midline deviation, and changes in arch length. Additionally, follicular cyst formation, infections, and resorption of the impacted tooth or nearby roots may develop [2].

Early identification of canine inclusion is therefore a cornerstone of preventive orthodontics, as it enables less invasive correction and better long-term outcomes. Multiple etiologic contributors have been associated with this condition, including [1,3] :

The presence of supernumerary teeth, odontomas, pathological lesions, delayed exfoliation of primary canine, early trauma to the maxilla, conditions like cleft lip and palate, ankylosis and genetic syndromes.

In cases of buccal impaction, lack of space within the dental arch, often due to crowding, is a commonly observed contributing factor [4]. Palatal impactions may occur via various mechanisms, with the guidance theory suggesting that the lateral incisor root directs the canine's eruption path [5] .If this root is missing or malformed, the canine's eruption may be disrupted. The genetic theory attributes palatal impactions to hereditary factors mainly due to small shaped or absent lateral incisors [5].

Managing impacted canines ranges from removing the primary canine early to make space for the permanent tooth, simply monitoring the impaction over time, surgical removal of the impacted tooth followed by replacement with a prosthesis, or orthodontic-surgical traction. However, predicting treatment success can rely on different parameters as the patient's age, the severity and type of impaction, the surgical technique and the orthodontic forces used, and overall patient health [5]. **The aim of this article is to assist orthodontists in evaluating the key etiological, diagnostic, and prognostic factors of impacted canines to guide treatment planning and optimize patient outcomes.**

MATERIALS AND METHODS

To conduct this narrative review, we searched the PubMed (MEDLINE), Web Of Science, Google Scholar, Cochrane Library, Scopus for relevant articles published between **January 2000 and December 2024** using the following keywords: Impacted canine, Prognosis, Surgical traction, Orthodontic treatment "**impacted canine**", "**prognosis",** "**surgical traction**", "**orthodontic treatment**". The selection and reporting of studies were guided by the **PRISMA** (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure a transparent and reproducible review process. **Quality assessment of the selected studies** was performed informally based on study design, sample size, clarity of prognosis-related outcomes, and relevance to orthodontic management of impacted canines. Articles that did not provide relevant data or were outside the scope of orthodontic management of canine impaction and studies with insufficient data or unclear methodology were excluded.

These keywords were combined in as many steps as necessary, using the Boolean operator "AND". Only articles written in French and English were considered. Articles were first selected by reading the titles and abstracts, and then by reading all the articles selected, in order to identify those that met the objective of this work, whatever the **type of study** (clinical trials, reviews, or observational studies).
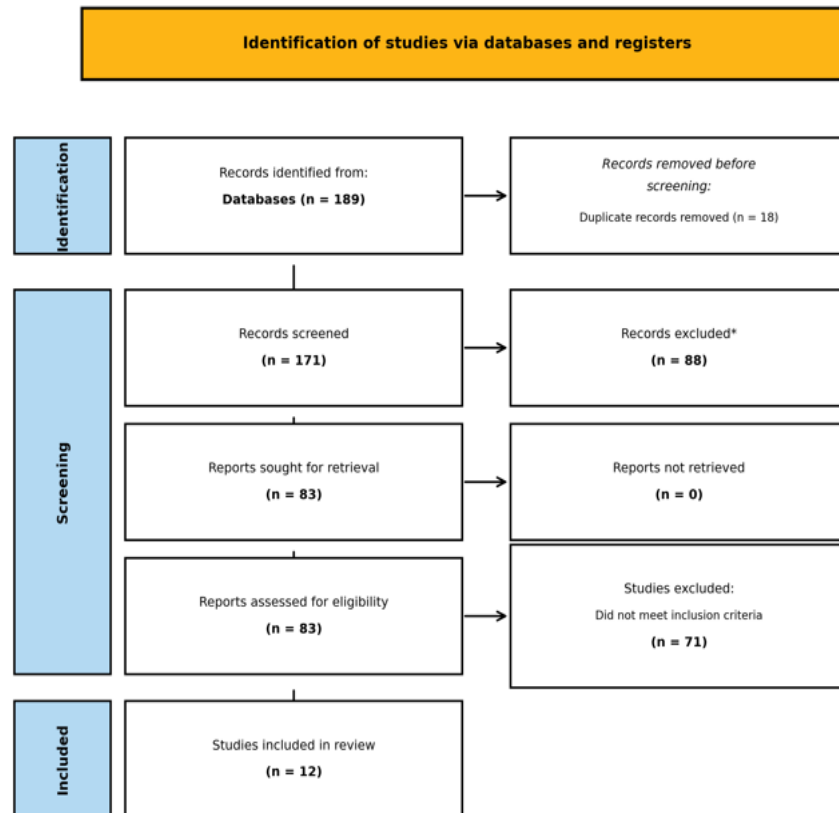
Study selection criteria

Identification of studies via databases and registers

	Records identified from: Databases (n = 189)	→	Records removed before screening: Duplicate records removed (n = 18)
	Records screened (n = 171)	→	Records excluded* (n = 88)
	Reports sought for retrieval (n = 83)	→	Reports not retrieved (n = 0)
	Reports assessed for eligibility (n = 83)	→	Studies excluded: Did not meet inclusion criteria (n = 71)
	Studies included in review (n = 12)		

Figure: PRISMA flowchart of study selection

The literature search identified 189 articles through the PubMed (MEDLINE) database, of which 83 were selected for full-text review after screening titles and abstracts. Among these, 71 full-text articles were assessed for eligibility, resulting in the inclusion of 12 studies in this narrative review. **(Table I)**

PROGNOSTIC FACTORS

Prognostic factors are variables that can influence the likelihood of successful treatment outcomes for impacted canines. These factors include a range of considerations, including patient-related aspects such as age, dental arch development, and overall health, radiographic features like the position and angulation of the impacted canine, and practitioner-related techniques that reflect the clinician's experience and skill [6, 7].

The prognosis of impacted canines is significantly affected by these elements, as they determine not only the success of the chosen treatment approach but also the overall clinical outcome. By

understanding and addressing these prognostic factors, treatment strategies enhance effectiveness and optimize their results [8,9].

Patient-Related Factors

Several patient-specific characteristics help determine the success of treating impacted canines.

Age is one of the most critical factors, as younger patients generally experience better outcomes. In younger individuals, the flexibility of the bone and the plasticity of the periodontal ligament allow for easier tooth movement and a higher likelihood of successful traction. As the patient ages, the bone becomes denser and less accommodating to orthodontic or surgical manipulation, reducing the chances of favorable results. Therefore, early intervention is strongly recommended to take advantage of these physiological conditions [10].

Patient motivation and cooperation are equally important, as successful treatment of impacted canines often involves a long and demanding process including multiple appointments and sometimes surgical procedures.

Conversely, a lack of motivation or financial resources may lead patients to opt for extraction or avoid treatment altogether, negatively impacting prognosis.

Additionally, the **patient's general health** can influence the success of treatment. Conditions such as diabetes, immune disorders, or other systemic health issues can slow healing or complicate surgical and orthodontic procedures, making treatment more challenging [11].

Gender is also considered a significant prognostic factor in canine impaction. Several studies have reported a greater occurrence of maxillary canine impaction has been observed in females compared to males, with female-to-male ratios varying between 2:1 to 3:1. This disparity may be linked to genetic, hormonal, or anatomical differences, although the exact reasons remain unclear. While sex alone does not determine treatment outcome, its association with higher impaction rates in females may prompt earlier monitoring and intervention in this population [6].

Radiographic Factors

Radiographic analysis is crucial for accurately assessing the position and complications associated with impacted canines. Several radiographic factors provide insight into the potential success of

treatment [12]. ***The degree of horizontal superposition*** of the impacted canine relative to adjacent teeth can significantly influence prognosis. Canines positioned closer to the midline, overlapping with adjacent incisors, often present a greater challenge for treatment. These cases typically require more complex orthodontic and surgical interventions and tend to have poorer outcomes than those where the canine is further from the midline [5,4].

The ***root anatomy and position of the impacted canine*** are also critical in predicting treatment success. Variations in root shape, such as excessive angulation or curvature, can complicate tooth movement and increase the likelihood of adverse outcomes, such as ankylosis or root resorption [5].

Assessing ***the position of the root apex in the horizontal*** plane is essential for developing a realistic treatment plan and determining the difficulty of the case.

The 'alpha angle' as defined by Becker et al describes the inclination between the axis of the impacted canine and the midline [5]. **(Figure 2).**

A smaller angle is generally associated with a better prognosis. When the angle is more severe, treatment becomes more complex, and the chances of success decrease.

Similarly, ***the vertical height of the impacted tooth in*** relation to the occlusal plane can provide insight into the potential difficulty of treatment **(Figure 3)** [13]. Canines positioned farther from the occlusal plane often require more extensive interventions as their distance from their intended position complicates the eruption process**.**

The stage of root development also plays a role in determining the appropriate treatment approach. Canines with partially formed roots may respond well to interceptive orthodontics, allowing for easier movement [7,3]. While those with fully developed roots often require more invasive procedures. Evaluating root development can help practitioners choose between less invasive and more complex treatment modalities.

A crucial prognosis factor influencing the treatment of impacted canines is the histological structure of the tooth, which regroups its composition and the integrity of its various components. Anomalies such as enamel hypoplasia or abnormal dentin formation can significantly impair the tooth's mechanical properties, affecting its ability to withstand orthodontic forces during traction. Such structural weaknesses may lead to

compromised bonding quality between the orthodontic attachments and the tooth surface, increasing the risk of premature detachment during treatment [8].

Moreover, the presence of complications such as infections, tumors, or cystic formations in the peri-apical area can create an unfavorable environment for the impacted canine. These complications not only complicate the treatment process but also necessitate a multidisciplinary approach [17, 18].

Practitioner-related factors

Certain practitioner-related factors can influence the success of orthodontic traction and the prognosis of tooth alignment. Key among these is the careful selection of incision sites and precise flap positioning, both of which play a crucial role in optimizing periodontal health [6,19] .The practitioner must prioritize the preservation of the attachment system and ensure respect for keratinized tissue to safeguard the long-term health of the surrounding structures [19] . A failure to control hemostasis or contamination by etching acid can lead to severe complications, such as ankylosis, cervical resorption, or even periodontal issues like recession or pocket formation. Furthermore, the application of excessive forces or the improper direction of traction can exacerbate the risk of ankylosis or resorption of adjacent teeth. From a biomechanical perspective, the use of light and continuous forces is important to the periodontal prognosis of the impacted canine, ensuring that the tooth emerges in a healthy periodontal environment [8]. Thus, a periodontal-conscious approach must be adopted at every stage of treatment, as the condition of the periodontal tissues will ultimately dictate the success of the procedure.

TREATMENT MODALITIES FOR CANINE IMPACTION BASED ON PROGNOSTIC FACTORS

The management of canine impaction includes a range of treatment modalities [3].

Early intervention is often the cornerstone of effective management for canine impaction, particularly in growing patients. Interceptive orthodontics involves measures that address potential impaction before full orthodontic treatment begins. Techniques such as palatal expansion or the extraction of primary teeth can be employed to create sufficient space for the permanent canines.

This early intervention can significantly reduce the likelihood of complications later on, including the need for more invasive treatments [7].

> **Favorable Prognosis**

- A widely accepted standard for treating impacted canines involves surgical exposure combined with controlled orthodontic traction, especially in cases with favorable anatomical conditions [8]. The choice of the surgical flap design depends on the depth and angle of the canine [5]. Proper flap design is crucial for reducing tissue trauma and promoting healing, which supports effective orthodontic movement [10].

- **Temporary Anchorage Devices (TADs)**: TADs have significantly improved the management of impacted teeth by providing extra anchorage points [22]. These devices allow orthodontists to apply controlled forces without relying on neighboring teeth. This is particularly helpful for canines that are deeply impacted or in difficult positions, as it gives greater control over tooth movement [18].

- **Abstention**: In certain cases, a conservative approach may be chosen, where no immediate treatment is undertaken [6]. This approach is considered when the impacted canine poses no immediate risk to the adjacent teeth or gum health. Spontaneous eruption may occur, especially in younger patients, and close monitoring can help assess whether intervention is necessary later, regular follow-up is critical to ensure no complications develop [10].

> **Unfavorable Prognosis**

Extraction: Extracting the impacted canine may be necessary when the tooth is severely misaligned, or presents a risk of damaging adjacent teeth, or fails to respond to orthodontic treatment. This is typically considered a last resort, used when other options are unlikely to succeed, or when keeping the tooth could lead to problems like root resorption or other complications [2]. Extraction is considered by weighing the potential risks and benefits.

Successfully treating canine impaction involves a combination of interceptive procedures, surgical methods, conservative approaches when needed, and appropriate orthodontic tools [16].

To summarize the treatment modalities for canine impaction based on the various prognostic factors, **Table II** presents an overview of the recommended approaches. These modalities range

from early interceptive measures to more invasive surgical interventions, depending on the prognosis and individual patient factors. The table below outlines key prognostic factors and their associated impact on treatment outcomes, categorizing them into **Good Prognosis**, **Average Prognosis**, and **Poor Prognosis** (Table II).

DISCUSSION

The management of canine impaction remains a complex challenge in orthodontic practice, impacting both esthetic and functional outcomes. The interplay of various predictive factors influencing treatment outcomes is crucial for guiding clinicians in developing effective intervention strategies.

One of the primary considerations is the initial position of the impacted canine. Studies have shown that the depth of impaction and the angulation relative to adjacent teeth play critical roles in treatment success. For instance, canines that are deeply impacted or have unfavorable angulations tend to require more invasive surgical procedures and longer treatment durations [22]. This aligns with findings by Stivaros and Mandall, who concluded that accurate radiographic assessments are essential for understanding the relationship between the impacted tooth and surrounding structures [23]. However, there are discrepancies in the reported success rates of orthodontic traction based on the alpha angle. For example, a study by Becker et al. showed a higher success rate in cases with a smaller alpha angle (<30°), while other studies suggest that angulation alone does not always predict treatment success [6].

Three-dimensional imaging modalities, most notably CBCT, have transformed clinical decision-making by enabling comprehensive evaluation of impacted canine cases which enhances the clinician's ability to visualize the impacted canine and plan appropriate interventions [24]. Numerically, studies have reported that the success rate of canine repositioning after early intervention using CBCT is significantly higher, with a reported success rate of up to 85% for cases identified early compared to 55% for later diagnoses. However, some authors point out that while CBCT offers superior accuracy, it is often underutilized due to cost or accessibility limitations [4]. Becker and al. noted that early diagnosis facilitated by advanced imaging can significantly improve treatment outcomes, as it allows for timely interventions before more severe complications arise [25].

Furthermore, conditions such as supernumerary teeth often complicate the eruption pathway and necessitate a more comprehensive treatment plan [26]. The systematic review by Grisar and al. underlines the importance of understanding these local factors when assessing the prognosis of impacted canines [27].

The periodontal health of the surrounding tissue is another critical consideration in the treatment of impacted canines. Research by Crescini and al. highlights the necessity of evaluating pre-treatment radiographic features to predict periodontal outcomes effectively [28].

Factors such as alveolar bone and periodontal tissues integrity can significantly influence the long-term success of the canine's repositioning. Maintaining periodontal health throughout the treatment process is essential for preventing any complications such as root resorption or ankylosis [29].

Moreover, the surgical procedure ensures the treatment success. The article by Pignoly and al. discusses the influence of the surgical technique, including the choice of orthodontic traction methods, on the overall prognosis [30]. For instance, improper flap design or excessive force application during traction can jeopardize the periodontal status and result in unfavorable outcomes. While there is a broad consensus that orthodontic traction is effective, variations in technique and the use of Temporary Anchorage Devices (TADs) have led to inconsistent results in some studies. Success rates for orthodontic traction of impacted canines generally range from 70% to 90%, although these rates vary depending on factors such as patient age, severity and position of impaction, and specific treatment techniques employed. Younger patients with favorable anatomical conditions tend to achieve higher success rates, while cases with severe impactions or complex root morphology may experience lower success. The use of adjunctive tools like Temporary Anchorage Devices (TADs) has improved outcomes in challenging cases but requires clinical expertise and access to such devices [31].

Finally, the psychological aspects of treatment can be considered as well as the cooperation during the treatment phase [31]. This involves the need for effective communication between clinicians and patients to align expectations and promote adherence to treatment plans [32]. Despite their importance, psychological and socioeconomic variables are rarely the primary focus of prognosis studies, and when included, they are often assessed subjectively or with inadequate tools, contributing to bias in outcome reporting. Although literature outlines important prognostic factors for canine impaction, research gaps remain: few longitudinal studies assess long-term effectiveness

of treatment options. Most current research is cross-sectional, providing only snapshot insights, which hampers understanding of how early indicators such as age or root maturity can influence long term outcome.

Additional limitations include small cohorts, retrospective designs, and inconsistent diagnostic criteria. Differences in practitioner skillsets and techniques add heterogeneity, making definitive conclusions difficult. Moreover, variables like socioeconomic background and healthcare access, which likely impact treatment success, are frequently overlooked. Addressing these issues will require robust, multicenter, longitudinal research to clarify which factors truly determine successful management of impacted canines.

CONCLUSION

In conclusion, the management of impacted canines requires a multidisciplinary approach that considers the underlying etiological factors, accurate diagnostic evaluation, and careful assessment of prognostic indicators. In addition to clinical factors, patient communication, motivation, and cooperation are critical components that influence treatment adherence and overall success. By using a combination of non-surgical and surgical treatment modalities tailored to each case, orthodontists can optimize outcomes and improve patient satisfaction. Timely diagnosis and a prognosis-based approach remain the cornerstones of successful canine impaction management.

References

1.Cruz, R. M. Orthodontic traction of impacted canines: Concepts and clinical application. Dental Press J. 2.Orthod. 24, 74–87. https:// **doi.org/10.1590/2177-6709.24.1.074-087.bbo (2019).**

2. Aquino-Valverde AJ, Barrientos-Sánchez DM, Atoche-Socola KJ. Orthodontic treatment in impacted maxillary canines: A review of the literature. Rev Cient Odontol (Lima). 2021;9(4):e085. **doi:10.21142/2523-2754-0904-2021-085**.

3. Bedoya MM, Park JH. A review of the diagnosis and management of impacted maxillary canines. *J Am Dent Assoc.* 2009;140(12):1485–1493. **doi:10.14219/jada.archive.2009.0099**

 4. **Dachi SF, Howell FV.** A survey of 3,874 routine full-mouth radiographs. II. A study of impacted teeth. *Oral Surg Oral Med Oral Pathol*. **1961;14(10):1165–1169.** doi:10.1016/0030-4220(61)90204-3

5.Manne, R, Gandikota CS, Juvvadi SR, Rama HRM, Anche S. Impacted canines: Etiology, diagnosis and orthodontic management. J Pharm Biollied Sci. 2012 Aug;4(Suppl 2):S234-8.

6.Becker A, Smith P, Behar R. The incidence of anomalous lateral incisors in relation to palatally displaced cuspids. Angle Orthod 1981;51:24-9.

7.Peck S, Peck L, Kataja M. The palatally displaced canine as a dental anomaly of genetic origin. Angle Orthod. 1994;64(4):249-56.

8.Ericson S, Kurol J. Early treatment of palatally erupting maxillary canines by extraction of the primary canines. Eur J Orthod 1988; 10(1): 283−295.

9. **Bishara SE, Kommer DD, McNeil MH, Montagano LN, Oesterle LJ, Youngquist HW.** Impacted maxillary canines: a review. *Am J Orthod Dentofacial Orthop*. **1992;101(2):159–171.** doi:10.1016/0889-5406(92)70008-X

10. Power S, Short M. An investigation into the response of palatally displaced canines to the removal of deciduous canines and an assessment of factors contributing to favourable eruption. J Orthod 1993; 20(3): 217−223.

11. Hwang, Y., & Lee, K. (2015). The influence of tooth position on the prognosis of impacted canines: A systematic review. Journal of Oral Rehabilitation, 42(12), 951-958. doi:10.1111/joor.12323.

12. Hsu, C. Y., & Lee, C. H. (2016). Impacted maxillary canines: A review of the literature. Clinical Oral Investigations, 20(2), 285-292. doi:10.1007/s00784-015-1544-4.

13. Leung, M., & Wong, K. (2011). The relationship between the location of impacted canines and treatment outcomes: A clinical study. Journal of Dental Sciences, 6(2), 88-95. doi:10.1016/j.jds.2011.03.003.

14. Mupparapu, M., & Kaur, H. (2015). Management of impacted canines: A comprehensive review. Journal of the American Dental Association, 146(5), 319-326. doi:10.1016/j.adaj.2015.01.012.

15. Bauss, O., & Schneider, L. (2010). Long-term results of surgical exposure and orthodontic traction of impacted maxillary canines. European Journal of Orthodontics, 32(2), 202-206. doi:10.1093/ejo/cjp070.

16. Vivas, A., & Berruecos, J. (2014). Canine impaction: A review of the literature. Medicina Oral Patologia Oral y Cirugia Bucal, 19(1), e75-e80. doi:10.4317/medoral.19215.

17. Kafas, P., & Tsakos, G. (2020). The role of genetics in canine impaction: A systematic review. European Journal of Orthodontics, 42(5), 471-479. doi:10.1093/ejo/cjaa008.

18. Henneman, S., & van der Weijden, F. (2015). Clinical outcomes of impacted canines after orthodontic treatment: A systematic review. Orthodontics & Craniofacial Research, 18(1), 1-12. doi:10.1111/ocr.12069.

19. Ritenour, M., & Kauffman, G. (2012). Surgical and orthodontic management of impacted canines: A literature review. Journal of Oral and Maxillofacial Surgery, 70(3), 639-645. doi:10.1016/j.joms.2011.08.021.

20. Shpack, N., & Chaushu, S. (2009). Treatment of impacted maxillary canines: A clinical approach. Dental Clinics of North America, 53(2), 345-357. doi:10.1016/j.cden.2008.12.001.

21. Garg, R., & Kaur, R. (2013). Impacted maxillary canines: A case report and review of literature. British Journal of Orthodontics, 40(4), 302-306. doi:10.1179/1465312513Y.0000000043.

22. Grisar K, Luyten J, Preda F, Martin C, Hoppenreijs T, Politis C, Jacobs R. Interventions for impacted maxillary canines: A systematic review on the relationship between initial canine position and treatment outcome. *Clin Oral Investig*. **2021;25(5):2665–2680.** doi:10.1007/s00784-020-03569-z

23. Stivaros N, Mandall NA. Radiographic factors affecting the management of impacted upper permanent canines. *J Orthod*. **2000;27(2):169–173.** doi:10.1093/ortho/27.2.169

24. Becker A, Chaushu S. Success rate and duration of orthodontic treatment for adult patients with palatally impacted maxillary canines. *Am J Orthod Dentofacial Orthop*. **2003;124(5):509–514.** doi:10.1016/S0889-5406(03)00603-0

25. Crescini A., Nieri M., Buti J., Baccetti T., Pini Prato GP. Pre-treatment radiographic features for the periodontal prognosis of treated impacted canines. J Clin Periodontol. 2007; 34: 581–587. doi: 10.1111/j.1600-051X.2007.01094.x.

26. Pignoly M, Monnet-Corti V, Le Gall M. Échec de la mise en place de dents retenues et incluses. *Rev Orthop Dento Faciale*. **2013;47(3):251–268.** doi:10.1051/odfen/2013018

27. Counihan K, Al-Awadhi EA, Butler J. Guidelines for the assessment of the impacted maxillary canine. *J Ir Dent Assoc*. **2013;59(1):29–33.** PMID:23573670

28. Machado Cruz R. Orthodontic traction of impacted canines: Concepts and clinical application. *Dental Press J Orthod*. **2019;24(6):82–90.** doi:10.1590/2177-6709.24.6.082-090.oar

29. Sambataro S, Baccetti T, Franchi L, Antonini F. Early predictive variables for upper canine impaction as derived from posteroanterior cephalograms. *Am J Orthod Dentofacial Orthop*. **2005;128(4): 485–488.** doi:10.1016/j.ajodo.2004.06.034

30. Stivaros N, Mandall NA. Radiographic factors affecting the management of impacted upper permanent canines. *J Orthod*. **2000;27(2):169–173.** doi:10.1093/ortho/27.2.169

31. Pignoly M, Monnet-Corti V, Le Gall M. Échec de la mise en place de dents retenues et incluses. *Rev Orthop Dento Faciale*. **2017;51(3):287–298.** doi:10.1051/odfen/2017031

32. Becker A, Chaushu S. Success rate and duration of orthodontic treatment for adult patients with palatally impacted maxillary canines. *Am J Orthod Dentofacial Orthop*. **2003;124(5):509–514.** doi:10.1016/S0889-5406(03)00603-0

Figures:

Figure 1: Alpha angle measuring canine angulation to the midline

Figure 2: Distance d measuring the vertical height of the canine to the occlusal plane (OP)

Figure 3: CBCT showing impacted canine

Tables:

Table I: Data extracted from studies in this review

TABLE II: Prognostic factors and their associated prognosis

Prognostic Factor	Good Prognosis	Average Prognosis	Poor Prognosis
Patient Age	Younger patients	Teens/After puberty	Adults (denser bone, less adaptable periodontal ligament)
Canine Position	Close to the arch, minimal overlap with adjacent teeth	Moderate overlap with adjacent teeth	Severe overlap or displacement
Angulation of Impacted Canine	Small alpha angle (<30° to midline)	Moderate alpha angle (30°–45°)	Large alpha angle (>45°), severe deviation
Root Development	Partially formed roots, flexible for movement	Fully developed roots, requiring more complex interventions	Ankylosed roots or significant curvature, complicating movement
Patient Cooperation	Highly motivated and compliant	Moderate motivation with occasional lapses	Poor cooperation or refusal of recommended treatment
Radiographic Findings	Favorable positioning, minimal root resorption	Moderate complications, manageable root resorption	Severe root resorption, cysts, or other pathologies
Periodontal Health	Healthy periodontal tissues and sufficient keratinized tissue	Minor periodontal issues that can stabilize with treatment	Significant periodontal problems or risk of tissue recession
Practitioner Experience	Skilled practitioner with experience in treating canine impaction	Practitioner with moderate experience	Inexperienced practitioner, risk of procedural complications

Table II: prognostic factors and their associated prognosis

Author (Year)	Study Design	Prognostic Factors Analyzed	Outcome Summary
Becker, Smith & Behar (1981) [6]	Clinical study	Lateral incisor anomalies linked to palatal canine impaction	Anomalous lateral incisors often coexist with impacted palatal canines, suggesting a genetic component
Peck, Peck & Kataja (1994) [7]	Observational	Genetic origin of palatally displaced canines	Confirmed palatally displaced canines as dental anomaly with hereditary background
Ericson & Kurol (1988) [8]	Prospective study	Early treatment by extraction of primary canines	Early extraction facilitates eruption of palatally displaced maxillary canines
Bishara et al. (1992) [9]	Review	Impacted canine characteristics & treatment	Provided an overview of impacted canine etiology and prognosis factors
Power & Short (1993) [10]	Clinical study	Response of palatally displaced canines after primary extraction	Early removal of primary canines correlated with favorable eruption outcomes
Becker & Chaushu (2003) [24]	Cohort study	Success rate and treatment duration in adults	Treatment success decreases with adult patients and complexity of impaction
Crescini et al. (2007) [25]	Clinical study	Pre-treatment radiographic features & periodontal prognosis	Radiographic features predict periodontal outcomes post-treatment
Grisar et al. (2021) [22]	Systematic review	Initial canine position and treatment outcome	Strong relationship between initial position and success of treatment
Stivaros & Mandall (2000) [23]	Retrospective study	Radiographic factors in impacted upper canines	Radiographic variables significantly influence treatment management and prognosis
Pignoly, Monnet-Corti & Le Gall (2013, 2017) [26]	Retrospective studies	Failure factors in impacted teeth management	Surgical technique and traction method affect prognosis; complications reduce success rates

| Sambataro et al. (2005) [29] | Cross-sectional | Early predictive variables from cephalograms | Certain cephalometric indicators predict likelihood of canine impaction |
| Machado Cruz (2019) [28] | Narrative review | Orthodontic traction techniques and clinical application | Highlighted critical prognostic factors and successful orthodontic approaches |

Table I: **Data extracted from studies in this review**
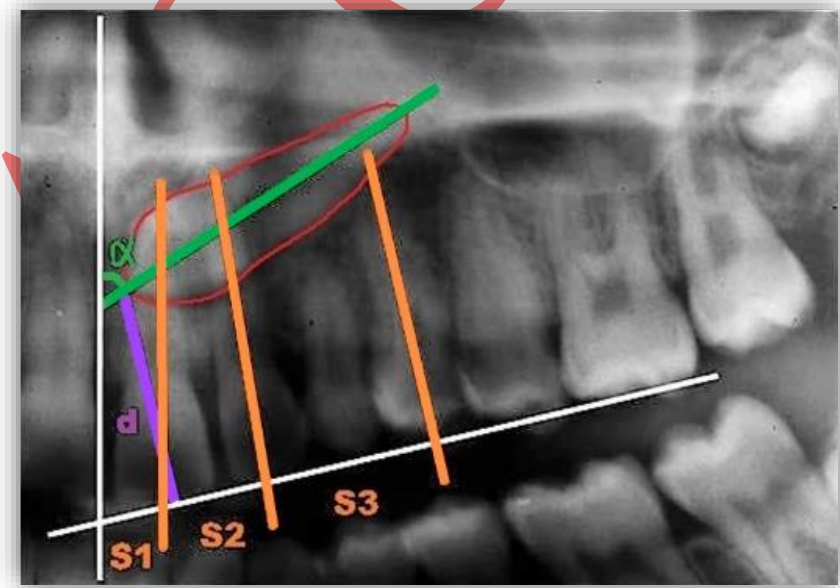
Figure 1: Alpha angle (the inclination between the axis of the impacted canine and the midline**).**
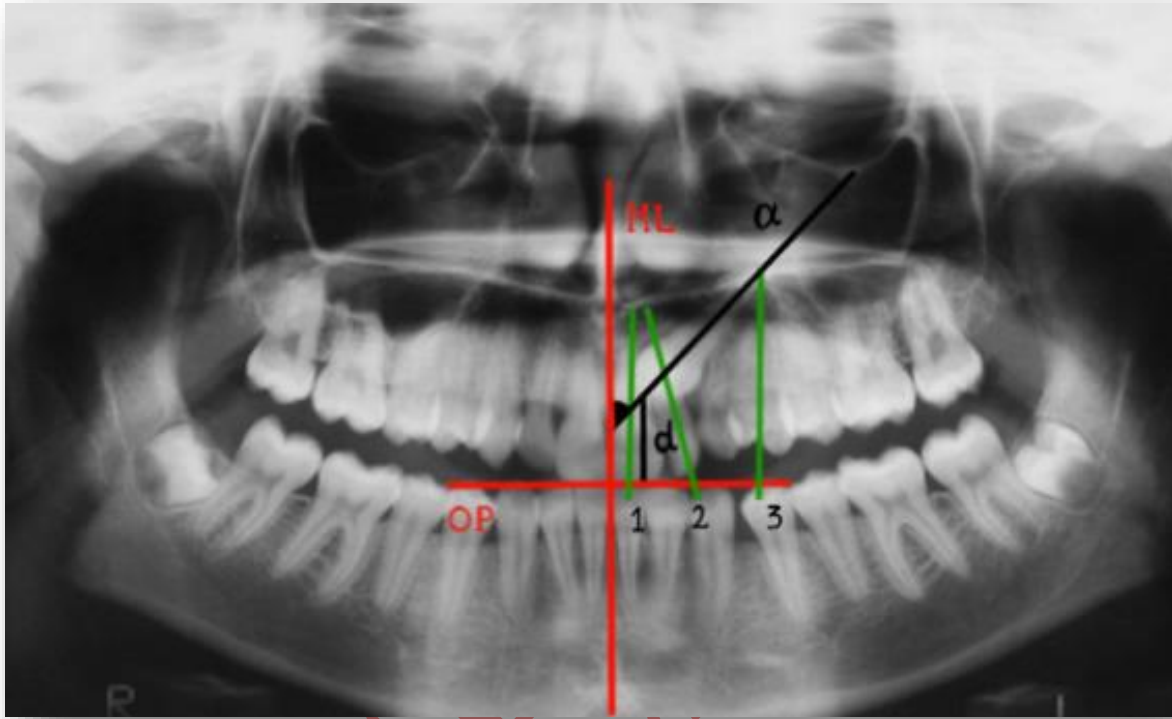

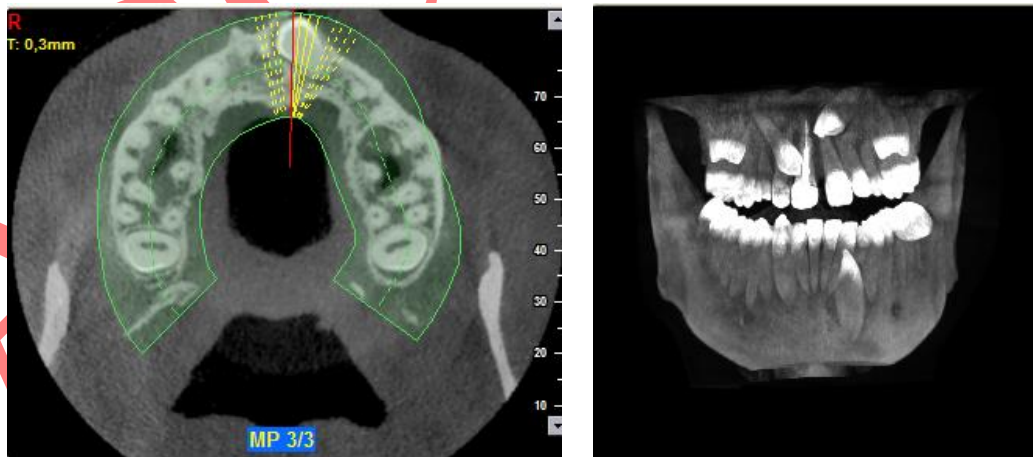**Figure 2 Distance d measuring the vertical height of the canine to the occlusal plane (OP)**

Figure 3 CBCT showing impacted canines