BULLETIN OF STOMATOLOGY AND MAXILLOFACIAL SURGERY
Volume 21, Issue 10

DOI: 10.58240/1829006X-2025.21.10-541

CASE REPORT

MANAGEMENT OF A PALATALLY IMPACTED MAXILLARY CANINE ASSOCIATED WITH ROOT RESORPTION OF ADJACENT TEETH USING TEMPORARY ANCHORAGE DEVICES (CASE REPORT)

Shno Yousif Ali[1] , Brwa Mahdi Khoshnaw[1]
[1]Department of Orthodontics, College of Dentistry, Hawler Medical University, Erbil, Iraq
Corresponding Author: Dr. Brwa Mahdi Khoshnaw Department of Orthodontics, College of Dentistry, Hawler Medical University, Erbil, Iraq
Email: brwakhoshnaw@hmu.edu.krd
Received: *Oct 29. 2025;* ***Accepted:*** *Nov7, 2025;* ***Published:*** *Dec.17, 2025*

ABSTRACT

Palatal impaction of the maxillary canine presents a frequent challenge in orthodontics, particularly when associated with root resorption of adjacent teeth. Early identification and carefully controlled traction are essential to minimize further damage and achieve successful alignment. This report outlines the clinical management of a severely palatally impacted maxillary canine in a 13-year-old patient, complicated by advanced root resorption. A Temporary Anchorage Device (TAD) was used to deliver controlled forces, ensuring effective alignment while safeguarding the adjacent dentition. Cone-beam computed tomography (CBCT) revealed a mesially angulated impacted canine with resorption of the upper right central and lateral incisors. Following surgical exposure, a TAD was inserted into the palatal alveolar bone to provide stable anchorage for orthodontic traction. This allowed for precise, controlled movement of the impacted tooth. The application of TAD-assisted biomechanics facilitated successful canine alignment without exacerbating root damage to neighboring teeth. Post-treatment radiographs confirmed stabilization, with no progression of resorption. The patient achieved satisfactory occlusion and improved dental aesthetics. Temporary Anchorage Devices offer a reliable solution for complex cases of canine impaction, particularly those complicated by root resorption. Their ability to provide controlled, targeted force makes them superior to conventional methods in preserving dental structures and achieving efficient outcomes.

Keywords**:** Maxillary canine impaction, Temporary Anchorage Device (TAD), Root resorption, Orthodontic traction.

INTRODUCTION

The maxillary canine is essential to both dental function and facial aesthetics, maintaining the continuity of the dental arch, enhancing smile symmetry, and contributing to lateral mandibular guidance.[1] Among the various dental anomalies, canine impaction is relatively common, with reported rates ranging from 0.9% to 3.6%, and a greater incidence is observed in females.[1, 2] Palatal impactions are more prevalent than labial ones, particularly in Caucasian populations.[3] If not addressed; impacted canines can result in complications such as crowding, resorption of adjacent roots, periodontal issues, and, in some cases, cyst development.[4, 5]

Tooth development of the maxillary canine begins near the infraorbital rim during the fourth to fifth month of gestation, with eruption typically between ages 11 and 13.[6, 7] Impaction may result from genetic factors such as hypodontia or peg-shaped lateral incisors, as well as environmental causes like crowding, early or delayed exfoliation of primary canines, ectopic eruption, or obstructions such as supernumerary teeth or cysts. [8] Systemic conditions, including hormonal disorders and cleidocranial dysplasia, may also disrupt normal eruption. [9]

Accurate localization and assessment are essential for effective treatment planning. Advances in imaging, particularly cone-beam computed tomography (CBCT), have significantly improved the ability to evaluate the impacted canine's position and its relationship with adjacent structures. [10]

Conventional approaches typically involve surgical exposure and orthodontic traction. Although effective, these methods can be associated with extended treatment duration, unintended root resorption, and periodontal compromise.[11,12] The emergence of Temporary Anchorage Devices (TADs) has

significantly changed this landscape by offering fixed anchorage points, which allow precise and controlled force application while minimizing adverse effects on surrounding teeth.[13] Clinical studies have shown that TADs can reduce overall treatment time, improve force control, and limit unwanted movements when compared to traditional anchorage methods,[14, 15] their high success rate, ease of placement, and minimal invasiveness have established them as reliable tools in managing complex orthodontic cases.[14]

This case describes the TAD-assisted management of a 13-year-old female with a palatally impacted upper right maxillary canine causing root resorption of adjacent lateral and central incisors, highlighting the clinical benefits of this approach.

Diagnosis and etiology

Patient Overview

A 13-year-old female patient presented with concerns about an impaired smile. Clinical examination revealed a symmetrical face, straight profile, and intraoral examination showed a mild class III occlusion with reduced overjet and overbite (Figure 1). Records were taken, including medical and dental history, intraoral photography, and Radiographic imaging, included CBCT, cephalometric and panoramic radiographs.

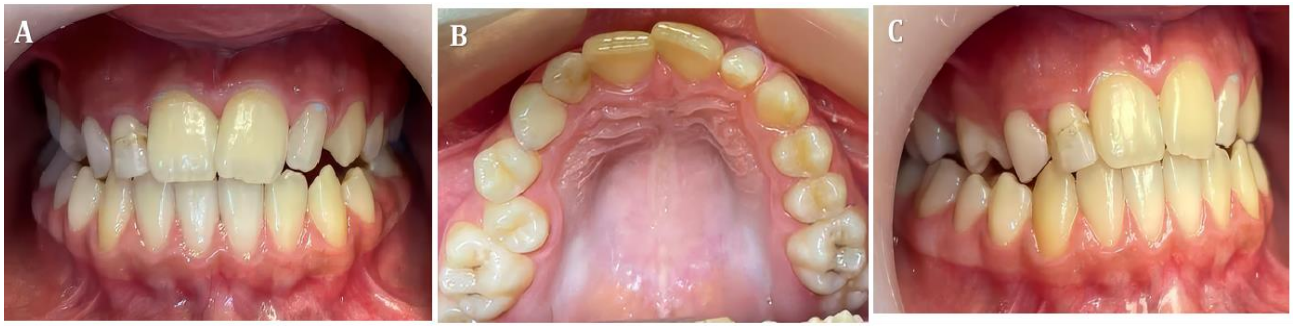


Figure 1. Pre-treatment Intraoral photographs **A)** frontal, **B)** occlusal and **C)** lateral

Radiographic examination

- CBCT showed that the impacted canine was mesially angulated and located superior to the roots of adjacent lateral and central incisors. The apex of the canine was underdeveloped, and the pericoronal follicle caused thinning of the palatal and labial cortices. Causing severe root resorption of adjacent teeth (Figure 2). According to the KPG Index (Kim, Park, and Group Index) for canine impaction based on CBCT imaging, the total KPG Index score is 15, indicating moderate to severe impaction (Figure 3).[16]
  - Vertical position (CY = 2 mm, RY = 0 mm) → the tooth is not deeply buried, which might make it a little easier to move.
  - Horizontal displacement (CX = 5 mm, RX = 3 mm) → the canine has marked mesiodistal deviation from its normal position.
  - Axial inclination (CZ = 2 mm, RZ = 3 mm) → the tooth is tilted, which could make alignment more challenging.

Since the score is on the higher side, the canine must be brought into place through surgical exposure and orthodontic traction.

- Panoramic radiograph revealed palatally impacted canine in the upper right quadrant (Figure 4).

The severity of maxillary canine impaction was also assessed using a difficulty index classification system based on an orthopantomogram (OPG) imaging; the case was classified as moderately to severely difficult (Figure 5).[17, 18]

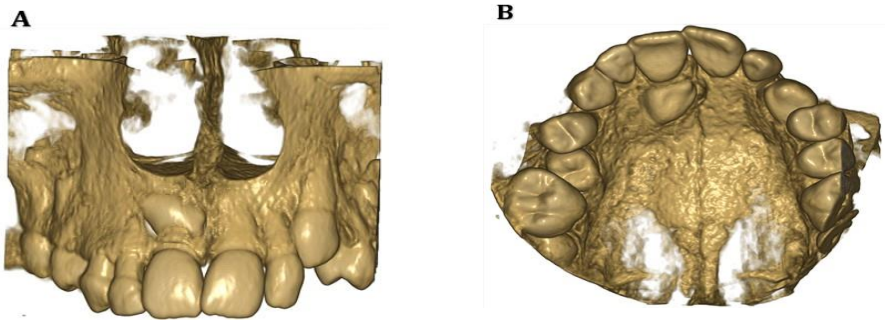


Figure 2. A) 3D Imaging of maxillary impacted canine from frontal view. **B)** CBCT of maxillary impacted canine from occlusal view

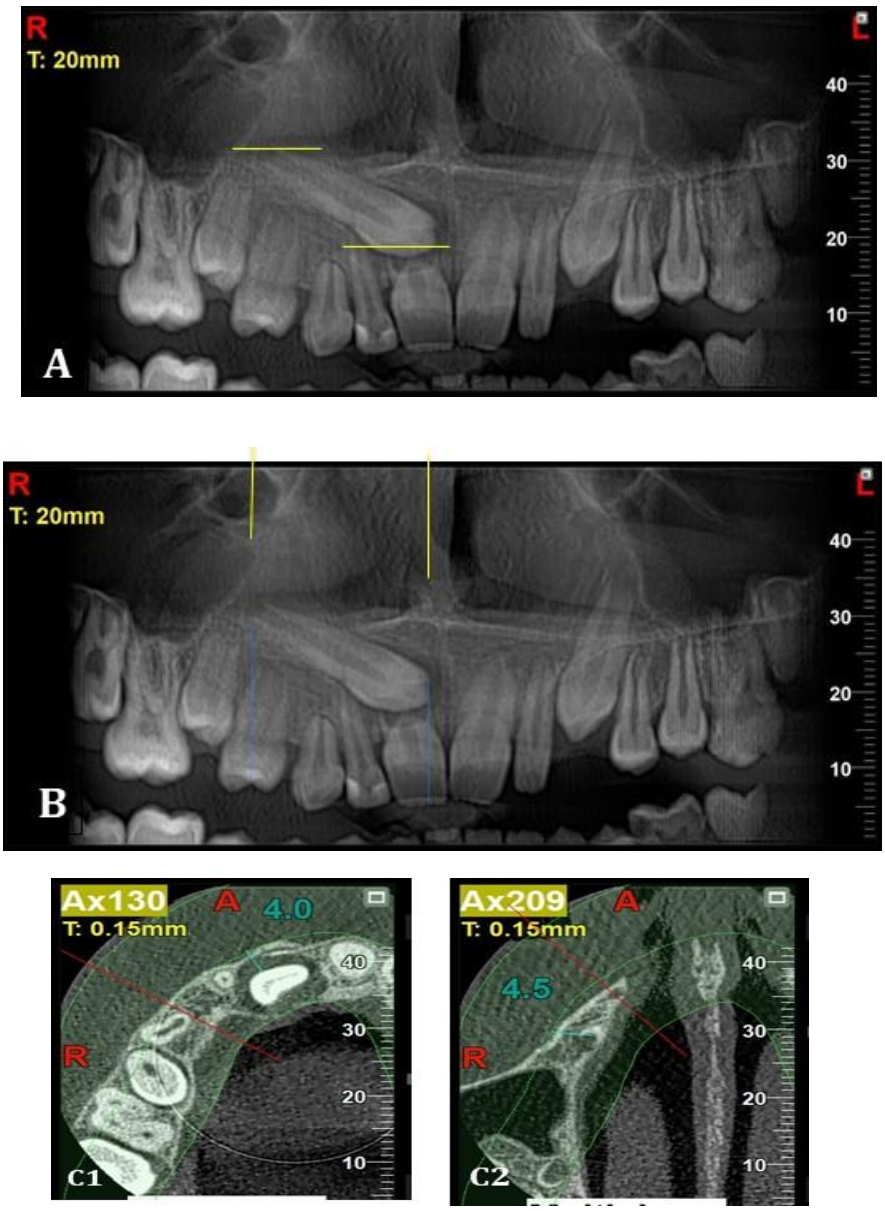


Figure 3. Severity of the canine impaction according to KPG index: A) Vertically cusp and root tip measured. B) Horizontally cusp and root tip measured. C) Axially cusp and root tip measured.
[Cone-beam computed tomography (CBCT) images obtained with NewTom giano hr (NNT 16.4 software). parameters: voxel size 0.15 mm, FOV 8 × 8 cm, 90 kVp, pulsed exposure with automatic mA adjustment.**]**

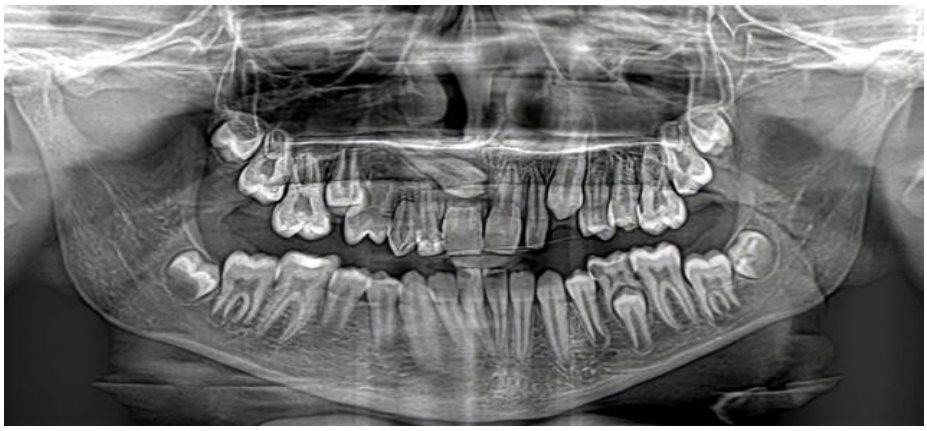


Figure 4. Panoramic radiograph; revealed impacted right maxillary canine

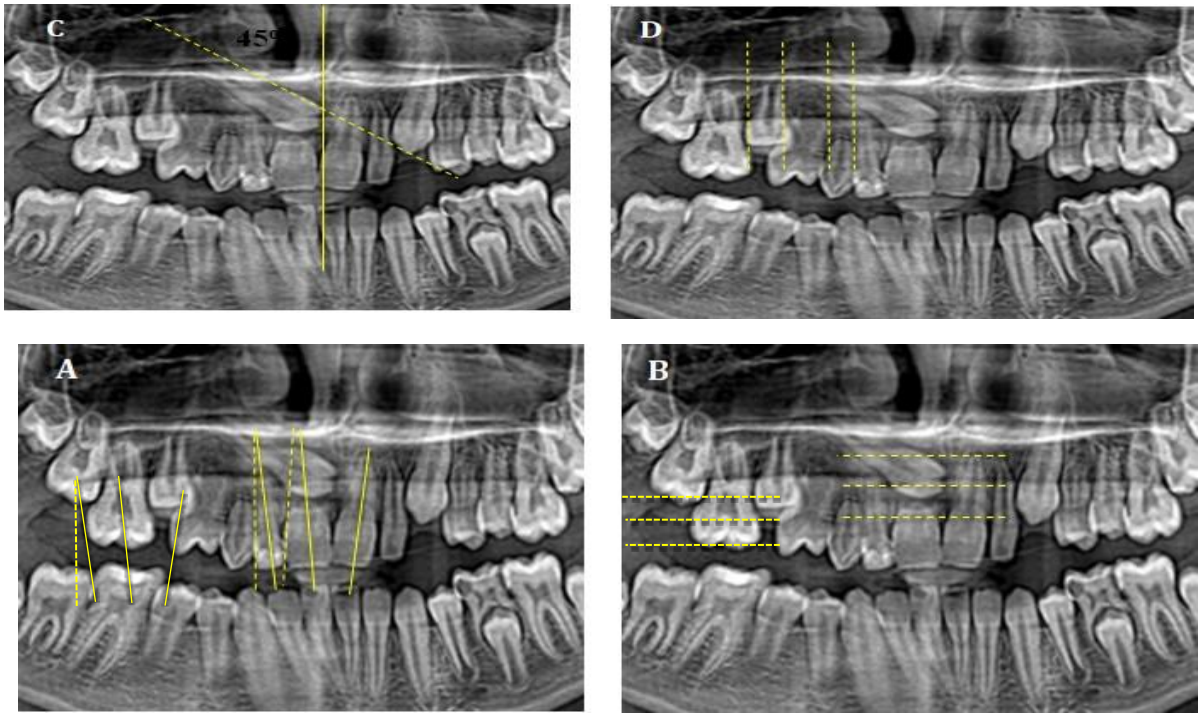


Figure 5. Severity of impaction based on difficulty index: A) Horizontal position of impacted canine; Score 4(severe): canine overlapping up to half the width of the central incisor. **B)** Vertical position of the impacted canine; Score 3 (severe): canine cusp tip within the apical third of the root of the adjacent incisor**. C)** Score 3(severe): ≥45 degree

Treatment objectives

1. Bring the impacted canine into occlusion.
2. Correct the angulation of the canine.
3. Move the impacted canine away from adjacent incisors to prevent further root resorption.
4. Develop a safe and effective treatment plan using TAD for controlled and stable tooth movement.
5. Preserve occlusion by preventing loss of anchorage during the traction of the impacted canine.
6. Achieve proper alignment and functional occlusion.
7. Minimize treatment time and potential complications.
8. Positioning the lateral and central incisors in their correct alignment supports both esthetics and favorable alveolar bone development, which is essential if future implant placement, becomes necessary.

Treatment Alternative

Treatment Option	Description	Main Problems
Conventional Orthodontic Traction	Uses adjacent teeth for anchorage with brackets and elastics.	Uncontrolled forces may lead to root resorption, anchorage loss, and longer treatment duration.
Extraction of Impacted Canine	Surgical removal of the impacted tooth.	Loss of aesthetics and function, require prosthetic replacement such as implants or bridges.
Auto transplantation	Surgical repositioning of the impacted canine into the dental arch.	Requires precise timing and technique; risks include ankylosis and root resorption.
Aligners with Mini-Screws (TADs)	Combines clear aligners and skeletal anchorage for controlled movement.	High cost, requires digital planning precision, limited long-term outcome.

Treatment Progress

After evaluating the diagnostic records, the impacted canine was classified as severely impacted based on the KPG Index (Figure 4) and the Difficulty Index (Figure 5). Orthodontic treatment commenced with the placement of a fixed appliance system following the Roth prescription, using brackets with a 0.022-inch slot size. Sufficient space was created by extracting the upper right deciduous canine. The impacted tooth was then surgically exposed using a open eruption technique (Figure 6A).

To provide stable anchorage and prevent unwanted movement of adjacent teeth, a self-drilling 3M Unitek miniscrew (1.8 mm in diameter, 10 mm in length, button/cross-hole head design) was carefully inserted into the palatal alveolar region near the upper right molars, at approximately 30–40° angulation relative to the palatal cortical bone surface and diverging from the long axis of the molar to avoid root proximity. The insertion torque was maintained within the optimal clinical range (≈8–10 Ncm), ensuring adequate primary stability, and the device functioned as a temporary anchorage device (TAD) (Figure 6A).

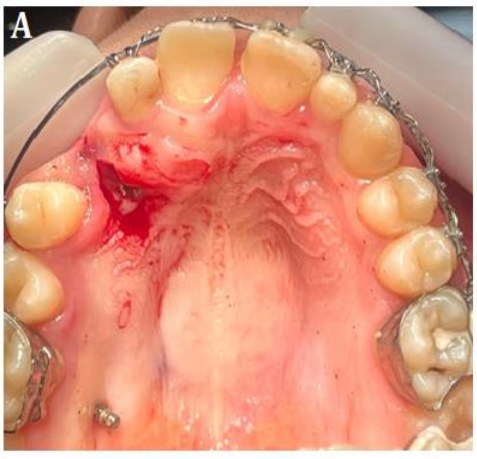
A controlled force was applied using a 12-mm medium-force 3M Unitek nickel–titanium closed-coil spring, attached to an eyelet bonded to the impacted canine. This force gradually guided the tooth into eruption while simultaneously directing it away from the roots of adjacent teeth. Regular radiographic monitoring was performed to evaluate tooth movement and confirm the integrity of neighboring roots (Figures 6B and 6C).

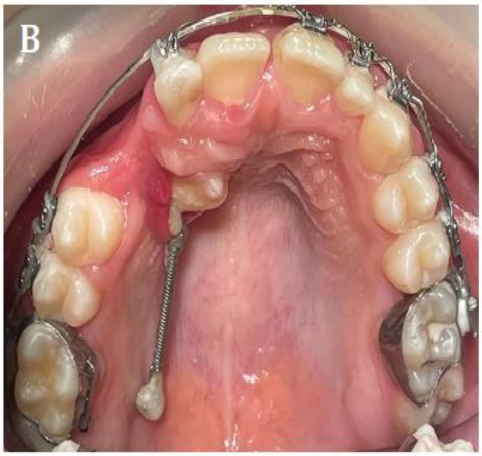
The patient was instructed to maintain meticulous oral hygiene around the miniscrew and surgical site, including gentle brushing with a soft toothbrush and rinsing with 0.12% chlorhexidine mouthwash, to minimize inflammation and promote stable healing.

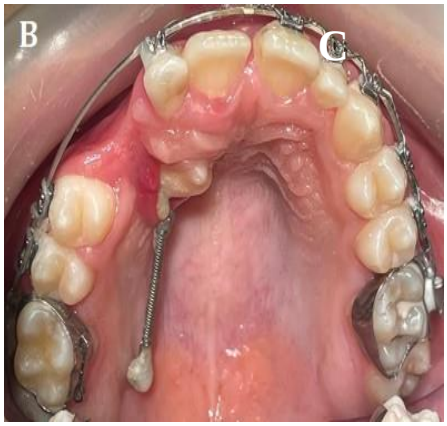
After the canine was sufficiently uprighted and emerged into the arch, labial traction was initiated. An elastic chain was attached to the impacted tooth and connected to a rectangular stainless steel archwire (0.019 × 0.025 inch) (Figure 7A and 7B). This was followed by the application of a secondary NiTi wire using the piggyback technique (Figure 7C), which further guided the canine into its correct position within the dental arch. Upon achieving proper alignment, the remaining spaces were closed, and the midline was corrected (Figure 8A and 8B). Additionally, the maxillary lateral incisors, which exhibited reduced dimensions, were reshaped with composite resin (3M Filtek Universal, shade A2) prior to the space-closing phase in order to correct the Bolton ratio discrepancy. Following appliance removal, the lateral incisors were further refined to achieve proper morphology, resulting in improved occlusion and enhanced esthetics (Figure 9).

RESULT

Proper alignment of the impacted canine was successfully achieved into the occlusion within 18 months, without compromising anchorage or occlusal integrity. The adjacent lateral and central incisors remained in their correct positions, showing no signs of further root resorption (Figure 10). Due to the patient's mild Class III occlusion, dentoalveolar compensation was applied to establish a satisfactory occlusal relationship (Figure 11, Table 1). Additionally, the peg-shaped upper lateral incisors were reshaped using composite restorations to correct discrepancy in the Bolton ratio and enhance dental esthetics.







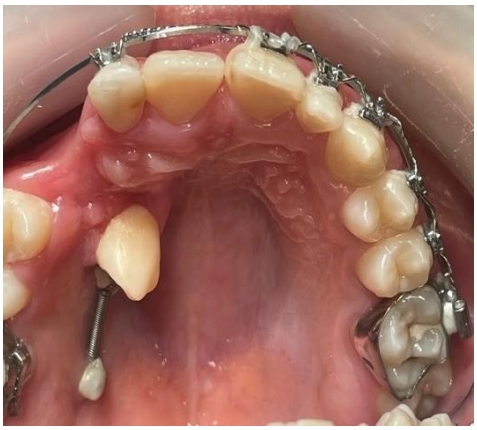
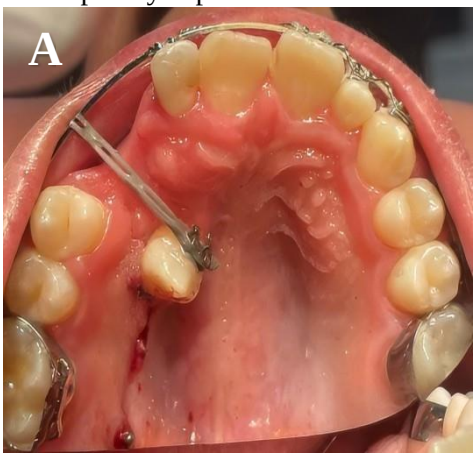
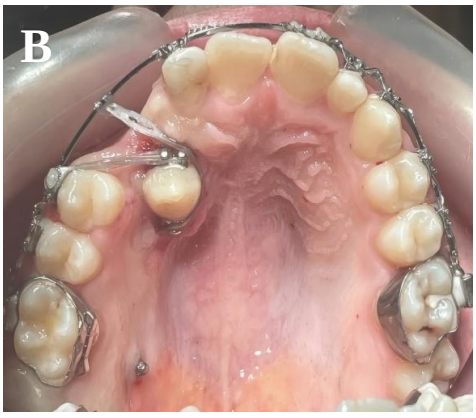


Figure 6. Initial phase of the treatment: **A)** Open technique surgical exposure and placement of TAD in palatal alveolus at the first molar area. **B)** Applying force to the canine through the attached closed spring to the TAD to disimpact the canine. **C)** The crown of the canine is completely exposed





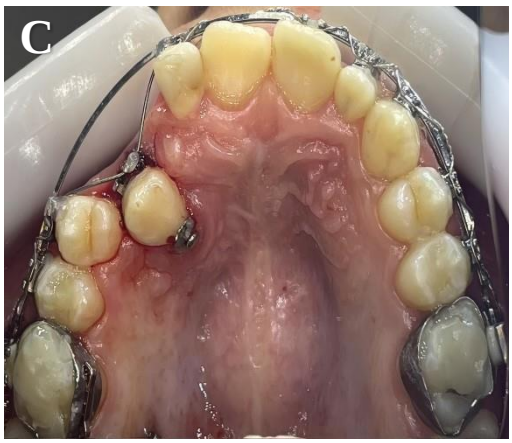
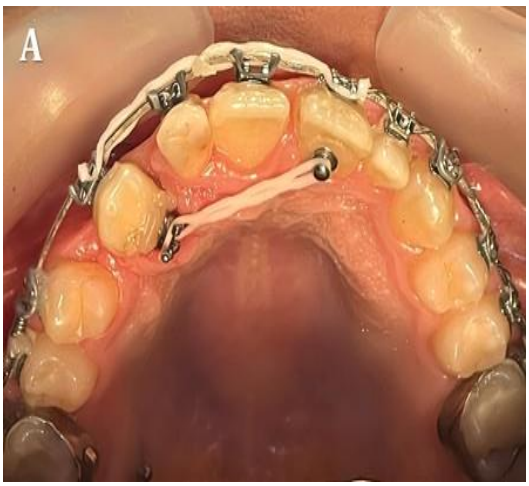


Figure 7 Second phase of the treatment: **A)** Traction of the canine by an elastic chain attached to the 0.019*0.025 S.S. archwire. **B)** Traction and derotation of the canine. **C)** Guiding canine into the arch line by piggy-back technique.



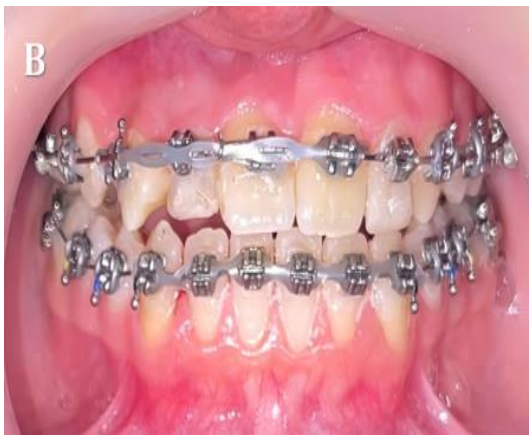


Figure 8 Third phase of the treatment: Closing spaces and midline correction. **A)** occlusal view. **B)** frontal view

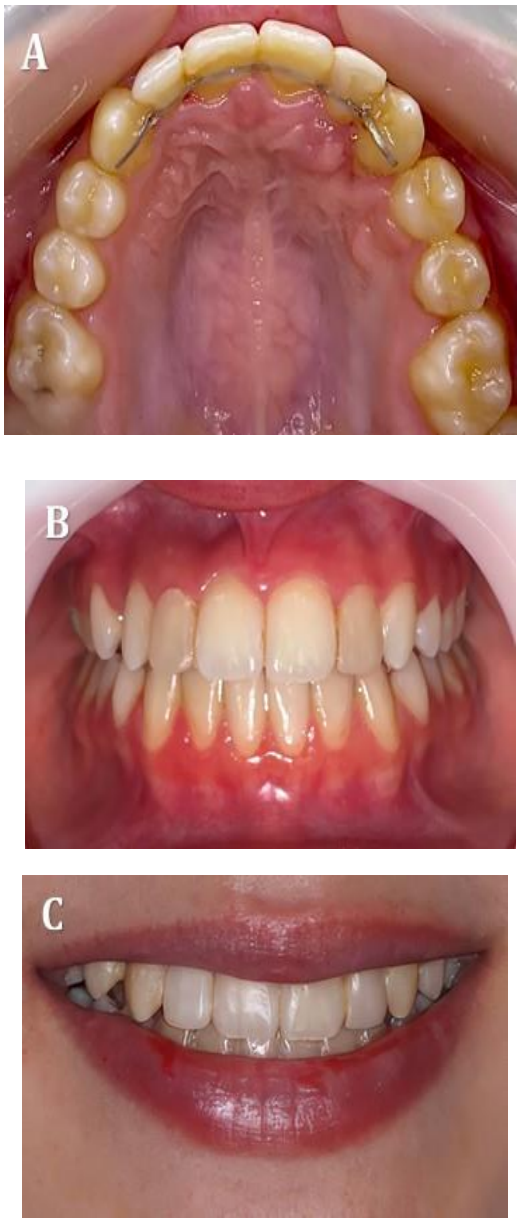


Figure 9 Post-treatment images after debonding

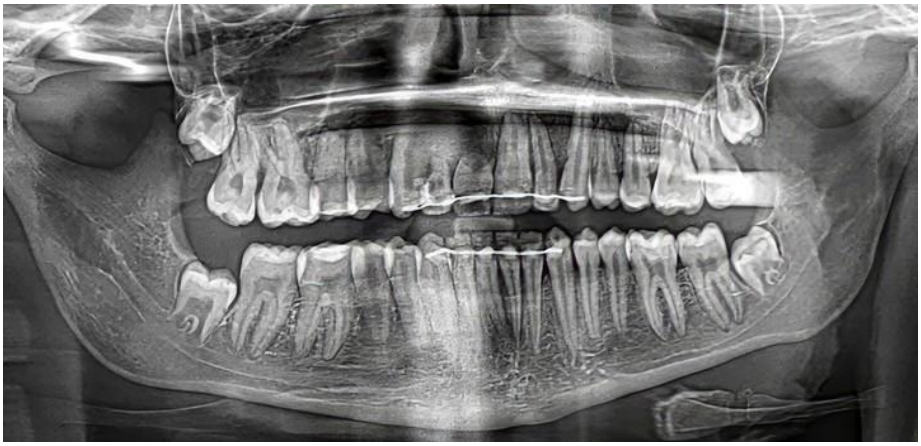


Fig. 10: post-treatment panoramic radiograph

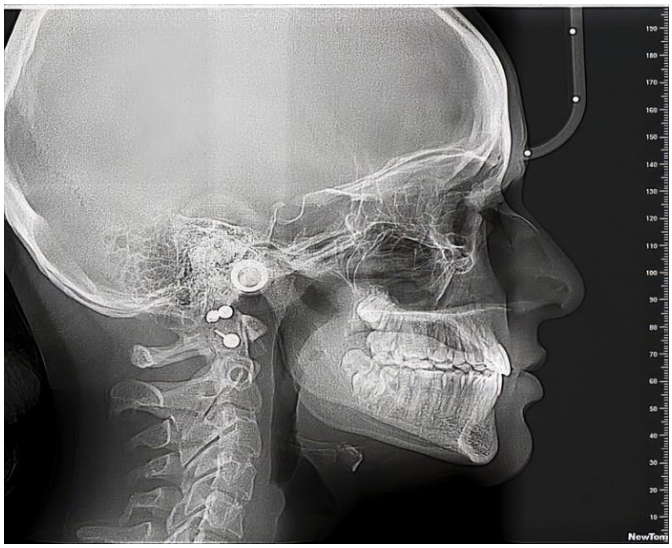


Figure 11 Post-treatment cephalometric radiograph

Table 1. Comparison of pre-treatment and post-treatment cephalometric measurements

Measurements/unit	**Means**	**Pre-treatment**	**Post-treatment**
SNA angle (º)	81.08	80.29	80.47
SNA angle (º)	79.17	81.12	79.54
ANB angle (º)	2.46	-0.83	1.93
Bjork sum (º)	397.16	389.96	392.41
FMA angle (º)	25	20.81	23.62
Gonial angle (º)	124.31	124.34	122.69
Wits appraisal (mm)	-0.3	-2.52	-0.23
Overjet (mm)	2	1	1.5
Overbite (mm)	2	0.91	1.85
UI to FH (º)	113. 8	117.73	114.37
UI to SN (º)	105.28	110.56	108.90
IMPA (º)	90	86.62	87.47
Interincisal angle (º)	130	128.84	131.83
UI to NA (mm)	4	2.90	1.99
UI to NA (deg) (º)	22	24.27	25.82
LI to NA (mm)	4	2.89	1.98
LI to NA (deg) (º)	25	17.71	16.17

DISCUSSION

Managing a palatally impacted maxillary canine, especially when there is severe root resorption of neighboring incisors, is one of the most challenging situations in orthodontics. Successful outcomes depend not only on the mechanics applied but also on careful timing, accurate diagnosis, and thoughtful planning. CBCT imaging has become an indispensable tool in such cases, as it allows precise localization of the impacted tooth and early detection of complications such as root resorption of adjacent teeth.[19]

In the present case, treatment was started at the age of 13 years, before the canine root was fully formed. This timing worked in our favor, as earlier intervention ideally before the age of 14 tends to be associated with better biological responses.[20] Teeth with incompletely developed roots are generally easier to guide into the

arch and are less likely to suffer adverse sequelae such as ankylosis or external resorption. [21]

A key concern with palatal impactions is the risk of progressive resorption of the neighboring incisors. The risk depends on how long the canine has been impacted, its position, and the magnitude of the orthodontic force applied. In our case, CBCT revealed advanced resorption of the maxillary right central and lateral incisors. This made it crucial to apply forces in a way that would not add stress to these already compromised roots. To achieve this, a palatal temporary anchorage device (TAD) was used. By directing light, controlled forces through the TAD, we avoided transmitting unwanted forces to adjacent teeth. This approach is supported by several studies showing that TAD-assisted mechanics are safer and more efficient than conventional archwire-based methods in similar situations.[22, 23]

The surgical approach chosen was open exposure. Open versus closed eruption techniques remain a subject of debate. The open technique allows immediate visualization and bonding of the impacted crown, which makes biomechanics easier to control. However, it can sometimes result in soft-tissue drawbacks such as gingival recession or scarring. Closed eruption techniques, on the other hand, often provide more favorable periodontal outcomes, especially for deeply impacted teeth [24]. In this case, because of the need for precise mechanics and careful monitoring of the resorbed incisors, open exposure combined with TAD anchorage offered a more predictable route.

Anchorage control was fundamental to the treatment plan. The palatal TAD provided absolute anchorage, preventing reciprocal side effects such as tipping or extrusion of neighboring teeth. With this secure anchor, light continuous forces were applied first with closed coil springs and later with elastic chains to guide the canine gradually into position. This staged approach shortened the overall treatment duration and reducedrisks, echoing findings in the literature that TAD-supported biomechanics improve both efficiency an safety.[25, 26] This approach is not without risks. TADs can fail due to loosening, inflammation, or soft-tissue irritation, and if that happens, treatment can be delayed or complicated. Recent surface-analysis studies have shown that even in clinically used TADs, corrosion, biofilm accumulation, and changes in surface morphology are prevalent, which may exacerbate soft tissue reactions and contribute to failure.[27] Periodontal health is another important consideration: teeth exposed by the open technique require careful long-term monitoring for gingival recession, loss of attachment, or inadequate

keratinized tissue. Regular follow-up with both clinical and radiographic checks is essential to ensure stability and periodontal health once alignment is complete.

Finally, it is important to acknowledge the limitations of this report. This is a single case, and while the outcome was favorable, it cannot be generalized to all patients. The follow-up period was also relatively short, so long-term stability of the canine, the periodontal condition, and the esthetic outcome remain to be seen. Larger studies with extended follow-up are needed to better define the role of TAD-assisted open-exposure protocols in managing complex canine impactions.

CONCLUSION

This case report demonstrates the effective use ofTemporary Anchorage Device in managing a palatally impacted maxillary canine. The treatment preserved adjacent teeth and achieved optimal alignment, offering a safer and more efficient alternative to conventional methods, with a shorter overall treatment duration.

DECLARATIONS

Funding

This research did not receive any specific grant or financial support.

Competing Interests

The authors have no competing interests to declare.

Informed Consent

Not applicable.

REFERENCES

1. Hamada Y, Timothius CJC, Shin D, John V. Canine impaction: a review of the prevalence, etiology, diagnosis and treatment. Semin Orthod. 2019;25(2):117-23. doi:10.1053/j.sodo.2019.05.002.
2. Alhammadi MS, Halboub E, Fayed MS, Labib A, El-Saaidi C. Global distribution of malocclusion traits: a systematic review. Dent Press J Orthod. 2018;23(6):40.e1-40.e10. doi:10.1590/2177-6709.23.6.40.e1-10.onl.
3. Ng WL, Cunningham A, Pandis N, Bister D, Seehra J. Impacted maxillary canine: assessment of prevalence, severity and location of root resorption on maxillary incisors: a retrospective CBCT study. Int Orthod. 2024;22(3):100890. doi:10.1016/j.ortho.2024.100890. PMID:38838434.
4. Ravi I, Srinivasan B, Kailasam V. Radiographic predictors of maxillary canine impaction in mixed and early permanent dentition: a systematic review and meta-analysis. Int Orthod. 2021;19(4):548-65. doi:10.1016/j.ortho.2021.07.005. PMID:34462251.
5. Vasiljkovic BM, Antic S, Pficer JK, Djokic D. Predictors of complications associated with unerupted maxillary canines: a cone beam computed tomography study. Odontology.

2024;112(2):526-36. doi:10.1007/s10266-023-00844-7. PMID:37644295.

6. Grisar K, Luyten J, Preda F, Martin C, Hoppenreijs T, Politis C, 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(2):180-93. doi:10.1111/ocr.12423. PMID:32799419.
7. Proffit WR, Fields HW, Larson B, Sarver DM. Contemporary orthodontics. 6th ed. St. Louis: Elsevier; 2019.
8. Ristaniemi J, Karjalainen T, Kujasalo K, Rajala W, Pesonen P, Lähdesmäki R. Eruption pattern of the maxillary canines: features indicating treatment needs as seen in panoramic radiographs at the late mixed stage. Eur Arch Paediatr Dent. 2022;23(4):567-78. doi:10.1007/s40368-022-00719-5. PMID:35687304; PMCID:PMC9337999.
9. Kolokitha OE, Balli D, Zarkadi AE, Gizani S. Association between maxillary canine impaction and other dental anomalies: radiological study of a mixed dentition children's cohort from an orthodontic clinic. Eur Arch Paediatr Dent. 2023;24(3):401-7. doi:10.1007/s40368-023-00798-y. PMID:37046044; PMCID:PMC10317884.
10. Yamaguchi T, Hosomichi K, Shirota T, Miyamoto Y, Ono W, Ono N. Primary failure of tooth eruption: etiology and management. Jpn Dent Sci Rev. 2022;58:258-67. doi: 10.1016/j.jdsr.2022.08.002.
11. Abdelkarim A. Cone-beam computed tomography in orthodontics. Dent J (Basel). 2019;7(3):89. doi:10.3390/dj7030089.
12. Cruz RM. Orthodontic traction of impacted canines: concepts and clinical application. Dent Press J Orthod. 2019;24(1):74-87. doi:10.1590/2177-6709.24.1.074-087.bbo.
13. Aquino-Valverde AJ, Barrientos-Sanchez 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.
14. Reynders RM, Ladu L. Mini-implants for orthodontic anchorage. Evid Based Dent. 2017;18(3):82-5. doi:10.1038/sj.ebd.6401257.
15. Sharma R, Soni DM. Temporary anchorage devices (TADs) in orthodontics: a review. Asian J Res Med Med Sci. 2023;5(1):1-11
16. Assali A, Neani H, Zaoui F, Halimi A. The effectiveness of temporary anchorage devices (TADs) in the orthodontic management of impacted canines: a systematic review. Braz Dent Sci. 2025;28:e4551. doi:10.4322/bds.2025.e4551.
17. Bajjad AA, Ahemad MS, Gupta S, et al. Assessment of clinical validity of KPG index for 3D classification of impacted maxillary canines by cone beam computed tomography in patients.

Orthod Craniofac Res. 2024;27 Suppl 2:48-55. doi:10.1111/ocr.12788.

18. Baidas LF, Alshihah N, Alabdulaly R, Mutaieb S. Severity and treatment difficulty of impacted maxillary canine among orthodontic patients in Riyadh, Saudi Arabia. Int J Environ Res Public Health. 2022;19(17):10680. doi:10.3390/ijerph191710680.
19. Alhammadi MS, Asiri HA, Almashraqi AA. Incidence, severity and orthodontic treatment difficulty index of impacted canines in Saudi population. J Clin Exp Dent. 2018;10(4):e327-34. doi:10.4317/jced.54626.
20. Grisar K, Piccart F, Al-Rimawi AS, Basso I, Politis C, Jacobs R. Three-dimensional position of impacted maxillary canines: prevalence, associated pathology and introduction to a new classification system. Clin Exp Dent Res. 2019;5(1):19-25. doi:10.1002/cre2.151.
21. Litsas G, Acar A. A review of early displaced maxillary canines: etiology, diagnosis and interceptive treatment. Open Dent J. 2011;5:39-47. doi:10.2174/1874210601105010039.
22. Nagani NI, Ahmed I, Rizwan S, Pervez H, Khan T, Arif T. Frequency and association of maxillary ectopic canine with incisor root resorption and dental agenesis. J Pak Med Assoc. 2021;71 Suppl 1(B):S277-80. doi:10.47391/JPMA.782. PMID:35157664.
23. Ritchie C, McGregor S, Bearn DR. Temporary anchorage devices and the forces and effects on the dentition and surrounding structures during orthodontic treatment: a scoping review. Eur J Orthod. 2023;45(3):324-37. doi:10.1093/ejo/cjac072.
24. Cassina C, Papageorgiou SN, Eliades T. Open versus closed surgical exposure for permanent impacted canines: a systematic review and meta-analyses. Eur J Orthod. 2018;40(1):1-10. doi:10.1093/ejo/cjx047.
25. Arriola-Guillén LE, Aliaga-Del Castillo A, Ruiz-Mora GA, Rodríguez-Cárdenas YA, Dias-Da Silveira HL. Influence of maxillary canine impaction characteristics and factors associated with orthodontic treatment on the duration of active orthodontic traction. Am J Orthod Dentofacial Orthop. 2019;156(3):391-400. doi:10.1016/j.ajodo.2018.10.018.
26. Krishnan V. Changing orthodontic mechanics with temporary anchorage devices. J World Fed Orthod. 2024;13(1):1. doi:10.1016/j.ejwf.2024.01.003.
27. Ioana TR, Boeru FG, Antoniac I, Mitruț I, Staicu IE, Rauten AM, et al. Surface analysis of orthodontic mini-implants after their clinical use. J Funct Biomater. 2024;15(9):244. doi:10.3390/jfb15090244.