DOI: 10.7860/JCDR/2026/89422.24018

Case Report

Dentistry Section

Auxiliary-assisted Torque Correction for Three-dimensional Finishing of Labially Impacted Maxillary Canine: A Case Report

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ABSTRACT

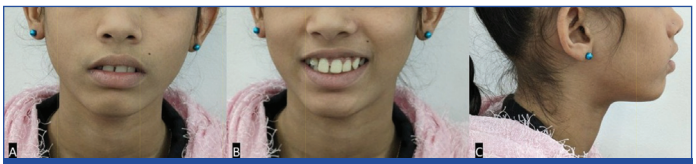
Impaction of the tooth often requires combined surgical and orthodontic management and presents a significant clinical challenge due to functional and aesthetic importance. Successful treatment depends not only on eruption and alignment of the impacted tooth, but also on precise control of root position and torque to achieve functional, aesthetic, and periodontal stability. A 14-year-old female patient presented with spacing in the maxillary anterior region and a clinically missing maxillary right canine. Clinical examination revealed a labial bulge in maxillary right region. Orthopantomogram (OPG), lateral cephalogram, and CBCT revealed a labially impacted maxillary right canine with mesial crown displacement. Treatment was carried out using pre-adjusted edgewise MBT 0.018-inch slot appliance. The impacted canine was surgically exposed using an open surgical exposure technique, and orthodontic traction was initiated simultaneously with space creation. The canine was gradually guided into the arch and subsequently refined using piggyback mechanics. Although satisfactory crown alignment was achieved, residual torque discrepancy necessitated the use of Begg-type torquing auxiliary. To improve three-dimensional root positioning.The total treatment duration was 18 months. Post-treatment CBCT confirmed favourable crown positioning, improved root angulation, and appropriate positioning within the alveolar housing. This case highlights that successful management of impacted maxillary canines extends beyond crown alignment alone. Coordinated biomechanics, auxiliary-assisted torque correction, and radiographic verification of root position can significantly improve three-dimensional finishing and contribute to stable, functionally and periodontally favourable outcomes with improved long-term stability.

Keywords: Auxiliary nickel-titanium wire, Ectopic canine, Root parallelism, Spec auxiliary, Traction

CASE REPORT

A 14-year-old female patient reported to the Department of Orthodontics with a chief complaint of spacing in the upper front teeth since few years. The patient's medical and dental history was unremarkable. After obtaining informed consent from patient's parent for both treatment and publication of clinical records and images, a detailed clinical examination was carried out.

On extraoral examination, the patient exhibited a mesoprosopic facial form with a mildly convex profile, average nasolabial angle, mento-labial sulcus and posterior divergent facial pattern. The lips were potentially competent at rest. The smile arc was consonant with no facial asymmetry was evident [Table/Fig-1].



[Table/Fig-1]: Pre-treatment extraoral photographs: (a) Frontal; (b) Frontal smiling; (c) Profile.

Intraoral examination revealed the presence of all permanent teeth up to second molar in both arches, except for maxillary right canine, which was clinically absent. The mandibular arch was well aligned, whereas the maxillary arch exhibited anterior spacing, with overbite of 4 mm and overjet of 3 mm. The maxillary dental midline deviated towards right-side. A bilateral Class I molar relationship was present, with Class I canine relationship on the left side, while the right side canine relationship could not be assessed clinically due to absence of the tooth in the arch.

Further clinical examination revealed a palpable labial bulge in the maxillary right lateral incisor region, suggestive of a labially positioned impacted canine. In view of the patient's age, clinical absence of the tooth, and presence of labial bulge, radiographic evaluation was advised for the confirmation of position and treatment planning [Table/Fig-2].

[Table/Fig-2]: Pretreatment intraoral photographs: (a) Maxillary arch; (b) Mandibular arch; (c) Right buccal view; (d) Frontal intraoral photograph showing labial bulge in the maxillary right canine region (arrows), suggestive of the labially impacted canine; (e) Left buccal view.

Pretreatment radiographic evaluation included an OPG, lateral cephalogram, and CBCT.

The pretreatment OPG confirmed the presence of all permanent teeth up to the second molar, with the maxillary right canine (13) impacted and clinically absent from the maxillary arch. No evidence of cystic change, periapical pathology, or root resorption of adjacent teeth was noted. The roots of adjacent incisors and premolar appeared intact [Table/Fig-3].

Cephalometric evaluation revealed a skeletal Class I jaw base relationship with vertical growth tendency. The patient demonstrated

[Table/Fig-3]: Pretreatment radiographs: (a) Orthopantomogram (OPG) showing impacted maxillary right canine; (b) Lateral cephalogram.

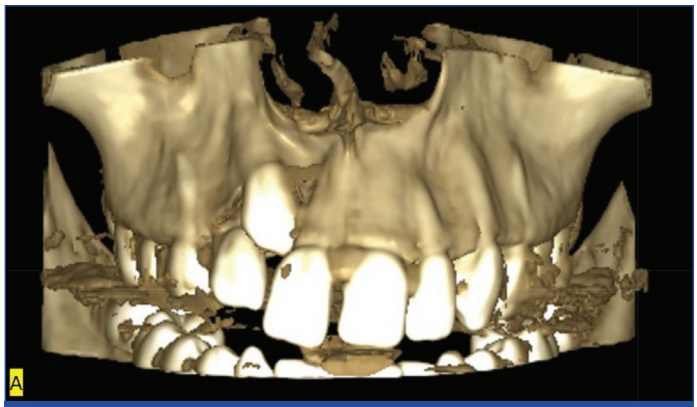
proclination of both maxillary and mandibular incisors, contributing to the increased overjet and dentoalveolar protrusive tendency. Soft-tissue analysis showed mildly protrusive lips a with a convex soft-tissue profile [Table/Fig-3,4].

Parameters	Norm	Pretreatment Values
SNA°	82°	82°
SNB°	80°	80°
ANB°	2°	2°
SN-MP°	32°	35°
U1 to NA (mm)	4 mm	6 mm
U1 to NA°	22°	25°
IMPA	90°	99°
Upper lip to E-line (mm)	-4 mm	3 mm
Lower lip to E-line (mm)	-2 mm	4 mm

[Table/Fig-4]: Pretreatment cephalometric readings.
SNA: Sella-Nasion-Point A angle; SNB: Sella-Nasion-Point B angle; ANB: Point A-Nasion-Point B angle; SN: Sella-Nasion Plane; MP: Mandibular Plane; U1: Upper incisor; NA: Nasion-Point A; IMPA: Incisor mandibular plane angle

Cervical vertebral maturation assessment was suggestive of Cervical Vertebrae Maturity Indicator (CVMI) stage VI, indicating completion of growth.

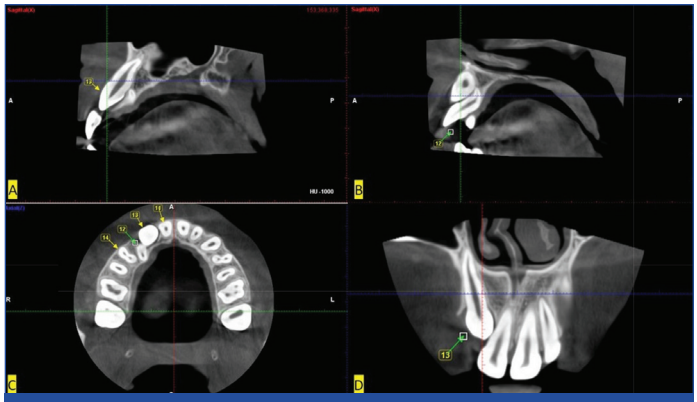
CBCT was utilised for precise three-dimensional localisation of the impacted canine and evaluation of its relationship with adjacent teeth [Table/Fig-5,6].



[Table/Fig-5]: Pretreatment three-dimensional CBCT showing labially impacted maxillary right canine with mesial crown displacement.

The maxillary right canine was located labially, positioned high in the alveolus, with its crown displaced mesially between the maxillary central and lateral incisor, while the root was directed distally. The tooth demonstrated an aberrant eruption path. The root was fully formed, and no evidence of root resorption of the adjacent incisor was appreciated on radiographic assessment [Table/Fig-5,6].

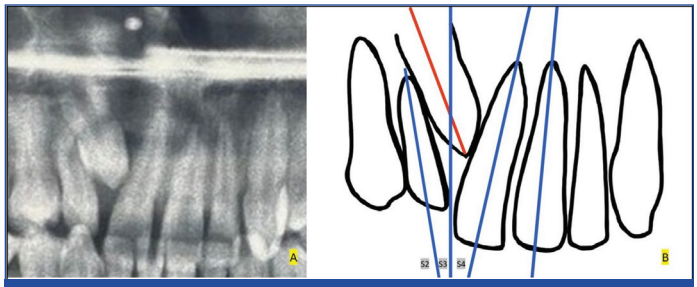
Three-dimensional imaging revealed space mesial and distal to maxillary lateral incisors; however, the space was insufficient for spontaneous eruption of canine. Pretreatment space analysis was performed on the study models. The available space in the maxillary arch in total was 5 mm, whereas an estimated 8mm was required to accommodate the permanent canine, indicating overall space deficiency of approximately 3 mm. These findings suggested that,



[Table/Fig-6]: Pretreatment CBCT sectional views showing the position of impacted canine: (a,b) Sagittal sections demonstrating labial impaction and altered eruptive path; (c) Axial section showing mesial crown displacement and relation to adjacent teeth; (d) Coronal section showing vertical position of the impacted canine.

in addition to inadequate arch space, an altered eruption path and ectopic positioning may have contributed to its failure of eruption.

Based on clinical and radiographic findings, the case was diagnosed as Skeletal Class I malocclusion with dentoalveolar Angles Class I Dewey's Type 2 modification with labially impacted maxillary right canine. The impaction appeared to be multifactorial in aetiology, with space discrepancy, altered eruption path, and ectopic positioning likely contributing to the failure of eruption. On panoramic radiographic assessment, the impacted canine crown was localised approximately in Sector 4 according to the modified sector classification described by Lindauer SJ et al., suggestive of moderately unfavourable eruptive position [Table/Fig-7] [1].



[Table/Fig-7]: (a) Pretreatment panoramic radiograph showing labilally impacted maxillary right canine with mesial crown displacement; (b) Case-based schematic representation illustrating canine localisation according to the sector classification described by Lindauer SJ et al., [1]. The outline diagram is derived from the pretreatment radiographic findings to depict the mesiodistal position of the canine cusp tip within Sector 4.

Considering the patient's age (14 years), favourable labial position of canine, complete root formation, and absence of adjacent root resorption, the prognosis for orthodontic alignment was considered favourable. Treatment options considered included observation for spontaneous eruption of tooth, interceptive space creation, surgical exposure with orthodontic traction, and extraction of the impacted tooth in unfavourable circumstances. In the present case, owing to the permanent dentition stage, mesially displaced canine, and low likelihood of spontaneous eruption, surgical exposure followed by orthodontic traction was selected as the most appropriate treatment approach. Controlled biomechanics and careful finishing were anticipated to be necessary.

Treatment Objective

The treatment objectives, corresponding interventions, and achieved outcomes are summarised in the [Table/Fig-8].

Treatment Plan

Comprehensive fixed orthodontic treatment with opensurgical exposure and orthodontic traction of the impacted maxillary right canine was planned using an MBT 0.018-inch slot appliance. Controlled space creation and redistribution within the maxillary arch were undertaken to develop an adequate eruptive pathway

Treatment objective	Intervention performed	Outcome achieved
Address factors contributing to impaction.	Space analysis, surgical exposure and orthodontic traction.	Impacted canine guided into arch after surgical exposure.
Create adequate space for canine eruption.	Open coil spring mechanics and space redistribution.	Adequate space created.
Align impacted canine within the arch.	Controlled traction followed by piggyback mechanics.	Canine aligned into the arch.
Correct maxillary midline deviation.	Space redistribution and fixed appliance mechanics.	Maxillary dental midline corrected.
Achieve appropriate torque and root positioning.	Spec auxiliary over rectangular stainless steel archwire.	Improved root angulation and root parallelism on CBCT.
Maintain bilateral Class I molar relationship.	Anchorage control with the help of TPA.	Bilateral Class I molar relation maintained.
Establish functional and aesthetic occlusion.	Finishing, detailing, settling elastics.	Functional occlusion and satisfactory aesthetics achieved.

[Table/Fig-8]: Treatment objectives, interventions and outcomes.

while maintaining the existing occlusal relationships and correcting the maxillary midline.Anchorage reinforcement was provided using Transpalatal Arch (TPA) to enhance maxillary molar stability during space creation and canine traction.

An open surgical approach was chosen here since the canine is positioned labially and relatively superficial, allowing for the direct attachment placement and visual control of the traction vector. Torquing auxiliary mechanics were to be employed subsequently for root positioning and torque refinement, if required.

Treatment Progress

Fixed orthodontic therapy was initiated using pre-adjusted edgewise MBT appliance with 0.018-inch slot brackets. Treatment commenced with bonding of the maxillary arch and anchorage reinforcement was provided using TPA and initial levelling and alignment was carried out using 0.016 Niti (nickel-titanium) arch wire followed by 0.018-inch Niti archwire.

After approximately two months of initial levelling and alignment with a 0.018-inch NiTiwire in place, the patient underwent open surgical exposure of the impacted maxillary right canine. A lingual button was bonded to exposed canine crown, and a passive ligature tie was placed between bonded attachment and archwire immediately post-exposure [Table/Fig-9].

[Table/Fig-9]: Intraoral photograph showing open surgical exposure of the labially impacted maxillary right canine, bonded attachment placement, and initiation of orthodontic traction.

On same day, the maxillary base arch wire was progressed to rigid 0.016 X 0.022 SS (stainless- steel) wire and an open coil spring was placed between maxillary right lateral incisor and first premolarto create space, for canine alignment. Simultaneously, the traction vector was modified to guide the mesially displaced canine distally and occlusally towards the developing space. Midline, position of the adjacent tooth, and anchorage were carefully monitored throughout this traction phase.

Subsequently mandibular arch was bonded and arches were coordinated. As the treatment progressed further, them axillary working archwire was advanced to 0.017×0.025-inch Stainless Steel (SS) wire. Piggyback mechanics using an auxiliary nickel-titanium wire over the rectangular stainless-steel base archwire were then employed to bring the canine into the final alignment within the main arch wire.

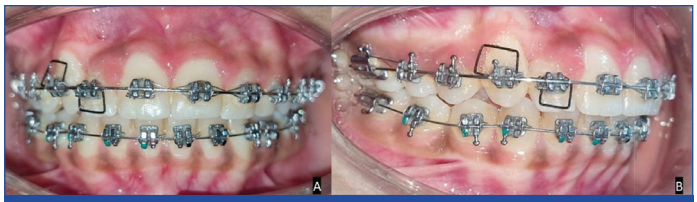
The staged biomechanical approach facilitated efficient alignment of the impacted canine while minimising undesirable movement of the adjacent teeth and maintaining the maxillary dental midline, bilateral Class I molar relationship, and periodontal support.

Once the impacted canine had been brought into the arch, it was evident that although the crown had aligned satisfactorily, ideal torque expression had not been fully achieved. Additionally, the adjacent lateral incisors required torque refinement to improve the root parallelism.

Torquing Auxiliary (Spec Auxiliary)

Following alignment of the canine crown into the arch, residual torque discrepancy of the impacted canine and adjacent incisors were noted. A Begg-type torquing auxiliary Spec auxiliary was therefore fabricated from 0.010-inch Australian A-J Wilcock wire [2].

The auxiliary consisted of two box components that were activated according to the toque requirement the adjacent teeth. The box on the maxillary canine was positioned gingivally to deliver palatal root torque, while the box on the adjacent lateral incisor was directed occlusally to produce labial root torque. The auxiliary was engaged first, followed by the engagement of the base archwire in piggyback fashion [Table/Fig-10].



[Table/Fig-10]: Intraoral photographs showing use of a Begg-type torquing auxiliary (SPEC auxiliary) for final root torque correction and three-dimensional finishing of the impacted maxillary right canine and adjacent teeth: (a) Frontal view; (b) Right buccal view.

This method allowed delivery of the light reciprocal torque moments on adjacent teeth in same arch for period of two-month resulting in improvement in root angulation, root parallelism, and final three-dimensional positioning prior to finishing.

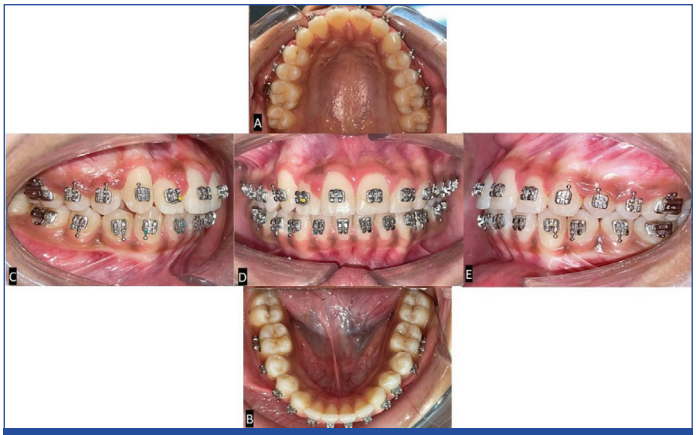
Finishing and Results

Final finishing and detailing were carried out using settling elastics to achieve intercuspation and occlusal stability. Mild localised gingival enlargement in the right maxillary canine region was noted during treatment and was managed with reinforcement of oral hygiene measures and periodontal care [Table/Fig-11,12].

The total active treatment duration was 18 months.

The impacted maxillary right canine was successfully aligned into functional occlusion. The maxillary dental midline was

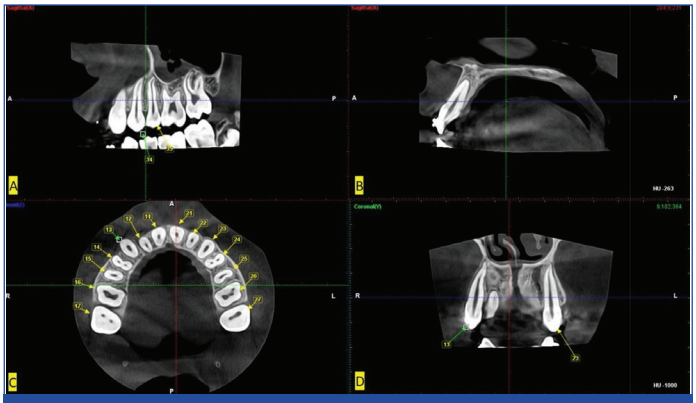
[Table/Fig-11]: Extraoral photographs during finishing stage: (a) Frontal; (b) Frontal smiling; (c). Profile.



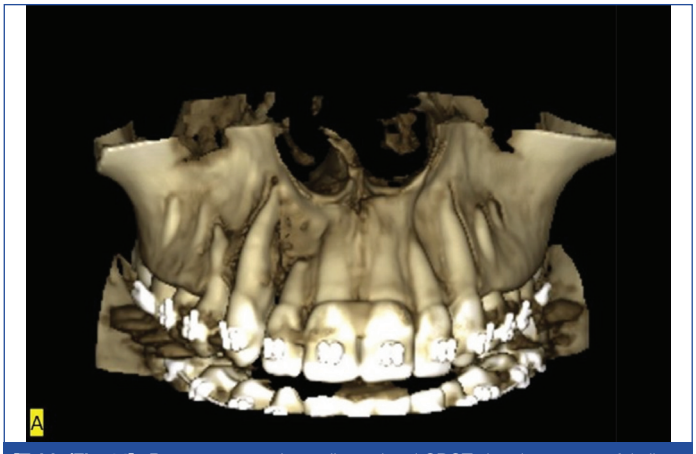
[Table/Fig-12]: Intraoral photographs during finishing stage: (a) Maxillary arch; (b) Mandibular arch; (c) Right buccal view; (d) Frontal; (e) Left buccal view.

corrected, and bilateral Class I molar and canine relationship were achieved.

Post-treatment CBCT demonstrated qualitative improvement in the crown position, root angulation, and root parallelism of the impacted canine and adjacent teeth. Although complete ideal torque correction was not achieved, significant improvement in three-dimensional positioning was evident [Table/Fig-13,14].



[Table/Fig-13]: Post-treatment CBCT sectional views demonstrating favourable crown position, root angulation, and three-dimensional positioning of the maxillary right canine after orthodontic alignment and torque correction: (a, b) Sagittal sections; (c) Axial section; (d) Coronal section.



[Table/Fig-14]: Post-treatment three-dimensional CBCT showing successful alignment and favourable positioning of the maxillary right canine within arch.

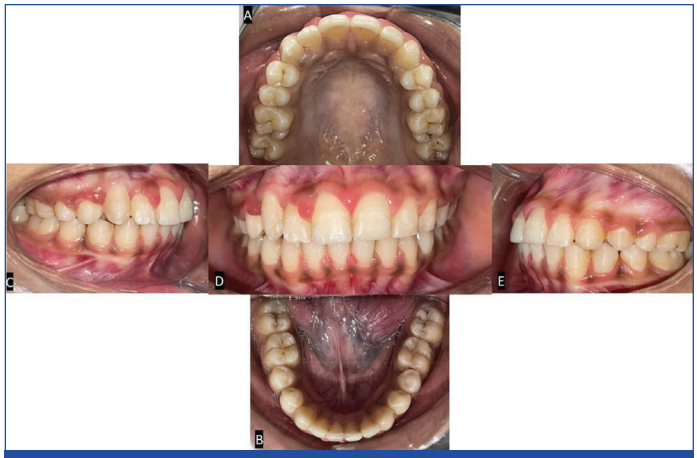
Retention Protocol

Following appliance removal, bonded lingual retainer was provided in upper and lower arch. The patient was instructed regarding oral hygiene maintenance and retention care. No immediate post-treatment relapse was observed [Table/Fig-15,16].

DISCUSSION

Impaction of the maxillary canine is a relatively common eruption disturbance and is considered the second most frequent dental

[Table/Fig-15]: Post-treatment extraoral photographs: (a) Frontal; (b) Frontal smiling; (c) Profile.



[Table/Fig-16]: Post-treatment intraoral photographs: (a) Maxillary arch; (b) Mandibular arch; (c) Right buccal view; (d) Frontal; (e) Left buccal view.

impaction after mandibular-third molars. Its reported prevalence ranges from approximately1%-3%, with a higher occurrence in females [3]. Palatal displacement is more common than labial impaction [3]. The aetiology is considered multifactorial, with both systemic and local factors implicated. Reported localfactors include arch length discrepancy, obstruction of the eruption pathway, trauma, ankylosis, and developmental disturbances [4].

In the present case spacing was clinically evident in the anterior maxillary segment; however, space analysis demonstrated residual space deficiency for complete accommodation of permanent canine, indicating that canine impaction could not be attributed to space deficiency alone. Pre-treatment panoramic radiograph and CBCT confirmed a labially impacted right maxillary canine with mesial crown displacement, suggesting that altered eruption path and ectopic position forming the major contributing factors. The finding supports previous reports that buccally impacted canine may arise from a combination of mild space discrepancy and positional disturbances rather than crowding alone [5,6]. Pre-treatment cephalometric findings demonstrate an average skeletal jaw relationship in the present case, suggesting that the canine impaction was primarily related to local eruptive and positional factors rather than an underlying skeletal discrepancy. This finding supports the multifactorial nature of canine impaction reported in literature.

Early diagnosis of the impacted maxillary canine is considered critical, as interceptive measures such asextraction of deciduous canine, space creation, or maxillary expansion may improve spontaneous eruption when performed in mixed dentition stage. Previous reports suggest more favourable outcomes when the canine cusp lies in sector 2 or 3 with moderate angulation, whereas more mesially displaced canines or patient diagnosed at later age often require surgical- orthodontic intervention [4,7]. In present case, the patient reported at 14 years of age with complete root formation and mesial crown displacement; therefore, spontaneous eruption was unlikely, and active surgical exposure with orthodontic traction was considered more appropriate treatment approach [7].

Selection of the surgical and orthodontic approach for impacted maxillary canine depends primarily on tooth position, soft-tissue coverage, proximity to the adjacent roots, and periodontal considerations [8]. Literature comparing open and close surgical approach techniques has not demonstrated universal superiority

of either method, and both remain clinically acceptable when appropriately selected [4,7]. Closed surgical techniques are often advocated where preservation of the soft-tissue contour and attached gingiva is a major concern, particularly in deeply placed teeth, whereas open exposure technique may offer advantages in relatively superficial labial impactions by allowing direct visualisation of the crown, easier attachment management and more controlled monitoring of the traction vector [4]. In present case tooth position supported the choice for open surgical technique, allowing for easy accessibility and control of the biomechanics.

The timing of orthodontic traction after surgical exposure also remains clinically relevant [9]. Delayed traction may permit spontaneous eruption in selected favourable cases on the basis of tooth position and timing of intervention; however immediate or early light traction has been reported to reduce unnecessary treatment delay and assist directional guidance when the eruptive path is unfavourable [3,4,10]. In the present case, simultaneous space development and controlled traction were preferred because the canine required redirection away from mesial path rather than passive observation alone. This approach allowed active biomechanical control while maintaininganchorage and preparing the canine segment for subsequent alignment.

The choice of a 0.018-inch slot MBT appliance was also clinically advantageous in this case. Since torque expression is influenced by the amount of play between the archwire and bracket slot, smaller slot system may permit earlier and more effective engagement of working rectangular wires during finishing, thereby improving control of third-order tooth movement [11]. This likely contributed to better torque expression during the final detailing stage in the present case.

A key biomechanical principle in impacted canine management is that treatment should not be regarded just as, “simple extrusion” of the crown into the dental arch. Effective movement requires consideration of the three-dimensional position of both crown and root, proximity to adjacent roots, available space coronally and apically, and the desired force vector during eruption guidance. Inappropriate traction mechanics or inaccurate interpretation of the root position may result in unwanted movement, compromised periodontal support, or incomplete root correction [4,7]. In the present case, coordinated tooth movement, with space creation and traction was donein a monitored staged manner so that canine could first be redirected from its mesial eruptive path then aligned into the prepared space. This approach likely improved the efficiency while minimising undesirable effects on adjacent teeth and anchorage.

An important finding in the present case was that satisfactory crown alignment did not equate to the ideal root positioning. Residual torque discrepancy of the impacted canine and adjacent lateral incisors persisted after alignment, which is consistent with previous reports that impacted canines frequently demonstrate incomplete third-order correction when conventional alignment mechanics alone are used. Rectangular archwire may provide limited torque expression because of bracket-wire play and the displaced initial position of the tooth. Therefore, a Begg-type torquing auxiliary (Spec auxiliary), based on the design described by Singh H et al., was used to deliver controlled reciprocal root movement, with palatal root correction of the canine and labial root correction of the canine and labial root correction of the adjacent lateral incisor [2]. Auxiliary torque mechanics such as torquing springs and customised finishing auxiliaries have been recommended where precise root parallelism and three-dimensional finishing cannot be predictably achieved using routine archwire mechanics alone. Conventional method by bracket inversion may also be considered; however, such approaches often require additional chairside time, rebonding procedure, and a subsequent round-tripping phase before alignment is re-established.

The CBCT imaging is valuable investigation in present case helping not only evaluate the position of the impacted tooth but also assessing the alignment within bone and reflecting the true rootposition, root parallelism and relation in surrounding bone [6]. This case is clinically relevant because residual labial root prominence or unfavourable positioning may increase risk of gingival recession, alveolar dehiscence and compromised periodontal stability. The present report is limited by its single-case design and lack of long-term follow-up; however, it highlights that CBCT-guided finishing may provide a more reliable assessment of treatment success than crown alignment alone, particularly in complex impacted canine case.

CONCLUSION(S)

Orthodontic management of impacted maxillary canine can be successfully achieved through early diagnosis, elimination of etiological factors, controlled biomechanics and appropriate finishing mechanics. The use of 0.018 slot system combined with auxiliary-assisted torque correction contributed to efficient treatment and optimal final positioning of the canine. This case highlights that successful outcomes depend not only on alignment but also on achieving proper root positioning and functional integration.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Apr 09, 2026
- Manual Googling: Jun 06, 2026
- iThenticate Software: Jun 09, 2026 (6%)

ETYMOLOGY: Author Origin

EMENDATIONS: 9

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Mar 30, 2026**
Date of Peer Review: **Apr 18, 2026**
Date of Acceptance: **Jun 11, 2026**
Date of Publishing: **Aug 01, 2026**