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Cone-Beam Computed Tomography-Guided Diagnosis and Surgical Management of a Horizontally Impacted Ectopic Maxillary Second Premolar by the Tooth-Split Odontotomy Technique

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Abstract

Impaction of the maxillary second premolar is uncommon, and displacement of the tooth to an ectopic position near the maxillary sinus complicates diagnosis and surgery. We report a 16-year-old female patient who presented with a missing maxillary left second premolar after spontaneous exfoliation of a retained primary second molar. Cone-beam computed tomography (CBCT) showed tooth 25 lying horizontally above the mesial root of tooth 26, 8 mm from the floor of the maxillary sinus, with no resorption of adjacent roots. Tooth transposition was considered and excluded because tooth 25 had not exchanged position with any other tooth. The tooth was removed through a buccal approach using a tooth-split (odontotomy) technique. Healing was uneventful at four weeks of follow-up. CBCT allowed accurate localization of the tooth, assessment of its relation to the sinus floor and adjacent roots, and planning of a conservative surgical approach.

Categories: Dentistry
Keywords: cone-beam computed tomography (cbct), ectopic eruption, maxillary second premolar, maxillary sinus floor, surgical tooth extraction

Introduction

Tooth transposition is a rare eruption anomaly, which is defined as the eruption of a tooth in the normal position of a nonadjacent tooth or the interchange of the position of two adjacent teeth [1]. Maxillary canines and third molars are the most common impacted teeth, but maxillary premolar impaction is less common, with a prevalence of 0.1% to 0.3% in the population [2]. Complete transposition of an impacted maxillary second premolar is a very rare clinical condition [1,3]. The exact etiology is unknown but tooth bud displacement, early trauma, retained primary precursors and genetic factors are all strongly suggested [1,2]. The management of a transposed impacted maxillary second premolar is very challenging in diagnosis and management due to its proximity to the maxillary sinus floor, loss of arch length and possible root resorption of adjacent teeth [2,3]. The interdisciplinary diagnostic and treatment protocol for a rare case of a transposed impacted maxillary second premolar is described in this report.

Case Presentation

A 16-year-old female patient presented to our department with a chief complaint of a missing tooth in the maxillary left posterior region and mild esthetic dissatisfaction. The patient's medical and systemic histories were unremarkable, with no reported history of facial trauma, previous orthodontic treatment, or family history of dental anomalies.

Clinical examination

Extraoral examination demonstrated a symmetrical facial profile, competent lips, and a non-contributory temporomandibular joint evaluation. Intraoral examination revealed permanent dentition with a Class I molar relationship on the right side and a history of a retained primary second molar (tooth 65) on the upper left side, which became mobile and exfoliated spontaneously three weeks before presentation. A noticeable space deficiency was present in the maxillary left posterior quadrant. The overlying palatal and buccal mucosa was healthy without swelling, pain, or sinus tracts upon palpation.

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Radiographic assessment

A panoramic radiograph was not taken, since it analyzes any impacted tooth only in a two-dimensional radiographic view. A cone-beam computed tomography (CBCT) scan was obtained to localize the unerupted tooth and plan prosthetic replacement of the space. It showed the maxillary left second premolar (#25, Fédération Dentaire Internationale (FDI) notation) lying horizontally above the mesial root of the first molar (#26), with the crown positioned bucally and root directed palatally. The crown was 8 mm from the floor of the maxillary sinus. No root resorption was seen on neighboring permanent teeth. Teeth #24 and #26 were in their normal positions and no tooth had changed position, so transposition was excluded (Figure *1A*-*1C*).

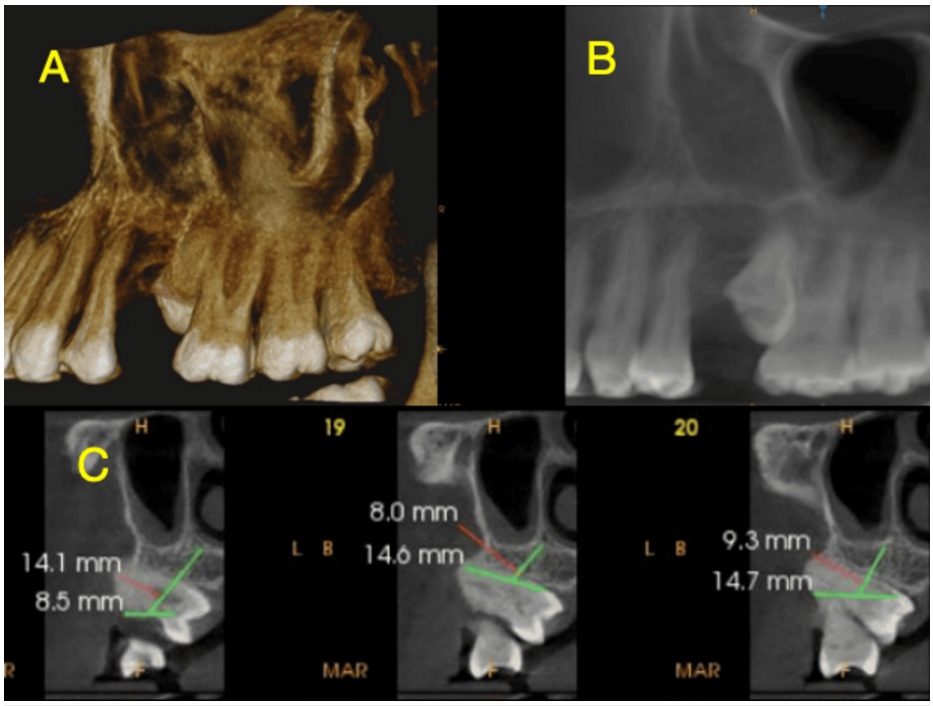


FIGURE 1: A) Cone-beam computed tomography (CBCT) volumetric acquisition image. B) Panoramic mode CBCT image. C) Serial cross-sectional views revealed a horizontally impacted ectopic left maxillary second premolar at a distance of 8 mm from the floor of the left maxillary sinus.

The width of the alveolar crest below the ectopic impacted left maxillary second premolar was 8.5 mm, above the ectopic impacted left maxillary second premolar was 8.0 mm, and 9.3 mm from an imaginary line passing perpendicularly to the long axis of the impacted ectopic left maxillary second premolar.

Adequate alveolar bone support was preserved around the adjacent teeth. Considering the unfavorable position near the sinus floor and the risk of root resorption of adjacent molars, surgical extraction of the impacted premolar through a buccal approach was selected over orthodontic traction. A buccal approach was chosen, since the crown is positioned buccal.

Interventions and outcomes

A controlled tooth-split (odontotomy) technique was used to preserve the adjacent roots, avoid perforation of the sinus, and preserve the alveolar ridge.

Surgical Access and Exposure

After local anesthesia (2% lidocaine, 2 mL), a posterior superior alveolar nerve block, buccal infiltration plus greater palatine nerve block, a full-thickness buccal mucoperiosteal flap was raised. To expose the crown and cementoenamel junction (CEJ) of tooth #25, a conservative osteotomy was performed with a round surgical bur and cold saline irrigation (Figure *2*).



FIGURE 2: Buccal approach of mucoperiosteal flap elevation and osteotomy.

Crown-Root Separation (Primary Odontotomy)

A high-speed tungsten carbide tapered fissure bur (No. 702) was placed perpendicular to the tooth's long axis at the CEJ under continuous saline irrigation. A trench was cut two-thirds through the tooth's thickness, avoiding complete penetration to protect the underlying sinus membrane. A straight elevator was placed in the groove and gently rotated to separate the crown from the root.

Crown Delivery

Using the void created by the osteotomy, the severed crown fragment was luxated away from the root body and delivered without applying pressure against neighboring teeth.

Sagittal Root Sectioning

The horizontal orientation and curvature of the root horizontal section along the long axis of the root to divide the root into two smaller fragments, thus eliminating the resistance of root curvature.

Root Retrieval

Points were marked on the root surface and an apical elevator was used to push the root fragments forward in the empty space of the socket for atraumatic retrieval.

Socket Inspection and Closure

The surgical site was debrided of remnants of the dental sac and irrigated thoroughly. Inspection revealed the Schneiderian membrane to be intact (negative Valsalva maneuver). The flap was reapproximated and secured with 3-0 silk sutures. The extracted tooth is shown in Figure 3.



FIGURE 3: Extracted horizontally impacted ectopic left maxillary second premolar by tooth-split technique.

Postoperative antibiotics (amoxicillin 500 mg with clavulanate potassium 125 mg) were prescribed for seven days, and an analgesic (aceclofenac 100 mg) twice daily for five days. Healing progressed uneventfully. At the four-week follow-up, objective findings recorded: pain score 0, soft-tissue healing was satisfactory, and absence of sinus-related symptoms such as nasal stuffiness. The patient was counseled regarding a fixed prosthesis supported by a dental implant.

Discussion

Tooth transposition is a rare eruption anomaly in which a tooth erupts in the position normally occupied by a non-adjacent tooth, or two adjacent teeth exchange positions [1]. In the present case, tooth #25 lay horizontally above the mesial root of tooth #26 and had not taken the position of another tooth. It is therefore best described as a horizontally impacted ectopic second premolar, and transposition was excluded. Maxillary canines and third molars are the teeth most often impacted, followed by maxillary premolars, whose impaction occurs in 0.1% to 0.3% of the population [2]. Proposed causes include tooth bud displacement, early trauma, retained primary teeth and genetic factors [1,2]. No cause was identified in this patient, although a retained primary second molar was present. An impacted premolar close to the maxillary sinus floor presents a diagnostic and therapeutic challenge because of the risk of sinus perforation, loss of arch length and resorption of adjacent roots [2,3]. Ectopic and transposed teeth are generally difficult to treat [4]. Interceptive treatment of unerupted or displaced premolars has been suggested where it promotes normal eruption of adjacent teeth [5], and traction may be considered where the tooth position allows it [6].

Surgical options for impacted ectopic premolars are summarized in Table *1*.

Technique	Primary indication	Flap design and access	Surgical methodology	Anatomical considerations and risks
Palatal sectioning extraction	The crown or body of the tooth lies palatal to the adjacent roots, making traction unpredictable.	Full-thickness palatal mucoperiosteal flap (envelope or triangular design) that extends across the neighboring teeth [6].	Controlled osteotomy with low-speed round or fissure burs under irrigation. The crown and root are sectioned to limit bone removal and to deliver the fragments safely, without levering against the adjacent roots.	High risk of perforating the floor of the maxillary sinus; possible injury to the nasopalatine or greater palatine neurovascular bundles.
Buccal corticotomy window approach	The tooth lies high in the buccal vestibule or is transposed buccally relative to the molar roots.	Sulcular incision with vertical releasing incisions, followed by elevation of a full-thickness buccal mucoperiosteal flap [6].	Conservative osteotomy to create a localized buccal bone window that exposes the crown. The tooth is sectioned along its long axis or at the neck before gentle luxation.	Risk of dehiscence or recession on the adjacent buccal roots; if the tooth lies high, it may be close to the infraorbital neurovascular structures.
Piezoelectric bone surgery (piezosurgery)	Complex bone removal next to delicate soft tissues or vital anatomical structures.	Palatal or buccal mucoperiosteal flap, tailored to the findings on three-dimensional CBCT imaging.	Ultrasonic micro-vibrations selectively cut mineralized bone without damaging the adjacent soft tissue or tooth roots, minimizing heat necrosis.	Considerably safer near the Schneiderian (sinus) membrane, although the surgery takes longer to perform.
Surgical autotransplantation	Favorable root apex development (50%–75% of the root formed) and sufficient bone at the recipient site.	Atraumatic palatal or buccal surgical exposure. A custom socket is prepared at the target site using three-dimensional printed surgical guides.	Minimal manipulation of the periodontal ligament (PDL) during luxation. The tooth is moved to the target position and secured with a splint, followed by root canal therapy if the root apices are closed.	Ankylosis, progressive root resorption, or pulp necrosis if the PDL is damaged.
Closed exposure for orthodontic traction	Orientation favorable for orthodontic traction, without a high risk of root resorption of the neighboring teeth [6,7].	A mucoperiosteal flap is elevated and bone is removed around the crown; the flap is then repositioned and closed over the attachment [7].	Conservative exposure of the crown only. An orthodontic bracket or button with a gold chain is bonded intraoperatively, the flap is closed primarily, and traction follows [7].	Lower esthetic risk than open exposure, but the bond may fail, requiring re-entry.

TABLE 1: Management options for impacted ectopic premolar teeth.

Table compiled by the authors; flap design and traction details are supported in part by references [4,6-8]. CBCT: cone-beam computed tomography.

Choice among them depends on tooth position, root development, relation to the sinus floor and adjacent roots, and periodontal condition. Here, the horizontal position and the proximity to the sinus floor and molar roots made traction unpredictable, and surgical removal by sectioning was chosen. Sectioning the crown and root limited bone removal and avoided levering against adjacent teeth. Careful diagnosis using advanced imaging, combined with conservative orthodontic and surgical approaches, can achieve satisfactory functional and esthetic outcomes while minimizing complications [8]. No dedicated classification exists for impacted ectopic maxillary second premolars. Abnormal premolar eruption has been grouped by eruption phase and aetiology [9]. CBCT showed the three-dimensional position of the tooth and its distance from the sinus floor, which informed the surgical approach. The limitations of this case report include a single case, absence of long-term follow-up, and standardized outcome measures; probing depth and bone level of the teeth were not recorded. Postoperative CBCT was not obtained because it is not routinely indicated after uncomplicated removal of an impacted tooth.

Patient perspective

"When my dentist first told me that my missing upper back tooth was buried horizontally in the roof of my mouth and lay above the roots of my other teeth, I was really worried about how complicated it would be to fix. I was scared to remove the tooth at first, worried about leaving a gap forever, or damaging the teeth next to it, especially since it was so close to my sinus.

The 3D scans helped a lot. My dental team pointed out exactly where the tooth was hiding and carefully explained why the safest option was to surgically remove it instead of trying to bring it into position with

orthodontic traction, which may take years. The surgery went well and I had very little discomfort afterward and healed quickly. I feel relieved and confident in my treatment plan knowing that my surrounding teeth and sinuses were protected."

Conclusions

A horizontally impacted ectopic maxillary second premolar close to the sinus floor and the roots of the first molar can be removed conservatively by tooth-split odontotomy. CBCT helped to localize the tooth, exclude transposition, evaluate the proximity to the maxillary sinus, and plan the approach. The treatment options are orthodontic traction, autotransplantation or surgical extraction, and the choice depends on the tooth position, the stage of root development and the condition of the adjacent teeth. The surgical extraction by tooth-split technique is the safest in a severe ectopic impacted maxillary second premolar.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

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