Odovtos-International Journal of Dental Sciences (Odovtos-Int. J. Dent. Sci.), 27 (2) (May-August) 2025: 15-23. ISSN: 2215-3411
https://doi.org/10.15517/ijds.2025.62488

ODOVTOS
International Journal of Dental Sciences

UNIVERSIDAD DE COSTA RICA FOd Facultad de Odontología

https://revistas.ucr.ac.cr/index.php/Odontos

CASE REPORT:

Orthodontic Management of Palatally Displaced Maxillary Canine with Bracket Modification Approach: A Case Report

Manejo ortodóntico del canino maxilar desplazado hacia palatino con énfasis en la modificación de brackets: reporte de un caso

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Received: 25-X-2024 Accepted: 20-II-2025

ABSTRACT: The maxillary permanent canine is known to be susceptible to displacement due to its long and complex journey from initial formation to its eventual placement in the occlusal position. This report presents a case of a 15-year-old female patient with a palatally positioned left maxillary canine. A fixed orthodontic approach using 0.022-slot brackets with MBT prescriptions was employed. During treatment, an open-coil spring and a power chain were utilized to reposition the canine within the dental arch. Additionally, a bracket originally designed for the upper left central incisor was rotated 180° to accommodate the displaced canine. When engaged with a 0.019 × 0.025-inch stainless steel wire, the modified bracket approach effectively provided the desired labial root torque. The modified bracket selection approach successfully delivered the intended labial root torque.

KEYWORDS: Orthodontics; Ectopic maxillary canines; Root torque; Case report.

RESUMEN: El canino permanente maxilar es conocido por ser susceptible al desplazamiento debido a su largo y complejo recorrido desde la formación inicial hasta su eventual posición en la oclusión. Este informe presenta el caso de una paciente femenina de 15 años con un canino maxilar izquierdo posicionado palatinamente. Se empleó un enfoque ortodóncico fijo utilizando brackets de ranura 0,022 con prescripciones MBT. Durante el tratamiento, se utilizó un resorte de espiral abierta y una cadena de potencia para reposicionar el canino dentro del arco dental. Además, se rotó 180° un bracket originalmente diseñado para el incisivo central superior izquierdo para acomodar el canino desplazado.

Al ser activado con un alambre de acero inoxidable de 0,019 × 0,025 pulgadas, el enfoque modificado de brackets proporcionó efectivamente el torque labial deseado en la raíz. El enfoque modificado en la selección de brackets logró proporcionar con éxito el torque labial de raíz previsto.

PALABRAS CLAVE: Ortodoncia; Caninos maxilares ectópicos; Torque de raíz; Informe de caso.

INTRODUCTION

The abnormal eruption of permanent upper canines is a common dental development anomaly (1, 2). These canines deviate from their normal eruptive path, either towards the palate or in a labial direction (2). Two primary theories have been proposed to explain the ectopic eruption of the maxillary permanent canine: the "guidance theory" and the "genetic theory" (2, 3). The “guidance theory” emphasizes the role of the lateral incisor in directing the emerging canine crown onto the correct path within the dental arch (2, 3). When the lateral incisor is missing or morphologically anomalous, this guiding function is compromised, resulting in the displacement of the canine towards the palate (3). The “genetic theory” posits that the palatal displacement of the canine is driven by genetic factors (2). This theory is supported by the presence of other dental anomalies often observed in patients with canines that are abnormally positioned (2, 4, 5). According to Leifert *et al*. (4) in 2003, the likelihood of displacement of the canine towards the palate was notably higher in patients with hypoplasia, peg-shaped, or congenitally absent upper lateral incisors, as well as those with additional impacted or congenitally absent teeth. Additionally, study by Shalish *et al*. (5) in 2009 revealed that palatally displaced canines and malposition of mandibular second premolars were significantly linked, suggesting a potential shared genetic cause.

The spatial arrangement in the maxilla may influence the development of eruption issues, such as ectopic eruption of the upper permanent canines. A lack of space in both the maxillary dental arch and the maxillary bone is commonly identified as a contributing factor for buccally displaced canines (BDCs) (6). Conversely, an ectopic canine located on the palate is often associated with having excess space in the maxilla (7). This space may be created through several mechanisms: (1) extensive growth in the maxillary base, or (2) the absence or peg-shaped formation of lateral incisors (7). Additionally, several studies have shown that patients with palatally displaced canines (PDCs) were more likely to have Class II, Division 2 malocclusion and deep overbite than the general population (7, 8).

Although palatally impacted canines and palatally erupted canines share common etiologic factors, their treatment approaches differ (9-11). For palatally impacted canines, treatment often involves surgical exposure combined with orthodontic traction (11-14). For palatally erupted canines, treatment typically involves orthodontic movement to reposition the tooth into its correct position in the dental arch (1).

To achieve a functional occlusion, one important requirement of orthodontic treatment is ensuring the proper inclination of all teeth by the end of treatment (15, 16). Torque is the force that allows the orthodontist to manage the axial inclinations of the teeth and position them in a balanced alignment (17, 18). It is one of the most essential and challenging forces in orthodontics (18). Clinically, torque is considered the third crucial element of occlusion, with positive torque occurring when the root is positioned lingually, and negative torque when the root is positioned facially relative to the crown (19). Adjustments to the bracket position, such as inversion, can also assist in achieving the desired movements of indivi-

dual teeth (20). The positioning of the brackets should be carefully planned from the beginning of treatment to maximize the benefits (20, 21). When an upper lateral incisor is positioned palatally, the brackets should be reversed to shift the torque values from positive to negative, facilitating the desired root movements (21). This approach helps save valuable treatment time by reducing the need for torqueing at the end (21). This case report aimed to discuss the use of a bracket modification approach to treat a palatally erupted maxillary canine in an adult patient without the need for tooth extraction.

CASE REPORT

DIAGNOSIS AND ETIOLOGY

A 15-year-old female patient came to the clinic with the primary concern that her smile was not satisfactory. Upon completing the medical questionnaire, it was confirmed that the patient had no systemic disorders, traumatic history, or previous orthodontic treatments. Following extra-oral evaluation (Figure 1), she was found to have a symmetrical, aesthetically pleasing, oval-shaped face. When she smiled, about two-thirds of the crowns of her maxillary anterior teeth were visible. Her facial profile showed a straight alignment with a prominent chin and a deep labiomental groove. Upon intra-oral examination, she was found to have a full set of permanent teeth with molar class I and canine class I relationships on the right side, and a molar class I on the left side. The facial midline aligned with the mandibular dental midline, while the upper dental midline was shifted 2mm to the left.

The pretreatment panoramic radiograph showed that all third molars were still developing, dental fillings were present on some molars, and no signs of abnormalities were found in the apical bone base or periodontal tissues (Figure 2.A). A web-based cephalometric analysis software (WebCeph) was employed to produce cephalometric tracing and measurements. Figure 2.B and Figure 2.C present lateral cephalometric X-ray and tracing of the patient prior to orthodontic treatment. The analysis revealed a class III skeletal relationship (ANB, 0.220; Wits appraisal, -4.58 mm) and a normodivergent facial pattern (FMA, 25.530). The upper incisors had normal inclination (U1 to maxillary plane angle, 110.690), while the lower incisors were retroclined (IMPA, 83.220). The upper and lower lip were slightly retruded (Upper lip to E-plane, -1.18 mm; Lower lip to E-plane, -1.7 mm) (Table 1).

TREATMENT OBJECTIVES

The primary aim of the treatment was to reposition the ectopic maxillary canine into the upper dental arch and establish proper occlusion. The additional objective was to enhance facial appearance and smile aesthetics without compromising the existing facial profile.

TREATMENT PROGRESS

In the first step of leveling and alignment, all teeth, except for the ectopic canine, were bonded with 0.022 slot brackets (MBT prescription). The initial archwire used was 0.012-inch nickel-titanium (Ni-Ti). The leveling and alignment process was carried out monthly, progressing to the 0.017x0.025-inch stainless-steel wire (SS). This step took six months.

In the next stage, enamel reduction was performed, and an opening coil spring was used to create more space for the upper left ectopic canine. Afterward, the canine was bonded with button on the lingual face, and a power chain was used to reposition it into the dental arch (Figure 3.A). Posterior turbos were placed on mandibular molars to eliminate interference while moving the canine into dental arch (Figure 3.B). When the upper left canine was nearly aligned with the dental arch, it was bonded with a bracket desig-

ned for upper left central incisor, but placed inverted to change the torque from +17 degrees to -17 degrees. The upper round 0.012-inch Ni-Ti wire was then placed, the posterior turbos were removed, and the alignment process of the upper dental arch was completed with a 0.019x0.025-inch SS wire.

TREATMENT RESULTS

The total treatment time was twenty months, and the treatment goals were achieved. The midlines of the teeth were in line with the facial midline, and smile aesthetic was favorably enhanced (Figure 4). Post-treatment analysis of the cephalometric radiograph showed improved values for several initial parameters (Table 1) (Figure 5). Skeletal analysis revealed that most values, including SNA, SNB, ANB, and FMA, showed no significant clinical differences. Dental analysis showed that the previously retroclined lower incisors had improved inclination (IMPA increased from 83.220 to 94.560). Soft tissue analysis illustrates that the previously retruded lip had a better position (Upper lip to E-plane changed from -1.18 mm to 0.47 mm; Lower lip to E-plane changed from -1.7 mm to 1.24 mm).

Figure 1. Pre-orthodontic photographs taken extraorally (A-C) and intraorally (D-H).

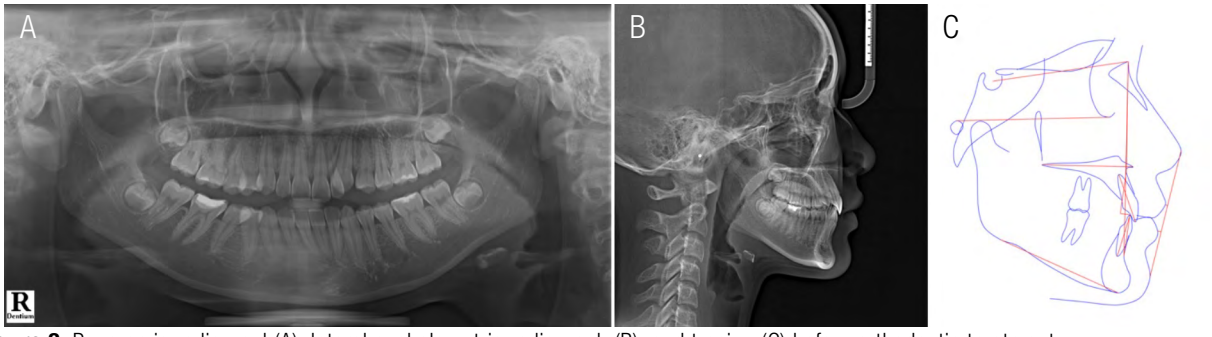

Figure 2. Panoramic radiograph(A), lateral cephalometric radiograph (B), and tracing (C) before orthodontic treatment.

Table 1. Cephalometric analysis.

Measurement	Pretreatment	Posttreatment
SNA (0)	80.77	80.69
SNB (0)	80.55	80.61
ANB (0)	0.22	0.08
Wits appraisal (mm)	-4.58	-4.80
Maxillary mandibular plane angle (0)	22.95	23.17
FMA (0)	25.53	25.27
MP-SN (0)	30.74	30.15
U1 to maxillary plane angle (0)	110.69	114.82
U1 to A-Pog (mm)	3.43	4.51
IMPA (0)	83.22	94.56
L1 to A-Pog (mm)	0.99	2.60
Upper lip to E-plane (mm)	-1.18	0.47
Lower lip to E-plane (mm)	-1.70	1.24

SNA= Stella, Nasion, A point; SNB= Stella, Nasion, B point; ANB= A point, Nasion, B point; Wits appraisal: the projections of A point and B point on the occlusal plane. FMA= Frankfort Mandibular Plane Angle; MP-SN: Mandibular plane-sella nasion; IMPA= Incisor Mandibular Plane Angle. Measurements generated by web-based cephalometric analysis software (WebCeph).

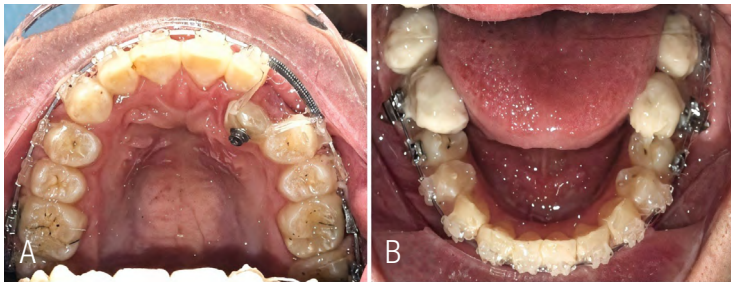

Figure 3. Intraoral photography during orthodontic treatment.

Figure 4. Post-orthodontic photographs taken extraorally (A-C) and intraorally (D-H).

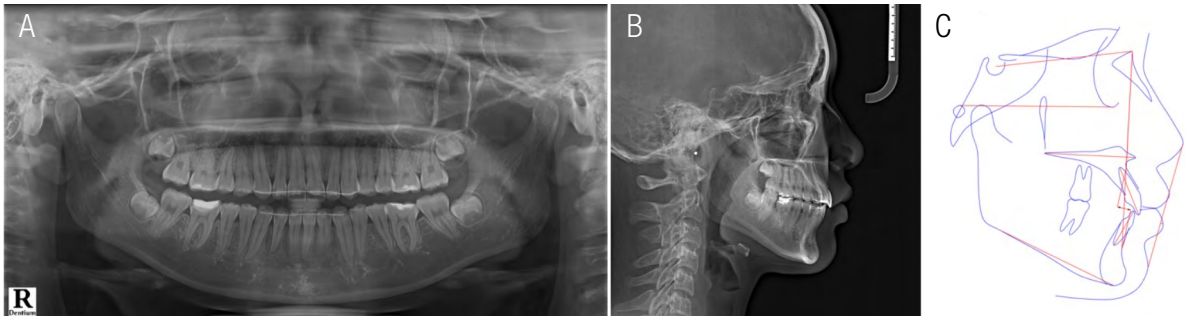

Figure 5. Panoramic radiograph (A), lateral cephalometric radiograph (B), and tracing (C) after orthodontic treatment.

DISCUSSION

It has long been asserted and taught that the upper permanent canine, due to its extended journey from start of development to its completed occlusal positioning, is prone to displacements (22). Our patient had a fully erupted palatally positioned canine, so we decided to perform orthodontic treatment using an opening coil spring, a button on the lingual face, and a power chain to bring the ectopic canine into the dental arch. In fact, the continuous archwire technique for significantly displaced canines can lead to undesirable movements in adjacent teeth (23). These adjacent teeth may experience intrusion, tipping, and occlusal cant, and a lateral open bite may develop (23). Additionally, the patient's arch form may undergo distortion (23). As an alternative, the piggyback technique or a nickel-titanium (NiTi) overlay can be employed (23). The piggyback technique involves the use of a rigid base archwire, typically made of high-tensile stainless steel, combined with a NiTi overlay wire (24, 25). In our case, we use an alternative approach to bring the palatally positioned canine to the dental arch (Figure 3). Our approach is assumed to provide better bucco-lingual inclination at the canine than the piggyback technique.

Modifications such as inverting the bracket position can facilitate individual tooth movements (17). It is crucial to plan the bracket positions from the beginning of treatment to achieve the greatest benefit (17). According to the MBT bracket prescription, the bracket for the maxillary canine has a torque of -7 degree, which is adequate for an upper canine erupting in the dental arch (26). Since orthodontic traction mainly induces tipping movement of the maxillary canine, this torque is often insufficient to provide the necessary labial root movement during the process of canine repositioning (26). In our case, we used the bracket designed for upper left central incisor but bonded it in an inverted position to change the torque from +17 degrees to to -17 degrees, allowing for greater labial root movement. Orthodontists follow the "flip, don't switch" principle to achieve reversed torque without altering the tip (26). For our patient, we selected the upper left central incisor bracket to bond for the upper left canine, resulting in an expected tip of +4 degrees, as per the MBT bracket prescription (26). At the end of treatment, we found that the previously displaced canine had good angulation and inclination, and did not need further detailed correction.

The limitation of this case report is that we had a single patient for follow-up. Further studies with larger sample sizes are necessary to assess the beneficial outcomes of the bracket modification approach in delivering optimal angulation for the treatment of palatally erupted canines.

CONCLUSIONS

This case report documents a successful orthodontic approach for the correction of a palatally positioned maxillary canine. During the treatment, we used an opening coil spring and a power chain to reposition the canine into the dental arch. The use of 0.022 slot brackets with MBT prescriptions, along with the selection of a bracket designed for the upper left central incisor but rotated 180 degrees for the displaced upper left canine, successfully delivered labial root torque upon engagement of 0.019x0.025-inch SS wire.

AUTHOR CONTRIBUTION STATEMENT

Study conception: C.T.B.V.
Data collection: T.M.D. and C.T.B.V.
Data analysis: T.M.D. and C.T.B.V.
Data interpretation: T.M.D. and C.T.B.V.
Manuscript writing: T.M.D. and C.T.B.V.

PATIENT CONSENT STATEMENT

The authors confirm that they have obtained a consent form from the patient. The form

authorizes the inclusion of patient's photographs and other clinical data in the article. The patient has been informed that her name and initials will remain confidential, and all necessary measures will be taken to safeguard her identity.

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