

Orthodontic correction of a complete maxillary canine–first premolar transposition

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Tooth transposition is the positional interchange of adjacent teeth, with a prevalence of 0.33%, often linked to genetic factors or supernumerary or retained deciduous teeth. In complete transpositions, both crowns and roots are displaced; in incomplete transpositions, only the crowns are affected. This case report describes an 11-year-old white female patient undergoing orthodontic treatment because of concerns regarding the complete transposition of the maxillary left canine and the maxillary left first premolar. The report highlights the realignment of these teeth to their proper anatomic positions. Despite the risks of periodontal compromise and prolonged treatment duration, the parents chose to correct the transposition, aiming to reduce the need for restorative procedures after treatment. The segmented mechanics were carefully planned and tailored to minimize risks and side effects. The transposition was corrected orthodontically over 25 months, but the treatment was completed in 48 months by moving the teeth to their desired positions without any detrimental effects on the adjacent teeth. Despite the long treatment time, all objectives were achieved. Transposed teeth can be brought into their correct positions, with feasible results, if the canine is not fully erupted. Otherwise, maintaining the transposition is appropriate if the involved teeth are fully erupted and completely aligned in the transposed position. (Am J Orthod Dentofacial Orthop Clin Companion 2026;XX:XX-XX)

Dental transposition is described as the positional alteration of 2 permanent teeth within the same quadrant,¹ resulting in a change in the natural order or sequence of tooth eruption.² Therefore, this condition can be considered a subdivision of ectopic eruption, characterized by an abnormality in which the tooth erupts through an unusual pathway and consequently assumes an atypical position. Peck et al³ defined it as the development of 2 adjacent teeth in swapped positions, mainly their roots, or the development or eruption of a tooth in a position typically occupied by a nonadjacent tooth.

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A meta-analysis conducted by Papadopoulos et al⁴ summarized previous findings that transposition is considered a rare phenomenon (0.33% prevalence) with multiple manifestations. In this context, transposition can be complete when both the crown and the entire root of the involved teeth are transposed, or it can be incomplete when only the crown is transposed and the root apex remains in its normal relative position.^{1,5}

Transposition occurs more frequently in the maxilla than in the mandible, is more common unilaterally than bilaterally,⁴ and the left side is the most affected side according to case reports described in the literature.^{2,5} However, the occurrence in both arches simultaneously and the transposition of the deciduous teeth are rare conditions.¹ The maxillary permanent canine is the tooth most frequently involved in transposition.¹ Among the variations of dental transposition, that between the maxillary canines and the first premolars (Mx.C.P1) is considered the most frequent,⁶ followed by transposition between the maxillary canines and the lateral incisors,^{1,2,7,8} whereas transposition rarely occurs between the lateral and central incisors, between the canines and the central incisors, and extremely rarely between the canines and the second premolars or first molars.^{1,2}

One of the etiological factors mentioned in the literature is the prolonged retention of deciduous teeth, which may explain the high incidence of deciduous canines associated with dental transposition.^{9,10} According to Peck et al,² the presence of a deciduous canine close to the transposition site can usually displace the permanent canine to a labial position. In addition, intraosseous migration of the canine,¹¹ trauma to the deciduous tooth,¹² the presence of cysts and other pathologic conditions,¹³ and supernumerary teeth are also found to be etiological factors in previous studies.⁷ However, transposition is considered a multifactorial condition influenced by both genetic³ and environmental factors.^{5,12,14,15}

The early diagnosis of this eruption anomaly relies on a comprehensive intraoral clinical examination, subsequently supplemented by radiographic assessment, including panoramic radiographs. Prompt identification of the alteration is crucial for ensuring a favorable treatment prognosis. According to the study conducted by Weeks and Power,¹⁶ the treatment options include (1) interceptive treatment involving the extraction of the deciduous tooth and the maintenance of space through the implementation of a lingual arch or a palatal bar. This approach is feasible only when the root is in close proximity to the desired position (pseudotransposition); (2) the alignment of the teeth while preserving the transposed position, followed by

reanatomization using composite materials; (3) the extraction of 1 or both transposed teeth, followed by orthodontic intervention, particularly when the extraction is deemed necessary because of crowding or caries; and (4) orthodontic mobilization aimed at reversing or rectifying the dental transposition. This option incorporates ambitious and complex mechanics.

In this context, a pertinent question emerges regarding the clinical approach to be undertaken: should dental corrections be pursued, or should the existing transposed tooth positions be accepted? Consequently, this article aims to elucidate the advantages and disadvantages associated with the correction of complete dental transposition through a case report involving the transposition of the Mx.C.P1.

DIAGNOSIS AND ETIOLOGY

A pediatric dentist referred an 11-year-old white female patient for orthodontic treatment because of concerns regarding the transposition of the maxillary left canine (UL3) and the maxillary left first premolar (UL4). The patient exhibited mixed dentition, maxillary constriction, peg-shaped maxillary lateral incisor, and severe crowding in the mandibular arch. The facial analysis revealed normal lip competence, a convex profile, and a pleasant smile (Fig 1).



Fig 1. Pretreatment facial and intraoral photographs.

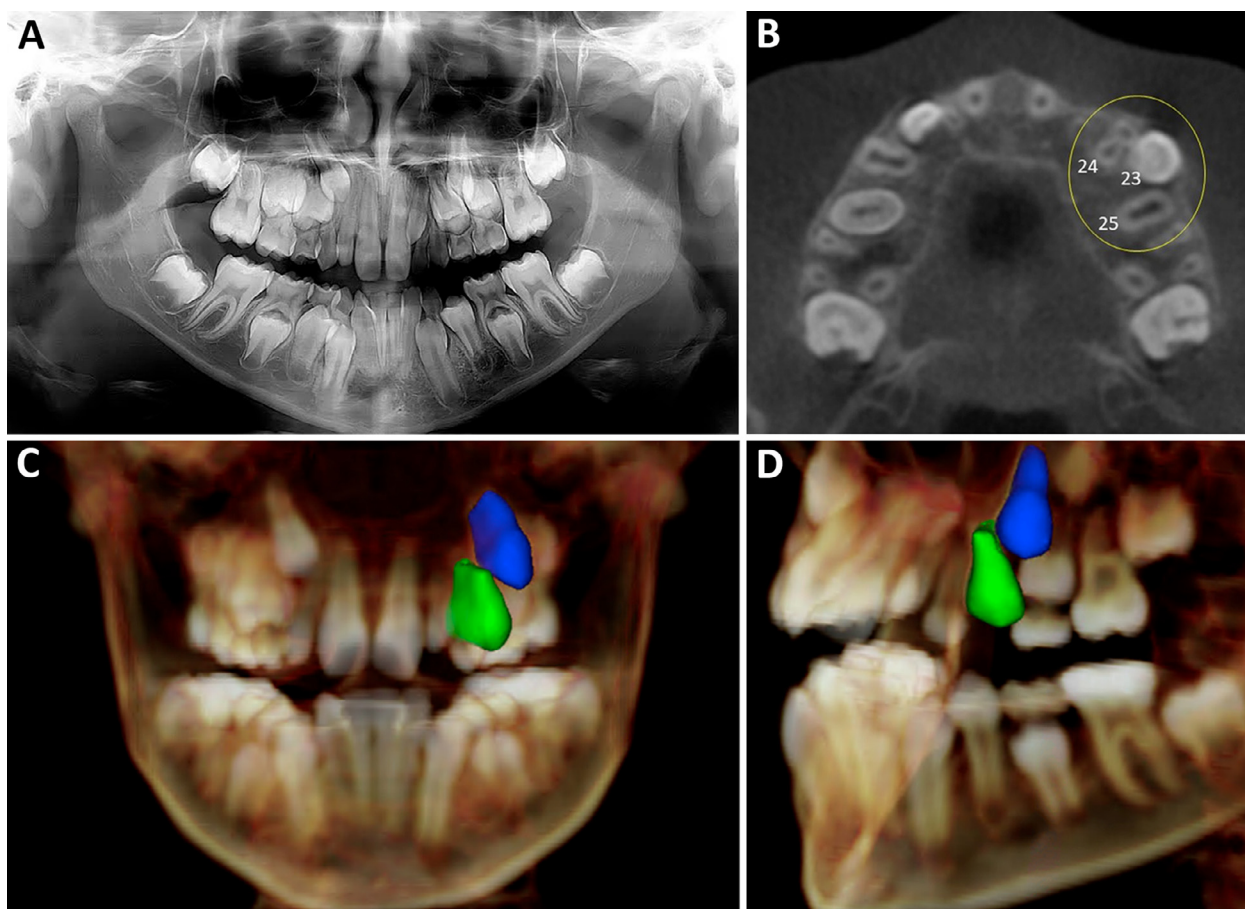


Fig 2. **A**, Pretreatment panoramic radiograph; **B**, Pretreatment CBCT; **C** and **D**, Three-dimensional segmented image. Note the complete transposition between the UL3 and UL4, in which the *green* tooth corresponds to UL4 and the *blue* tooth corresponds to UL3.

Intraorally, the patient exhibited an Angle Class I molar malocclusion, with an average overbite and overjet. Additionally, notable findings included conical maxillary lateral incisors, complete transposition of the UL3 and UL4, and significant mandibular crowding (Fig 1).

A panoramic radiograph and pretreatment cone-beam computed tomography (CBCT) images confirmed the complete transposition of UL3 and UL4, along with the morphological anomaly of the maxillary lateral incisors (Fig 2).¹⁷

Skeletal analysis indicated a Class I relationship (ANB, 3°) characterized by a vertical growth tendency (SN-GoGn, 40°) and retrognathism of both the maxilla and mandible (SNA, 80°; SNB, 77°). The maxillary incisors were mildly proclined (I-NA, 29° and 5 mm), whereas the mandibular incisors exhibited retroclination (L1-NB, 14° and 3 mm; IMPA, 77°) (Fig 3; Table).

TREATMENT OBJECTIVES

The treatment objectives were to accomplish the following: rapid maxillary expansion, the correction of the dental transposition between UL3 and UL4, the alignment

of the mandibular incisors, the maintenance of the Angle Class I relationship, and the preservation of the normal overbite, overjet, and the soft-tissue profile.

TREATMENT ALTERNATIVES

Two treatment alternatives, which consisted of maintaining or correcting the dental transposition, were presented and explained to the patient and her legal guardians. Regardless of the choice, a preliminary phase of treatment was deemed necessary to address maxillary constriction and severe mandibular crowding before fixed orthodontic treatment. A bonded palatal expander was placed for rapid maxillary expansion, and a lingual arch was used in the mandibular arch to preserve the Leeway space for the physiological alignment of the mandibular incisors.^{18,19} The bonded rapid palatal expander was selected because its acrylic coverage provided a splinting effect, distributing forces across multiple teeth.²⁰

Despite the risks of periodontal compromise and prolonged treatment duration, the parents opted for the correction of the transposition, aiming to minimize the need



Fig 3. Pretreatment cephalometric radiograph and tracing.

for restorative procedures after treatment. Consequently, only the conical maxillary lateral incisors were planned for reshaping after orthodontic treatment.

TREATMENT PROGRESS

The treatment began with preventive and interceptive approaches to create space in the maxilla and preserve the Leeway space in the mandible using a bonded palatal splint expander¹⁹ and a lingual arch, respectively (Fig 4).

After 6 months of stabilization, the expander was removed, and a removable retention plate was delivered to the patient; it was used for approximately 6 months

until the establishment of the permanent dentition. Meanwhile, the permanent conical lateral incisors were temporarily reshaped with composite restorations to facilitate their inclusion in the fixed appliance and to improve smile esthetics.

Orthodontic treatment was initiated with the bonding of the maxillary arch using LP brackets with a 0.022 × 0.028-in slot and Roth prescription (American Orthodontics, Sheboygan, Wis). Alignment and leveling were achieved sequentially with 0.012-, 0.014-, 0.016-, 0.018-, and 0.017 × 0.025-in nickel-titanium (NiTi) archwires (Highland Metals, Franklin, Ind). An asymmetrical

Table. Cephalometric measurements

<i>Variables</i>	<i>Norm</i>	<i>Standard deviation</i>	<i>Pretreatment</i>	<i>Posttreatment</i>
SNA (°)	82.0	3.5	80.5	81.1
SNB (°)	80.9	3.4	77.3	80.6
ANB (°)	1.6	1.5	3.2	0.5
U1-NA (mm)	4.3	2.7	4.2	8.5
U1-SN (°)	102.8	5.5	108.1	111.7
L1-NB (mm)	4.0	1.8	3.9	6.6
L1-MP (°)	95.0	7.0	83.3	90.1
Lower lip to E-plane (mm)	−2.0	2.0	1.4	−0.9
Upper lip to E-plane (mm)	−6.0	2.0	0.0	−2.9

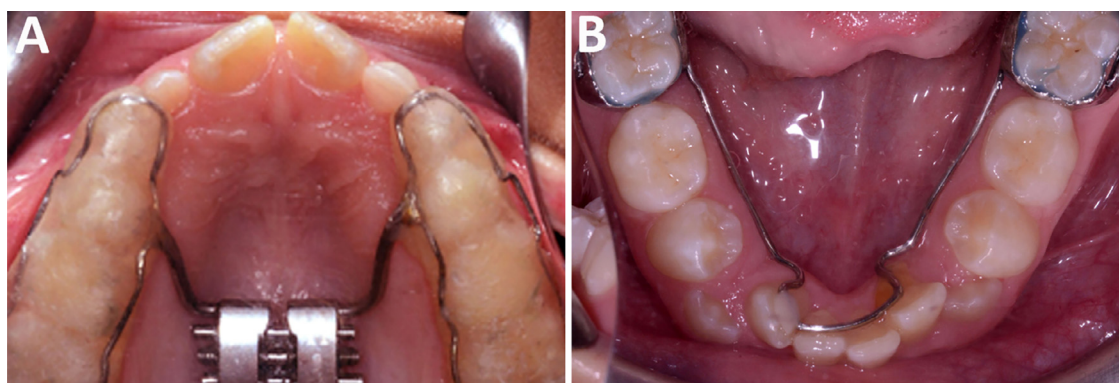


Fig 4. A, McNamara expander to improve maxillary transverse constriction; **B,** Lingual arch to preserve the Leeway space.

Nance button was incorporated to reinforce anchorage and assist in the correction of the transposition (Fig 5).

The mechanics for transposition correction involved the application of palatal root torque and controlled translation of the UL4 to avoid interference with the eruption path of the UL3 (Fig 6). This was accomplished using segmental mechanics with a 0.018 × 0.025-in titanium-molybdenum alloy segment (Morelli Ortodontia, Sorocaba, São Paulo, Brazil), which included a vertical double helicoid to increase flexibility and facilitate the expression of palatal root torque on the UL4 (Figs 5 and 7).

In response to the increased patient discomfort associated with the helicoid bends, as well as the eruption of the UL3 and the pronounced palatal displacement of the UL4, the Nance button was replaced with a transpalatal arch to maintain the transverse and vertical anchorage reinforcement (Fig 8). The transpalatal arch was fabricated from 0.036-in stainless-steel (SS) wire, with a 0.019 × 0.025-in SS horizontal segment soldered to it, specifically designed to facilitate the buccal displacement of the UL4 (Fig 9).

Controlled palatal bodily movement of the UL4 was required to create an unobstructed path for the eruption and alignment of the UL3. This objective was achieved through segmented mechanics employing rectangular wire

segments. After the palatal displacement of the UL4, the UL3 erupted spontaneously. The UL3 was carefully positioned within the arch with the aid of piggyback mechanics, using a 0.019 × 0.025-in SS base archwire in conjunction with a 0.012-in NiTi archwire that was ligated to the UL3.

Once the UL3 had achieved adequate vertical positioning, its protraction was initiated. This was accomplished using an open-coil spring placed on a 0.019 × 0.025-in SS base archwire, compressed between the UL3 and maxillary left second premolar. In addition, a second-order bend was incorporated into the archwire in the canine region to produce slight buccal displacement of the UL3, thereby preventing interference with the adjacent UL4 during protraction. After the correction of the transposition of the UL3 at both the crown and root levels, the UL4 was successfully repositioned buccally into its final position (Figs 10 and 11).

For esthetic considerations and at the patient's request, the maxillary metallic brackets were replaced with esthetic sapphire brackets (Roth prescription, 0.022 × 0.028-in slot; PURE, Sapphire Bracket System, Ortho Technology, Carlsbad, Calif) in combination with esthetic NiTi and SS archwires (Trianeiro Ind Com Imp Exp Ltda, Rio Claro, São

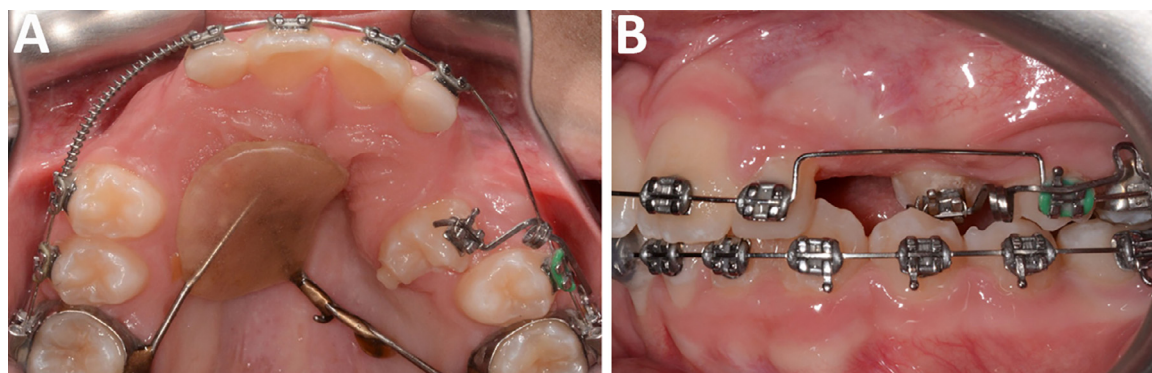


Fig 5. A, Nance button used to improve anchorage and facilitate transposition correction; **B,** Segmental mechanics using a 0.018 × 0.025-in TMA wire with a vertical double helix to facilitate palatal root torque of UL4. UL6 served as the anchorage unit, incorporated into the Nance button. TMA, titanium-molybdenum alloy. UL6, the maxillary left first molar.

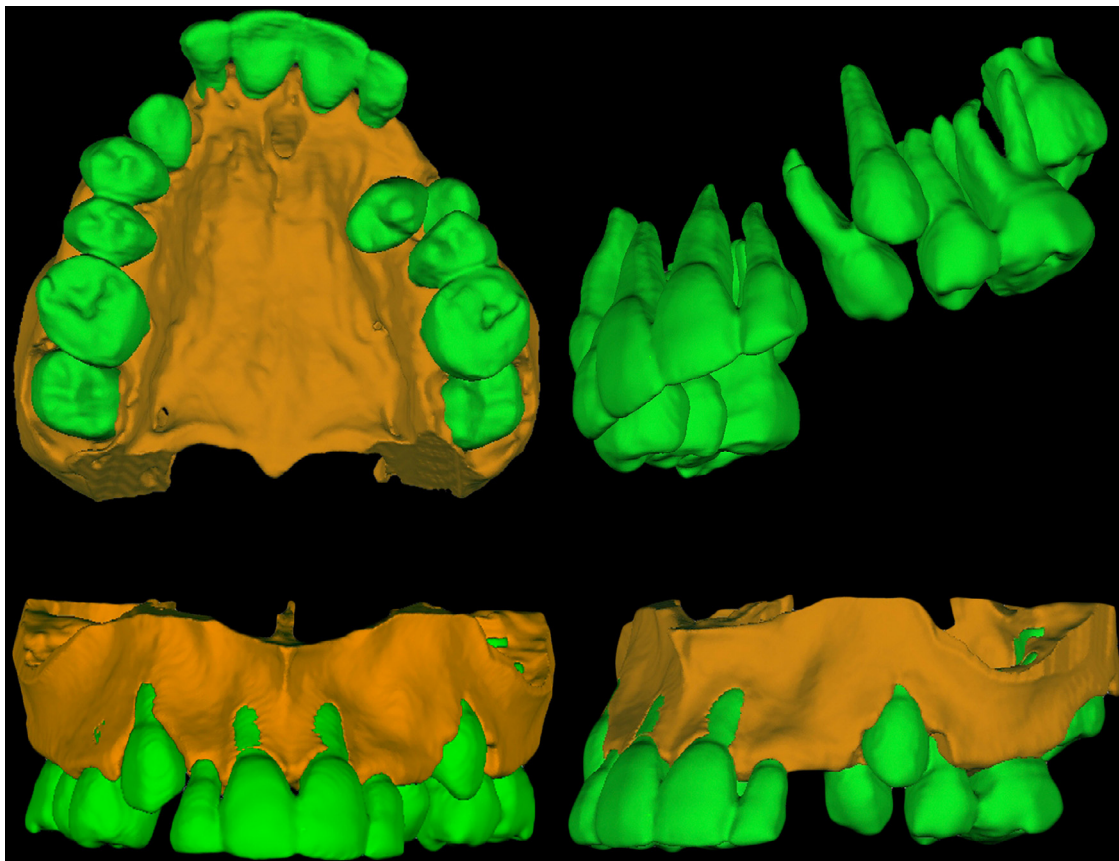


Fig 6. Midtreatment segmentation illustrating the correction of the transposition. Brackets were removed from the segmentation images to enhance visualization.

Paulo, Brazil). Final alignment, leveling, and finishing were subsequently carried out using continuous archwire mechanics (Fig 10).

The comprehensive treatment, encompassing the interceptive phase, extended over a period of 48 months. All treatment objectives were successfully achieved, with the establishment of a normal overjet and overbite and satisfactory posterior intercuspation (Fig 11). However, the UL3 exhibited minor gingival recession and buccal bone dehiscence of the alveolar process. Consequently, the patient was referred to a periodontist for gingival coverage of the cervical area of UL3 (Figs 12 and 13). Additionally, the patient was referred to an esthetic dentist to facilitate the placement of definitive restorations for the diminutive lateral incisors.

TREATMENT RESULTS

Upon completion of this multidisciplinary treatment, the patient exhibited stable facial esthetics, attributable to the preservation of the position of the maxillary incisors. Furthermore, lip competence, as well as the harmonious proportions of the nasolabial angle and facial thirds, were successfully maintained (Fig 14).

The patient's smile underwent significant enhancement because of the accurate positioning of the canines, in conjunction with the leveling and alignment of the remaining teeth and the reshaping of the lateral incisors. From a skeletal perspective, the relationship between the maxilla, mandible, and maxillary cranial structures was preserved, along with the appropriate vertical positioning of the mandible (Fig 15). The Class I molar relationship was maintained throughout the treatment process.

Furthermore, both maxillary and mandibular crowding, along with transposition issues, were effectively corrected. A satisfactory occlusal relationship was established, characterized by normal overjet, overbite, and coincident midlines. Importantly, the maxillary expansion exhibited stability after the removal of the appliance, and the mandibular arch retained its pretreatment configuration, with only minimal root and bone resorption observed. Treatment resulted in the establishment of an optimal mutually protected occlusion. Cephalometric superimpositions confirmed the vertical and anteroposterior maintenance of both the maxilla and the mandible for both the skeletal and dental structures (Fig 16).

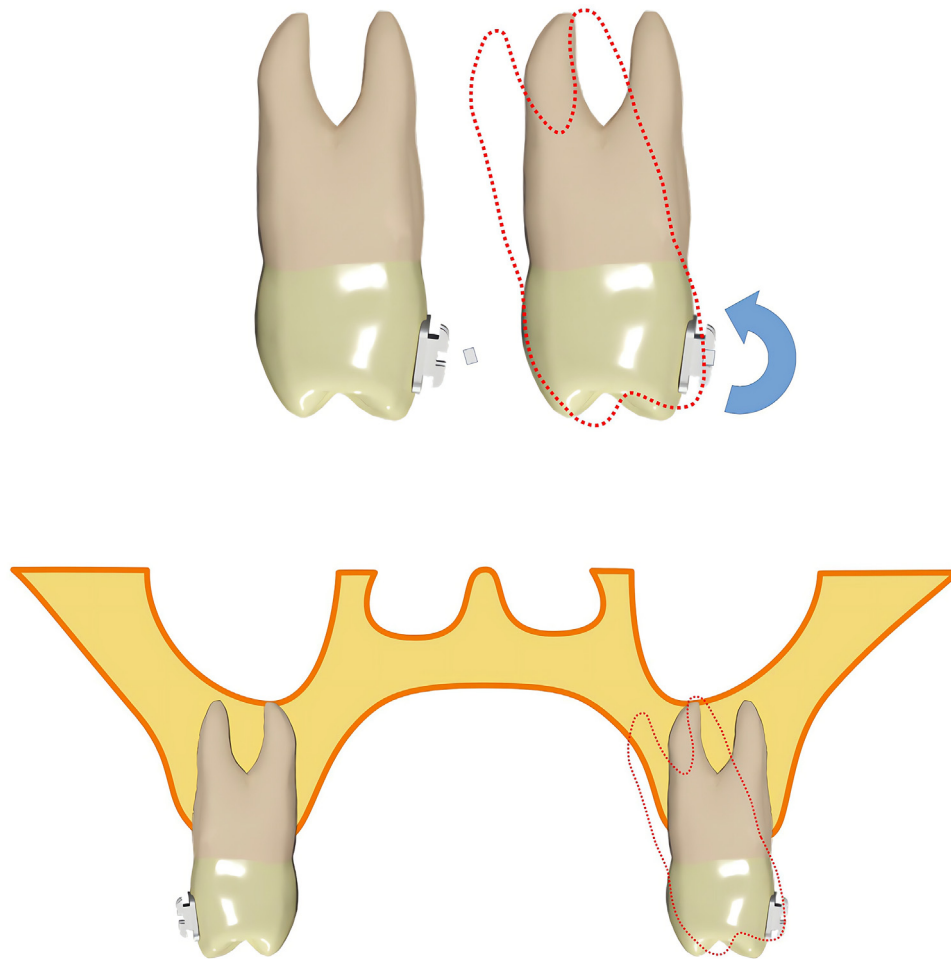


Fig 7. Schematic illustration showing segmental mechanics using a 0.018 × 0.025-in TMA wire incorporating a vertical double helix to facilitate palatal root torque of UL4. TMA, titanium-molybdenum alloy.

The patient and her parents were advised to continue with periodontal follow-up to improve the prognosis of the UL3 and to reduce gingival recession.

RETENTION

In the mandibular arch, a 0.011-in titanium ribbon was bonded from canine to canine. A 0.018-in SS V-loop

retainer was bonded, extending from the UL4 to the maxillary right canine, in conjunction with a wraparound retainer. The patient was advised to wear the wraparound retainer full-time during the first year after treatment and only during nighttime for the second year. Detailed instructions were provided for home care and for the maintenance of the retainers.



Fig 8. **A,** Maxillary occlusal view. The transpalatal arch incorporated a horizontal segment of SS measuring 0.019 × 0.025-in, designed to enhance the horizontal displacement of the UL4; **B,** Left intraoral view; **C,** The complete transposition has been corrected. At this point, the first premolar started to move labially.

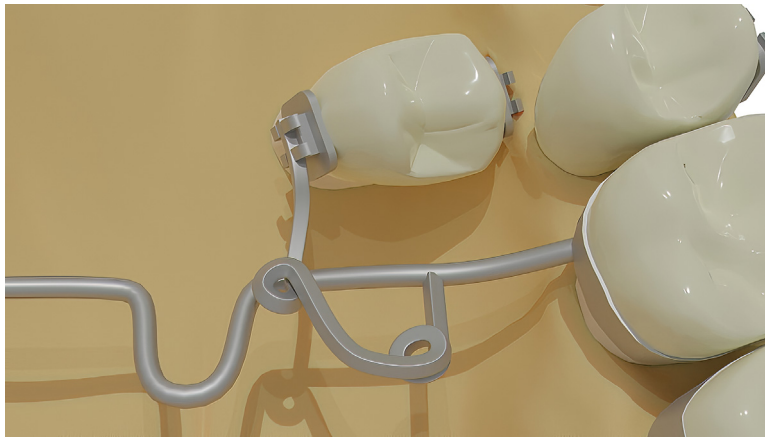


Fig 9. Schematic illustration showing the transpalatal arch with an incorporated 0.019 × 0.025-in SS horizontal segment designed to enhance the horizontal displacement of UL4.



Fig 10. Intraoral photographs showing the progress of the multibracket appliance treatment.

DISCUSSION

Generally, orthodontic correction of dental transpositions is approached with caution due to the potential limitations in buccopalatal bone width, particularly when adjacent teeth are required to move in divergent directions after eruption. A strategic approach to repositioning transposed teeth involves initially moving 1 tooth palatally to create sufficient space for the buccal movement of the adjacent tooth, thereby optimizing the use of available alveolar bone and facilitating more controlled tooth movement.²¹

Moreover, according to Ciarlantini and Melsen,⁷ segmented mechanics offer biomechanical advantages by enabling the application of precise, defined, and frictionless force systems. This approach facilitates highly controlled tooth movement, achieved through the strategic design of cantilevers and loops that adhere to the principles of static equilibrium. As a result, the outcomes of such force systems are generally predictable, whereas undesirable side effects, such as round-tripping or iatrogenic damage, can be minimized and closely monitored. For these reasons, in this patient, segmented mechanics were employed to displace UL4 palatally during the early stages of UL3 development, before its full eruption (Fig 6). This palatal repositioning of UL4, while UL3 remained high in the alveolus, guided the canine's eruption into a more

favorable location and optimized the overall occlusal outcome, as reported in similar cases.²²

Early intervention enabled space creation in the maxilla and the effective use of the Leeway space in the mandible, as reflected in the overall treatment results. However, regarding the transposition, early interceptive treatment proved insufficient to redirect the eruption paths of the maxillary canines and premolars. Notably, the tooth buds remained in a fully transposed position even during the earlier stages of development. Consequently, in this patient, a complete transposition of Mx.C.P1 had to be addressed in the permanent dentition during the second phase of treatment.

According to Adam et al,²³ the orthodontic management of transpositions must take into account the overall malocclusion, including crowding severity, esthetic outcomes, root positioning, the risk of root resorption, and patient motivation. The treatment options include (1) the extraction of 1 of the transposed teeth, (2) acceptance of the transposed positions, and (3) orthodontic repositioning to correct anatomic alignment. In this patient, the decision to correct the transposition was influenced by strong patient motivation and favorable chronological and dental ages; the canine had not fully erupted.

Furthermore, in patients with Mx.C.P1 transposition, optimal treatment outcomes often depend on the timing

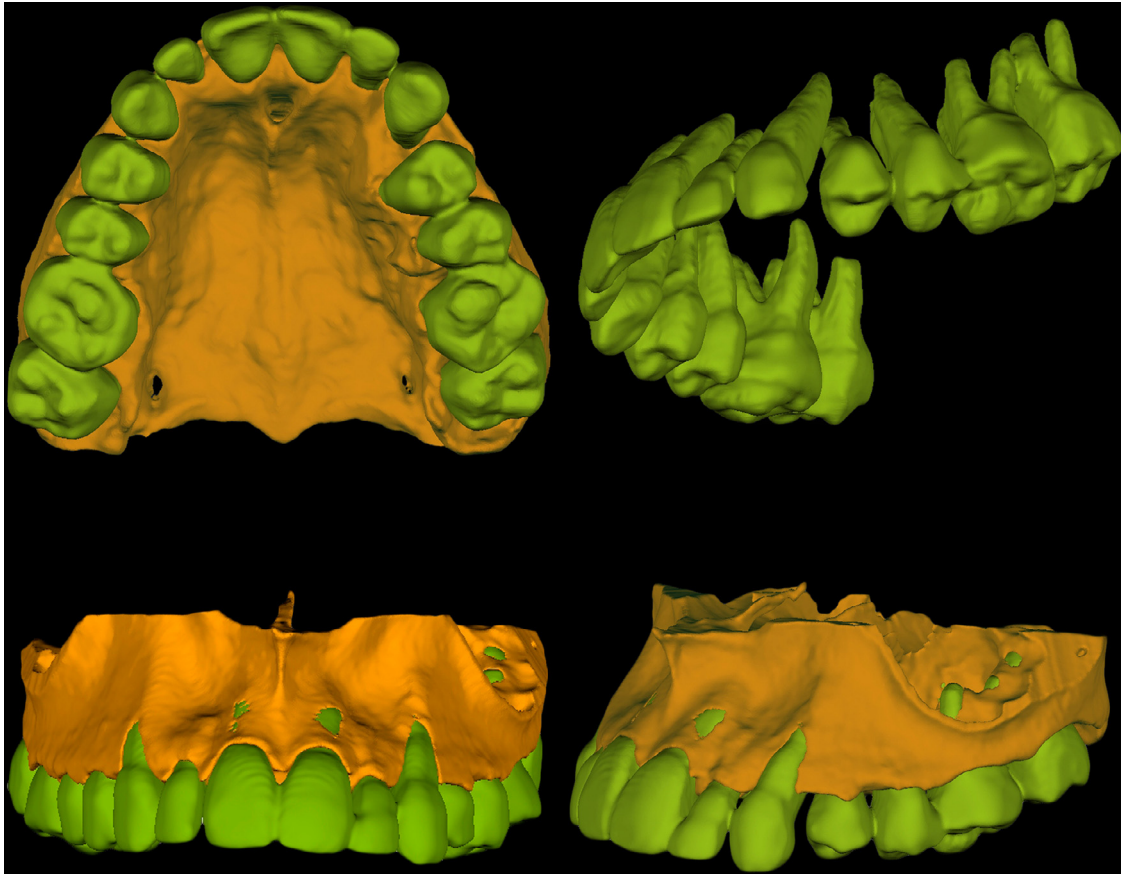


Fig 11. Near end-of-treatment segmentation illustrating the final stage of transposition correction. Brackets were removed from the segmentation images to enhance visualization.

and complexity of the anomaly. When canines have not fully erupted, early intervention makes it possible to correct transposition and improve results. However, in cases of complete transposition, if the transposed teeth are fully erupted and well aligned in their transposed positions, it may be more practical to accept the transposition rather than attempting to correct it.⁷ Furthermore, this approach may be considered safer in mitigating the risk of gingival dehiscence, thereby optimizing periodontal outcomes.⁷

Despite the prolonged treatment duration and the gingival recession observed on the UL3 at the conclusion of therapy, the selected strategy produced a successful result. The crown and root of the UL4 were ultimately well-aligned within the dental arch. Meanwhile, the transposed canine was positioned between the UL4 and the maxillary left second premolar. The key challenge was to reposition the UL4 palatally, adjusting both the crown and root, to allow space for the UL3 to align correctly in the arch. This palatal bodily movement of the UL4 was achieved using



Fig 12. Intraoral photographs obtained immediately after debonding. The UR2 and UL2 had not yet undergone restorative reshaping. Minor gingival dehiscence was present at the UL3. UR2, maxillary right lateral incisor; UL2, maxillary left lateral incisor.

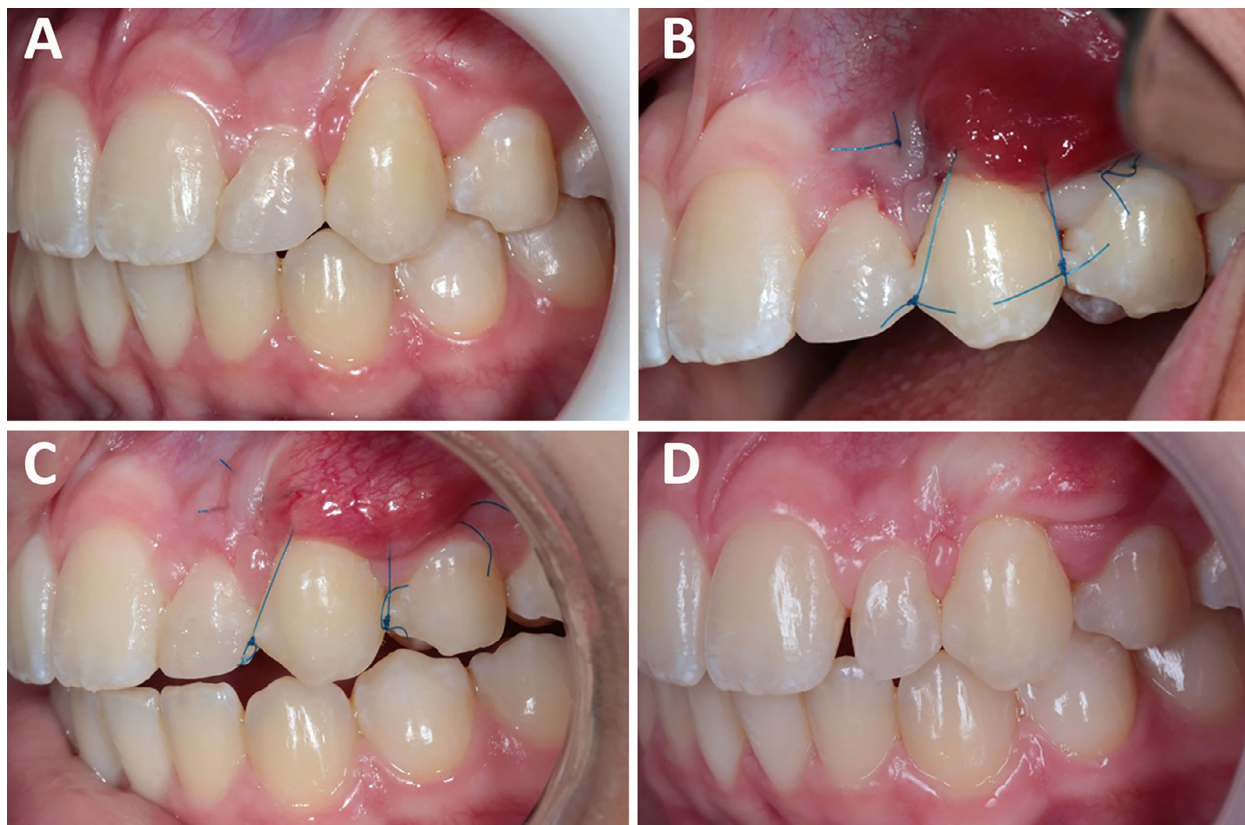


Fig 13. Intraoral photographs: **A**, Before gingival grafting; **B**, One week after gingival grafting; **C**, Two weeks after gingival grafting; **D**, Eight weeks after gingival grafting.

segmented mechanics. Once adequate space was established, mesial movement of the UL3 was accomplished using push-and-pull mechanics. Subsequently, the UL4 was repositioned and leveled within the arch. Achieving an esthetic and functionally sound outcome required meticulous control of the torque and tipping movements of both the canine and the premolar.

Although the total treatment time of 48 months was relatively long, the complete transposition was corrected within 25 months. This treatment duration was justified by the complexity of the case and the successful correction achieved. At the end of treatment, the patient exhibited a standard overjet and overbite, along with a mutually protected occlusion. Although canine-guided occlusion is often regarded as the ideal form of functional occlusion in natural dentition, the supporting evidence for this assumption remains limited. Weinberg²⁴ found that, in a sample of untreated natural dentitions, 81% exhibited group function, whereas only 5% presented canine guidance. Subsequent studies have echoed these findings.²⁵⁻³¹ Despite the limited evidence, canine guidance remains the preferred occlusal scheme among many orthodontists.

A potential drawback of the acrylic-bonded expander used in this case report is its influence on the vertical dimension. The occlusal acrylic coverage functions as a bite block, inhibiting posterior eruption while allowing

anterior eruption. However, the literature is inconsistent regarding its vertical effects. Some authors have reported a potential molar intrusion effect,¹⁹ whereas others have suggested a mild increase in lower anterior facial height.²⁰ Nevertheless, comparative studies have shown no statistically significant differences between banded and bonded expanders in terms of vertical changes.²⁰ In this patient, no significant alterations in the vertical dimension were observed.

In situations in which the gingival attachment has a questionable prognosis, a multidisciplinary approach is warranted to determine the most appropriate course of action. Depending on the magnitude and direction of the planned tooth movement, prophylactic gingival grafting may be indicated to reduce the risk of gingival recession and ensure optimal periodontal outcomes.³² In this patient, the UL3 had not yet erupted at the initiation of comprehensive orthodontic treatment; therefore, a gingival coverage graft was not considered at that stage.

Another potential drawback associated with the correction of the transposition was the development of gingival recession on the UL3, likely a consequence of extensive canine repositioning and the associated root prominence within an underdeveloped alveolar area. Importantly, CBCT evaluation revealed no relevant differences in marginal bone levels when comparing the maxillary right



Fig 14. Six months into retention, facial and intraoral photographs. Note that maxillary lateral incisors were reshaped with porcelain crowns.

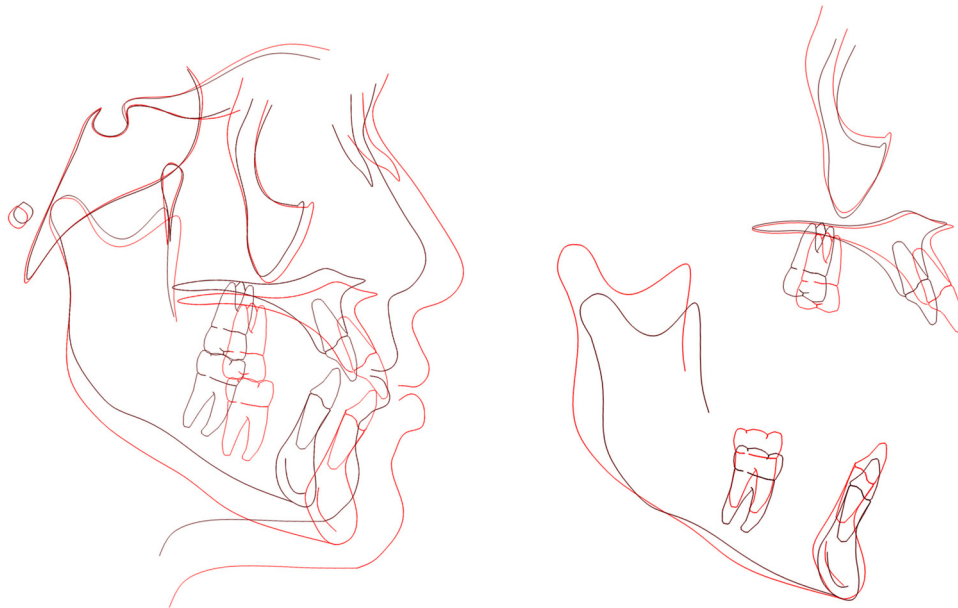


Fig 15. Pre- and posttreatment superimposition (*black, pretreatment; red, posttreatment*).

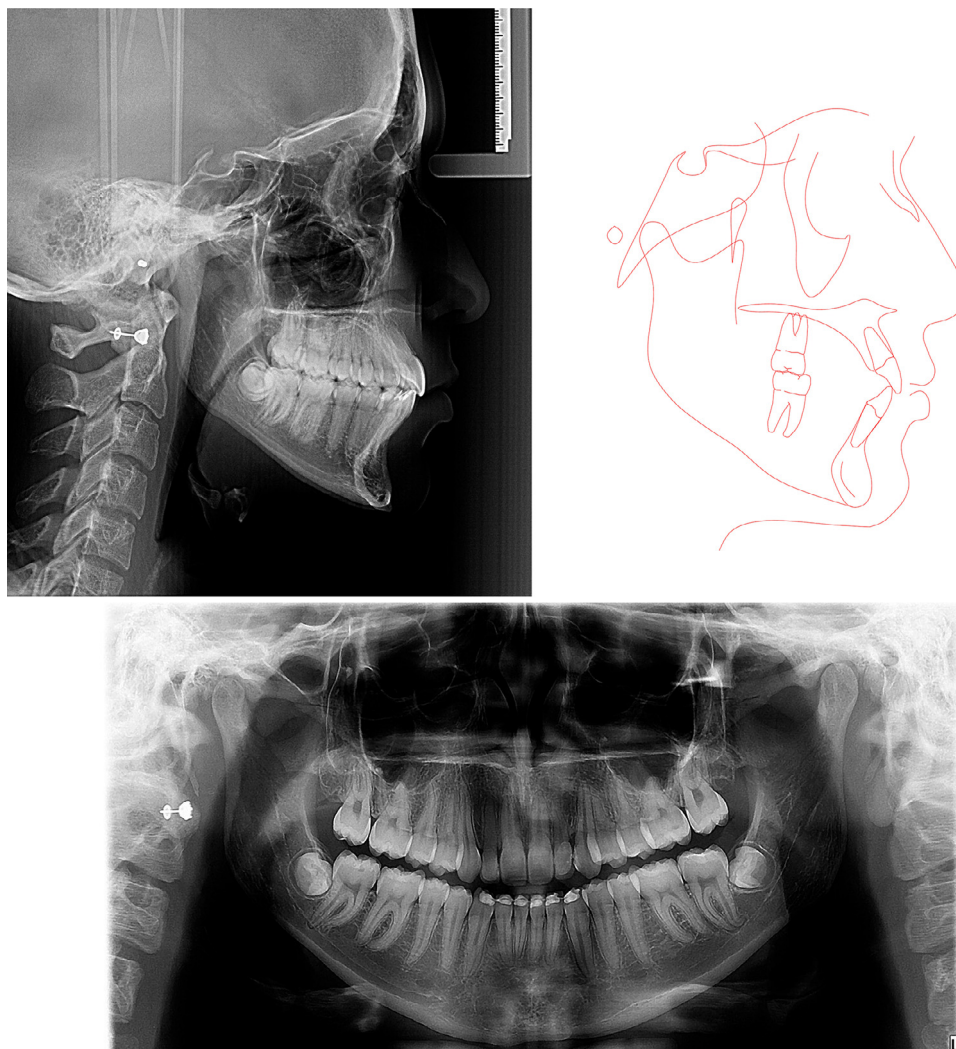


Fig 16. Posttreatment lateral cephalogram, tracing, and panoramic radiograph.

canine with the UL3 (Fig 11). This complication was subsequently resolved with a gingival graft. Nevertheless, the correction of the transposition resulted in excellent esthetic outcomes,³³ eliminating the need for prosthetic rehabilitation. However, limited data exist regarding the long-term durability of direct-bonded restorations used to modify the morphology of canines and premolars.^{34,35}

CONCLUSIONS

- CBCT provided precise information regarding the position and condition of transposed teeth. Furthermore, it facilitated the direction of traction and prevented interference with adjacent teeth.
- Controlled tooth movement in 3 spatial planes allows for successful correction of the transposition by applying the correct force vector through proper biomechanics.
- The second phase of treatment, using a fixed appliance, was directed toward achieving a correct occlusion from both esthetic and functional perspectives, while concurrently addressing the transposition of Mx.C.P1. A satisfactory outcome was attained.
- Despite tooth transposition correction being a feasible treatment option, the prognosis, treatment duration, professional experience, and patient preferences should be considered in the decision-making process.
- If comprehensive transposition correction is selected for treatment, it is advisable to conduct the correction before the eruption of the canine to facilitate spontaneous mesialization of the canine when the premolar is displaced palatally.

AUTHOR CREDIT STATEMENT

Diego Junior da Silva Santos contributed to patient management, treatment planning, collection and

interpretation of clinical records, and writing — review and editing. Deise Caldas Kühlman contributed to treatment planning, collection and organization of clinical records, literature review, preparation of figures and tables, writing of the original draft, and writing — review and editing. Flavia Artese contributed to treatment planning, clinical supervision, interpretation of findings, and writing — review and editing. José Augusto Mendes Miguel contributed to study conceptualization, treatment planning, clinical supervision, interpretation of findings, and writing — review and editing. All authors read and approved the final manuscript.

CONFLICTS OF INTEREST

All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.

STATEMENT OF INFORMED CONSENT

The patient and her legal guardians provided written informed consent for participation in this study, including the use of diagnostic records and clinical images for publication purposes. All procedures followed ethical guidelines in accordance with the Declaration of Helsinki.

Supplementary materials

Supplementary material associated with this article can be found in the online version at [doi:10.1016/j.xaor.2026.06.008](https://doi.org/10.1016/j.xaor.2026.06.008).

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