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CANINE–LATERAL INCISOR TRANSPOSITION CORRECTION: A CASE REPORT

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ABSTRACT

Background: Tooth transposition is defined as an abnormality in the position of teeth in the same quadrant that are interchanged within the dental arch. Although rare, this abnormality can cause aesthetic and functional problems. The permanent maxillary canine is the most frequently transposed tooth. **Objective:** This study aims to provide evidence that anatomical correction can be a feasible alternative in carefully selected cases to achieve favorable functional and esthetic outcomes. **Case:** This case report describes the successful treatment of a left maxillary canine transposed with a lateral incisor. A 16-year-old female patient presented with crowding of the upper anterior teeth, negatively impacting esthetics. The left maxillary canine erupted between the lateral and central incisors, and primary tooth 63 remained intact. A fixed orthodontic appliance with a straight wire system was used in a 0.022 bracket slot to initiate active treatment. Tooth 23 erupted ectopically between teeth 21 and 22, while the retained primary tooth 63 occupied its expected position. **Case Management:** To facilitate distal movement of tooth 23, it was retained and bonded to the upper left posterior teeth (24, 25, and 26) using an elastomeric chain with very light force. After tooth 23 approached the location of tooth 63, the deciduous tooth was removed, and gradual vertical traction was applied using a 0.12 NiTi wire, followed by a larger diameter NiTi wire and rectangular stainless steel to achieve the correct root position and angle. The correction of complete lateral canine-incisor transposition has a high risk of root resorption and periodontal complication. However, this study successfully performed anatomical repositioning without any tooth extraction. **Conclusion:** This case demonstrates that anatomical repositioning can be achieved with good esthetic, functional, and periodontal results through careful treatment planning, the use of light orthodontic forces, and tight anchorage control.

Keywords: Canines; Lateral incisors; Orthodontics; Tooth transposition

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INTRODUCTION

Tooth transposition is defined as the alternation of the positions of two permanent teeth in the same quadrant of the dental arch.¹ The canines are the most frequently transposed teeth, with ectopic eruption mesial to the lateral incisors or distal to the first premolars.² Although this anomaly has a low prevalence (0.2%–0.5%),³ with an overall average of approximately 0.33%,⁴ it can significantly compromise occlusion and esthetics.³ Tooth transposition occurs more frequently in the maxilla than in the mandible and is predominantly unilateral.^{1,4} Matsumoto and Stuanil¹ reported that 76% of cases occur in the maxilla, 88% are unilateral, and canines are involved in approximately 90% of cases, most commonly with the first premolar (71%) or the maxillary lateral incisor (20%). While Matsumoto and Stuanil¹ observed a higher prevalence in females, other studies have reported no significant sex difference.⁴

Tooth transposition can occur due to genetic factors, the exchange of positions of the developing tooth germ, trauma, premature loss of permanent teeth, mechanical disturbances, and a lack of space for tooth growth.⁵ Tooth transposition can also occur in the presence of other dental anomalies, such as dental agenesis, peg-shaped lateral incisors, and retained primary teeth.⁶ The results of a previous study reported that the presence of transposed or ectopic canines in 15.3% of the sample, as evidenced by family pedigrees, indicates an autosomal dominant inheritance. These results may support a genetic etiology of transposition associated with the presence of dental anomalies.⁷ Furthermore, Liu et al.⁸ classified the transpositions as follows: 1) maxillary canine–first premolar, 2) lateral incisor–maxillary canine, 3) maxillary canine–first molar, 4) maxillary central–lateral incisor, 5) maxillary canine–central incisor, and 6) mandibular canine–lateral incisor. Additionally, transposition can be categorized into complete and incomplete. Complete transposition occurs when both the crown and the root of the tooth exchange positions in the dental arch. In contrast, incomplete transposition (pseudo-transposition) occurs when the crown is exchanged, but the root remains in its normal position.⁸

Several treatment options are available for transposed lateral incisors and canines. These include extraction of lateral incisors or canines (transposed teeth), correction of the transposition into its normal position, or retaining the transposed tooth with the cosmetic reconstruction of the affected tooth.² Treating and correcting transposed teeth will lead to a natural, esthetically pleasing arch shape, an ideal smile arc, and an improved gingival contour,^{1,9} function, stabilize occlusion, and preserve the facial profile and patient confidence.¹⁰ However, transposition correction requires a longer treatment duration, carries the increased risk of root resorption, and torque correction can be difficult.¹¹

Although canine substitution is a very common clinical scenario and can result in quality outcomes if done well and in the right situation, teeth that have been restored will need to be renewed over a certain period and may experience color changes, which will, of course, be less esthetically pleasing. Therefore, restoring the transposed teeth to their correct position is a good long-term esthetic option.¹² This study aims to provide evidence that anatomical correction can be a feasible alternative in carefully selected cases to achieve favorable functional and esthetic outcomes.

CASE REPORT

A 16-year-old patient presented with upper anterior tooth crowding, which negatively affected esthetics. The patient's primary complaint was that the arrangement of her upper front teeth appeared irregular and compromised the aesthetics of her smile. Based on clinical and radiographic examinations, the patient was diagnosed with complete transposition between the left maxillary canine (23) and the left maxillary lateral incisor (22), because the crowns and roots of both teeth had completely exchanged positions. Additionally, tooth 63 was retained. The molar relationship was Class I, the right canine was Class I, the overjet and overbite were normal (2 mm), and teeth 21 and 22 were rotated (Figure 1).



Figure 1. Pre-treatment intraoral photographs. (A) Patient profile. (B) Frontal intraoral view showing complete transposition of the maxillary left canine and lateral incisor. (C) Right lateral intraoral view demonstrating a Class I molar and canine relationship. (D) Left lateral intraoral view showing the retained primary maxillary left canine (tooth 63).

The cephalometric analysis also revealed bimaxillary protrusive (SNA 90.1° and SNB 88°) (Figure 2). The final extraoral photograph showed the patient's profile was slightly convex due to a slightly flared tooth, but it remained esthetically acceptable. Although cephalometric analysis indicated bimaxillary protrusion that could theoretically be corrected with first premolar extraction, a non-extraction approach was chosen after considering several clinical factors. The patient had a good bilateral Class I molar relationship, normal overjet and overbite, and a chief complaint focused on esthetics due to tooth transposition. Furthermore, the relatively mild crowding allowed transposition correction without requiring significant additional space.

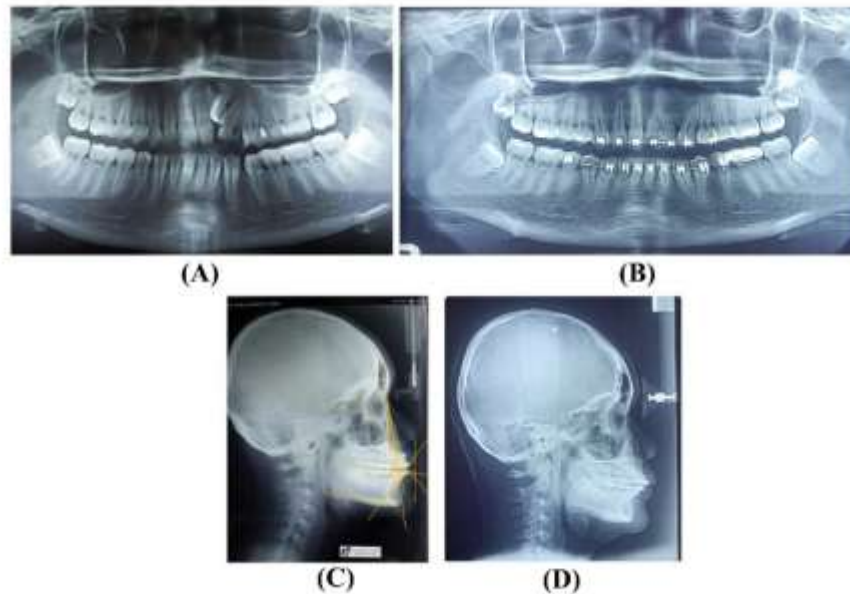


Figure 2. Complete transposition between teeth 22 and 23 at (A) pre-treatment and (B) post-treatment in panoramic radiographs. (C) Pre-treatment and (D) final phase of treatment for cephalometric radiograph pre-treatment.

The results of the cephalometric analysis did not show a significant difference before and after treatment (Table 1). There was a slight proclination of the upper incisors due to flaring. However, the patient was very satisfied with the treatment results and did not want to retract the incisors if the premolars had to be extracted.

Table 1. Cephalometric analysis before and after treatment (times of writing)

Stainer analysis	Normal	Before treatment	Last control
SNA	82°	90.1°	89.4°
SNB	80°	88.0°	84.8°
ANB	2°	2.1°	4.6°
UI-NA_Angular	22°	28.1°	31.9°
UI-NA_Linear	4 mm	7.9 mm	8.4 mm
LI-NB_Angular	25°	44.7°	45.0°
LI-NB_Linear	4 mm	10.0 mm	10.0 mm
FIS	105°–115°	118.5°	124°
IMPA	81.5°–97°	114.5°	115°
I-I	130°	108°	107°

Treatment was performed using a 0.022-inch slot Roth prescription fixed appliance (American Orthodontics, USA). Initial levelling and alignment were achieved with a 0.012-inch round NiTi archwire. A bracket was bonded to tooth 23 from the beginning of treatment, whereas the retained primary canine (tooth 63) was preserved to provide anchorage, therefore, no extraction was performed. The bracket on tooth 63 was ligated to the maxillary left posterior segment (teeth 24–27) to reinforce anchorage, and a light elastomeric chain was applied from teeth 23 to 24 to distalize tooth 23.

Transposition correction was carried out in stages using a series of NiTi wires with progressively increasing sizes, followed by elastomeric and power chains for distalization of tooth 23 and correction of the

mispositioned teeth. Ligation was performed from teeth 16 to 21 as anchorage, and traction using an elastomeric chain from teeth 21 to 22 was used to move tooth 22 mesially. Gingival inflammation occurred when tooth 23 was labial to tooth 22, and the patient was instructed to maintain good oral hygiene, including using mouthwash routinely. Gradually, tooth 23 moved distally. Maintaining tooth 23 in a more labial position during distalization creates a safer movement path for the roots of both teeth. This approach helps reduce the risk of root interference, root resorption, and alveolar bone damage. After tooth 23 approached the position of tooth 63, tooth 63 was extracted, and tooth 23 was slowly extruded into its correct position. The gingival inflammation remained present but gradually decreased as tooth 23 reached its correct position (Figure 3).



Figure 3. Intraoral photographs showing the treatment process.

After approximately 2 years of treatment (Figure 4), the transposed teeth were corrected to an ideal occlusal relationship (Class I canine relationship) and showed healthy periodontal tissues. Because the patient did not want the brackets removed, the final photograph shows the brackets still in place (Figure 4). The results of the OPG photo X-ray show that the roots of teeth 22, 21, and 23 are intact to their tips and not resorbed, even though they appear bent. This is supported by clinical conditions in which the teeth are in strong condition with healthy periodontal tissue. Figure 5 shows the initial occlusal photo and during the last control.

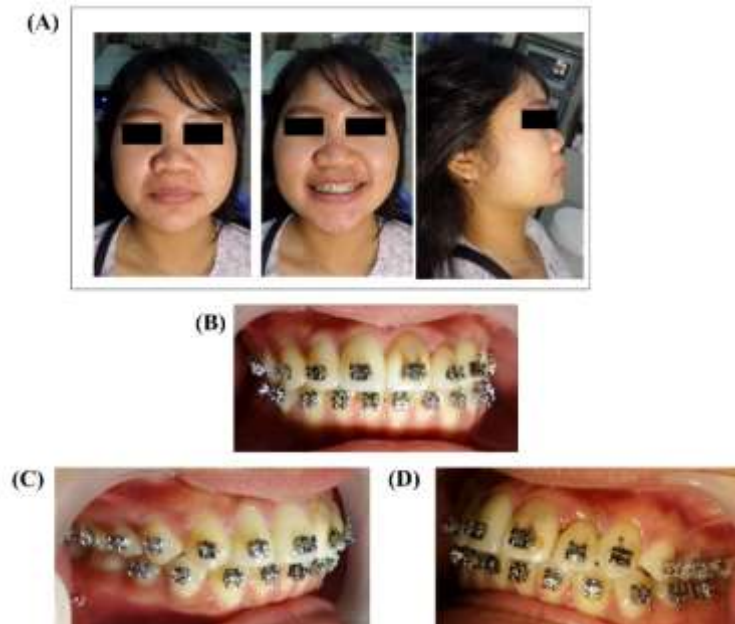


Figure 4. Extraoral and Intraoral photographs after treatment. (A) Near-treatment completion profile. Intraoral views: (B) frontal, (C) right, and (D) left, showing maintained Class I molar and canine relationships following transposition correction.

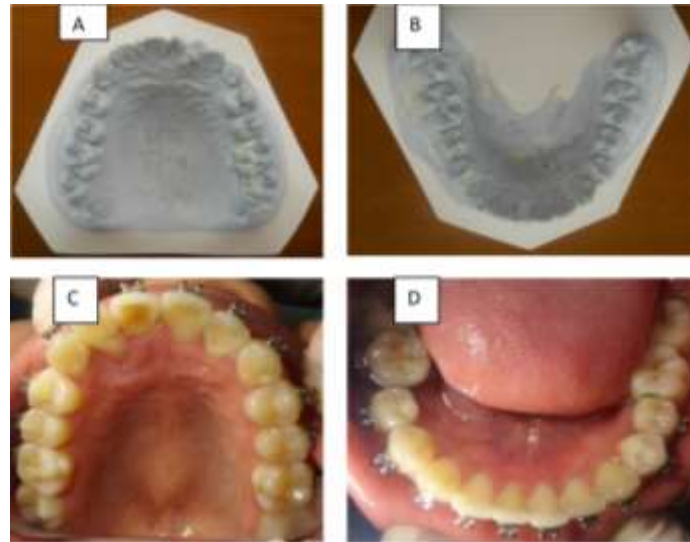


Figure 5. Occlusal view of study model: initial (A: upper, B: lower) and final control (C: upper, D: lower).

Gingival inflammation that had appeared during treatment gradually improved after oral hygiene checks and stabilized at the end of treatment. These findings demonstrate that transposition correction can achieve good esthetic and functional results without significant periodontal complications or root damage.

DICUSSION

The patient in this case was a teenager who was very satisfied with the treatment outcome. Although the teeth were already well-aligned and the use of a retainer was recommended to maintain the results and ensure proper root positioning, the patient preferred to keep the fixed appliances in place. Social trends influenced this decision, as wearing suspenders is still considered fashionable among adolescents in Indonesian society. Therefore, at the time of writing, treatment was still ongoing, and the final photographs and radiographs still have brackets *in situ*.

Early diagnosis of tooth transposition is essential and is associated with a better treatment prognosis. Investigations such as periapical, occlusal, panoramic, cephalometric, and CBCT radiographs are crucial to help decide the appropriate treatment plan.¹³ In this case, the patient presented with a case of transposition at the age of 16 years, when she was almost in the final stage of growth. Orthodontic treatment at this age focuses on dental alignment rather than jaw growth.¹⁴

Peck and Peck¹⁵ suggested that teeth with incomplete transposition (pseudo-transposition) can be corrected to their normal position; however, correction is not recommended for teeth with complete transposition. There are very few reports on cases of complete transposition correction. Shapira and Kuftinec¹⁶ stated that complete transposition correction is complicated and can damage the tooth and its supporting structures. Several successful cases reported have been treated with extreme care to avoid contact between the teeth, creating a clear path of movement for the transposed teeth.

Maintaining the canine in the location of the lateral incisor can lead to long-term esthetic compromise due to differences in crown morphology, gingival contour, and visual dominance of the canine over the lateral incisor. Therefore, the decision between maintaining the transposition and performing anatomical repositioning should be made on an individual basis based on the patient's biological condition, esthetic needs, and acceptable risks. In this case, good periodontal condition, absence of root morphological abnormalities, and high patient motivation were the main reasons for choosing anatomical repositioning over maintaining the transposition position.^{6,8,17} Anatomical repositioning in complete transposition cases can result in a more ideal occlusal and aesthetic outcome; however, this approach is not always the best option for every patient. In cases with unfavorable root position or limited periodontal support, maintaining the transposition may be a safer option. Conversely, in this case, no root morphological abnormalities or significant periodontal disruption were found, making anatomical repositioning still feasible. This approach aligns with case reports of transpositions successfully corrected through careful biomechanical control and appropriate case selection.^{6,17}

The buccolingual thickness of the alveolar bone is also important when two adjacent teeth are moved in different directions. Additionally, during correction, pressure and frictional forces can cause iatrogenic damage to the teeth, such as root resorption, alveolar bone resorption, and gingival recession.⁸ Furthermore, the distalization of tooth 23 and mesialization of tooth 22 used an elastomeric chain with a very light force, slowing tooth movement but reducing the risk of unwanted side effects. During the distalization of tooth 23, maintaining its labial position is also essential to prevent contact with tooth 22. In this case, the treatment technique was very simple, only using an elastomeric chain but maintaining light pressure by pulling the elastomeric chain first (stretched) before being applied; thus, it became more flexible, and the pressure was lighter when applied. These findings are consistent with a recent systematic review that demonstrated that the magnitude of orthodontic forces and the duration of tooth movement are important factors associated with root resorption during orthodontic treatment.¹⁸

One of the main considerations in the correction of complete transposition of the canine and lateral incisor is the risk of external root resorption. This risk is increased because transposition correction requires extensive root movement within a limited alveolar space, which can lead to interroot contact and excessive stress on the periodontal ligament if biomechanics are not properly controlled. Zhao et al.¹⁸ and Dawood et al.¹⁹ reported that the magnitude of orthodontic forces, the duration of tooth movement, and the complexity of biomechanics are all contributing factors to root resorption during orthodontic treatment. Pithon et al.¹⁰ showed that anatomical repositioning can produce satisfactory occlusal, periodontal, and aesthetic results in appropriately selected cases.

Anterior tooth transposition is a rare case but has a less favorable esthetic effect. This case can be detected during tooth growth; therefore, this case report illustrates that early treatment offers an opportunity to return transposed teeth to their correct positions. Therefore, educating patients on maintaining good oral hygiene is also necessary to prevent inflammation. The use of a mouth rinse containing chlorhexidine (CHX) helps relieve inflammation. CHX mouthwash has shown significant reductions in plaque accumulation and gingivitis, particularly in orthodontic patients.^{20,21} Liu et al.⁸ revealed that maintaining the path of tooth movement within the alveolar bone is vital. With careful control of tooth movement in the three planes of space, the transposed teeth can be successfully moved to their normal positions over time.⁸ From a clinical perspective, this case demonstrates that the success of complete transposition correction is determined not only by the orthodontic technique used, but also by appropriate case selection. Factors such as patient age, root position, periodontal condition, patient motivation, and ability to maintain oral hygiene must be considered before deciding to perform anatomical repositioning. Therefore, the results obtained in this case cannot be generalized to all cases of complete transposition, but they do provide evidence that correction to a normal anatomical position can be a viable option in patients with favorable biological conditions and good cooperation during treatment.

All treatment goals were achieved in this case. The patient was satisfied with the outcome and continued with the use of fixed appliances to stabilize the final tooth position. Long-term monitoring is still needed to assess tooth position stability and periodontal health after complete transposition correction. Post-treatment stability is a critical aspect of orthodontic care because relapse frequently occurs after active tooth movement has been completed.²²

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