Case Report

A 15-year follow up of an orthodontic treatment including a lower incisor extraction and keeping the maxillary canine–premolar transposition

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ABSTRACT

Lower incisor extraction is an effective option for treating lower anterior crowding in patients with a good facial profile, Class I molar occlusion, and narrow upper incisors. This report describes the successful treatment of an adolescent patient with lower anterior crowding and a transposed maxillary canine and premolar treated by extracting a lower incisor and keeping the transposed positions of the teeth. With the use of retainers, treatment results were stable up to the 2-year postretention visit. However, upon a 15-year postretention appointment, the fixed retainer had been removed and the removable retainer was no longer in use, which resulted in relapse of lower anterior alignment. Moreover, the transposed canine had extruded during this period, causing occlusal interference and gingival recession, as well as loss of tooth vitality, which indicates the importance of maintaining orthodontic retainers for long-term stable occlusion. (*Angle Orthod.* 2019;89:812–826)

KEY WORDS: Long term; Incisor extraction; Transposition; Relapse; Retention

INTRODUCTION

Lower incisor extractions are occasionally included in orthodontic treatment in up to about 6% of cases, despite the general notion that this approach is unconventional and less favored by clinicians.[1,2] Although this treatment has its shortcomings, such as dental midline discordance, loss of interdental papillary height in the incisor area, and a possibility of increased overjet, it has the advantage of resulting in minimal facial profile change and less posterior tooth movements compared to premolar extractions; this may in turn reduce treatment time.[3–7] Class I patients in good posterior occlusion with little crowding and narrow incisors in the upper arch but moderate crowding of over 4 to 5 mm in the lower anterior segment are good candidates for lower incisor extraction.[7] The long-term stability of this treatment is controversial, as some studies report stable results compared to premolar extractions, while others emphasize the importance of prolonged fixed retention.[4,6,8,9]

Transposition is a rare condition, with a prevalence rate of less than 0.5%, in which two adjacent teeth have positional changes within the same quadrant.[10,11] The etiology of this malocclusion is usually multifactorial and may include genetic factors, retained deciduous canine, interchange in position of a developing tooth, and trauma.[12–16] Transposition is often accompanied by peg-shaped lateral incisors and occurs most

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Figure 1. Pretreatment extraoral and intraoral photographs.

frequently in the maxillary canine and first premolar area.[17–19] In cases in which both crown and root have completely changed places, keeping the transposed positions has been considered as a viable option with successful treatment results.[20–23] However, there are few reports that show long-term retention of over 10 years after orthodontic treatment, which would be useful for clinicians when considering treatment options for transposed teeth.[24,25]

This report demonstrates the successful treatment of a Class I patient with moderate crowding in the lower arch, transposition of an upper right canine–first premolar, and peg-shaped upper lateral incisors who was treated by extracting a lower incisor and keeping the transposed positions. Treatment results were well maintained up to the 2-year retention period with the use of retainers. However, upon a 15-year follow-up visit, the retainers had been removed, lower anterior crowding had reoccurred, and the transposed upper canine showed detrimental effects from occlusal interference.

Diagnosis and Etiology

A 12-year, 6-month–old boy visited the Department of Orthodontics at Gangnam Severance Dental Hospital in Seoul, Korea, with a chief complaint of an upper canine that had erupted “in front of another tooth.”

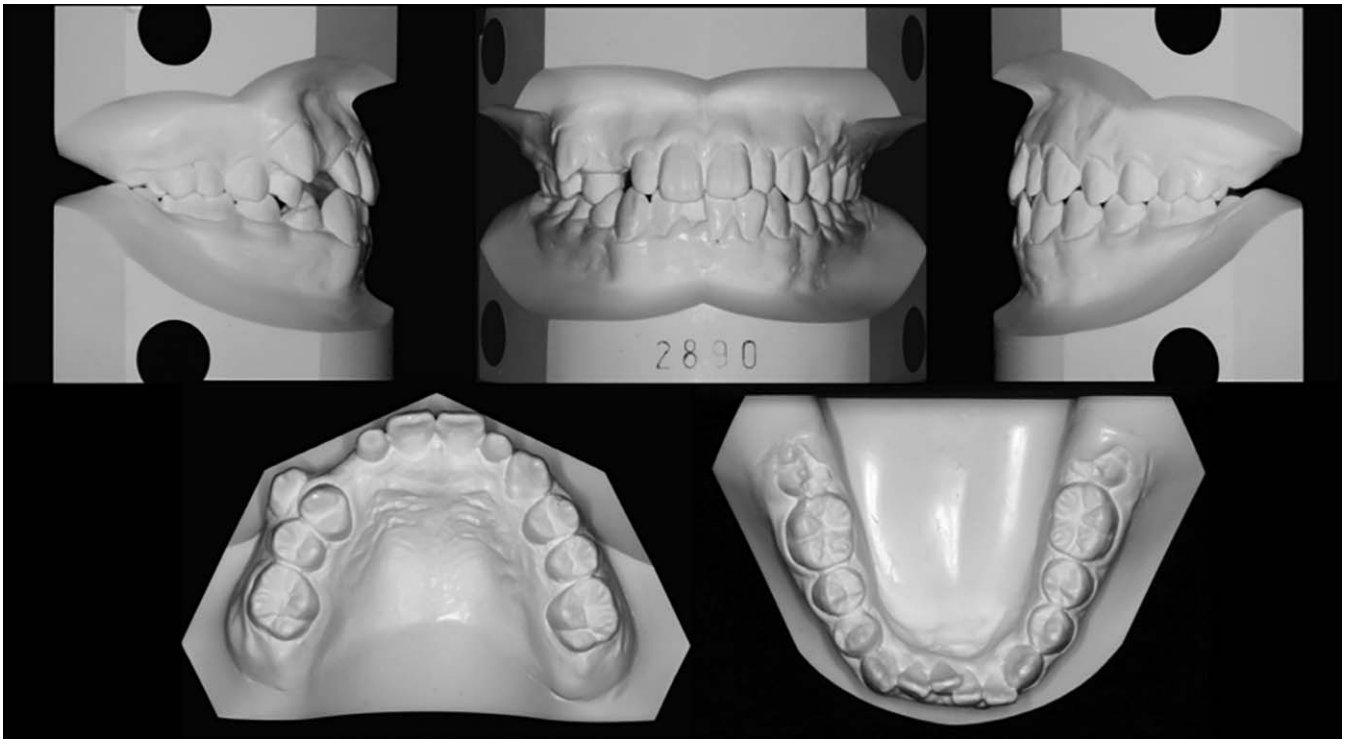

Figure 2. Pretreatment dental casts.

Clinical oral examination showed an upper right canine located buccally between the first and second premolars with insufficient keratinized tissue, peg-shaped upper lateral incisors, lower anterior crowding, and severe rotation of the lower right first premolar. He had a good facial profile, with a Class I molar relationship on both sides (Figure 1). The arch length discrepancy was 2.0 mm in the upper arch and close to 4 mm in the lower arch, with a Bolton anterior ratio of 86% (Figure 2). A panoramic radiograph showed complete transposition of the upper right canine and first premolar (Figure 3). The lateral cephalometric analysis showed a Class I skeletal relationship with a hyperdivergent facial profile, indicated by an ANB angle of 4° and a mandibular plane angle of 41.5°. The upper incisors were slightly tipped to the lingual, with an U1 to SN angle of 99°. On the basis of these findings, the patient was diagnosed as skeletal Class I malocclusion with complete transposition of the upper right canine and first premolar, moderate crowding in the lower arch, and peg-shaped lateral incisors.

Treatment Objectives

The treatment objectives were to (1) maintain good facial profile, (2) align the ectopically erupted maxillary canine–premolar and relieve crowding in the lower arch, and (3) maintain good posterior occlusion as well as establish proper overjet and overbite.

Treatment Alternatives

Two treatment options were presented to the patient. Both treatment options included aligning the canine and premolar in their transposed positions. Although the palatal cusp of the premolar could cause occlusal interference, a decision to maintain the transposed positions was influenced by the reasoning that excessive orthodontic correction of completely transposed crowns and roots into proper alignment could result in damage to the teeth or supporting structures.[22,23]

The first option was to extract a lower incisor to resolve crowding. This would easily solve the lower anterior crowding and anterior tooth size discrepancy while maintaining the facial profile and Class I molar relationship. However, the lower midline would not align with that of the upper and there would be an increased possibility for a less-than-ideal gingival embrasure in the lower incisor area.

The second option would involve alignment of the lower dentition without extraction and prosthetic restoration of the peg-shaped lateral incisors. This treatment would align the upper and lower midlines, and the lateral incisors would be restored to their ideal size and shape. However, after relieving crowding in the lower arch and space regaining for the upper lateral incisors, the incisors would be positioned labially,

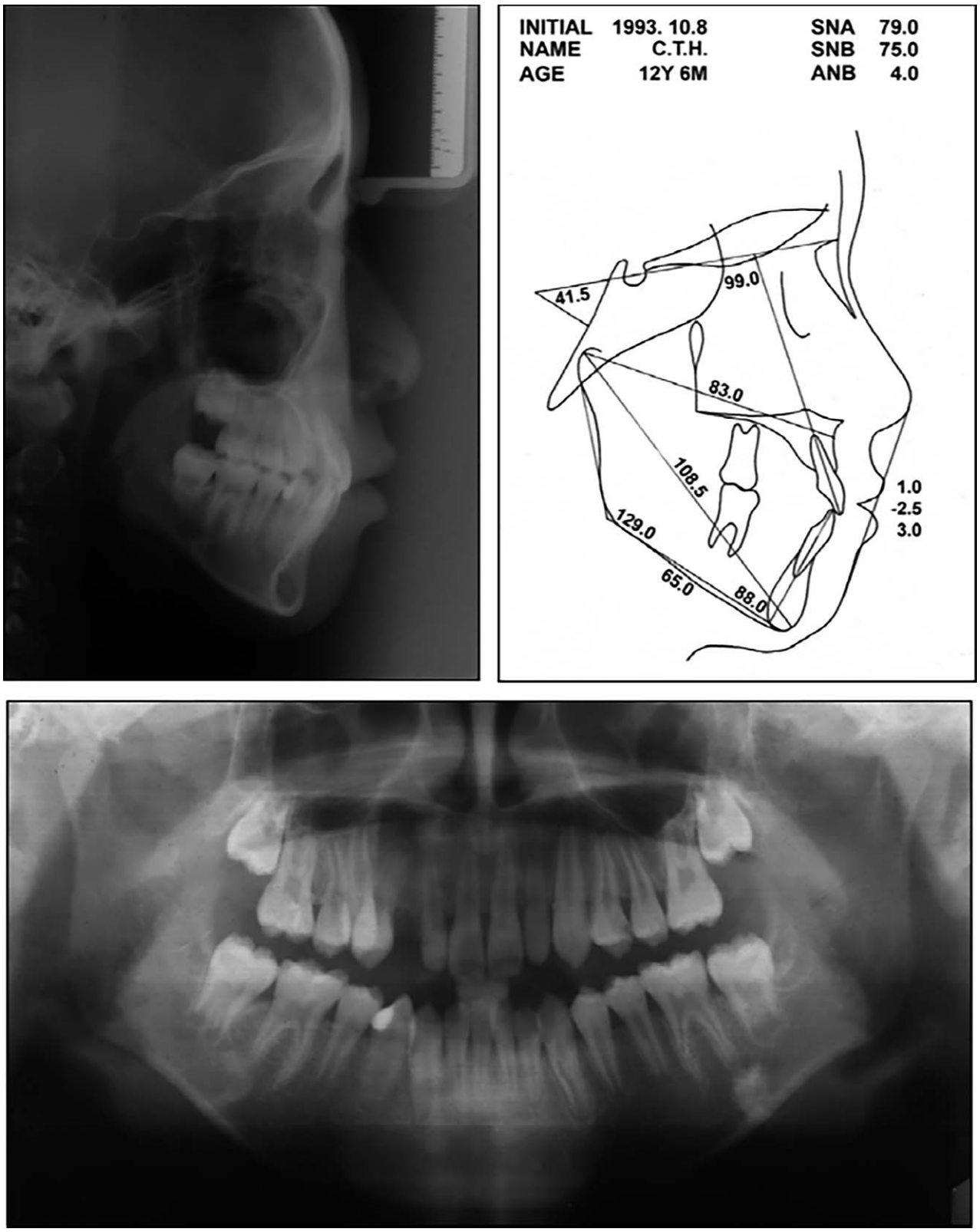

Figure 3. Pretreatment radiographs: lateral cephalogram, lateral cephalometric analysis, and panoramic radiograph.

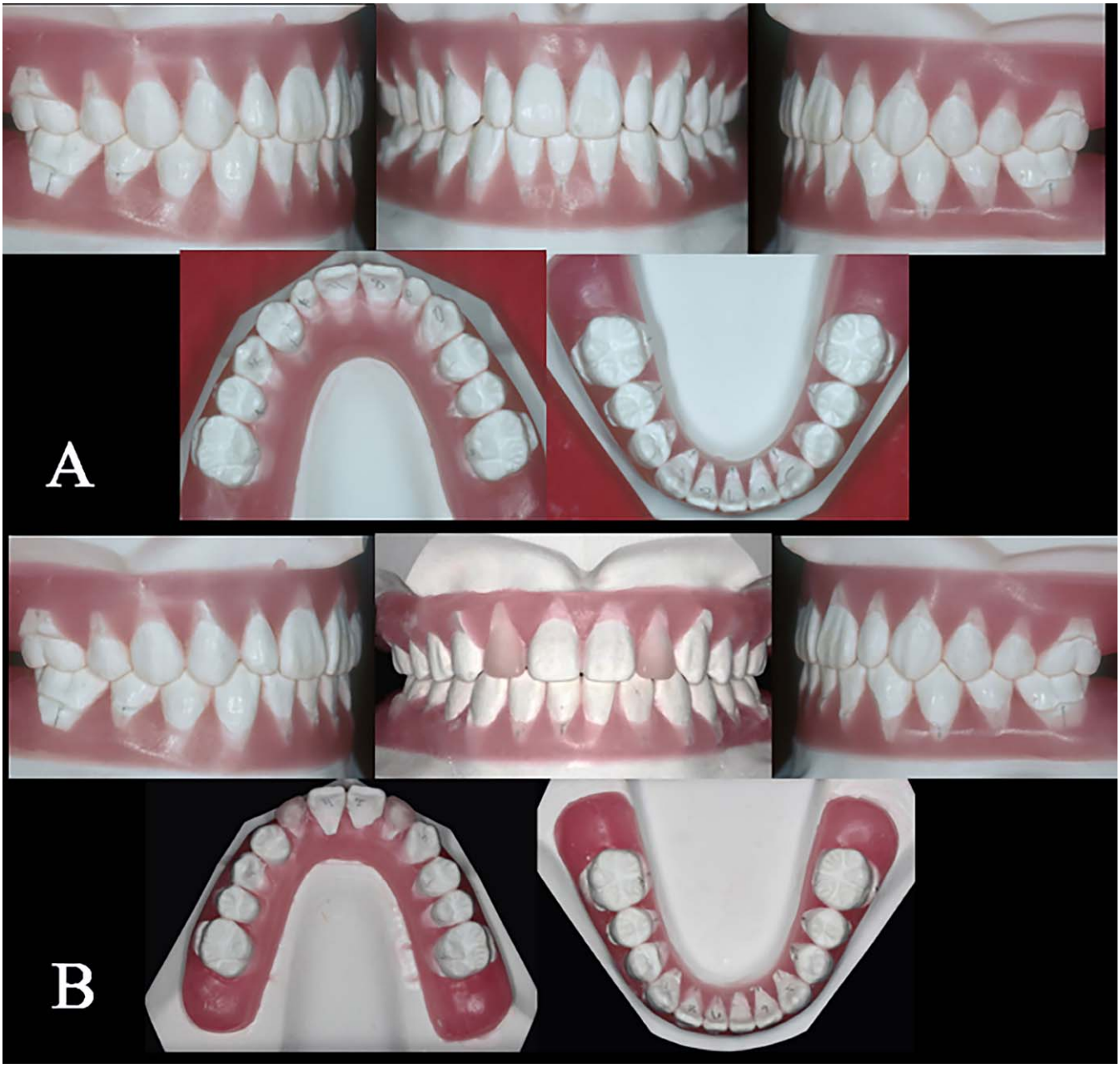

Figure 4. Diagnostic setup: (A) lower incisor extraction; (B) nonextraction with prosthetic treatment of peg lateral incisors.

which may have led to unwanted lip protrusion and facial profile change.

Two diagnostic set-ups were made to show the expected treatment outcomes to the patient (Figure 4). The patient wanted minimal changes to the facial profile and chose the first treatment option, which did not require additional prosthetic treatment.

Treatment Progress

A removable appliance with an anteroposterior screw was used to regain space for the upper right canine and premolar because the maxillary incisors showed slight lingual tipping. A hook was soldered to the removable appliance, and elastics were used to move the upper right premolar to the canine position with 150 g of force. The upper right premolar was positioned close to the upper right lateral incisor after 7 months of traction, at which time the lower left central incisor was extracted (Figure 5).

Roth prescription brackets (0.018-inch; Tomy, Tokyo, Japan) were bonded, excluding the rotated lower right first premolar, and alignment was started with

Figure 5. Intraoral photographs using removable appliance and elastic.

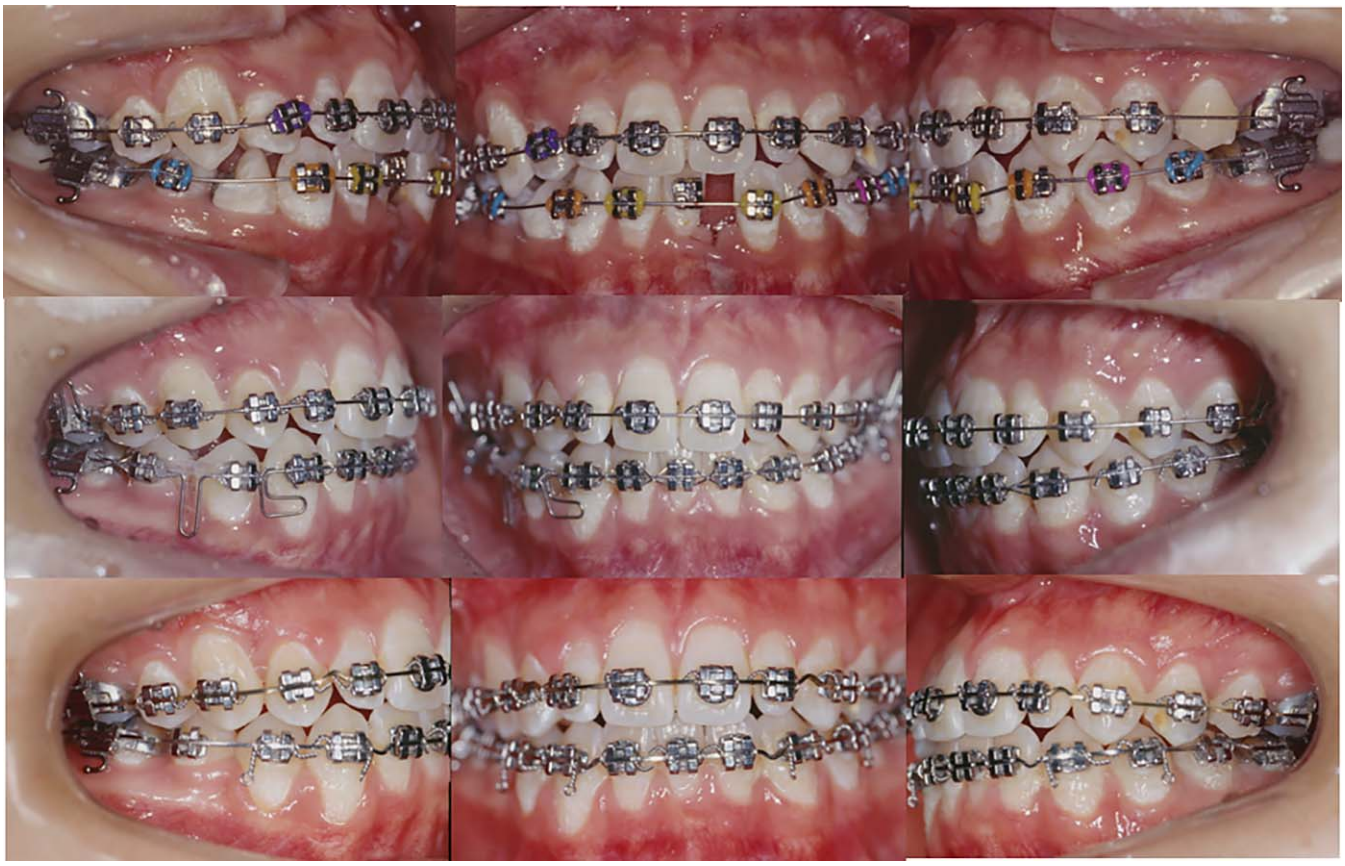

Figure 6. Intraoral photographs during fixed orthodontic treatment.

Figure 7. Posttreatment extraoral and intraoral photographs.

0.016-inch nickel-titanium (Ni-Ti) arch wires. The bracket on the upper right canine was bonded gingivally for more occlusal eruption in order to achieve similar gingival margin levels to the adjacent teeth, and the cusp of the canine was reshaped after alignment. After 9 months of fixed orthodontic treatment, the lower extraction space was nearly closed, the upper right canine and premolar were aligned to the transposed position, and the rotated lower right first premolar was aligned using loop mechanics. A 0.017 × 0.025-inch beta-titanium alloy wire was used during the finishing stage to apply optimal palatal crown torque to the upper right first premolar to prevent occlusal interference caused by the palatal cusp. Despite the use of light continuous forces, the gingival margin levels of the transposed canine and premolar did not fully match the teeth on the contralateral side (Figure 6).

The appliances were removed after a total treatment time of 24 months, which included 7 months of removable appliance treatment followed by 17 months of fixed appliance treatment. For retention, a circumferential retainer was used in the upper arch, and lingual fixed retainers were bonded on the lower arch.

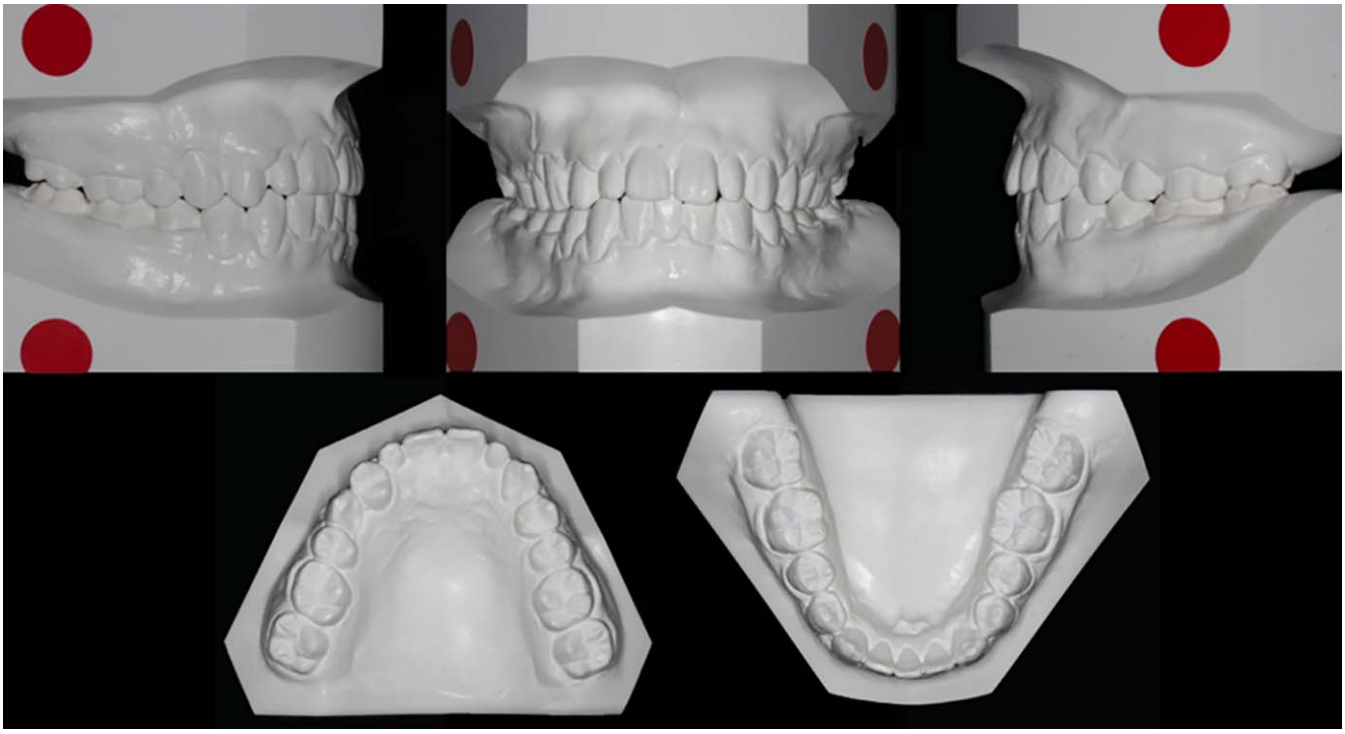

Figure 8. Posttreatment dental casts.

Treatment Results and Retention

The upper right canine and premolar were aligned in their transposed positions with minimal gingival recession, and the lower arch was aligned while maintaining a Class I molar relationship as well as a good facial profile. The lateral cephalometric analysis showed upper and lower incisor inclinations that were within normal limits. The final panoramic radiograph showed good root alignment (Figures 7 through 10).

The patient returned to the clinic for periodic checkups and during the 2-year retention period and alignment and occlusion were stable overall (Figure 11). However, the patient revisited the clinic 15 years after treatment, showing crowding in the lower anterior teeth and gingival recession in the area of the transposed upper right premolar and canine. The patient did not remember when the lower lingual fixed retainer had been removed and had not used the upper circumferential retainer for a long time. The upper right canine had gradually extruded, causing occlusal interference, gingival recession, and vitality loss, and it showed discoloration, which required endodontic treatment at a local clinic (Figures 12 through 14).

DISCUSSION

Extracting a lower incisor may be an uncomfortable decision for the orthodontist because (1) such extraction is less frequently practiced compared to premolar extractions, (2) it increases the risk of less than ideal overjet and overbite, and (3) it finishes with a midline discrepancy. Despite the negative preconception, these cases can result in good occlusal outcomes with proper case selection. The main indications for this treatment are patients with a good facial profile, Class I molar key, moderate lower anterior crowding, increased widths of lower incisors, and narrow upper incisors.[7,9] Some of the well-known advantages of this treatment are minimal changes to the facial profile, improved root proximity and parallelism after crowding relief in the lower anterior segment, reduced treatment time due to less tooth movement for space closure, and a decrease of intercanine width, which increases the potential for stable occlusion and reduces the possibility of relapse.[5,26] Upon diagnosis, this patient was a good candidate for lower incisor extraction, and a lower left central incisor was extracted based on a decision that the tooth was the most misaligned incisor in the lower arch, which would minimize the unnecessary tooth movement of many teeth.[8] Although a midline discrepancy had occurred, the overbite and overjet relationship finished within normal limits, which was due to the reduced upper anterior tooth width caused by the peg-shaped lateral incisors.

A loss of interproximal gingival papilla is one of the esthetic disadvantages of this treatment, a result that may happen more often in older patients.[27] A previous study[28] reported that more than half of the cases

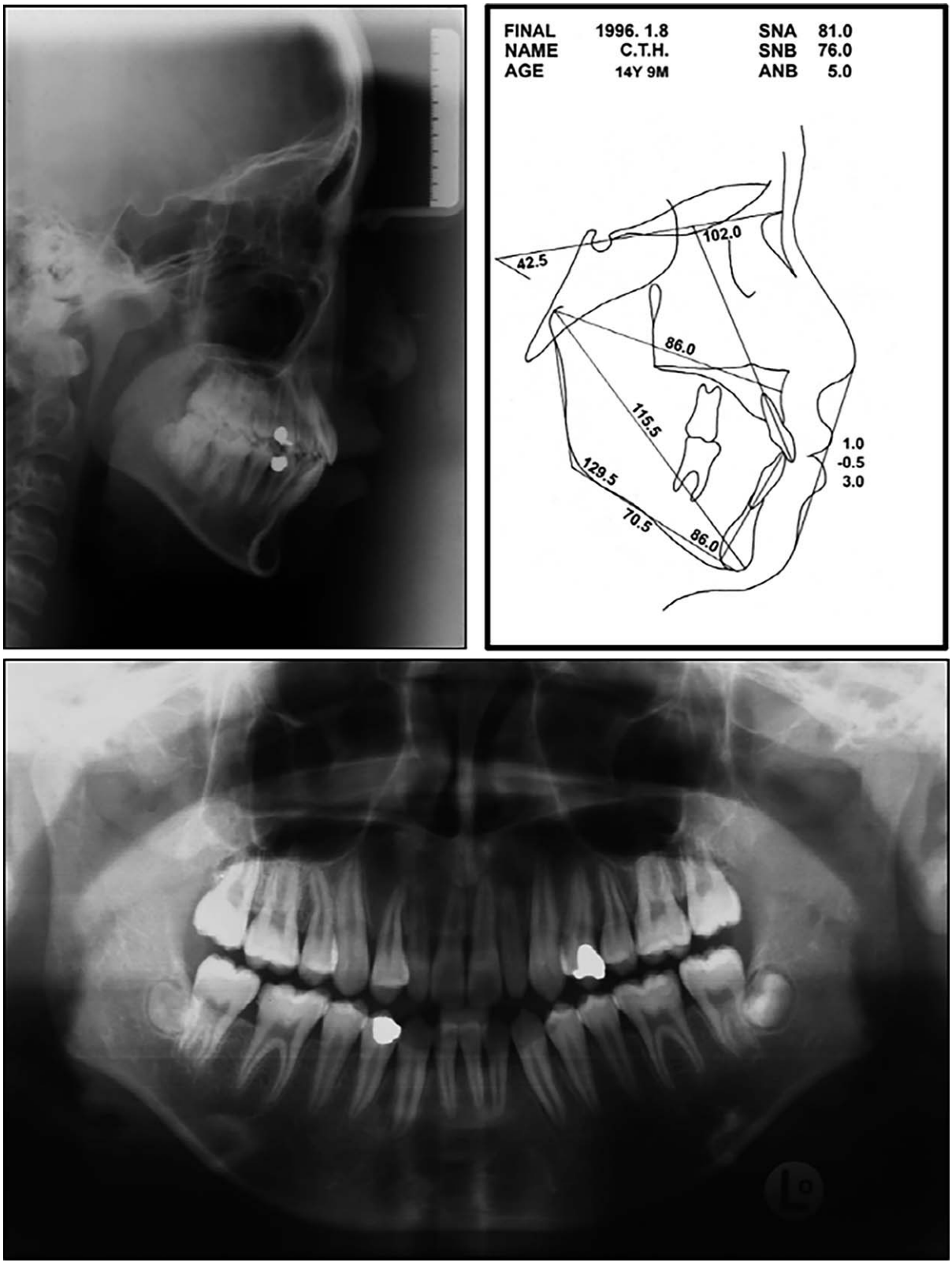

Figure 9. Posttreatment radiographs: lateral cephalogram, lateral cephalometric analysis, and panoramic radiograph.

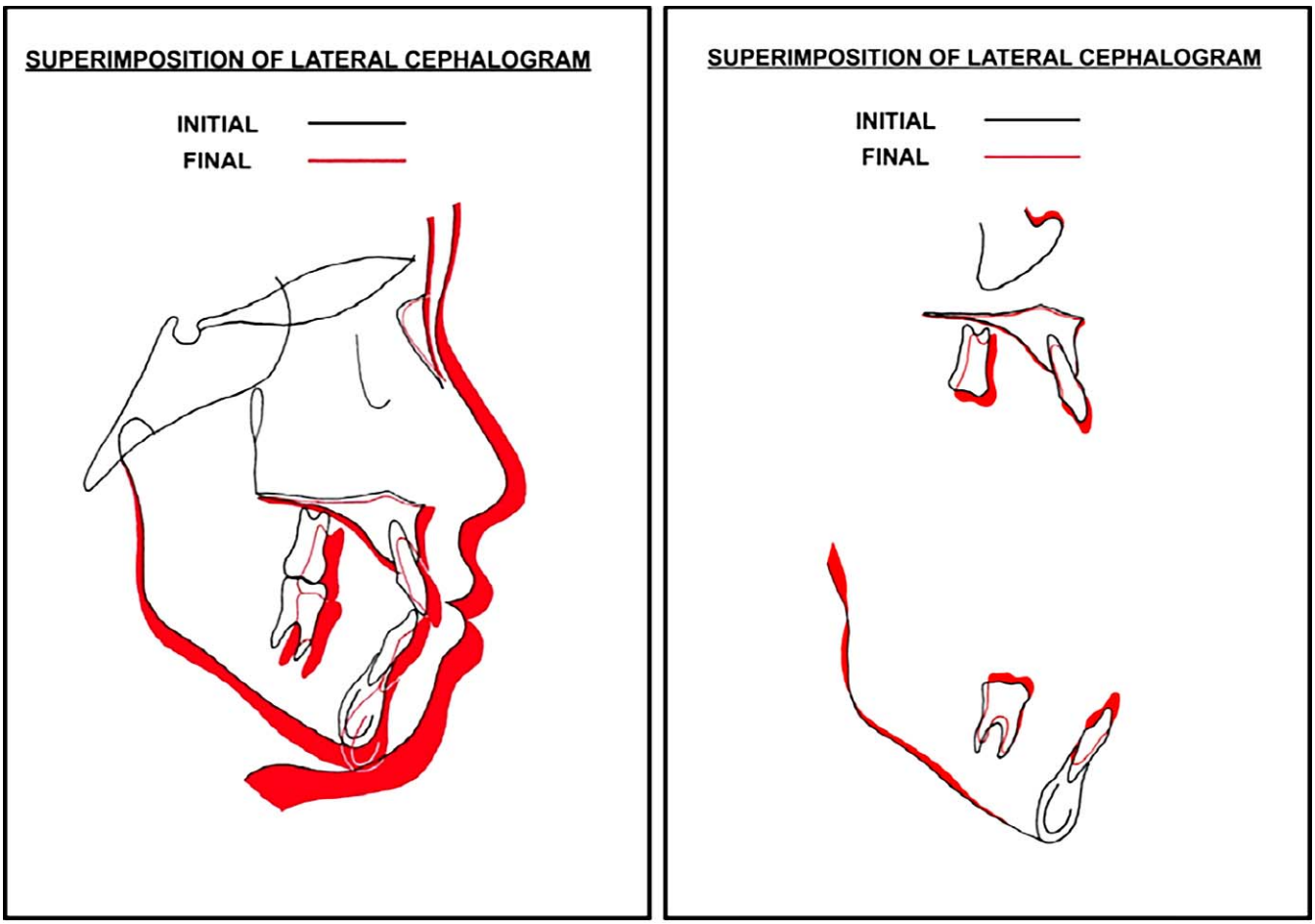

Figure 10. Cephalometric superimposition of before and after treatment.

treated with lower incisor extractions may show clinically noticeable open gingival embrasures. If the amount of misalignment is similar between incisors, extracting a lateral incisor may help reduce the appearance of black triangles in the anterior region because the lateral surface of a central incisor is aligned to the mesial surface of a canine.[29] In this case, a central incisor was selected for extraction because it was the most misaligned tooth, which resulted in a slight loss of the gingival papilla, which was subsequently treated by interproximal reduction.

Several authors[3,6,8,27] have reported that extraction of a lower incisor provides greater stability because there is less movement of other teeth besides the incisors and because muscular pressures are less likely to influence the anterior alignment. However, in a study by Riedel et al.,[6] 29% of the incisor extraction cases resulted in moderate to severe incisor crowding during a 10-year retention period. Another study[8] reported that a mean crowding of 1.49 mm was observed after 5 to 8 years following lower incisor extraction. Moreover, in a study of orthodontically untreated growing individuals,[30] the arch length and width were observed to decrease throughout the second decade of life. In this report, the patient was 14 years and 9 months of age at the end of treatment and still growing. Up to the 2-year posttreatment time, the intercanine width and lower incisor alignment was well maintained by a fixed retainer. However, the patient lost the retainer sometime during the 15-year retention period, resulting in development of crowding. The absence of a lower fixed retainer resulted in a decrease of the intercanine width, followed by a relapse of alignment. This case demonstrates that although lower anterior extractions may be anticipated to show good stability, a fixed retainer should be used continuously to ensure good alignment in the long term.

This patient was not a good candidate for further extractions in the upper arch when considering the small amount of arch length discrepancy and good lateral profile. If extracting the premolar and moving the transposed canine into its correct position is not an

Figure 11. Two-year postretention extraoral and intraoral photographs.

applicable treatment option, which was the case for this patient, alignment of completely transposed canines and premolars in their transposed position is generally an acceptable treatment to prevent unnecessary gingival recession and root resorption from orthodontic alignment. At the beginning of treatment, the upper right canine showed insufficient keratinized gingiva due to its labial position in the upper arch. Therefore, care was taken to move the lingually positioned premolar to the transposed position before aligning the canine to preserve the compromised gingival condition. The upper right first premolar initially showed mesial root angulation, which allowed some tipping movement with elastics, which was followed by fixed orthodontic treatment to position the transposed canine and premolar. Despite the efforts to maintain the gingival level, the upper right canine still showed labial gingival recession. Nonetheless, the transposed teeth were well aligned without clinical signs of root resorption or loss of tooth vitality.

Despite the ease of alignment when keeping the canine and premolar in the transposed position, in the

Figure 12. Fifteen-year postretention extraoral and intraoral photographs.

case of this treatment, additional considerations were required for good esthetics and functional occlusion. Palatal root torque should be applied to the canine to mask the root prominence, and palatal crown torque should be given to the premolar to mimic the canine eminence and to avoid functional interference caused by the palatal cusp. As for gingival contour, the transposed premolar in place of a canine may need additional periodontal treatment to match the contralateral side. In this case, after detailed torque adjustments in the finishing phase, the palatal cusp of the premolar required slight reshaping to prevent occlusal interference, and the transposed canine was aligned so that it did not occlude with the opposing arch. Although there was an esthetic compromise in the gingival levels of the transposed teeth, this was not a concern for the patient.

The transposed canine and premolar showed good alignment up to the 2-year retention time. However, sometime during the 15-year retention period, the transposed upper right canine extruded, causing occlusal trauma, gingival recession, and loss of tooth vitality, which required endodontic treatment. This result is in line with the findings of many previous

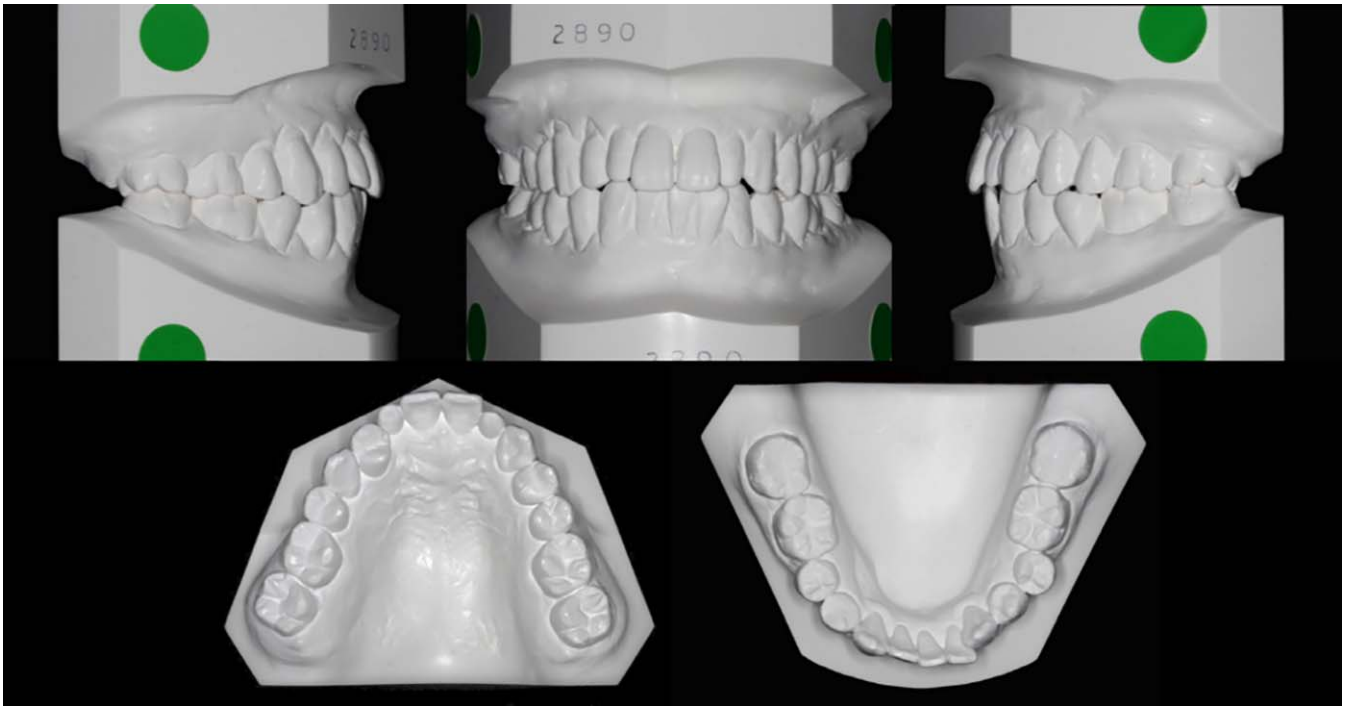

Figure 13. Fifteen-year postretention dental casts.

reports[31,32] in that gingival recession and pulpal change may be caused by increased occlusal interference caused by extrusion. For future cases including transpositions of the canines and premolars, several considerations after orthodontic treatment would aid in better long-term results. Since the canine crown shape is unsuitable to withstand the occlusal forces of the opposing premolar, a solution for a transposed canine would be to restore the tooth into a premolar by prosthetic treatment.[25] Another recommendation would be to use a bonded fixed retainer instead of a removable retainer to prevent undesirable extrusion and occlusal trauma for teeth aligned in their transposed position to enhance long-term occlusal stability.

This case illustrated that orthodontic treatment including extraction of a lower incisor and keeping the transposed positions of the canine and premolar was well maintained while the fixed retainer was in place and while the patient showed good compliance in using removable retainers. However, once the retainers were removed and unused, the lower incisors showed a relapse in alignment, and the canine positioned in place of a premolar was subject to continuous occlusal trauma, which led to detrimental gingival recession as well as to a loss of tooth vitality at the 15-year postretention visit. The importance of continuous use of orthodontic retainers cannot be overemphasized in maintaining stable occlusion.

CONCLUSIONS

- Lower incisor extraction is an effective treatment option for patients with a good facial profile, Class I molar key, and peg laterals that show lower anterior crowding. A fixed retainer should be in place to ensure long-term lower anterior alignment.
- A transposed maxillary canine and premolar were successfully aligned by keeping the transposed positions, with stable 2-year postretention results using a removable retainer. However, during the 15-year postretention period, the retainers were lost, leading to extrusion of the transposed canine, causing occlusal interference, gingival recession, and loss of tooth vitality. A fixed retainer is recommended for the transposed maxillary canine–premolar to maintain stable occlusion in the long term.

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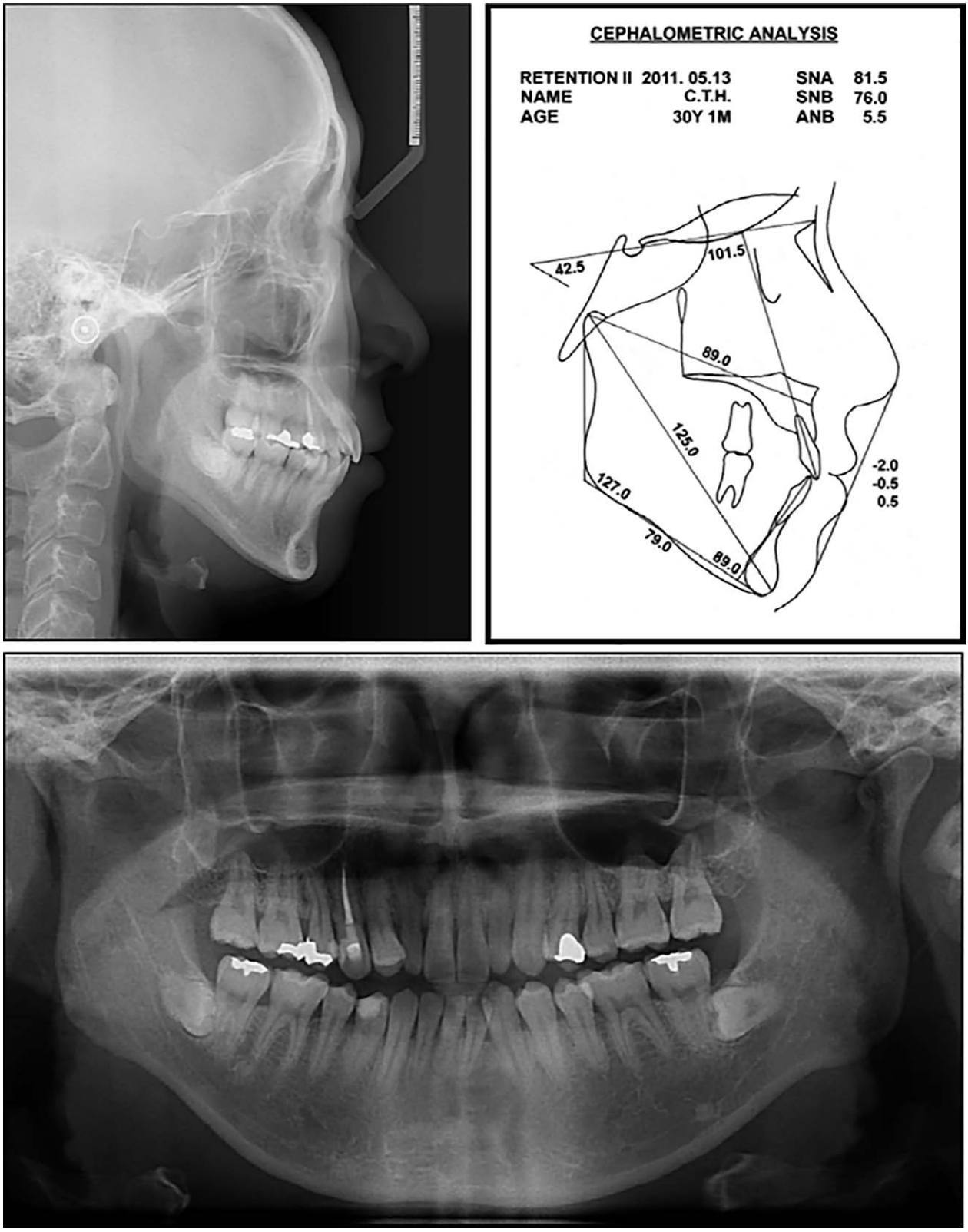

Figure 14. Fifteen-year postretention radiographs: lateral cephalogram, lateral cephalometric analysis, and panoramic radiograph.

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