

Interdisciplinary treatment of a nonsyndromic oligodontia patient with implant-anchored orthodontics

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We successfully treated a nonsyndromic oligodontia patient with implant-anchored orthodontics and prosthetic restorations. A woman, age 18 years 11 months, had a straight profile and a skeletal Class I jaw-base relationship but had spaced arches because of 7 congenitally missing teeth. After leveling and alignment of the dentition, a titanium miniscrew was temporarily placed at the distal alveolus of the mandibular right first premolar, and the posterior teeth were mesialized to reduce the restorative spaces. After determination of the incisor positions, 3 dental implants were respectively inserted at the sites of the maxillary canines and the mandibular left lateral incisor with guided bone regeneration procedures. Then, screw-retained temporary prostheses were delivered after subepithelial connective tissue grafting and used for molar mesialization as absolute anchorage. After 36 months of active orthodontic treatment, an acceptable occlusion was achieved, both functionally and esthetically, with the 3 dental implants. The maxillary and mandibular molars were mesialized, but the changes of incisor position were minimal. As a result, a proper facial profile was maintained, and an attractive smile was achieved. The resultant occlusion was stable throughout a 3-year retention period. In conclusion, interdisciplinary treatment combined with orthodontics, implant surgery, and prosthodontics was useful for a nonsyndromic oligodontia patient. Especially, the new strategy—implant-anchored orthodontics—can facilitate the treatment more simply with greater predictability. (*Am J Orthod Dentofacial Orthop* 2014;145:S136-47)

Oligodontia refers to the congenital absence of many but not all permanent teeth; it is a rare finding.¹⁻⁴ However, orthodontists might encounter this condition because management often requires an integrated orthodontic and restorative approach.⁴ The orthodontic treatment of oligodontia is

difficult in general because only a few anchorage teeth are available to support tooth movement.

Recently, implant anchorage has been shown to be effective in treating a wide variety of malocclusions. Dental implants, miniplates, and titanium screws have been used as anchorage for orthodontic treatment, and they are often referred to as temporary anchorage devices.⁵⁻¹⁰ Temporary anchorage devices can provide absolute anchorage for tooth movement without the patient's compliance. The use of miniscrews has gained acceptance among orthodontists and patients because there is little discomfort, they are relatively noninvasive, and there are fewer limitations in placement.^{11,12} Despite their small diameter and short length, miniscrews can provide stable anchorage for various types of tooth movements, including intrusion, retraction, and protraction.^{11,13,14} Use of temporary anchorage devices is helpful in treating oligodontia patients. As for molar mesialization, we previously reported the successful outcome in an oligodontia patient with titanium screws and extended anchorage wires placed in the retromolar area.¹⁵ However, the mechanics were complicated, and the wires were sometimes

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Fig 1. Pretreatment facial and intraoral photographs.

difficult to adjust. Thus, a more simple mechanism was needed.

Dental implants are now considered an effective and reliable modality for the rehabilitation of a dentition with missing teeth. However, severely reduced bone quantity caused by the congenital absence of multiple teeth is often found in patients with oligodontia.^{4,16} Therefore, bone augmentation procedures to establish appropriate bone quantity are required in most cases. The surgical procedures should be carefully planned on an individual basis, and their timing is considerably important to facilitate the interdisciplinary treatment. It occasionally makes treatment planning difficult and complicated.

In this case report, we demonstrate the successful outcome of interdisciplinary treatment in a nonsyndromic oligodontia patient. Dental implants were placed with bone augmentation immediately after the leveling

and alignment phase, and the implants and a miniscrew were used for absolute anchorage during mesial movement of the posterior teeth.

DIAGNOSIS AND ETIOLOGY

A woman, age 18 years 11 months, had a chief complaint of missing maxillary canines. Her facial profile was straight, and the frontal view was almost symmetrical (Fig 1). The molar relationships were Angle Class I on both sides (Fig 2). Overjet and overbite were both 2.5 mm. Spaced arches were observed in the both dentitions because of the 7 congenitally missing permanent teeth: the maxillary canines, a mandibular incisor, and all second premolars. The maxillary left deciduous canine and all deciduous second molars showed prolonged retention. As for the maxillary first premolars, the right side was rotated distally, and the left was rotated mesially.

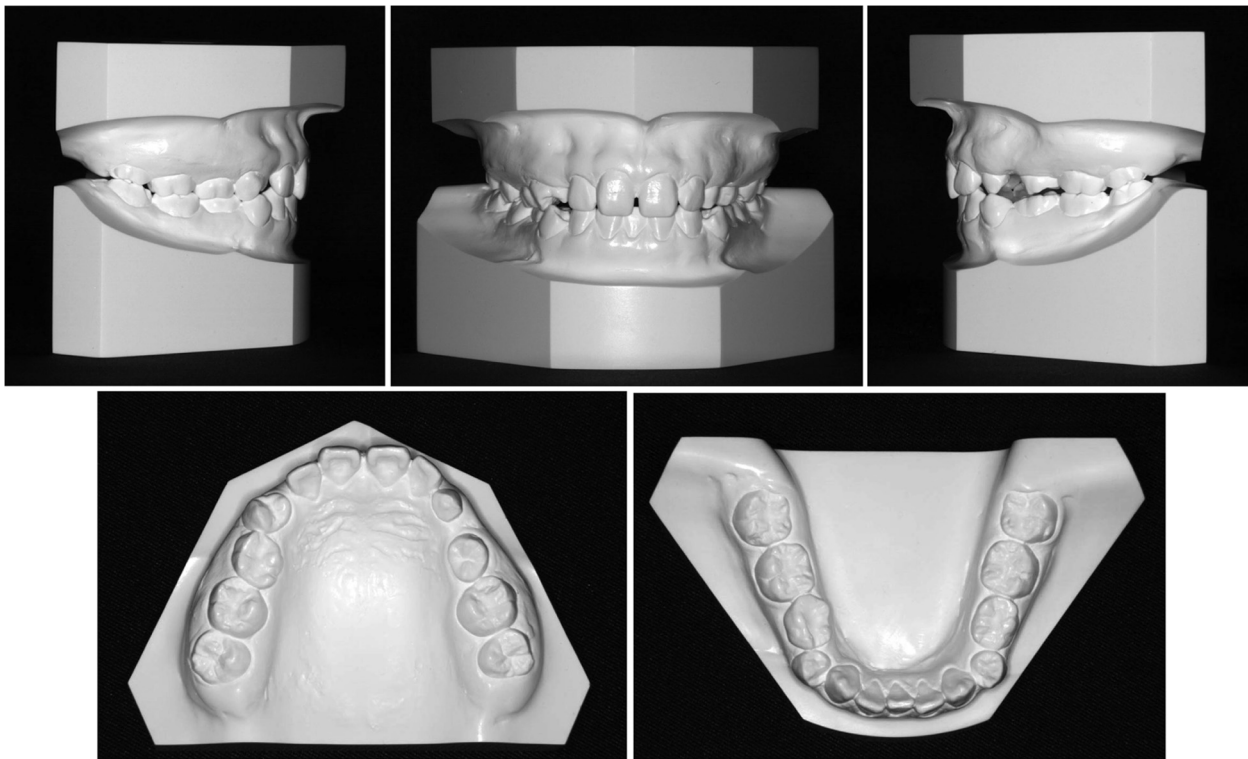


Fig 2. Pretreatment dental casts.

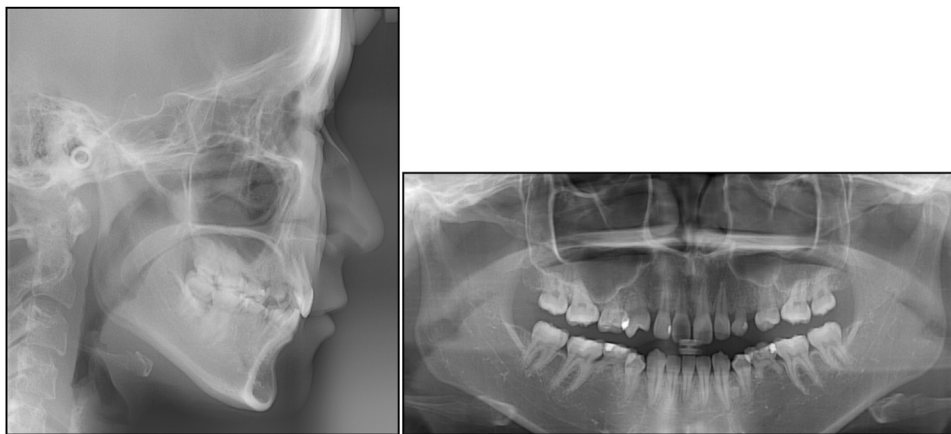


Fig 3. Pretreatment lateral cephalogram and panoramic radiograph.

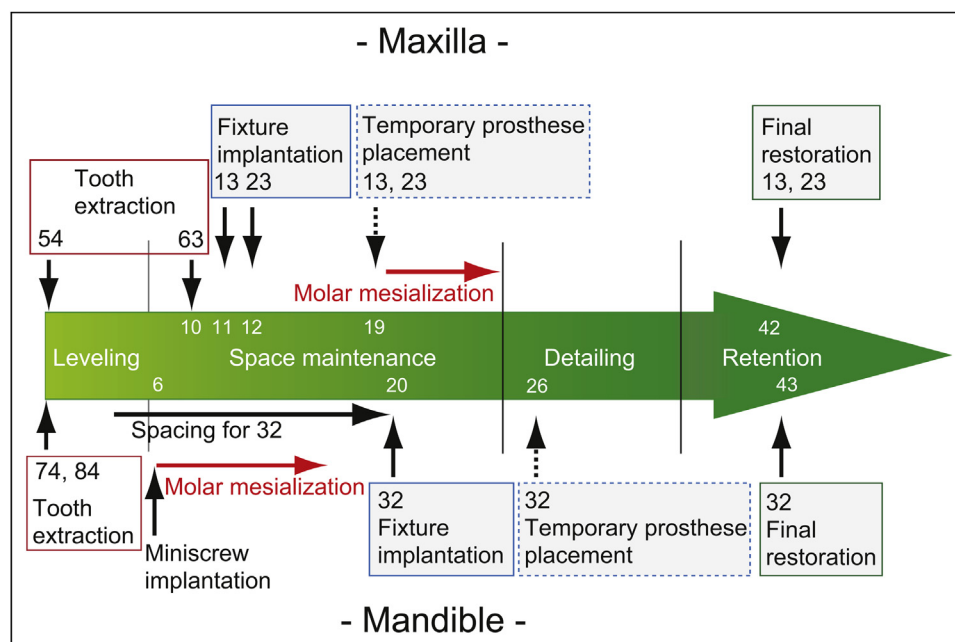
The maxillary dental midline almost coincided with the facial midline; however, the mandibular dental midline was deviated 3.0 mm to the left.

In the panoramic radiograph, root resorption was clearly observed in the maxillary left deciduous canine and the mandibular deciduous molars but was not shown in the maxillary right deciduous molar (Fig 3). The floor of the maxillary sinus was near the roots of the maxillary molars.

The cephalometric analysis, when compared with the Japanese norm, showed a skeletal Class I jaw-base relationship (ANB, 5.0°) (Table).¹⁷ The mandibular plane angle was average (MP-FH plane, 27.0°). The maxillary incisors were lingually inclined (U1-FH plane, 102.0°), but the mandibular incisors had an average inclination (L1-MP, 90.0°). As a result, the interincisal angle was significantly increased (IIA, 142.5°).

Table. Cephalometric summary

			<i>Pretreatment</i>	<i>Posttreatment</i>	<i>Postretention</i>
<i>Variable</i>	<i>Japanese norm*</i>	<i>SD</i>	<i>18 y 11 mo</i>	<i>21 y 11 mo</i>	<i>24 y 11 mo</i>
Angles (°)					
ANB	2.8	2.4	5.0	4.0	4.0
SNA	80.8	3.6	82.0	82.0	82.0
SNB	77.9	4.5	77.0	78.0	78.0
Mandibular plane-Frankfort horizontal plane	30.5	3.6	27.0	27.0	27.0
Gonial angle	122.1	5.3	123.0	123.0	123.0
U1-FH plane	112.3	8.3	102.0	102.0	102.5
L1-Mandibular plane	93.4	6.8	90.0	90.0	90.0
Interincisal angle	123.6	10.6	142.5	142.5	142.0
Occlusal plane	16.9	4.4	13.5	11.0	11.0
Lines (mm)					
S-N	67.9	3.7	69.0	69.0	69.0
N-Me	125.8	5.0	128.5	128.5	128.5
Me/palatal plane	68.6	3.7	70.5	71.0	71.0
Ar-Go	47.3	3.3	47.0	47.0	47.0
Ar-Me	106.6	5.7	112.0	113.5	113.5
Go-Me	71.4	4.1	78.0	79.5	79.5
Overjet	3.1	1.1	2.5	2.5	2.5
Overbite	3.3	1.9	2.5	3.0	3.0

*Wada et al.¹⁷**Fig 4.** Time course of interdisciplinary treatment. *White numbers* indicate treatment duration (in months) after the start of active orthodontic treatment.**TREATMENT OBJECTIVES**

The patient was diagnosed as having an Angle Class I malocclusion with a skeletal Class I jaw-base relationship and a spaced arch due to 7 congenitally missing perma-

nent teeth. The treatment objectives were (1) to achieve an acceptable occlusion with a good functional Class I occlusion, (2) to control the available spaces for the dental implants with mesialization of the maxillary

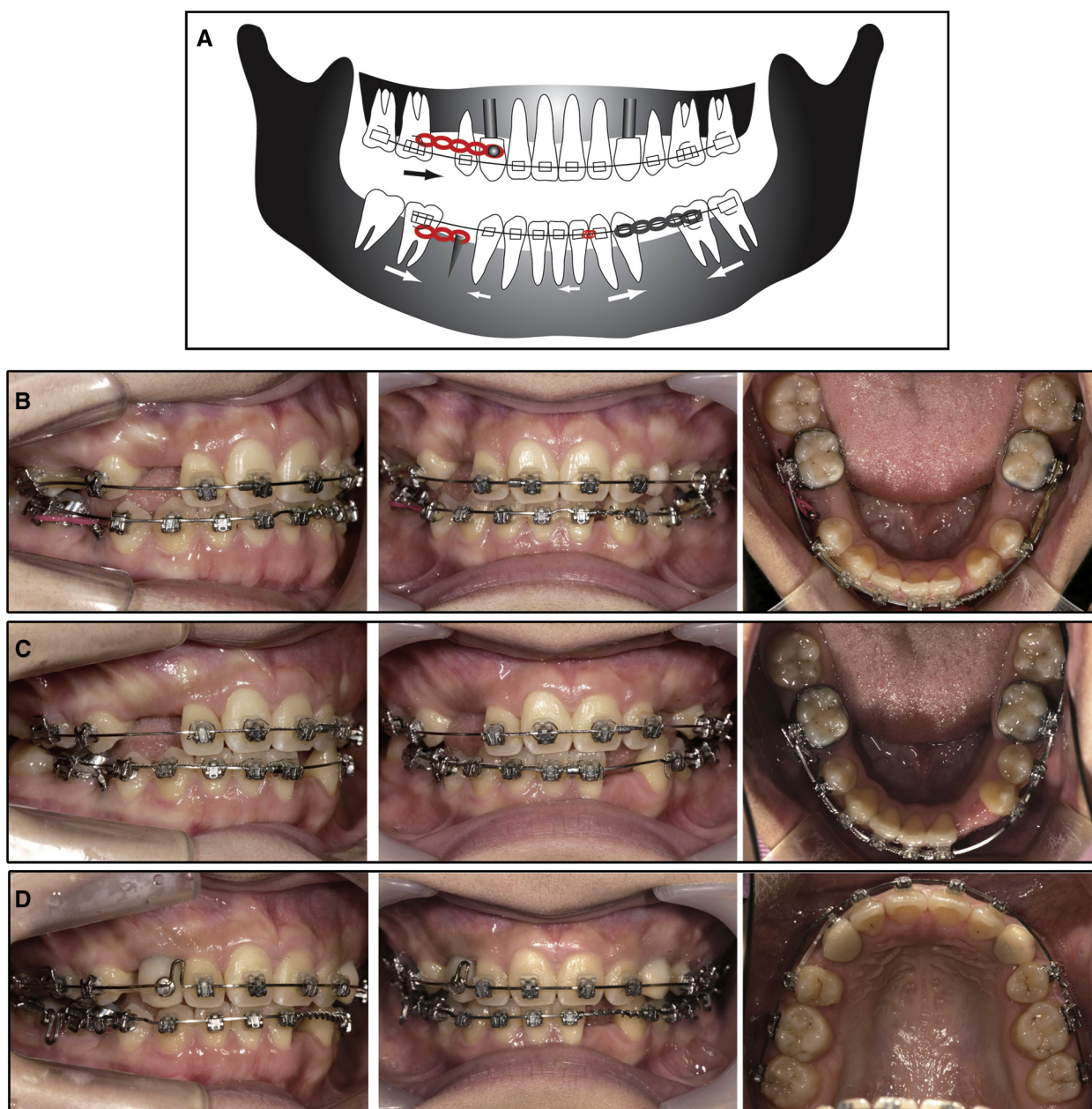


Fig 5. Treatment progress: **A**, schematic illustration of molar mesialization; **B**, oral photographs at 6 months after the start of treatment; after leveling and alignment, a miniscrew was implanted at the distal alveolus of the mandibular right first premolar, and the molar mesialization was started with elastomeric chains; **C**, 15 months later, the mandibular second molars were completely mesialized, and dental implants had already been placed at the maxillary canine sites; **D**, 19 months later, screw-retained temporary prostheses were delivered and used for absolute anchorage for maxillary molar mesialization; in the mandible, space for the incisor dental implant had already been gained.

and mandibular molars, and (3) to achieve an attractive smile and maintain a proper facial profile. Then, dental implants with bone augmentation were planned for the maxillary canines and the mandibular left lateral incisor.

TREATMENT ALTERNATIVES

Several procedures were explored to achieve an acceptable occlusion. Prosthetic restorations without orthodontic treatment might shorten the total treatment

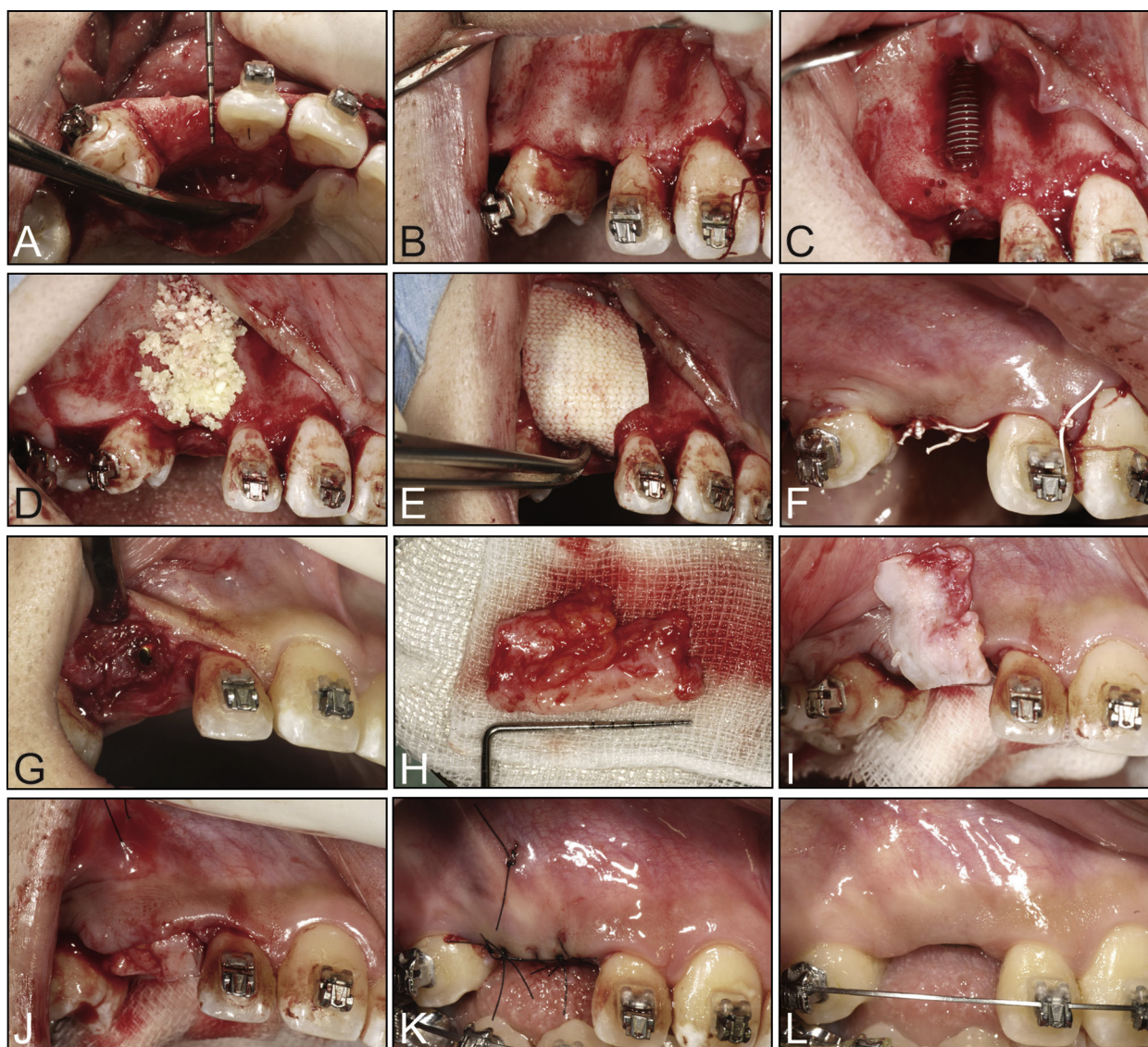


Fig 6. Oral photographs at fixture implantation with guided bone regeneration, and subepithelial connective tissue graftings: **A-C**, the implanted fixture was exposed because of thin alveolar bone caused by early loss of the maxillary right deciduous canine; **D-F**, procedures of guided bone regeneration; artificial bones were placed and covered with a resorbable membrane; **G-K**, 7 months after the implantation, subepithelial connective tissue graftings were performed on the labial side of the maxillary fixture; note the increase of buccolingual bone thickness in **G**; a connective tissue graft was resected from the palate and placed subepithelially (**H-K**); **L**, 2 months after the subepithelial connective tissue graftings, thick keratinized gingivae were acquired.

period; however, this required extraction or pulpectomy of some teeth before the restorations. In addition, it is almost impossible to achieve a Class I occlusion and to correct the midline deviation. Therefore, the best plan seemed to be a compromise.

Comprehensive treatment including orthodontics was proposed to improve her specific issues. If the deciduous

canine and molars were planned to be maintained as long as possible, the restorations could be minimal in this timing. Meanwhile, the plan could not ensure a stable occlusion over time because the patient was still growing and some root resorption was seen in the deciduous teeth. If the dental implants were placed after extraction of all remaining deciduous molars, an ideal occlusion could



Fig 7. Posttreatment facial and intraoral photographs.

be achieved. However, the placement of 7 implants would be expensive and would involve considerable surgical invasion. Therefore, we planned to mesialize both the maxillary and mandibular molars to reduce the spaces for the prosthetic restorations.

TREATMENT PROGRESS

A time course of the interdisciplinary treatment is shown in [Figure 4](#). Three deciduous second molars were extracted, and 0.022-in slot preadjusted edgewise appliances were placed in both arches. After leveling and alignment with nickel-titanium archwires, space gaining for the left lateral incisor and correction of the deviated midline were started with a stainless steel archwire in the mandibular arch.

After the midline correction, a miniscrew (diameter, 1.3 mm; length, 7 mm; Absoanchor; Dentos, Daegu,

South Korea) was implanted at the distal alveolus of the mandibular right first premolar, and molar mesialization was started with elastomeric chains ([Fig 5, B](#)).

After alignment of the maxillary dentition, the maxillary left deciduous canine was extracted, and ridge preservation was performed at the same time. One month later, a dental implant fixture was placed at the site of the maxillary right canine with a horizontal guided bone regeneration ([Fig 6, A-F](#)). At the left canine region, a sinus lift procedure and horizontal guided bone regeneration were performed simultaneously in the next month. Five and 7 months after the implantation, subepithelial connected tissue graftings were performed on the labial side of both maxillary fixtures ([Fig 6, G-K](#)), and screw-retained temporary prostheses were delivered in the next month. Then, mesial movement of the maxillary right molars was started using the implant as absolute anchorage ([Fig 5, D](#)).

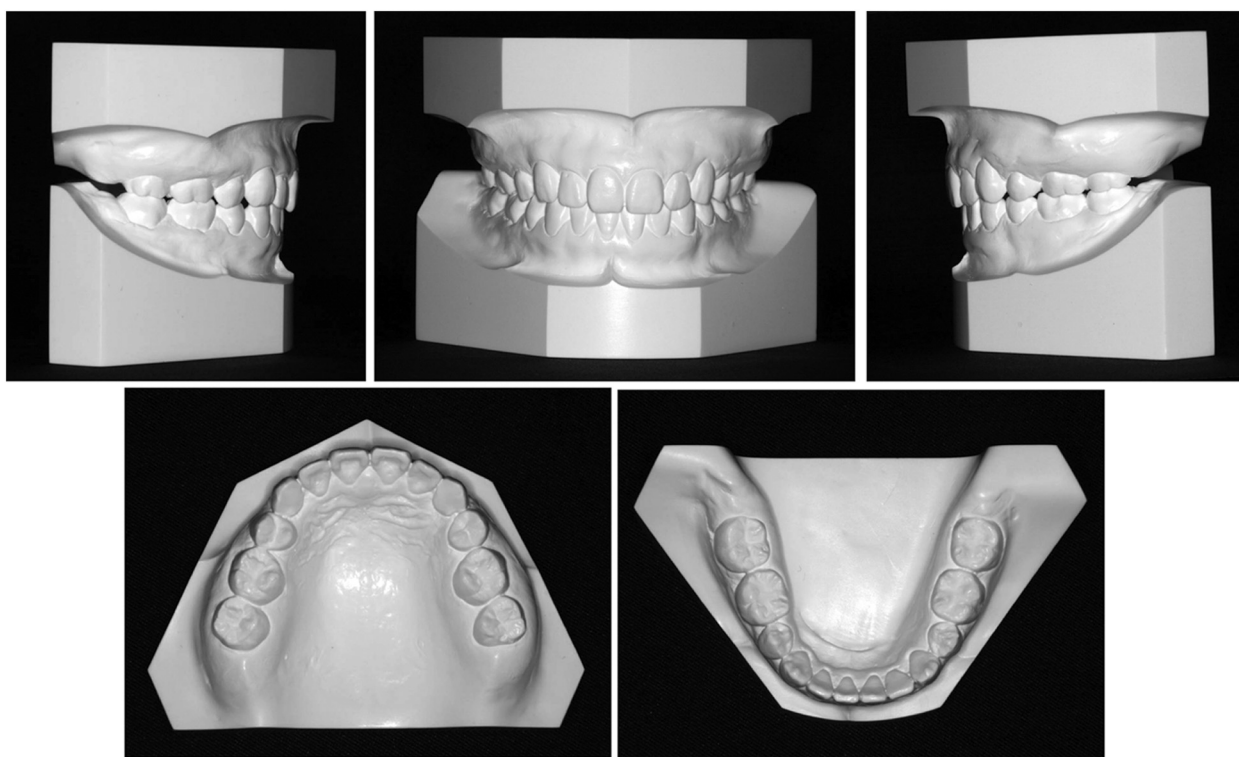


Fig 8. Posttreatment dental casts.

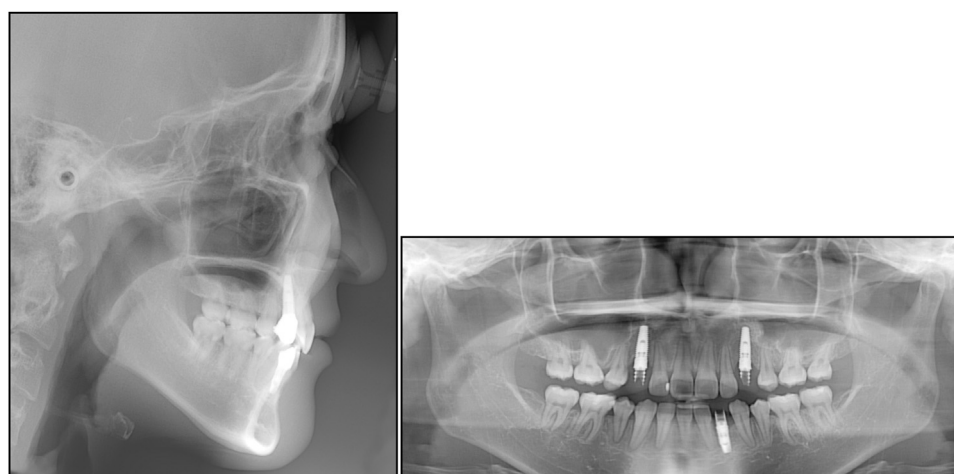


Fig 9. Posttreatment lateral cephalogram and panoramic radiograph.

In the mandible, after space gaining, a fixture was placed at the site of the left lateral incisor with guided bone regeneration, and the provisional restoration was screwed into the fixture before debonding the braces to reduce the total treatment period.

After removal of the edgewise appliances, wraparound-type retainers were placed in both arches.

The total active orthodontic treatment time was 36 months. During the retention period, final restorations of zirconia abutments and crown were delivered.

TREATMENT RESULTS

The posttreatment facial photographs show that a proper facial profile was maintained, and an attractive

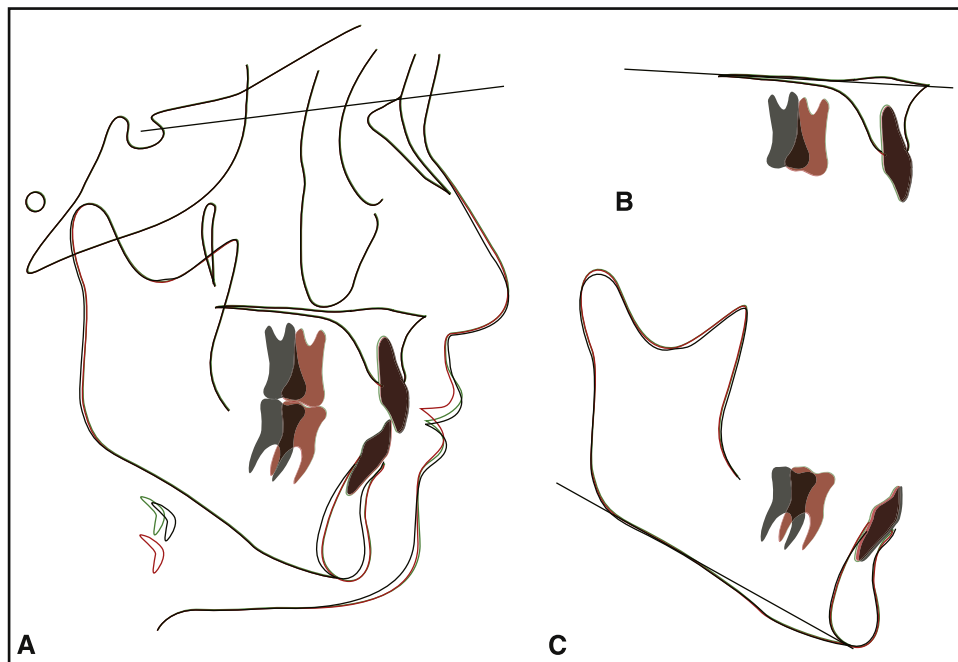


Fig 10. Cephalometric tracings at pretreatment (*black line*), posttreatment (*red line*), and 3 years post-retention (*green line*) superimposed on **A**, sella-nasion plane at sella; **B**, the anterior palatal contour; and **C**, the mandibular plane at menton.

smile was achieved (Fig 7). The occlusion was much more stable, and acceptable intercuspation of the teeth was achieved with Class I canine and molar relationships (Fig 8).

In the panoramic radiograph, the 3 dental implants and proper root paralleling are shown (Fig 9). The maxillary molars were completely mesialized, although their roots were much closer to the sinus. Posttreatment cephalometric evaluation showed little changes in the skeletal variables. The Class I jaw-base relationship was kept (ANB, 4.0°), and the mandibular plane angle was stable (MP-FH plane, 27.0°) (Fig 10, Table). The maxillary and mandibular molars were mesialized 5.0 mm, without any lingual inclinations of the incisors (U1-FH, 102.0; IMPA, 90.0°). As a result, an acceptable interincisal relationship was also maintained. No symptoms of temporomandibular disorders were observed throughout active orthodontic treatment.

At 3 years postretention, the occlusion was stable, and the good facial profile was also retained (Fig 11). The panoramic radiograph and the cephalometric analysis showed few changes (Fig 12, Table).

DISCUSSION

The patient had a poor smile caused by the missing maxillary canines before treatment. Initially, she desired treatment with a restorative approach only because of its short treatment period. However, she had 7 congenitally

missing teeth, and 4 deciduous teeth showing some root resorption were still retained. Even though several reports indicated a good prognosis for deciduous molars with missing permanent successors, it would not guarantee the longevity of her teeth.¹⁸⁻²⁰ Additionally, her maxillary first premolars were significantly rotated, and there were not enough spaces for dental implants. Therefore, an interdisciplinary approach combined with orthodontics and prosthetics was recommended to achieve proper occlusion.

We planned to mesialize the posterior teeth to reduce the surgical invasion and the medical costs associated with dental implants. During the molar mesialization, lingual tipping of the incisors had to be prevented in both arches because the patient had a balanced facial profile and a Class I occlusion. Then, in the maxilla, dental implants were placed at the canine positions immediately after the leveling and alignment phase and were used in the succeeding treatment as absolute anchorage to prevent anchorage loss. Moreover, the patient's dental esthetics were improved by the provisional restorations, and her chief complaint was eliminated in the early stage of the interdisciplinary treatment.

We started the maxillary molar mesialization 8 months after the implantations. Recent studies have shown that immediate loading of dental implants is beneficial and considered to be a useful alternative.²¹⁻²³



Fig 11. Three-year postretention facial and intraoral photographs.

Meanwhile, our patient did not have enough bone mass and quality in the edentulous areas for implantation because of the congenital absence of the canines, and bone augmentation was required. Therefore, we chose the submerged technique to perform a sinus lift procedure and horizontal guided bone regeneration simultaneously, and the implants were used as orthodontic anchorage after their healing period.

In the mandible, after extraction of the deciduous molars, reciprocal tooth movements of both first premolars and molars were started to gain the space for implantation and to correct the deviated midline. Following the coincidence of midline, a miniscrew was placed at the distal alveolus of the right premolar and was used for the mesial molar movement. As a result of the usage of these absolute anchorages—dental implants and a miniscrew—the spaces of 4 congenitally

missing premolars were completely closed without counteractions that would worsen the facial profile and the interincisal relationship.

Careful treatment planning is required for the placement of a dental implant during active orthodontic treatment because it will never move once it is implanted. In this patient, planning of the maxillary implant position was relatively easy because the maxillary incisor position at pretreatment did not have to be changed anteroposteriorly. In the mandible, the fixture was placed during active treatment to reduce the total treatment period. However, it complicated the treatment in the finishing and detailing phase because the mandibular position was unstable during active orthodontic treatment. Therefore, it is better to plan the placement of dental implants in the mandible during the retention phase if enough treatment time is available.

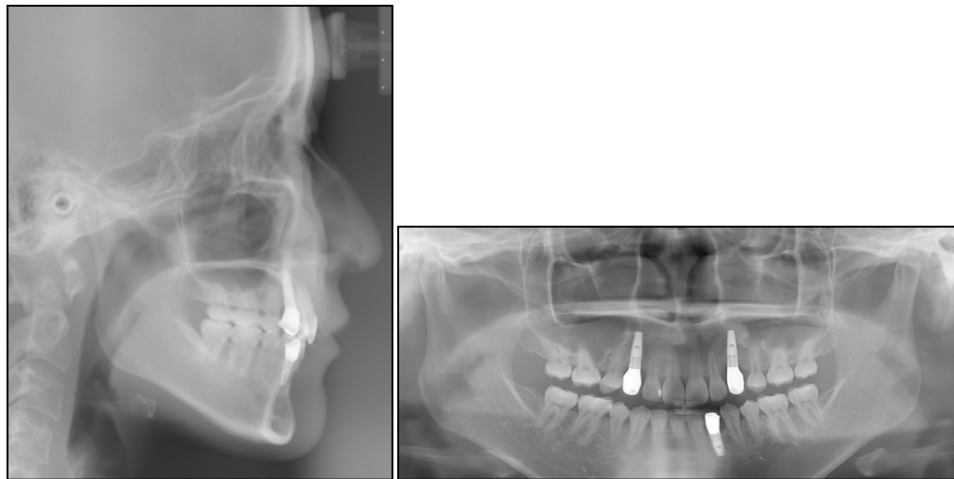


Fig 12. Lateral cephalogram and panoramic radiograph at 3 years postretention.

Implantation of the mandibular incisor in a patient with 3 incisors has several advantages: midline correction, improvement of the anterior ratio, and achievement of a proper interincisal relationship with a canine Class I relationship. These must contribute not only to dental and facial esthetics but also to stomatognathic functions with proper guidance during jaw movements.

Most oligodontia patients have particular considerations in their edentulous areas: thinner attached gingiva, atrophic alveolar bone ridge, and downward extended maxillary sinus.⁴ Our patient's deciduous teeth had been retained as long as possible to prevent bone loss after their extraction. Meanwhile, the buccolingual bone thickness and the width of keratinized mucosa at the maxillary canines were not enough for dental implants. Moreover, the maxillary sinus floor was near the teeth on the left side, and a sinus lift procedure was required. Then a guided bone regeneration procedure was added at the fixture implantation, and subepithelial connected tissue graftings were also performed at the secondary operation. As a result of these procedures, esthetic and functional restorations were achieved.

Tooth movement through bone-deficient areas is considered a major limitation and might reduce the alveolar bone height or the root length.²⁴⁻²⁶ Wehrbein et al^{24,26} described in their dog experiment and human biopsy study that root resorption and loss of osseous supporting tissue occurred in the basal cortical bone of the nasal sinus after translatory tooth movements. However, the maxillary molars can be moved mesially without side effects, even though the sinuses seemed to be in front of the first molars in this patient. Some authors recently reported that bone formation on the

surface of the maxillary sinus was evoked by mechanotransduction of mechanical stress applied to a tooth in an experimental tooth movement model.²⁷ Osteogenesis was induced ahead of bone resorption on the periodontal ligament side, and the bone thickness of the sinus was generally consistent throughout the period of tooth movement, and no accentuated root resorption was observed. These can support the hypothesis that the teeth can be moved into the sinus without losing bone support or inducing root resorption, and might give the histologic evidence of tooth movement shown in this patient.

In conclusion, interdisciplinary treatment combined with orthodontics, implant surgery, and prosthodontics was useful to treat a nonsyndromic oligodontia patient. Especially, the new strategy, implant-anchored orthodontics, can facilitate the treatment more simply with greater predictability.

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