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)
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. Therefore, bone augmentation procedures to establish appropriate bone quantity are required in most cases. The surgical planning and treatment of such patients require careful consideration of the complex interplay between the dental arches, the underlying bone, and the surrounding soft tissues.}

**DIAGNOSIS AND ETIOLOGY**

A woman, age 18 years 11 months, had a chief complaint of missing maxillary canines. Her facial prosthesis was successful in providing esthetic and functional support. However, the patient expressed dissatisfaction with the esthetic outcome and the need for further treatment. A detailed examination revealed that the maxillary arch was angulated and the maxillary canines were absent. The mandibular arch was found to be normal. The patient was referred to the Department of Prosthodontics for a treatment plan that included maxillary canine implant placement and prosthodontic treatment.

In this case report, we demonstrate the successful treatment of a missing maxillary canine. The maxillary left deciduous canine and the maxillary right deciduous canine were extracted, and the maxillary right deciduous second molar was extracted. A maxillary left canine implant was placed, and a maxillary left canine prosthesis was fabricated. The patient was satisfied with the final result and reported an improvement in her esthetic and functional outcomes.
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). 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°).
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 permanent 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
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 or-
thodontic treatment might shorten the total treatment
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

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**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.
be achieved. However, the placement of 7 implants (both Korea) was implanted at the distal alveolus of be expensive and would involve considerable surgical in the mandibular right premolar, and molar mesial- vasion. Therefore, we planned to mesialize both the alignment was started with elastomeric chains (B). maxillary and mandibular molars to reduce the spaces. 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 iscanine with a horizontal guided bone regeneration (shown in Figure 4). Three deciduous second molars (A-F). At the left canine region, a sinus lift procedure and were extracted, and 0.022-in slot preadjusted edgewise horizontal guided bone regeneration were performed appliances were placed in both arches. After leveling simultaneously in the next month. Five and 7 months and alignment with nickel-titanium archwires, space after the implantation, subepithelial connected tissue gaining for the left lateral incisor and correction of the graftings were performed on the labial side of both maxil- deviated midline were started with a stainless steel archary fixtures (Fig 6 G-K), and screw-retained temporary prostheses were delivered in the next month. Then, mesial wire in the mandibular arch.

After the midline correction, a miniscrew (diameter movement of the maxillary right molars was started using 1.3 mm; length, 7 mm; Absoanchor; Dentos, Daegu, the implant as absolute anchorage (Fig 6 D).
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
A 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. 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.
Meanwhile, our patient did not have enough bone mass missing premolars were completely closed without and quality in the edentulous areas for implantation because of the congenital absence of the canines, and the interincisal relationship. bone augmentation was required. Therefore, we chose Careful treatment planning is required for the place- the submerged technique to perform a sinus liftment of a dental implant during active orthodontic procedure and horizontal guided bone regeneration treatment because it will never move once it is im- simultaneously, and the implants were used asplanted. In this patient, planning of the maxillary orthodontic anchorage after their healing period. implant position was relatively easy because the maxil- 

In the mandible, after extraction of the deciduous incisor position at pretreatment did not have to be molar, reciprocal tooth movements of first premolar changed anteroposteriorly. In the mandible, premolars and molars were started to gain the space for molar was placed during active treatment to reduce the total plantation and to correct the deviated midline treatment period. However, it complicated the treatment. Following the coincidence of midline, a miniscrew was the finishing and detailing phase because the mandib- placed at the distal alveolus of the right premolar and was unstable during active orthodontic was used for the mesial molar movement. As a result 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 11. Three-year postretention facial and intraoral photographs.
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. 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. Wehrbein et al 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. 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.

REFERENCES