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Interdisciplinary treatment of a patient with multiple missing teeth and periodontitis

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A 49-year-old woman with several missing and periodontically compromised teeth was referred to the orthodontic department of National Health Insurance Service Ilsan Hospital by the periodontic department for interdisciplinary treatment. Multiple posterior teeth had been extracted 10 days earlier. Her chief complaint was crowding of the anterior teeth, and she wanted to improve both esthetics and function. Orthodontic, periodontic, and prosthodontic treatments were undertaken in the proper timing and sequence with an interdisciplinary approach. As a result, improved periodontal health and a stable occlusion and vertical dimension were achieved. Although there were limited teeth and alveolar bone for anchorage, good esthetic and functional treatment results were obtained through the application of temporary anchorage devices and proper biomechanics. (Am J Orthod Dentofacial Orthop 2018;153:278-89)

Recently, the numbers of adult patients requiring comprehensive orthodontic treatment have increased. Many patients have some missing teeth and others that are periodontically compromised. An interdisciplinary approach is needed to restore the occlusion for these patients. If associated with the periodontal tissues, when periodontic treatment is completed before orthodontic treatment and oral hygiene is well-controlled, periodontal support can achieve tooth movement without compromising the situation.[1,2] Also, the orthodontic movement of teeth can improve their level of attachment.[3-7]

In patients with many missing teeth, anchorage sites might not be available, and tooth movements such as distalization, retraction of anterior teeth, and intrusion are challenging. However, temporary anchorage devices (TADs) can be used for the anchorage of those types of tooth movements even in edentulous areas with a limited amount of alveolar bone support.[8,9] Although the procedure is challenging with conventional mechanics, the desired tooth movements can be obtained through the application of proper biomechanics with TADs.

In patients with missing posterior teeth, the vertical dimension should also be considered. When implantation is planned, the early placement of implants restored with temporary crowns can support or increase the vertical dimension during the orthodontic treatment.[10,11]

This case report describes the interdisciplinary approach to treat a partially edentulous patient with periodontitis. The report focuses on the consideration of the treatment plan and sequence for a patient with multiple missing teeth and periodontitis, the improved periodontal health after orthodontic treatment with strict periodontic control and oral hygiene instructions, the support of the vertical dimension with dental implants during the orthodontic treatment, and the application of goal-oriented biomechanics with TADs.

ETIOLOGY AND DIAGNOSIS

A 49-year old woman with several missing and periodontically compromised teeth was referred to the orthodontic department of National Health Insurance Service Ilsan Hospital by the periodontic department for interdisciplinary treatment. She had multiple missing teeth in the posterior area that had been extracted 10 days previously. Her chief complaint was crowding of the anterior teeth, and she wanted to

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Fig 1. Pretreatment facial and intraoral photographs.

improve both esthetics and function. Her medical history was noncontributory, and she had no signs of temporomandibular joint disorder. The extraoral examination showed facial symmetry, incompetent lips at rest, an acute nasolabial angle, and protruded lips. Her mandibular dental midline had shifted to the left of the facial midline (Fig 1).

Intraorally, due to periodontitis, her maxillary right first and second premolars, maxillary right first and second molars, maxillary left first and second molars, and mandibular right first molar were missing. Periodontal probing showed deep pockets in the molar areas and the mandibular left lateral incisor area, as well as bleeding (Table I). There was crowding of the maxillary and mandibular anterior teeth and a crossbite of the left lateral incisors, with overeruption of the mandibular left lateral incisor. Overjet was 5 mm, and the maxillary incisors were labially tilted. In the maxillary arch, the canines and premolars were mesially tilted, and the right canine was overerupted. Moreover, the mandibular right second molar was mesially tilted. The canines were in a Class I relationship, but the molar relationship could not be evaluated (Figs 1 and 2).

The panoramic radiograph showed overall decreased support of the alveolar bone and extensive bone loss of the mandibular left lateral incisor. The cephalometric analysis indicated a skeletal Class I relationship with a normal vertical facial type, labioversion of the maxillary incisors, and a protruded upper lip in relation to Rickett's E-line (Figs 3 and 4; Table II). The patient was diagnosed with a skeletal Class I malocclusion, with chronic generalized moderate periodontitis and multiple missing teeth.

TREATMENT OBJECTIVES

The overall treatment objectives were to treat the periodontal disease, rehabilitate the posterior occlusion, and improve the patient's smile esthetics. The orthodontic objectives were to alleviate the crowding in the maxillary and mandibular anterior regions, upright the mandibular

Table I. Initial pocket depth and bleeding on probing (mm) (Fédération Dentaire Internationale tooth numbers)

Maxillary teeth	*17*	*16*	*15*	*14*	*13*	*12*	*11*	*21*	*22*	*23*	*24*	*25*	*26*	*27*
Pocket depth (buccal)	779	777	799	996	534	335	444	435	444	333	333	333		777
Bleeding on probing	***	***	***	***	**	**	**	**	***	**	*	**		***
Pocket depth (lingual)	999	999	999	996	865	555	534	445	444	332	323	223		777
Bleeding on probing	***	***	***	***	**	**	***	***	***	**	**	**		***
Mandibular teeth	*47*	*46*	*45*	*44*	*43*	*42*	*41*	*31*	*32*	*33*	*34*	*35*	*36*	*37*
Pocket depth (buccal)	557		544	333	333	333	333	333	467	644	433	444	336	755
Bleeding on probing	***		**	**	*	***	***	***	***	*	*	**	***	***
Pocket depth (lingual)	757		644	333	333	333	333	334	469	654	333	333	334	665
Bleeding on probing	***		**	**	**	***	***	***	***	**	**	*	***	***

The asterisks indicate bleeding on probing.

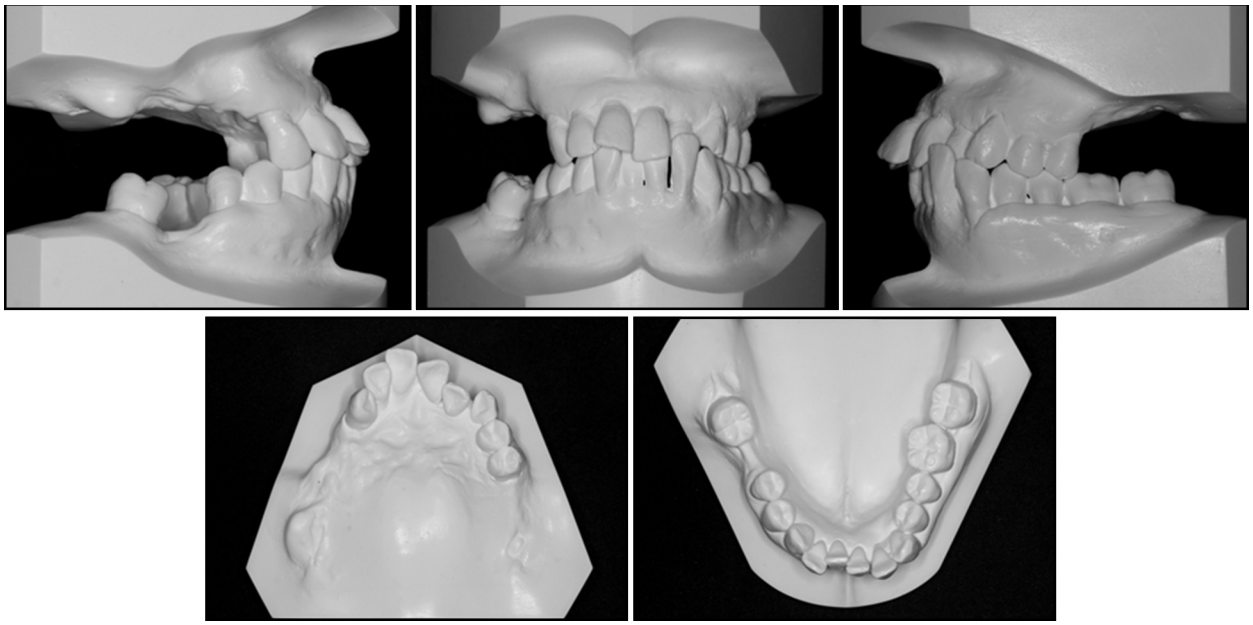

Fig 2. Pretreatment dental casts.

right second molar, correct the crossbite of the left lateral incisors, and establish proper overjet with torque control of the labially tilted maxillary incisors.

TREATMENT ALTERNATIVES

Since the patient's chief complaint was crowding of the anterior teeth, we considered alignment of the maxillary and mandibular anterior teeth with adjunctive orthodontic treatment to upright the mandibular right second molar. However, it was expected that the anterior teeth would become more labially tilted, because aligning them would worsen the torque of the maxillary anterior teeth and the lateral profile. It has been reported that labial movement of a tooth is related to gingival recession, whereas lingual movement increases the width of the labial gingiva and induces incisal migration of the gingival margin.[12] Moreover, the prognosis for the mandibular left lateral incisor was too poor to apply orthodontic force.

For the rehabilitation of the patient's occlusion, comprehensive orthodontic treatment was planned. We considered extraction of the mandibular lateral incisor with a poor prognosis and space closure. Distalization of the maxillary dentition was also planned to improve overjet, the torque of the anterior teeth, and the mesially tilted premolars and canine. Intrusion of the maxillary right canine and uprighting of the mandibular right second molar were also planned. The treatment options were discussed, and the patient decided to have comprehensive orthodontic treatment to improve the esthetics and function of her dentition.

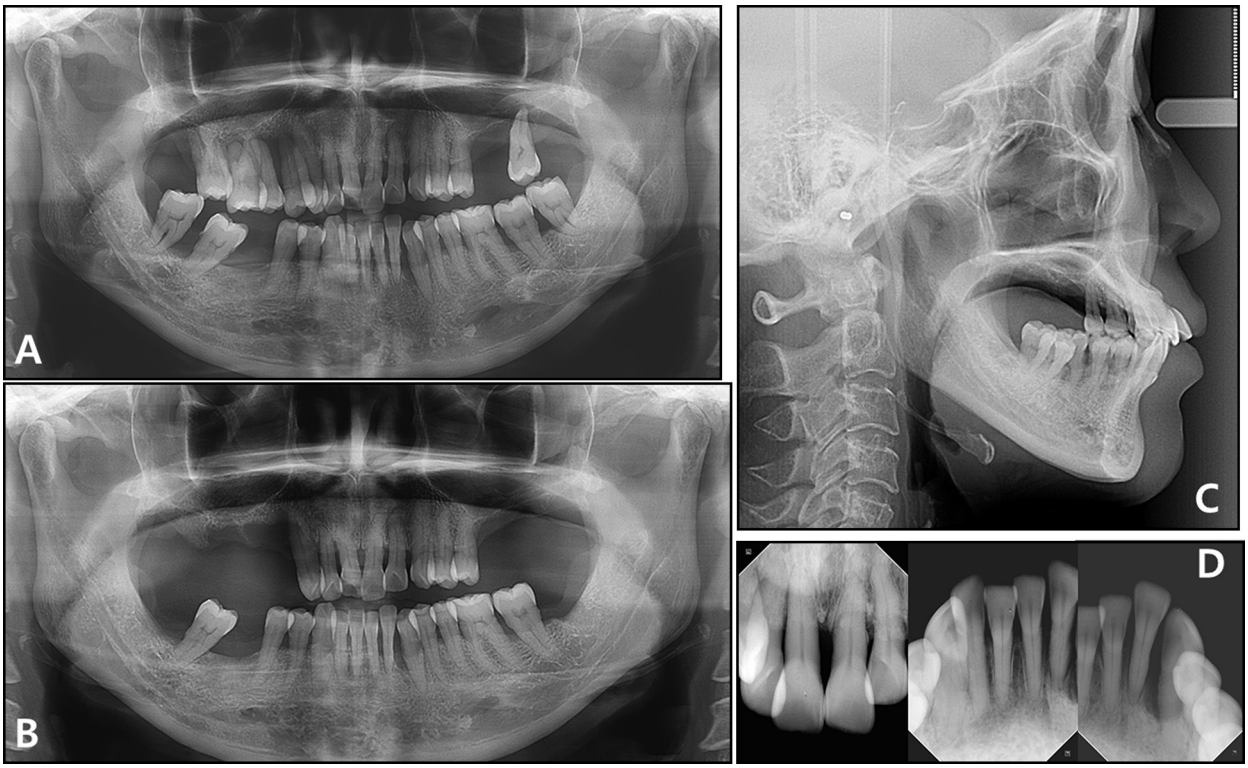

Fig 3. Pretreatment radiographs: **A,** panoramic radiograph before periodontic treatment; **B,** panoramic radiograph after periodontic treatment; **C,** lateral cephalogram; **D,** periapical radiographs.

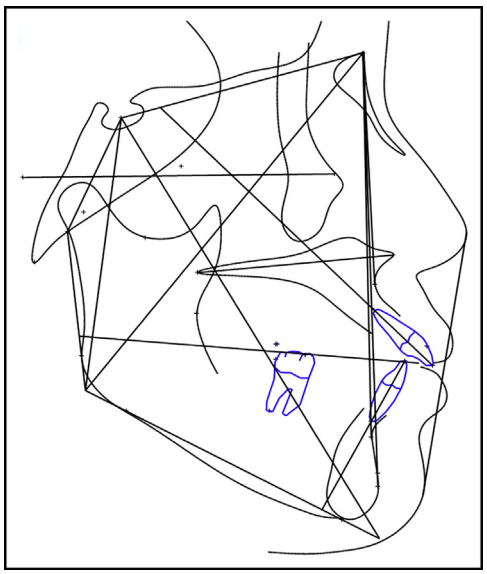

Fig 4. Pretreatment cephalometric tracing.

Table II. Cephalometric analysis before and after treatment

Measurement	*Norm*	*Pretreatment*	*Posttreatment*
Hard tissue			
SNA angle (°)	81.6	76.9	76.9
SNB angle (°)	79.1	75.3	74.9
ANB angle (°)	2.4	1.9	1.9
Wits appraisal (mm)	−2.7	−2.4	−2.6
SN to mandibular plane (°)	33.3	42.9	42.5
Bjork sum (°)	393.3	403.9	403.6
Gonial angle (°)	126.0	123.1	123.2
Mandibular body length (mm)	78.1	76.5	77.0
U1 to SN (°)	107.0	120.5	110.7
IMPA (°)	95.9	90.8	90.8
Anterior facial height (mm)	128.9	129.8	129.5
Posterior facial height (mm)	85.0	76.2	76.4
Soft tissue			
Upper lip to Ricketts' E-line (mm)	−1.0	1.2	−1.5
Lower lip to Ricketts' E-line (mm)	1.0	1.9	1.0

TREATMENT PROGRESS

After the diagnostic setup was completed, a stable occlusion after treatment was confirmed (Fig 5). Before proceeding to the treatment, the treatment plan and sequence needed to be confirmed through a multidisciplinary approach involving orthodontics, periodontics, and prosthodontics (Fig 6). Periodontic treatment

Fig 5. Diagnostic setup for the treatment plan.

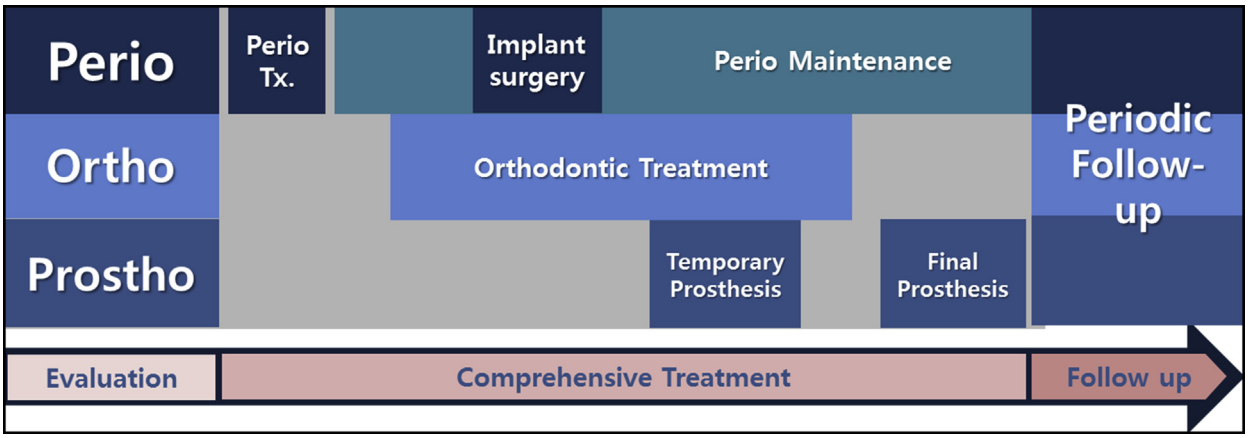

Fig 6. Treatment plan and sequence of multidisciplinary approach with orthodontics, periodontics, and prosthodontics.

should be completed before orthodontic treatment. The periodontic disease was treated with full-mouth scaling, curettage of the maxillary and mandibular anterior regions, and a flap operation in the mandibular left posterior region. After a resting period of 3 months, pocket depth reduction had been achieved at almost every site, and there was little bleeding on probing (Table III). The inflammation was controlled, and orthodontic treatment was initiated. Periodic periodontic maintenance visits were scheduled during the orthodontic treatment.

The mandibular left lateral incisor was extracted, and the mandibular and maxillary teeth were bonded with 0.022-in Clippy-C appliances (Tomy, Tokyo, Japan), except for the 4 anterior teeth. Molar tubes were bonded onto the mandibular molars. The alignment started with a 0.014-in nickel-titanium archwire, followed by a 0.016-in nickel-titanium archwire. A pontic was placed in the extracted mandibular left lateral incisor space for esthetics. To prevent round tripping of the teeth, the 4 maxillary anterior teeth were bypassed so as to be aligned after distalization of the canines. Two TADs (Orlus, Ortholution, Seoul, Korea) were placed on the palate, and hooks were attached. A small section of 0.016-in stainless steel archwire was placed on the maxillary left canine and

Table III. Preorthodontic treatment pocket depth and bleeding on probing (mm) (Fédération Dentaire Internationale tooth numbers)

Maxillary teeth	*17*	*16*	*15*	*14*	*13*	*12*	*11*	*21*	*22*	*23*	*24*	*25*	*26*	*27*
Pocket depth (buccal)					533	334	444	435	433	333	333	333		
Bleeding on probing					*						*			
Pocket depth (lingual)					743	444	433	445	444	332	323	223		
Bleeding on probing												*		
Mandibular teeth	*47*	*46*	*45*	*44*	*43*	*42*	*41*	*31*	*32*	*33*	*34*	*35*	*36*	*37*
Pocket depth (buccal)	445		544	333	333	333	333	333	466	644	433	444	345	645
Bleeding on probing			*									*		
Pocket depth (lingual)	655		643	333	333	333	333	334	468	644	333	333	334	655
Bleeding on probing	*						*							

The asterisks indicate bleeding on probing.

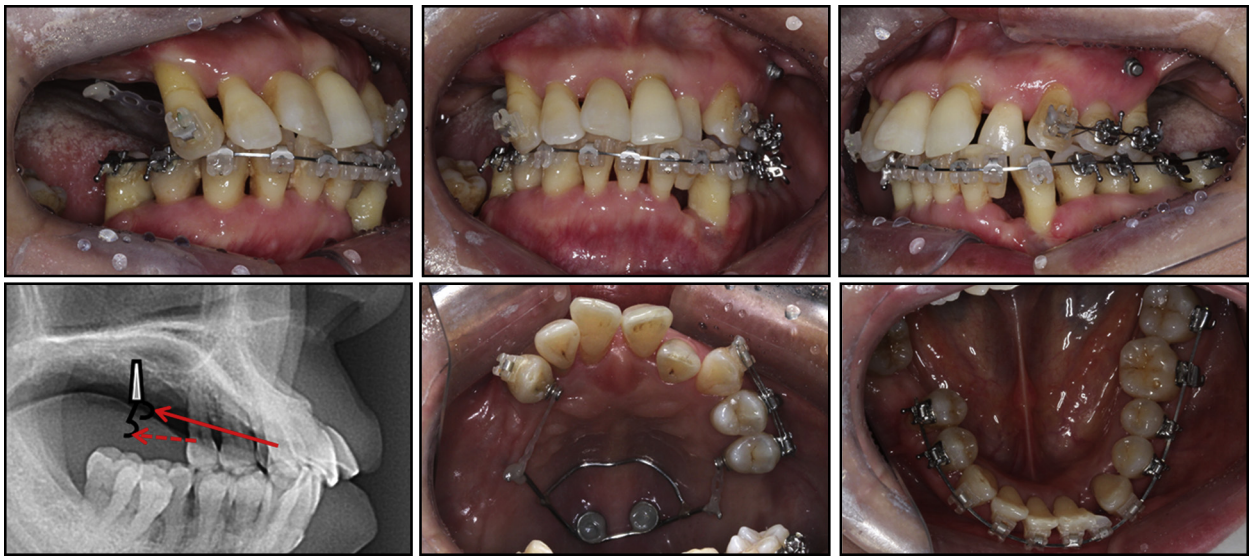

Fig 7. Distalization of the maxillary teeth with TADs. Two hooks were attached to the TADs for differential vectors.

premolars, and the maxillary canines and left premolars were distalized with hooks attached to the palate. For the mesially tipped and overerupted maxillary right canine, controlled distal tipping and intrusion of the tooth were required. Differential vectors were applied on both sides with 2 hooks, so that intrusion of the right canine was expected (Fig 7). After distalization of the maxillary canines, the 4 maxillary anterior teeth were aligned with a 0.014-in nickel-titanium archwire. Progressively stiffer archwires were placed, until 0.017 × 0.025-in stainless steel archwires were placed in both arches. The mandibular anterior space was then closed, and the full dentition of the maxilla was distalized with the same mechanics as before to obtain proper overjet and overbite. Moreover, an uprighting spring with a 0.017 × 0.025-in beta-titanium wire was applied to the mandibular right second molar. As the uprighting spring was engaged onto the main archwire, intrusion of the premolar, extrusion of the second molar, buccal inclination of the premolar, and lingual inclination of the second molar were induced to correct the arch form (Fig 8).

Because the patient had multiple missing posterior teeth, the loss of the vertical dimension was considered. However, she had visited the orthodontic department right after the extraction of the posterior teeth; she had occluding natural left premolars, and there was no anterior occlusal wear. Therefore, it was determined that the vertical dimension would be maintained. During the orthodontic treatment, dental implants were placed at the sites of the maxillary posterior teeth and the mandibular right first molar (Fig 9). After a 3-

Fig 8. Uprighting spring of the mandibular second molar engaged on the main archwire.

Fig 9. Distalization of the maxillary teeth, correction of the inclination of the mandibular left molars, and placement of implants.

month period of osseointegration, the implants were restored with temporary crowns to support the vertical dimension.

After the patient's adaptation to the vertical dimension and the occlusion were confirmed, the appliances were removed (Fig 10). The active treatment time was 17 months. The teeth were immediately retained with fixed bonded retainers from premolar to premolar on the mandibular teeth, and from premolar to temporary crown on the premolar on the maxillary teeth. Moreover, vacuum-formed retainers were applied to both arches. The patient was referred to the prosthodontist for further restorative procedures and to the periodontist for maintenance and follow-up. After confirming her stable occlusion and adaptation, the final prostheses were applied.

TREATMENT RESULTS

At the end of the treatment, good alignment of the anterior teeth, a Class I canine relationship, and

Fig 10. Posttreatment facial and intraoral photographs (implants restored with temporary crowns).

adequate overjet and overbite had been achieved through the extraction of the mandibular lateral incisor, space closure, and distalization of the maxillary dentition. The patient's lateral profile was improved, and her lip incompetence was relieved. The mandibular right second molar was uprighted, and the posterior teeth were restored with a stable occlusion (Figs 10 and 11). The periodontal treatment and control of the periodontal disease resulted in stable pocket depths, and there was no bleeding on probing.

The posttreatment panoramic radiograph showed no significant bone loss compared with the initial values. The maxillary canine was intruded and distalized, resulting in improved bone level of the canine in the periapical view. There were severe alveolar bone loss around the extracted mandibular lateral incisor and an infrabony defect caused by the periodontal disease on the mesial side of the canine. During the space closure, the mandibular central incisor and canine had been moved toward the defect area, and the defect around the lateral incisor had been recovered (Fig 12). Moreover, the gingival recession on the canine was clinically improved (Fig 13).

The posttreatment cephalometric analysis showed improved inclination of the maxillary incisors and lip position to the E-line (Table II). Superimposition of the pretreatment and posttreatment cephalometric tracings showed posterior movements of the maxillary and mandibular incisors with intrusion of the maxillary incisors. The vertical dimension was maintained after the interdisciplinary orthodontic treatment. The superimposition of 3-dimensional casts showed a distalized maxillary dentition, retracted mandibular anterior teeth, and an intruded maxillary right canine (Fig 14).

DISCUSSION

Many studies have reported that under absolute control of the inflammation and bacterial biofilms,

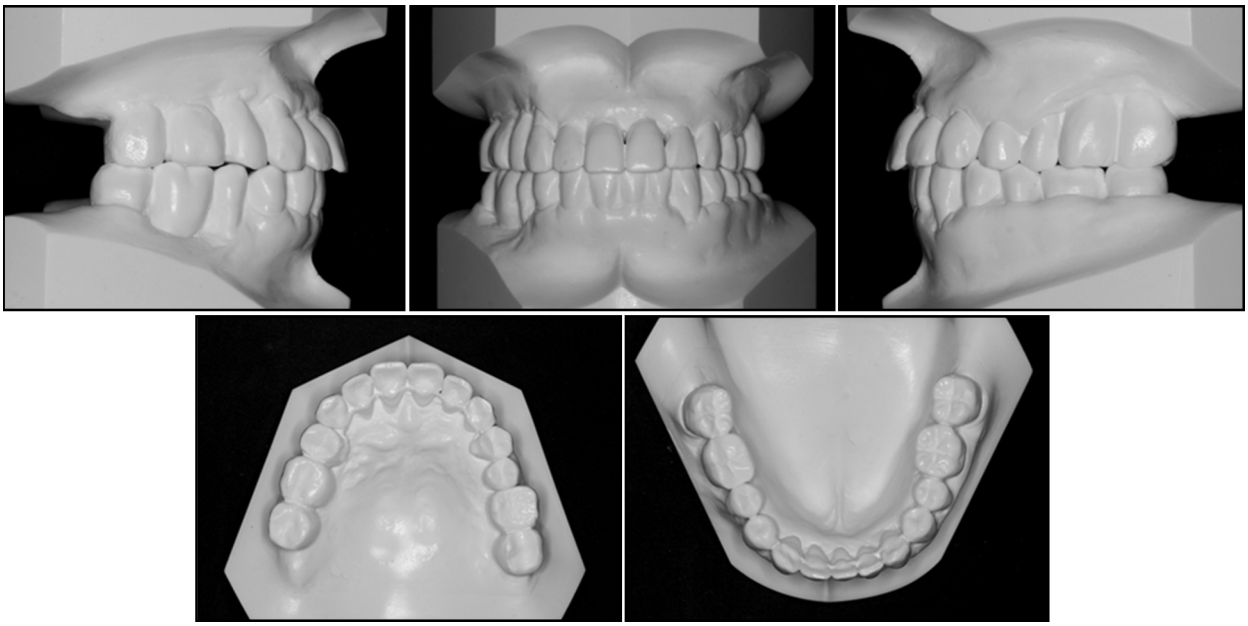

Fig 11. Postreatment dental casts.

intrusion of the teeth can considerably improve the level of attachment,[3,4] and the orthodontic moving of teeth into infrabony defects might modify the defects by changing their morphology, reduce their probing depth, and resolve the radiologic bone defect.[5-7] Intrusion should be performed with light forces (10-20 g per tooth), and the line of action of the force should pass near the center of resistance to prevent tilting of the tooth. In our patient, the maxillary right canine was mesially tilted and overerupted before treatment. Although there was no tooth for anchorage in the posterior area, by applying proper mechanics with TADs, the canine was intruded with improved angulation. A significantly improved radiologic bone level of 3.5 mm was found from the periapical radiographs before and after treatment (Fig 15), and the pocket depths were decreased clinically (Table IV). Moreover, the intrusive component of the force had induced intrusion of the maxillary incisors during the distalization, and an improved alveolar bone level was seen on the periapical radiographs. Meanwhile, if the implant was first positioned in molar area, this mechanic can be controlled by using provisional restoration of the implant as anchorage. The advantage of this approach was that it addressed the patient's chief complaint, which was to reestablish occlusion and esthetics by reversing the flaring of the maxillary anterior teeth and replacing the missing posterior teeth for occluding with minimal surgical intervention.[13] But when intrusive force was applied, it was unfavorable to apply the vertical force vector on the line of force. It took much time to complete the total treatment, and the provisional restoration could be broken during the orthodontic treatment.[13]

Orthodontic tooth movement into an infrabony defect has been reported to modify the defect's morphology, reduce its probing depth, and resolve the bony defect.[6] Furthermore, enhanced bone healing has been shown to occur in periodontal defects after orthodontic movement.[7] In our patient, full-mouth scaling and curettage of the mandibular anterior region were performed 3 months before the orthodontic treatment. The mandibular left lateral incisor with a poor prognosis was extracted, and there was severe bone loss. The mandibular left central incisor and canine were moved toward the defect area, the alveolar bone moved with the teeth, and the defect around the lateral incisor was recovered. The mandibular left canine had an infrabony defect, but the shape and size of the defect became more favorable without bone loss (Fig 13). Alveolar bone created through orthodontic tooth movement may be expected to remain stable.[14]

The mandibular right second molar was uprighted with proper angulation for the implantation and prosthesis of the mandibular right first molar. Bone leveling of the infrabony defect has been reported after uprighting,[15] and it has been found that changes in the alveolar bone height mesial to uprighted molars were not different from changes mesial to control teeth.[16] The

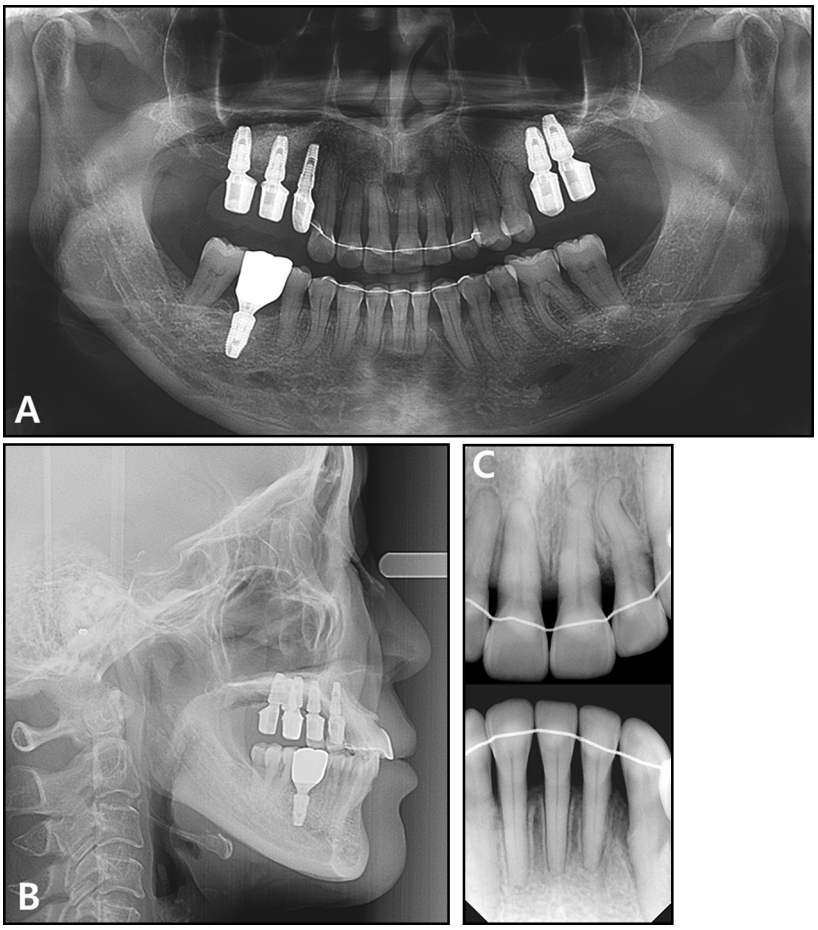

Fig 12. Postreatment radiographs: **A,** panoramic radiograph; **B,** lateral cephalogram; **C,** periapical radiographs.

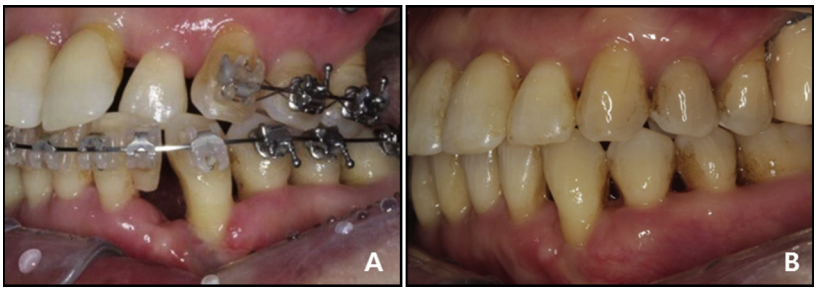

Fig 13. Change of the mesial defect in the mandibular left canine: **A,** during treatment; **B,** after treatment.

patient also showed a constant height from the cementoenamel junction to the alveolar bone before and after treatment.

If the patient's vertical dimension is definitely decreased, therapeutic alteration of the vertical dimension of the occlusion is needed. Removable prostheses or fixed transitional crowns can be used to increase the vertical dimension of the occlusion.[10] However, the decrease of the vertical dimension is mainly found in completely edentulous patients. A study comparing patients with a complete dental arch and a short dental arch found that both groups

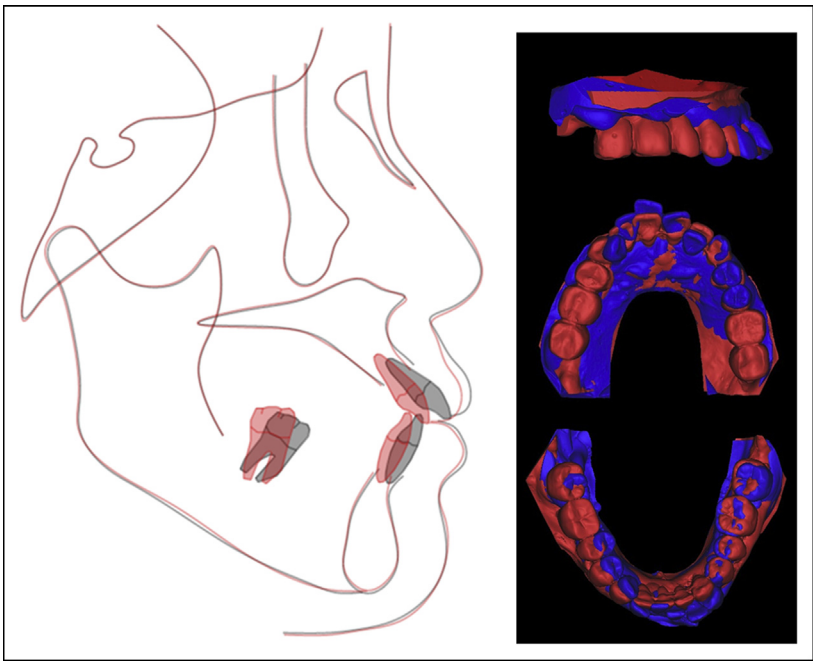

Fig 14. Cephalometric and 3-dimensional cast superimpositions.

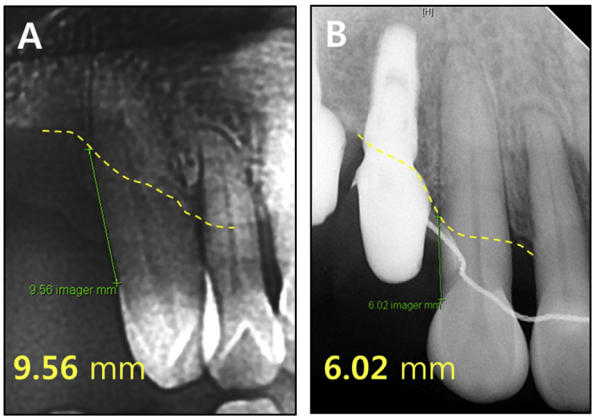

Fig 15. Radiologic bone level of the maxillary right canine: **A,** before treatment; **B,** after treatment.

exhibited similar overbite and occlusal tooth wear.[17] According to Dawson,[18] the vertical dimension of patients with occluding natural teeth should be maintained as the vertical dimension of the maximum intercuspation position. Since there was no sign of decreased vertical dimension and the patient had occluding natural teeth, the vertical dimension was maintained.

During the orthodontic treatment, implants were placed, and temporary crowns were applied to support the vertical dimension and achieve bilateral occlusal stability. The location of the implant was discussed by the orthodontist, the periodontist, and the prosthodontist. A diagnostic setup was essential for this (Fig 5). It is important to plan the orthodontic treatment in a realistic manner with a diagnostic setup to prevent compromising circumstances at the end of orthodontic treatment.[19] The final locations of the teeth were determined by the diagnostic setup; based on this, the final location of the implants could be determined. Since a stable occlusion was confirmed and the patient was comfortable with the newly established occlusion, the final prosthesis could be delivered. For the retention of patients with tooth loss, prosthetic reconstruction should be accomplished to prevent occlusal trauma, progressive mobility, migration, or pain on function.[12] Because this patient underwent implantation and prosthetic treatment before the end of the orthodontic treatment, it might be helpful for the retention and stability of the treatment results.

CONCLUSIONS

This case report shows the successful comprehensive treatment of a patient with multiple missing teeth and periodontitis. The periodontic and prosthodontic treatments were undertaken in the proper timing and sequence with an interdisciplinary approach. As a result, improved periodontal health and a stable occlusion and

Table IV. Postorthodontic treatment pocket depth and bleeding on probing (mm) (Fédération Dentaire Internationale tooth numbers)

Maxillary teeth	*17*	*16*	*15*	*14*	*13*	*12*	*11*	*21*	*22*	*23*	*24*	*25*	*26*	*27*
Pocket depth (buccal)					433	333	333	335	333	333	333	333		
Bleeding on probing								**						
Pocket depth (lingual)					544	444	433	335	333	332	323	223		
Bleeding on probing					*		*				*	**		
Mandibular teeth	*47*	*46*	*45*	*44*	*43*	*42*	*41*	*31*	*32*	*33*	*34*	*35*	*36*	*37*
Pocket depth (buccal)	444		433	333	333	333	333	333		533	333	333	344	545
Bleeding on probing	**		*							*			*	*
Pocket depth (lingual)	454		443	333	333	333	333	334		533	333	333	334	544
Bleeding on probing						*	*	*		*				**

The asterisks indicate bleeding on probing.

vertical dimension were achieved after the orthodontic treatment. Although there were limited teeth and alveolar bone for anchorage, esthetic and functional treatment results were obtained through the application of TADs and proper biomechanics.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.ajodo.2016.10.043.

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