Comprehensive periodontal/orthodontic treatment of bimaxillary dentoalveolar protrusion caused by posterior bite collapse due to periodontal disease

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Background: Increased mobility of teeth in adult patients with advanced periodontal disease causes posterior bite collapse, which is characterised by mesial inclination of the molars and vertical dimension loss, often resulting in bimaxillary dentoalveolar protrusion.
Aim: A case is reported of successful comprehensive periodontal/orthodontic treatment of a 51-year-old woman presenting with bimaxillary dentoalveolar protrusion accompanied by severe crowding in the mandibular arch and flaring of the maxillary anterior teeth as a result of posterior bite collapse due to periodontal disease.
Method: Miniplates and fixed appliances were used to upright the mandibular molars and create space for the retraction of the anterior teeth. Prior to orthodontic treatment, the patient underwent periodontal therapy to create a healthy oral environment. The treatment outcomes, including the periodontal condition, were stable 24 months after the conclusion of active orthodontic care.
Results and conclusion: The outcome demonstrates that anchorage control with miniplates is advantageous for the treatment of bimaxillary dentoalveolar protrusion and posterior bite collapse due to periodontal disease.
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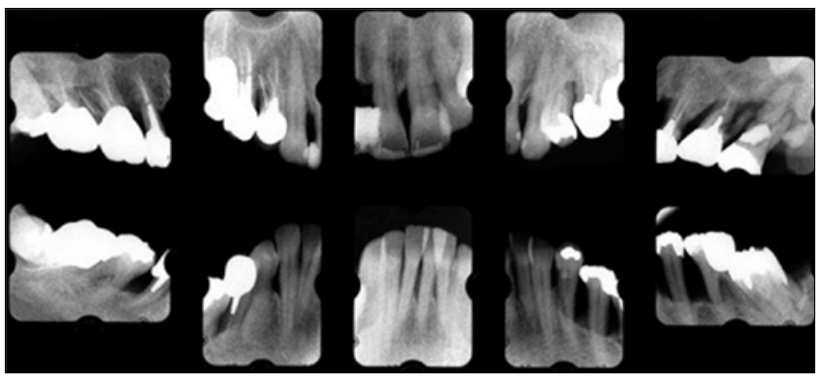
Introduction

An increasing number of adults present for orthodontic treatment and many have underlying periodontal problems.[1] A previous study revealed that the orthodontic movement of teeth into infra-bony pockets may enhance the rate of destruction of the connective tissue attachment if inflammation is present.[2] Additional studies have shown that patients with periodontal disease can be treated orthodontically after periodontal inflammation has been eliminated and the ability to maintain a healthy oral environment has been demonstrated.[3-5] However, orthodontic treatment may be challenging in patients with significant periodontal problems, and treatment should be performed using a comprehensive team approach.[6] Excellent maintenance of oral hygiene at home and through visits to dental professionals is important during and after active orthodontic care.[7]

Increased mobility of teeth in adult patients with advanced periodontal disease, characterised by severe attachment loss and reduction of alveolar bone support, causes mesial inclination of the molars, the loss of vertical dimension, through posterior bite

A

B



C

Mobility 1)	1	0	0	0	0		1		1	0	0	0	0	2	3	
Furcation 2)	B: I	B: II M: II	B: I D: I											B→D: III		
Buccal: PPD/BoP	④③⑤	④④⑤	⑤④④	5 3 4	④④③	4 3 4	4 3 4	4 3 ⑤	5 3 4	3 3 5	3 2 3	4 4 ⑤	⑤ 3 4	⑤⑤⑤	⑤④⑤	
Upper	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	
Lingual: PPD/BoP	④③⑤	④⑤⑤	④④⑤	④④④	④④③	④③③	4 3 ④	④ 3 ④	6 3 4	⑤④④	⑤②③	④③③	④ 2 ④	⑤ 4 ④	⑤④④	
Lingual: PPD/BoP	6 4 6	5 4 5	5 3 4	5 3 5	4 4 ③	4 2 3	3 2 3	3 2 3	4 2 4	4 2 3	3 2 3	4 3 4	4 4 4	4 4 4	④ 4 4	
Lower	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	
Buccal: PPD/BoP	④③③	④④④	④⑤④	4 3 4	4 2 ④	4 2 ③	3 2 3	4 2 4	④ 3 4	4 3 4	3 2 3	4 ③ ④	4 3 ⑤	4 ⑤ 4	⑦ 3 ⑤	
Furcation 2)																
Mobility 1)	1	0	0	1	0	0	0	1	1	1	0	0	1	1	0	

PCR: 38.6%, PPD≧ 4mm: 67.8%, PPD≧ 6mm: 20%, BoP(+): 41.7%, BoP: ○

Figure 1. Initial examination. A: Intraoral Photographs. Front and side views of the dentitions. B: Periapical radiographs. C: Periodontal chart. 1) According to the classification by Miller (1964), 2) According to the classification by Hamp et al. (1975). PPD: Probing Pocket Depth, BoP: Bleeding on Probing.

collapse, which secondarily results in bimaxillary dentoalveolar protrusion with labial inclination of the maxillary incisors.[8] In these cases, treatment ideally involves the orthodontic repositioning of teeth (uprighting of molars) in addition to the management of the periodontal problem. Although anchorage control is important for efficient fixed appliance treatment, the attainment of optimal results in patients with advanced periodontal disease is challenging because of decreased posterior anchorage. The use of temporary anchorage devices (TADs), in the form of miniscrews[9,10] and miniplates,[11] has gained popularity because patient co-operation is not required, which enhances the ability to treat adult patients with reduced alveolar bone. TADs should facilitate the anchorage control required for the uprighting of mesially-inclined molars.

In the present case report, the comprehensive periodontal/orthodontic treatment of a patient with bimaxillary dentoalveolar protrusion, severe crowding, and flaring of the maxillary anterior teeth and posterior bite collapse due to periodontal disease, is described. Miniplates were used to upright the molars to create space for the retraction of the anterior teeth.

Diagnosis

A 51-year-old female with severe periodontal disease presented at the hospital of Health Sciences University of Hokkaido, with the chief complaints of mandibular arch crowding accompanied by flaring and excessive spacing of the maxillary anterior teeth. A periodontal examination revealed a 38.6% plaque control record (PCR: O'Leary classification[12]) and 41.7% bleeding on probing (BoP; Figure 1). Probing pocket depth (PPD) ranged from 3 to 8 mm, with PPD ≥ 4 mm at 67.8%

Figure 2. Facial and intraoral photographs at the start of the orthodontic treatments.

of all sites. Twelve teeth showed greater than Class 1 mobility (Miller classification[13]). An examination of radiographs showed moderate to severe bone loss in both arches. The clinical and radiological evaluations indicated that extraction of the distobuccal and mesiobuccal roots of the maxillary molars (trisection of teeth 16, 17, and 26), maxillary left second (tooth 27) and third (tooth 28) molars, and mandibular right third molar (tooth 48) was required.

Facial photographs indicated that the patient had a symmetrical face, with a convex profile and lip protrusion (Figure 2). An intraoral examination showed bilateral Angle Class III molar relationships, with severe crowding of the mandibular dentition and mesial inclination of all mandibular molars. Anterior spaces were observed on the mesial and distal sides of the maxillary right lateral incisor, although they were filled with resin-made fixed temporary pontics. The mandibular dental midline corresponded to the facial midline, but the maxillary dental midline deviated 3.0 mm to the left. The patient had a 4.0 mm overjet and 1.0 mm overbite.

A cephalometric assessment indicated that the mandible protruded relative to the cranial base (SNB angle, 82.2°), resulting in a skeletal Class III relationship (ANB angle, –0.63°) with a low mandibular plane angle (FMA, 21.2°; Table I). The maxillary and mandibular incisors were proclined (U1–SN, 130.7°; FMIA, 33.7°). The occlusal plane was flat (SN–OP, 7.0°).

Treatment objectives

The patient was diagnosed with a Class III malocclusion with severe crowding of the mandibular dentition, flaring of the maxillary anterior teeth, and bimaxillary dentoalveolar protrusion following posterior bite collapse due to periodontal disease. The treatment objectives were to manage the periodontal disease, stabilise the posterior vertical dimension by uprighting of the mandibular molars, reposition the maxillary and mandibular anterior teeth, and reduce the dentoalveolar protrusion to achieve satisfactory facial aesthetics. Periodontal therapy, including

Table I. Summary of cephalometric measurements.

Measurement	Norm	Pretreatment (52y 10m)	Post-treatment (55y 4m)	Two years follow up (57y 4m)
SNA	81.5	81.5	80.2	80.2
SNB	78.6	82.2	82.2	82.2
ANB	2.9	-0.7	-2.0	-2.0
FMA	28.2	21.2	21.2	21.2
U1-SN	107.1	130.7	119.6	120.3
L1-MP	92.5	125.1	114.4	116.1
FMIA	59.3	33.7	44.4	42.7
SN-OP	18.0	7.0	15.0	15.0

oral hygiene instruction, supragingival scaling, root planing with professional tooth cleaning, and surgical periodontal treatment (flap surgery and trisection), was required before the commencement of active orthodontic treatment.

Treatment alternatives

To achieve the treatment objectives, two possibilities were considered and discussed with the patient. Both plans required the patient to undergo periodontal therapy to achieve a healthy oral environment before orthodontic care. The treatment options were:

1. The extraction of four second premolars (teeth 15, 25, 35, and 45) to align the mandibular arch, retraction of the maxillary and mandibular anterior teeth to reduce the dentoalveolar and lip protrusion, and the extraction of three molars (teeth 27, 28, and 48); or
2. primarily non-extractive treatment, except for teeth 27, 28, and 48 due to severe periodontal involvement; the use of miniplates to upright the mandibular molars, thereby achieving an Angle Class I molar relationship and creating the space in the mandibular dentition for the alignment and retraction of the anterior teeth; and use of the space created in the maxillary dentition to retract the maxillary anterior teeth, thereby improving lip protrusion and the facial profile.

The patient chose the second treatment plan and provided informed consent.

Treatment progress

Before the initiation of active appliance treatment, the patient received professional periodontal therapy, including instruction in performing oral hygiene, supragingival scaling and root planing, and tooth cleaning. Periodontal flap surgery was performed, and the disto-buccal and mesio-buccal roots of the maxillary molars (trisection of teeth 16, 17, and 26), the maxillary left second and third molars, and mandibular right third molar were extracted (Figure 3). After 15 months, the PCR (3.6%), PPD (PPD ≥ 4 mm, 0%), and BoP (1.2%) values, as well as the patient's oral hygiene, had improved significantly (Figure 4) to allow active orthodontic treatment to proceed. Periodontal management continued on a monthly basis during orthodontic treatment.

Miniplates (Super Mini Anchor Plate; Dentsply-Sankin, Tokyo, Japan) were placed on the buccal surfaces of the mandibular molars under local anaesthesia using self-tapping mono-cortical screws. Pre-adjusted edgewise brackets (0.022 × 0.028 inch slots) were bonded to the mandibular posterior teeth, which were levelled and aligned with round 0.014 inch nickel-titanium segmental archwires (Figure 5A). Segmental 0.016 × 0.022 inch cobalt-chromium-nickel archwires with helical loops and reverse arms were ligated to the mandibular arch for canine retraction. The posterior segments were retracted using elastomeric chains (100 g load) and miniplate anchorage. Nickel-titanium archwire (0.016 inch) was also ligated to brackets bonded on the anterior teeth (Figure 5B). After six months of alignment, an intrusive arch of 0.016 × 0.016 inch cobalt-chromium-nickel wire was ligated and activated to depress the mandibular anterior teeth, while simultaneously, retraction of the posterior segments continued using nickel-titanium closed coil springs (100 g load; Figure 5C). Following a further six months of treatment, a pre-adjusted edgewise appliance (0.022 inch slot)

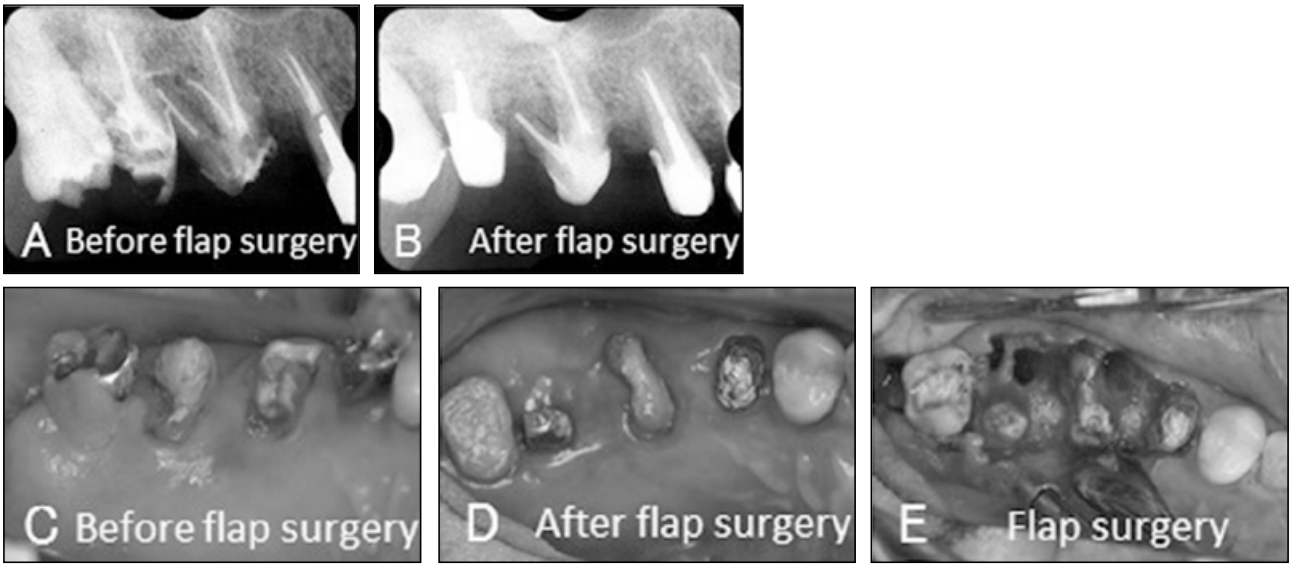


Figure 3. Periapical radiographs and clinical photographs before and after periodontal flap operation. A & C: before the surgery. E: during the surgery. B & D: after the surgery.

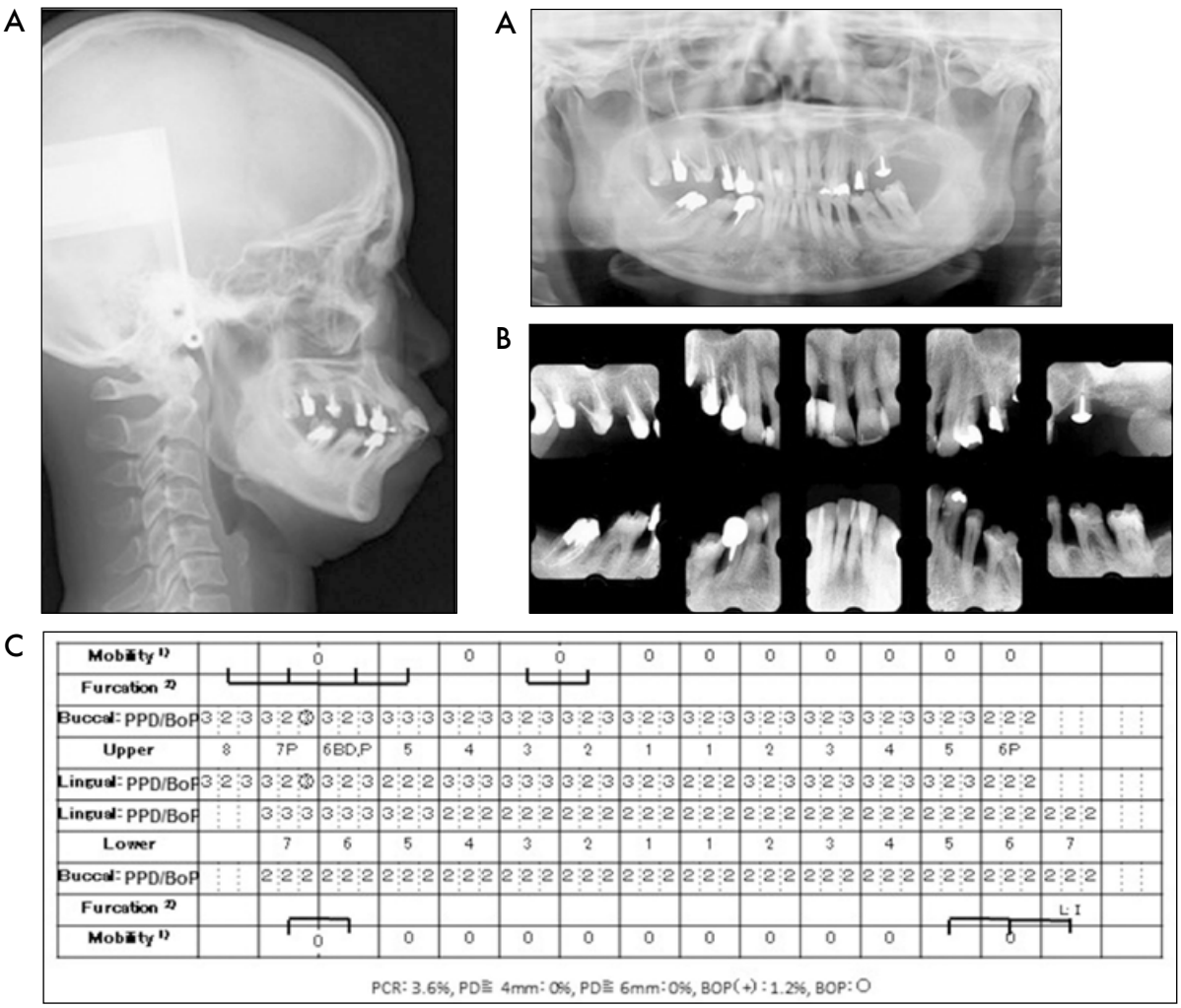


Figure 4. Clinical conditions at the start of the orthodontic treatments. A: Pantomographic and cephalometric X-ray photographs. B: Periapical radiographs. C: Periodontal chart. 1) According to the classification by Miller (1964), 2) According to the classification by Hamp et al. (1975). PPD: Probing Pocket Depth, BoP: Bleeding on Probing.

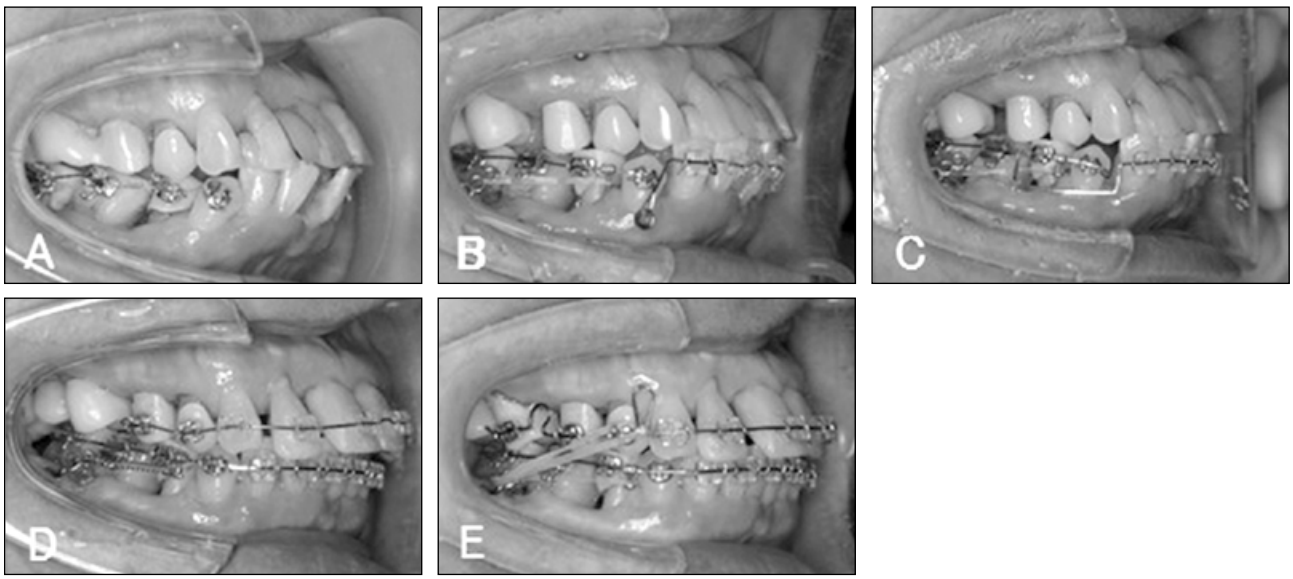


Figure 5. Intraoral photographs showing various orthodontic apparatus applied during each step of orthodontic treatment.

was bonded to the maxillary dentition, and levelling and alignment were initiated with sequential nickel-titanium wires (Figure 5D). A closing loop of 0.016 × 0.022 inch cobalt-chromium-nickel archwires was ligated in the maxillary arch for retraction of the incisors, and Class II elastics were applied between the anterior aspect of the maxillary arch and each miniplate (Figure 5E). The fixed appliances were removed after two years of treatment (Figure 6), and the patient received a maxillary 'wrap-around' retainer and mandibular bonded lingual retainer.

Treatment results

Post-treatment records indicated significant improvement of the patient's facial profile, including the correction of lip protrusion (Figure 6). The overjet and overbite were corrected, and proper bilateral canine and molar relationships and root proximity were obtained due to the successful uprighting of the mandibular molars. The dental midlines were coincident with the facial midline. Post-treatment intraoral photographs showed no increase in gingival recession. Although the bone level and PPD were maintained in most areas, BoP values indicated some relapse (Figure 7). New furcation defects were observed in the mandibular molars (teeth 36, 37, 46, and 47).

A cephalometric analysis and superimposition (Figure 8) showed that the mandibular and maxillary incisors had been retracted (by 7 and 5 mm, respectively) and retroclined (mandibular [L1–Mp], from 125° to 114°; maxillary [U1–SN], from 131° to 120°). Intrusion (3 mm) of the mandibular incisors was achieved without the extrusion of the mandibular molars which were uprighted. The mesiobuccal cusps of the mandibular first molars were moved 6 mm distally.

Two years after treatment, the patient maintained good facial aesthetics and excellent occlusal stability (Figures 9, 10 and 11). Final restorative and prosthetic treatment (teeth 14–17, 25, 26, and 44–47) was performed, with consideration of permanent retention of the mandibular dentition and continuation of periodontal management.

Discussion

The identification of soft tissue problems before treatment is important to formulate a correct treatment plan and sequence of orthodontic and periodontal therapy to enhance a patient's periodontal health.[1] The success of adult orthodontic treatment depends on periodontal preparation and the maintenance of tissue health throughout all phases of mechanotherapy.[14] Therefore, orthodontists must work co-operatively with periodontal specialists to achieve desired treatment goals. In the present case, pre-orthodontic periodontal therapy (oral hygiene instruction, supragingival scaling and root planing with professional tooth cleaning, flap

Figure 6. Facial and intraoral photographs at the end of the active orthodontic treatments.

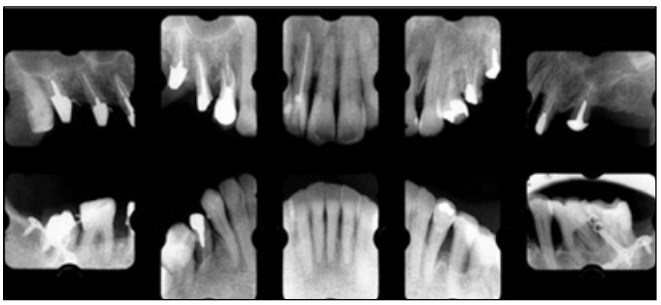
surgery, trisection and the extraction of some teeth) significantly improved the patient's periodontal condition, as reflected by improved PCR, PPD, and BoP values. After 12 months of pre-orthodontic periodontal therapy, it was determined that the patient's condition was sufficiently stable to proceed with orthodontic care. During active orthodontic treatment, bone levels and PPD were maintained in most areas, although PCR and BoP values indicated some relapse (Figure 10). The BoP status continued to improve during retention, all of which indicated the success of the periodontal management of this case.

The mesial inclination of the molars due to severe periodontal disease is often associated with a decreased vertical dimension and posterior bite collapse. It also subjects the maxillary anterior teeth to excessive occlusal force from the opposing mandibular arch, resulting in bimaxillary dentoalveolar protrusion with maxillary anterior flaring. This condition may be corrected using a fixed or removable prosthesis, with dental implant placement in appropriate cases.[8] Comprehensive periodontal/orthodontic treatment can be used to regain a proper vertical dimension by uprighting the molars, ideally with the preservation of a healthy periodontium. The restoration of the occlusal vertical dimension may cause disclusion of the anterior teeth, followed by flaring and lingual tipping of the maxillary incisors. However, sufficient anchorage is difficult to obtain in patients who have advanced periodontal disease and reduced posterior support due to multiple missing teeth. In the present case, the mandibular molars were uprighted and a Class I molar relationship was produced. In addition, the incisors were retracted using miniplate anchorage. These results confirmed the benefit of miniplates as sources of anchorage in patients with advanced periodontal disease. Concern about dentofacial aesthetics in the adult population has increased the demand for orthodontic treatment.[5] Periodontal disease often causes bimaxillary dentoalveolar protrusion and an unacceptable facial appearance due to lip protrusion. In the present case, the post-treatment result showed significant improvement of the patient's facial profile, including the correction of the lip protrusion.

A

A

B



C

Mobility 1)		0			0	0	1	1	1	1	0	0	0	0		
Furcation 2)																
Buccal: PPD/BoP	3 2 3	⊘ ⊘ 3	3 2 3	3 2 2	2 2 2	2 2 2	2 2 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 ⊘	⊘ 2 2	2 2 2		
Upper	8	7P	6P	5	4	3	2	1	1	2	3	4	5	6P		
Lingual: PPD/BoP	3 2 2	⊘ 3 2	⊘ 2 3	3 2 3	3 2 2	3 2 2	2 1 2	2 1 2	2 1 2	2 2 2	3 2 3	3 2 ⊘	3 2 3	2 2 2		
Lingual: PPD/BoP		3 3 3	3 3 ⊘	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	3 2 3	3 2 3	3 2 3	3 3 3	
Lower		7	6	5	4	3	2	1	1	2	3	4	5	6	7	
Buccal: PPD/BoP		⊘ 3 ⊘	⊘ 3 ⊘	3 2 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 2 2	3 2 3	2 2 3	3 2 3	
Furcation 1)		⊔	⊔											⊔ I	⊔ I	
Mobility 2)		0	1	1	0			0				0	0	0	0	

PCR: 8.9%, PD≧ 4mm: 0%, PD≧ 6mm: 0%, BOP(+): 6.5%, BOP: ○

Figure 7. Clinical conditions at the end of the active orthodontic treatments. A: Pantomographic and cephalometric X-ray photographs. B: Periapical radiographs. C: Periodontal chart. 1) According to the classification by Miller (1964), 2) According to the classification by Hamp et al. (1975). PPD: Probing Pocket Depth, BoP: Bleeding on Probing.

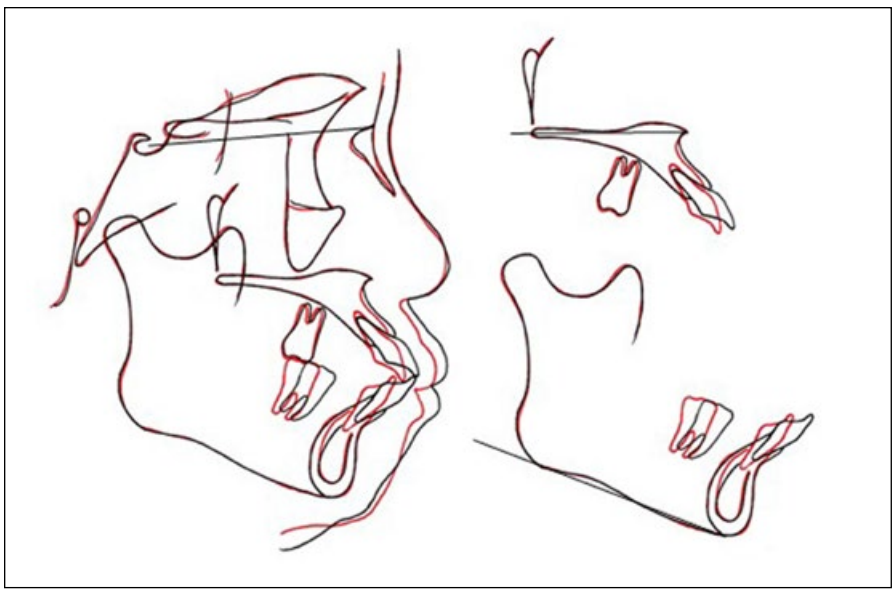


Figure 8. Superimposed lateral cephalometric tracings: pretreatment, black line; post-treatment, red line.

Figure 9. Facial and intraoral photographs at the two-year post-retention.

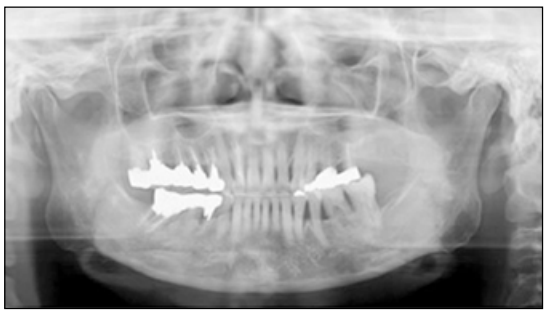
Previous studies[3,4] have shown that orthodontic force and tooth movement do not damage periodontal tissues when good oral hygiene is present, whereas orthodontic force on unhealthy teeth with periodontal inflammation may produce further rapid tissue breakdown, including root resorption, pocket deepening, and attachment loss.[2] In the present case, active orthodontic treatment was initiated only after a healthy periodontal condition was achieved and maintained throughout treatment. The mandibular incisors were retracted (7 mm), and significant dental intrusion (3 mm) was achieved. The intrusive orthodontic force did not negatively affect PPD or BoP, or produce periodontal tissue breakdown (e.g., attachment loss and root resorption). These treatment results confirm the findings of previous studies that orthodontic tooth movement does not affect periodontal tissues when good oral hygiene is maintained.

Conclusions

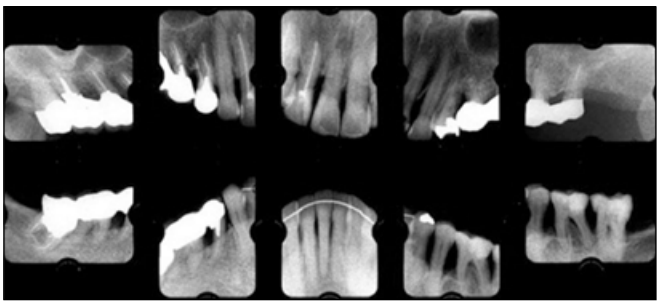
An adult case was presented with bimaxillary dentoalveolar protrusion, severe crowding in the mandibular arch, flaring of the maxillary anterior teeth and posterior bite collapse due to periodontal disease. The comprehensive periodontal/orthodontic treatment resulted in significant improvement of the periodontal condition, occlusion, and facial appearance, which remained stable after two years. The results also demonstrated that miniplates are useful in the treatment of bimaxillary dentoalveolar protrusion in patients with compromised posterior anchorage

A

A



B



C

Mobility 1)		0			0	0	1	1	1	0	0	0	0			
Furcation 2)																
Buccal: PPD/BoP	3 3 3	3 3 3	3 3 3	3 3 3	3 3 3	3 2 3	3 2 3	2 1 2	2 1 2	2 1 2	2 1 2	2 1 3	3 2 3	3 3 3		
Upper	8	7P	6P	5	4	3	2	1	1	2	3	4	5	6P		
Lingual: PPD/BoP	3 2 3	3 2 2	2 2 2	2 ① 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	3 2 3	3 2 3		
Lingual: PPD/BoP		2 2 2	2 2 2	2 1 2	2 1 2	3 2 3	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	3 2 3	3 2 3	3 3 3	
Lower		7	6	5	4	3	2	1	1	2	3	4	5	6	7	
Buccal: PPD/BoP		3 ① 3	3 3 3	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 3	3 3 3	3 2 3	
Furcation 2)														I	I	
Mobility 1)		0		0			0					0	0	0	0	

PCR: 11.6%, PD≧ 4mm: 0%, PD≧ 6mm: 0%, BOP(+): 1.1%, BOP: ○

Figure 10. Clinical conditions at the two-year post-retention. A: Pantomographic and cephalometric X-ray photographs. B: Periapical radiographs. C: Periodontal chart. 1) According to the classification by Miller (1964), 2) According to the classification by Hamp et al. (1975). PPD: Probing Pocket Depth, BoP: Bleeding on Probing.

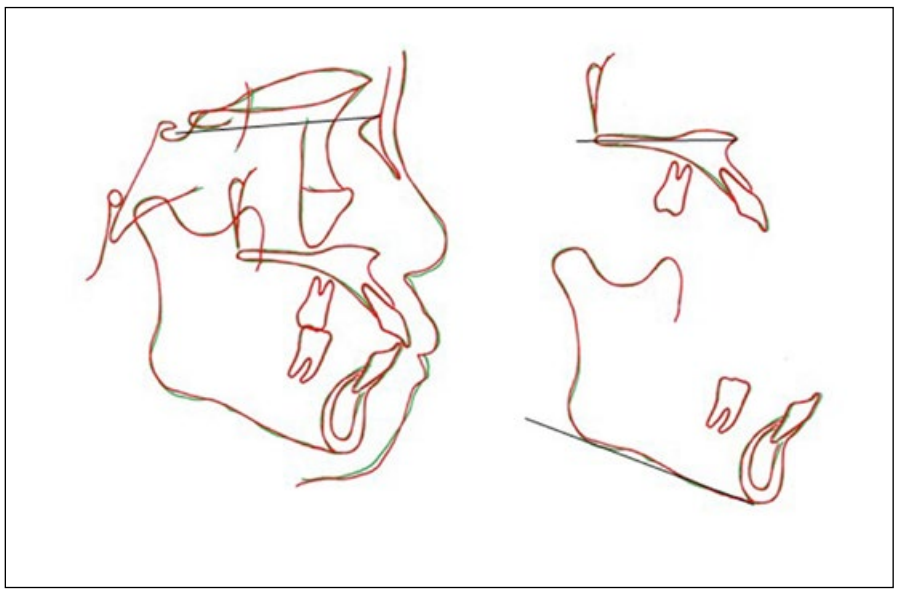


Figure 11. Superimposed lateral cephalometric tracings: post-treatment, red line; two-year post-retention, green line.

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