

# Management of open bite that developed during treatment for internal derangement and osteoarthritis of the temporomandibular joint

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This case report describes the orthodontic treatment performed for open bite caused by internal derangement (ID) and osteoarthritis (OA) of the temporomandibular joint (TMJ). A Japanese woman, aged 31 years and 11 months, referred to our department by an oral surgeon had an open bite with clockwise rotation of the mandible and degeneration of the condyle. The overbite was corrected through intrusion of the maxillary and mandibular molars using mini-screw implants to induce counterclockwise rotation of the mandible. Then, the mandibular second premolars were extracted and comprehensive orthodontic treatment was performed to establish a Class I molar relationship with distalization of the maxillary arch and to eliminate anterior crowding. Following treatment, her facial profile improved and a functional and stable occlusion was achieved without recurrence of the TMJ symptoms. These results suggest that orthodontic intrusion of the molars is one of the safer and less stressful alternatives for the management of open bite due to degeneration of the condyles caused by ID and OA of TMJ.  
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**Key words:** Temporomandibular joint, Internal derangement, Osteoarthritis, Mini-screw implant

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## INTRODUCTION

Patients with internal derangement (ID) and osteoarthritis (OA) of the temporomandibular joint (TMJ) primarily undergo serial non-surgical treatment, including physiotherapy, occlusal splint therapy, and medication, to relieve functional TMJ pain.<sup>1,2</sup> However, surgical procedures are sometimes required if the symptoms do not improve after nonsurgical treatment and/or are caused by degenerative changes in the condyle.<sup>3-6</sup>

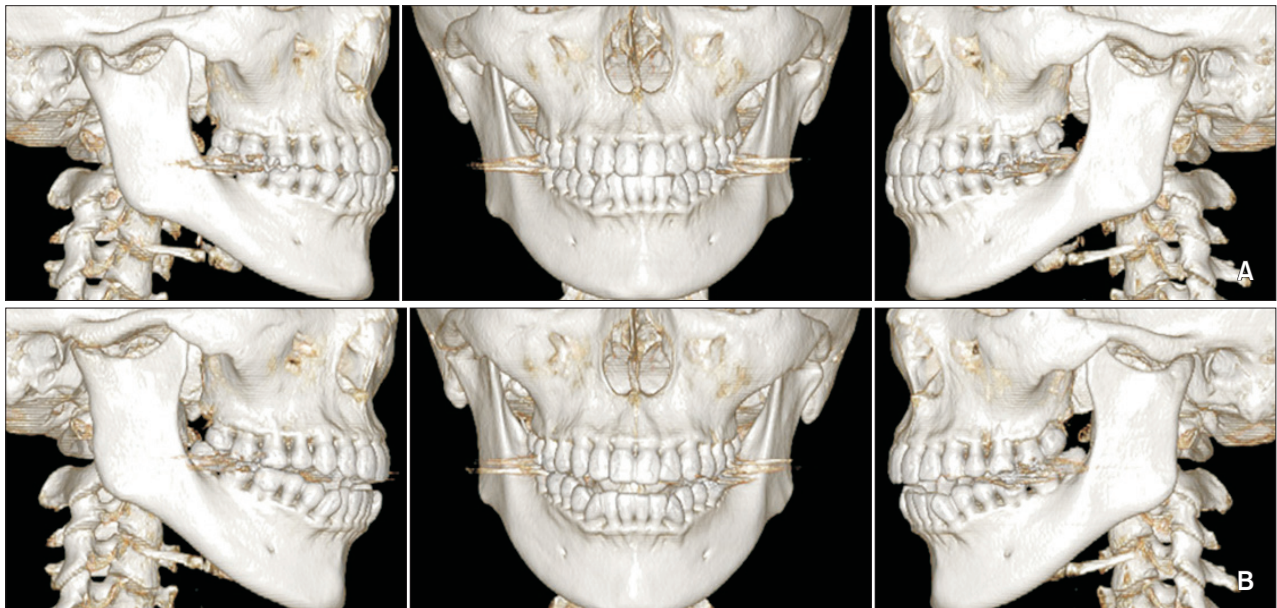
However, even after symptom resolution, morphological changes of the condyle persist in these patients. These degenerative changes infrequently lead to severe occlusal deformities such as open bite and facial deformities.

Despite the necessity of orthodontic and/or orthognathic treatment to correct the deformities in these patients, the methods and planning of treatment remain controversial.

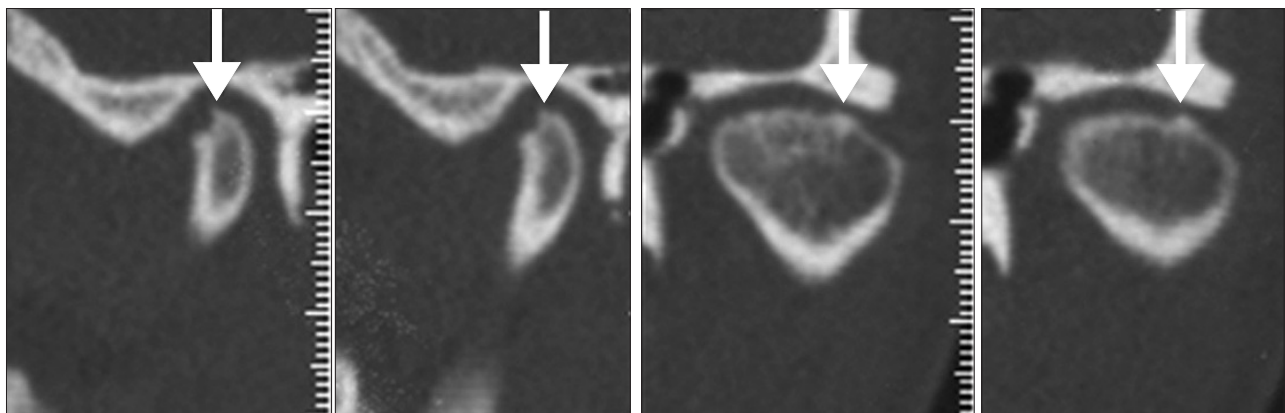
This case report describes the successful orthodontic treatment of a Japanese woman aged 31 years and 11 months who developed open bite due to bilateral condylar degeneration during the treatment for ID and OA of TMJ.

## DIAGNOSIS AND ETIOLOGY

A Japanese woman aged 31 years and 11 months was referred to our department by an oral surgeon for the



**Figure 1.** Computed tomography images. A, Before condylar degeneration at the age of 28 years and 9 months. B, After condylar degeneration at the age of 31 years and 10 months.



**Figure 2.** Computed tomography images of the left condyle. The white arrow illustrates osteophytes.

correction of open bite. She had undergone orthodontic treatment that required bilateral maxillary first premolar extraction between the age of 9 and 15 years. During this period, she experienced bilateral clicking in TMJ. At the age of 28 years and 2 months, she developed trismus and pain in the TMJ region and visited the Department of Oral and Maxillofacial Surgery at our hospital. The oral surgeon diagnosed ID and OA of TMJ and prescribed physiotherapy and occlusal splint therapy to relieve the pain. No morphological changes in the condyles were observed at that time (Figure 1A).

However, the patient's TMJ symptoms did not improve and deteriorated further. In addition, osteophyte-like degenerative changes appeared in the left condyle (Figure 2). Consequently, visually guided TMJ irrigation and open TMJ surgery were performed, following which her symptoms resolved. However, bilateral degeneration of the condyles during treatment resulted in open bite

with clockwise rotation of the mandible. The open bite and condyles were monitored for a year to rule out deleterious changes (Figure 1B). Subsequently, the patient was referred to the Department of Orthodontics for the correction of open bite.

Facial photographs showed a convex profile and mentalis muscle strain on lip closure (Figure 3). Intraoral examination revealed open bite between the right and left second premolars (Figures 3 and 4). The overbite and overjet were  $-3.5$  mm and  $+1.2$  mm, respectively, and the maxillary and mandibular midlines coincided with the facial midline in the frontal view. A Class II molar relationship was observed on both sides, with moderate crowding in the mandibular anterior region.

A panoramic radiograph indicated the presence of all four third molars, root resorption in the maxillary incisors, and considerable resorption of the bilateral mandibular condyles (Figures 1B and 5A). Lateral



**Figure 3.** Pretreatment facial and intraoral photographs.





Figure 4. Pretreatment dental casts.

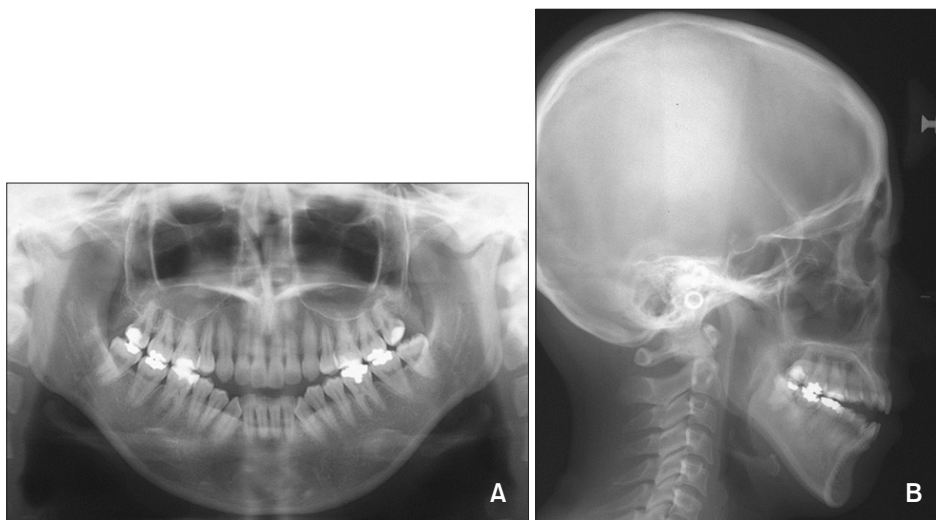


Figure 5. Pretreatment radiographic examination. A, Pretreatment panoramic radiograph. B, Pretreatment lateral cephalogram.

cephalometric analysis showed the following values: ANB angle, 4.5°; FMA, 46.7°; U1-SN, 95.8°; L1-MP, 83.7° (Table 1, Figure 5B). On the basis of the above findings, the patient was diagnosed with open bite caused by morphological changes in the bilateral condyles. For the definitions for cephalometric measurements in the main text, refer to the legends of Table 1.

### TREATMENT OBJECTIVES

The following objectives were established: correction of open bite, elimination of mandibular anterior crowding, establishment of a Class I molar relationship on both sides, and improvement in the facial profile.

**Table 1.** Cephalometric measurements

Variable	Norm	Pretreatment	Posttreatment	Two years after treatment
Angle (°)				
SNA	81.3 ± 3.0	82.3	83.0	82.5
SNB	79.2 ± 3.0	77.8	78.3	77.8
ANB	2.1 ± 2.1	4.5	4.7	4.7
Facial angle				
FMA	27.1 ± 5.2	46.7	43.0	42.1
U1-SN	107.3 ± 5.8	95.8	91.8	93.3
FMIA	58.0 ± 6.0	49.6	59.3	60.4
IMPA	93.0 ± 6.2	83.7	77.7	77.5
Linear (mm)				
N-Me	126.0 ± 4.7	133.4	128.5	128.1
Ans-Me	70.1 ± 4.4	78.4	73.3	74.0
U1-PP	29.8 ± 3.6	29.4	28.8	30.0
U6-PP	23.8 ± 2.5	23.1	20.2	20.5
L1-MP	43.8 ± 1.9	44.7	44.4	45.1
L6-MP	34.2 ± 2.6	36.9	35.7	35.8

Values are presented as mean ± standard deviation or data only.

Norm, average values of Japanese women; S, sella; N, nasion; A, A-point; B, B-point; SN, sella-nasion plane; Facial angle, angle between Frankfort (FH) plane and nasion-pogonion plane; FMA, angle between FH plane and mandibular plane; U1-SN, upper incisor axis to SN; FMIA, angle between FH plane and axial inclination of mandibular central incisor; IMPA, angle between axial inclination of mandibular central incisor and mandibular plane; N-Me, distance between nasion and menton; Ans-Me, distance between anterior nasal spine and menton; U1-PP, perpendicular distance of the maxillary central incisor to palatal plane; U6-PP, perpendicular distance of the maxillary first molar to palatal plane; L1-MP, perpendicular distance of the mandibular incisor to mandibular plane; L6-MP, perpendicular distance of the mandibular first molar to mandibular plane.

### TREATMENT ALTERNATIVES

To achieve the treatment objectives, particularly open bite correction, we suggested two treatment plans. The first included Le Fort I osteotomy with upward movement of the maxillary posterior segment to induce counterclockwise rotation of the mandible. The second included orthodontic intrusion of the maxillary and mandibular molars using mini-screw implants to induce counterclockwise rotation of the mandible. The first plan required a surgical procedure under general anesthesia, which imposes heavy psychological and physical burdens on the patient, while the second could facilitate achievement of the treatment objective with minimum intervention, similar to the results of surgical treatment, although the post-treatment stability of the intruded teeth was uncertain. Both plans necessitated mandibular second premolar and all third molar extractions to achieve the other objectives.

After discussion with the patient, the second plan was selected because of safety and minimum patient burden.

### TREATMENT PROGRESS

In preparation for molar intrusion, transpalatal and lingual arch appliances were placed in the maxillary and mandibular arches, respectively. Then, sectional arch wires from the second premolar to the second molar on both sides were placed in the maxillary and mandibular arches.

Under local anesthesia, mini-screw implants were bilaterally embedded into the buccal side of the alveolar bone between the second premolar and first molar and between the first and second molars in the maxilla and between the second premolar and first molar in the mandible. Four weeks after implantation, molar intrusion was initiated by the attachment of elastic chains from the mini-screw implant to the sectional arch wire. Eleven months later, the overbite increased from -3.5 mm to 0.5 mm (Figure 6). There were no TMJ symptoms during this period. The overbite and overjet were 0.5 mm and 3.5 mm, respectively. Lateral cephalometric analysis showed mandibular autorotation (FMA, 46.7° to 44.0°). Thus, the first objective was achieved. The mini-screw implants



**Figure 6.** Intraoral photographs obtained after molar intrusion.



**Figure 7.** Intraoral photographs at distalization of the maxillary arch.

and lingual arch were removed from the mandible.

Then, the mandibular second premolars were extracted and comprehensive orthodontic treatment was initiated to eliminate anterior crowding and establish a Class I molar relationship by distalization of the maxillary arch (Figure 7).

Orthodontic treatment was completed at the age of 36 years and 1 month, with the use of the Begg retainer in the maxillary arch and the Hawley retainer in the mandibular arch for retention.

## RESULTS

The post-treatment facial and intraoral photographs showed successful results (Figure 8). Her facial profile had considerably improved, particularly in the lip region. The overbite and overjet had increased from  $-3.5$  mm to  $3.5$  mm and from  $1.2$  mm to  $2.0$  mm, respectively. Favorable occlusion with a Class I molar relationship and no crowding was established (Figures 8 and 9).

A panoramic radiograph showed no signs of progressive root resorption in the maxillary anterior teeth. However, the roots of the mandibular molars showed slight resorption, while root parallelism showed further scope





**Figure 8.** Post-treatment facial and intraoral photographs.

of improvement (Figure 10A).

Lateral cephalometric analysis showed a decrease in the mandibular plane angle from  $46.7^\circ$  to  $44.0^\circ$ . The height of the maxillary first molar had decreased by 2.9 mm, while that of the mandibular molar had decreased by 1.2 mm. The facial height had also decreased (N-Me: 133.2 mm to 127.7 mm, Ans-Me: 78.5 mm to 72.6 mm; Table 1, Figures 10B and 11). The maxillary and mandibular incisors showed palatal and lingual inclination, respectively (U1-SN:  $95.8^\circ$  to  $91.8^\circ$ , IMPA:  $83.7^\circ$  to  $77.7^\circ$ ).

Superimposition of the pre- and post-treatment lateral cephalograms clearly demonstrated counterclockwise rotation of the mandible and lingual movement of the maxillary and mandibular incisors (Figure 11). Computed tomography revealed an unchanged condylar morphology, while T2-weighted magnetic resonance imaging revealed an improvement (data not shown). There were no symptoms of TMJ disorder during treatment.

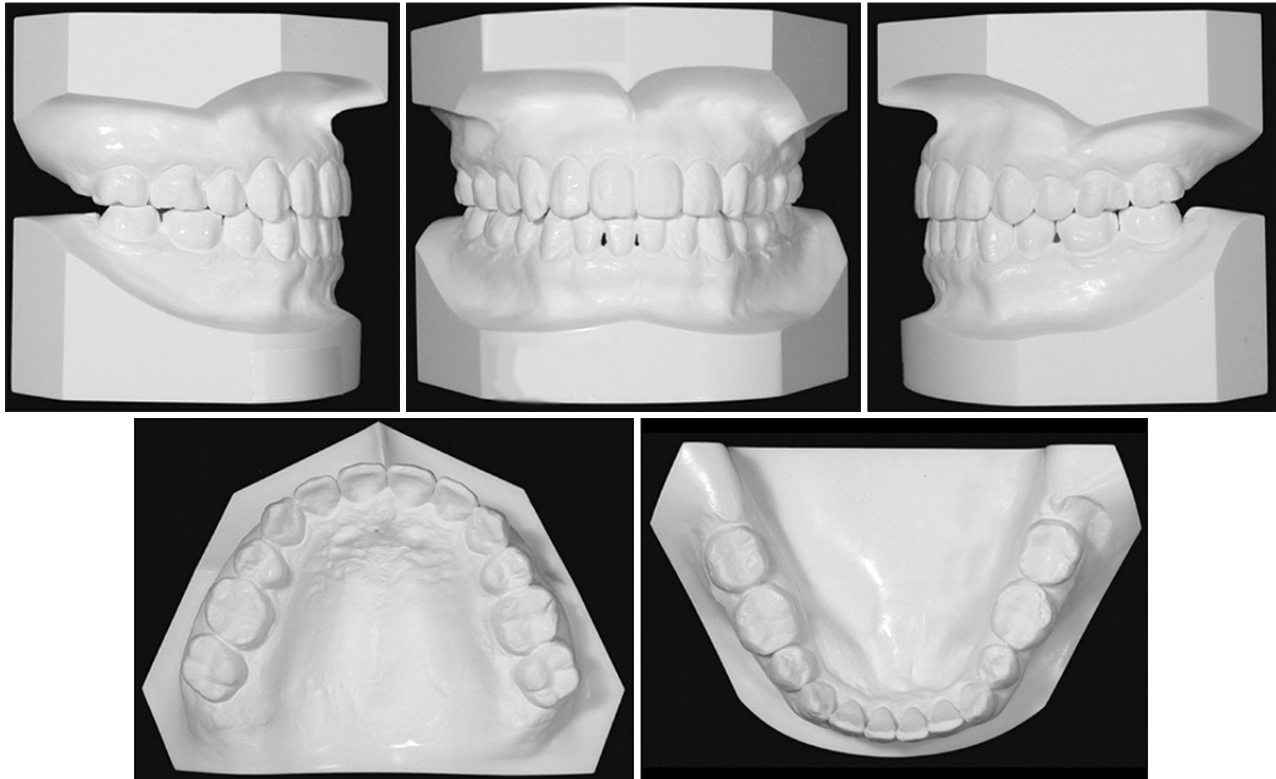
After two years of retention, her facial profile and

occlusion were well maintained, and the patient was satisfied with the treatment outcomes (Table 1, Figure 12). There were no symptoms of TMJ disorder on any side.

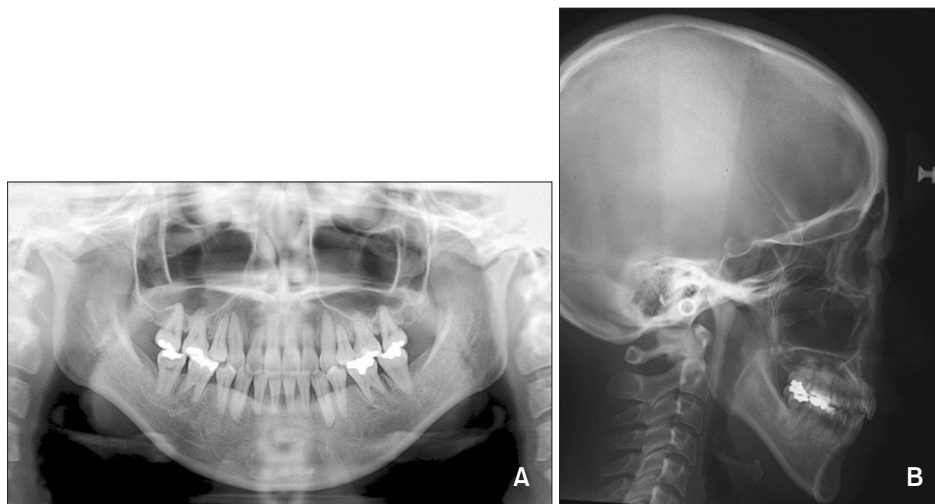
## DISCUSSION

ID and OA are TMJ disorders characterized by limited mouth opening with functional TMJ pain, and these pathologies occasionally induce morphological changes in the condyles.<sup>6-9</sup> Although the present patient was also diagnosed with ID and OA and was treated at the Department of Oral and Maxillofacial Surgery, she unfortunately experienced considerable condylar degeneration, which resulted in open bite.

Several treatment options are available for the management of this type of open bite: maxillary surgery with Le Fort I osteotomy, orthodontic and orthognathic surgical procedures, and condylar replacement with a costochondral graft.<sup>8-15</sup> These three procedures generally induce counterclockwise rotation of the mandible for



**Figure 9.** Post-treatment dental casts.



**Figure 10.** Post-treatment radiographic examination. A, Post-treatment panoramic radiograph. B, Post-treatment lateral cephalogram.

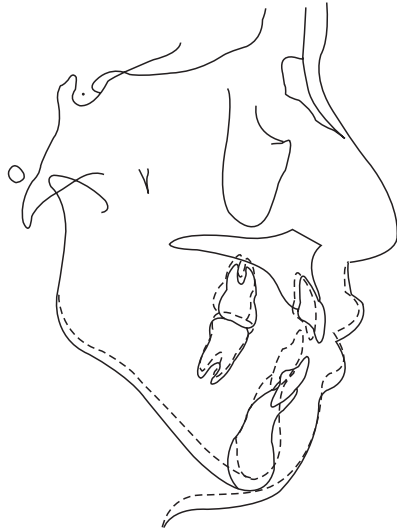
open bite correction, although stability of the treatment outcomes remains debatable.

Recently, several reports on the orthodontic treatment of open bite through molar intrusion were published.<sup>16-18</sup> Molar intrusion with mini-screw implants enables counterclockwise rotation of the mandible, which is similar to the results of the surgical procedures, and carries the added advantage of minimum intervention for mini-screw placement, as opposed to that for surgical pro-

cedures under general anesthesia.

For our patient, we opted for orthodontic treatment with molar intrusion to correct open bite caused by condylar degeneration. The maxillary and mandibular molars were intruded without incisor extrusion, inducing counterclockwise rotation of the mandible and resulting in open bite correction without any TMJ symptoms. However, slight gingival recession occurred in the mandibular anterior region, believed to be a con-





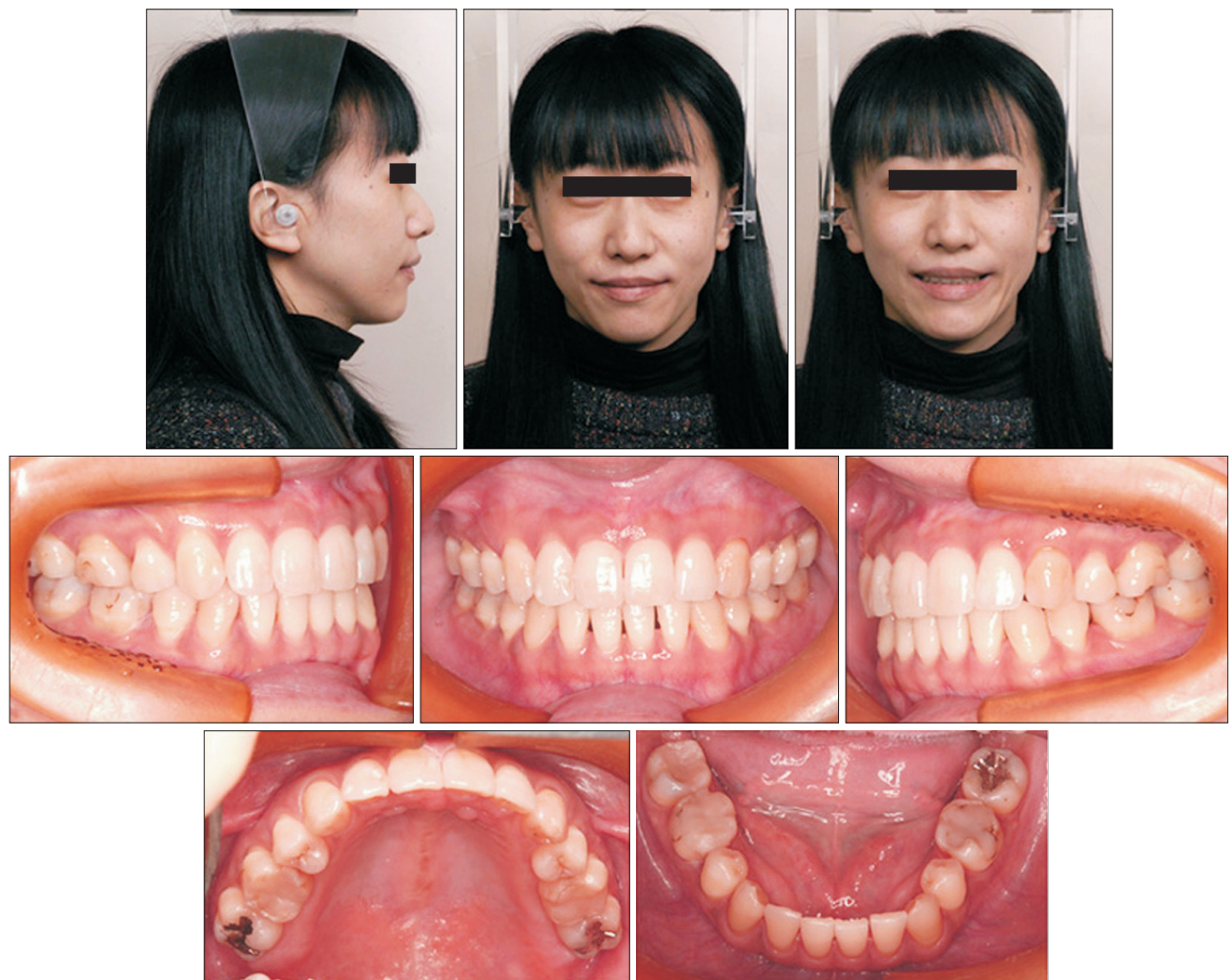
**Figure 11.** Superimposition of pre- (solid lines) and post-treatment (dashed lines) lateral cephalometric tracings.

sequence of excessive lingual movement of the mandibular anterior teeth.

The stability of molar intrusion remains a critical issue. Several reports described that approximately 20% to 30% relapse occurred in a short period of time during retention.<sup>17-19</sup> In our patient, however, almost no relapse was observed 2 years after treatment (Table 1, Figure 12). This may be due to the peculiarity of this type of open bite, which was caused by condylar resorption, unlike a non-pathological open bite. Open bite correction through molar intrusion facilitated restoration of the original vertical dimensions, consequently preserving the functional adaptation of the circumoral musculature. Further observation of the overbite and condyles will be necessary to maintain a stable occlusion.

### CONCLUSION

The findings from this case suggest that orthodontic



**Figure 12.** Facial and intraoral photographs obtained 2 years after treatment.

intrusion of the molars is a safer and less stressful alternative for the management of open bite due to bilateral condylar degeneration secondary to ID and OA of TMJ. Furthermore, it improves the patient's masticatory function, esthetics, and quality of life.

## REFERENCES

1. Dimitroulis G. Temporomandibular disorders: a clinical update. *BMJ* 1998;317:190-4.
2. McNeill C. Temporomandibular disorders: guidelines for classification, assessment, and management. 2nd ed. Chicago, IL: Quintessence Books; 1993.
3. Nitzan DW, Dolwick MF, Martinez GA. Temporomandibular joint arthrocentesis: a simplified treatment for severe, limited mouth opening. *J Oral Maxillofac Surg* 1991;49:1163-7; discussion 1168-70.
4. Dimitroulis G, Dolwick MF, Martinez A. Temporomandibular joint arthrocentesis and lavage for the treatment of closed lock: a follow-up study. *Br J Oral Maxillofac Surg* 1995;33:23-6.
5. Kondoh T, Dolwick MF, Hamada Y, Seto K. Visually guided irrigation for patients with symptomatic internal derangement of the temporomandibular joint: a preliminary report. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2003;95:544-51.
6. Dimitroulis G. A review of 56 cases of chronic closed lock treated with temporomandibular joint arthroscopy. *J Oral Maxillofac Surg* 2002;60:519-24.
7. Bertram S, Rudisch A, Innerhofer K, Pümpel E, Grubwieser G, Emshoff R. Diagnosing TMJ internal derangement and osteoarthritis with magnetic resonance imaging. *J Am Dent Assoc* 2001;132:753-61.
8. Arnett GW, Milam SB, Gottesman L. Progressive mandibular retrusion-idiopathic condylar resorption. Part II. *Am J Orthod Dentofacial Orthop* 1996; 110:117-27.
9. Arnett GW, Milam SB, Gottesman L. Progressive mandibular retrusion--idiopathic condylar resorption. Part I. *Am J Orthod Dentofacial Orthop* 1996; 110:8-15.
10. Wolford LM, Cardenas L. Idiopathic condylar resorption: diagnosis, treatment protocol, and outcomes. *Am J Orthod Dentofacial Orthop* 1999;116:667-77.
11. Arnett GW, Tamborello JA. Progressive Class II development: female idiopathic condylar resorption. *Oral Maxillofac Surg Clin North Am* 1990;2:699-716.
12. Crawford JG, Stoelinga PJ, Blijdorp PA, Brouns JJ. Stability after reoperation for progressive condylar resorption after orthognathic surgery: report of seven cases. *J Oral Maxillofac Surg* 1994;52:460-6.
13. Merckx MA, Van Damme PA. Condylar resorption after orthognathic surgery. Evaluation of treatment in 8 patients. *J Craniomaxillofac Surg* 1994;22:53-8.
14. Huang YL, Pogrel MA, Kaban LB. Diagnosis and management of condylar resorption. *J Oral Maxillofac Surg* 1997;55:114-9.
15. Bailey LJ, Proffit WR. Combined surgical and orthodontic treatment. In: Proffit WR, Fields HW, eds. *Contemporary orthodontics*. 3rd ed. St. Louis: Mosby; 2000. p. 679-82.
16. Paik CH, Woo YJ, Boyd RL. Treatment of an adult patient with vertical maxillary excess using mini-screw fixation. *J Clin Orthod* 2003;37:423-8.
17. Kuroda S, Katayama A, Takano-Yamamoto T. Severe anterior open-bite case treated using titanium screw anchorage. *Angle Orthod* 2004;74:558-67.
18. Baek MS, Choi YJ, Yu HS, Lee KJ, Kwak J, Park YC. Long-term stability of anterior open-bite treatment by intrusion of maxillary posterior teeth. *Am J Orthod Dentofacial Orthop* 2010;138:396.e1-9.
19. Sugawara J, Baik UB, Umemori M, Takahashi I, Nagasaka H, Kawamura H, et al. Treatment and posttreatment dentoalveolar changes following intrusion of mandibular molars with application of a skeletal anchorage system (SAS) for open bite correction. *Int J Adult Orthodon Orthognath Surg* 2002;17:243-53.