Accelerated Extraction Treatment with the Invisalign System and Photobiomodulation

KENJI OJIMA, DDS, MDSc
CHISATO DAN, DDS
HITOSHI WATANABE, DDS, PhD
YURIKO KUMAGAI, DDS
RAVINDRA NANDA, BDS, MDS, PhD

Treatment with Invisalign* clear aligners has produced favorable results in a variety of orthodontic situations.[1-8] The manufacturer recommends wearing each aligner for seven days (at least 20 hours per day), but as the number of prescribed aligners increases, the length of treatment also increases. In a previous article, we demonstrated that the use of photobiomodulation (PBM), or low-level laser therapy, could shorten aligner treatment.[2]

Invisalign treatment of premolar extraction cases has traditionally been considered difficult because the bowing effect caused by warping of the trays can hinder anchorage control. The following case demonstrates successful extraction treatment of a patient with severe crowding using aligners and PBM.

Case Report

A 32-year-old female presented with the chief complaint of poor esthetics owing to anterior

*Registered trademark of Align Technology, Inc., San Jose, CA; www.aligntech.com.


Dr. Ojima


Dr. Dan


Dr. Watanabe


Dr. Kumagai


Dr. Nanda

Drs. Ojima, Dan, Watanabe, and Kumagai are in the private practice of orthodontics at Smile Innovation Orthodontics, Kataoka Building 2F, 2-39-5 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan. E-mail Dr. Ojima at kenjiojima@jaligner.com. Dr. Nanda is a Professor Emeritus, Division of Orthodontics, Department of Craniofacial Sciences, University of Connecticut School of Dental Medicine, Farmington, CT; Editor-in-Chief, *Progress in Orthodontics*; and an Associate Editor of the *Journal of Clinical Orthodontics*.

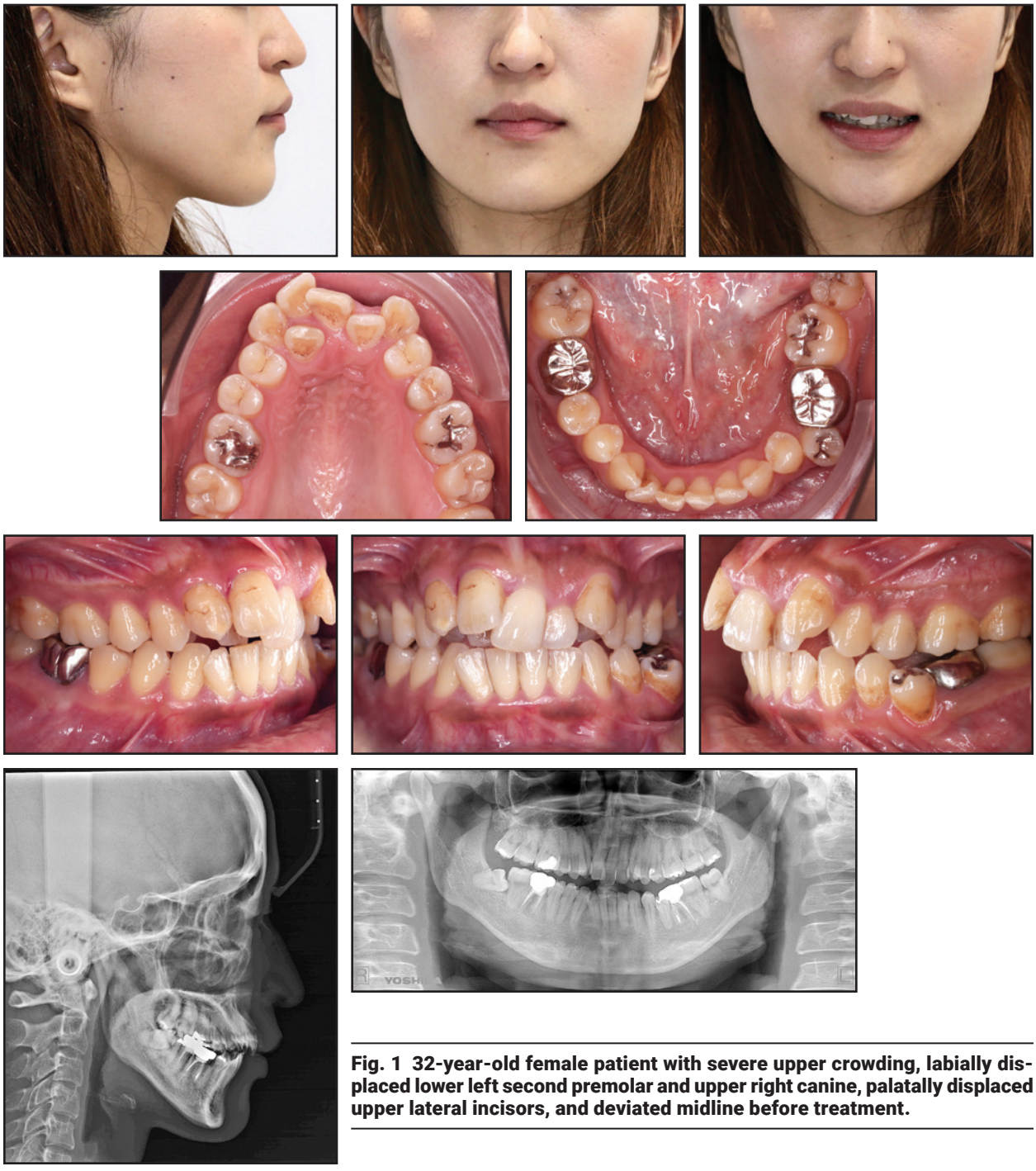

Fig. 1 32-year-old female patient with severe upper crowding, labially displaced lower left second premolar and upper right canine, palatally displaced upper lateral incisors, and deviated midline before treatment.

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TABLE 1
CEPHALOMETRIC ANALYSIS

	Japanese Norm	Pretreatment	Post-Treatment
SNA	82°	81°	82°
SNB	80°	78°	80°
ANB	2°	3°	2°
U1-SN	104°	123°	104°

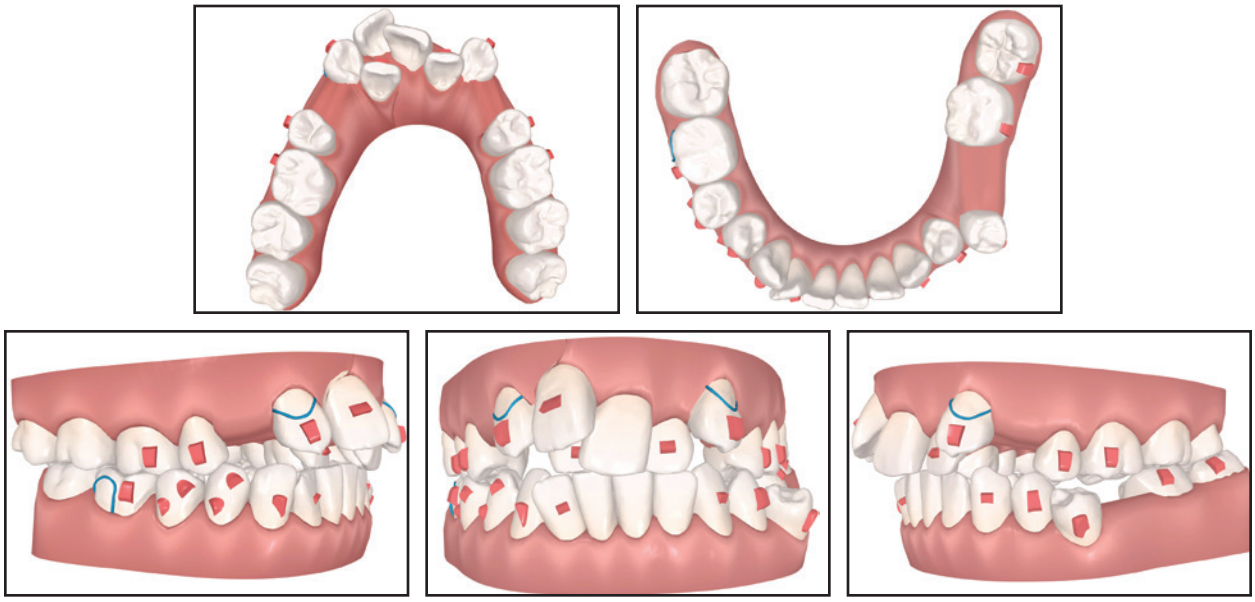

Fig. 2 ClinCheck* treatment plan.

crowding (Fig. 1). She requested orthodontic treatment that could be completed before a planned wedding. Intraoral findings included severe crowding and protrusion of the upper anterior teeth, labioversion of the lower left second premolar, and a deviation of the upper midline to the right. The facial profile was straight. Although no skeletal or mandibular abnormalities were noted in the cephalometric analysis (Table 1) or on the panoramic radiograph, we observed poor root-canal filling of the lower left first molar. The patient was diagnosed with severe crowding, involving the upper right canine in labioversion and the upper lateral incisors in palatoversion.

The treatment plan called for extraction of both upper first premolars and the lower left first molar, followed by orthodontic treatment with aligners. Tooth movement was simulated by ClinCheck* to determine the shapes and locations of attachments (Fig. 2). An implant would be placed in the lower left first-molar extraction site at the end of treatment.

Because the treatment needed to be completed in a short time and esthetic improvement would be difficult, a PBM device was prescribed to accelerate tooth movement. When placed in the

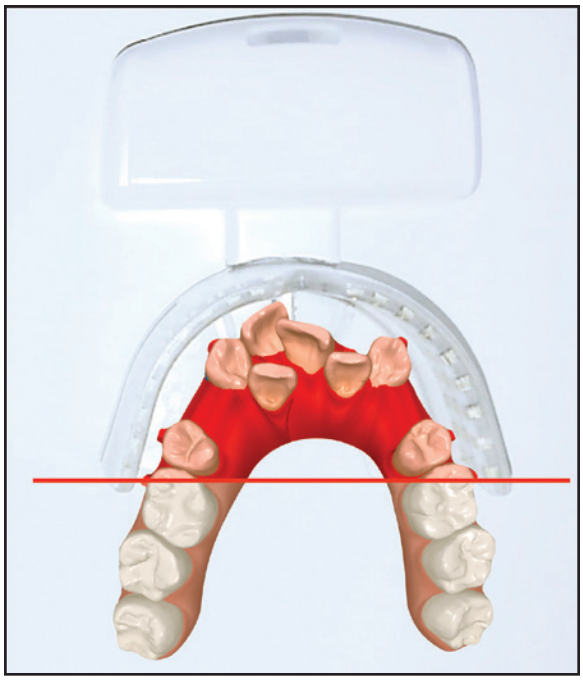

Fig. 3 OrthoPulse covers upper arch from second premolar to second premolar, so that molar anchorage is unaffected by acceleration treatment.**

mouth, the arch-shaped portion of the OrthoPulse** appliance covers the teeth from second premolar to second premolar (Fig. 3). Therefore, the first molars are unaffected by the accelerating device and can be used to anchor retraction of the upper anterior teeth.

The upper first premolars and lower left first molar were extracted. Attachments were bonded according to the planned simulation, and initial aligners were delivered (Fig. 4). The patient was instructed to change aligners every three days and to use the PBM appliance for 10 minutes per day.

Retraction of the upper anterior teeth was accomplished in six months with 20 hours per day of Class II elastic wear (Fig. 5). The anterior portion of the lower arch was expanded slightly during this phase. The lower left second premolar, which had been buccally displaced before treatment, was tipped lingually to leave at least 8mm of space for the lower left first-molar implant (Fig. 6).

Orthodontic treatment was completed in eight

**Trademark of Biolux Research Ltd., Vancouver, BC, Canada; www.bioluxresearch.com.

Fig. 4 First set of aligners with attachments.

TABLE 2
UPPER ARCH WIDTH

	Pretreatment	Post-Treatment	Change
Canine to canine	34.0mm	39.0mm	+5.0mm
First premolar to first premolar	37.0mm	46.5mm	+9.5mm
Second premolar to second premolar	45.5mm	52.5mm	+7.0mm
First molar to first molar	52.0mm	56.5mm	+4.5mm

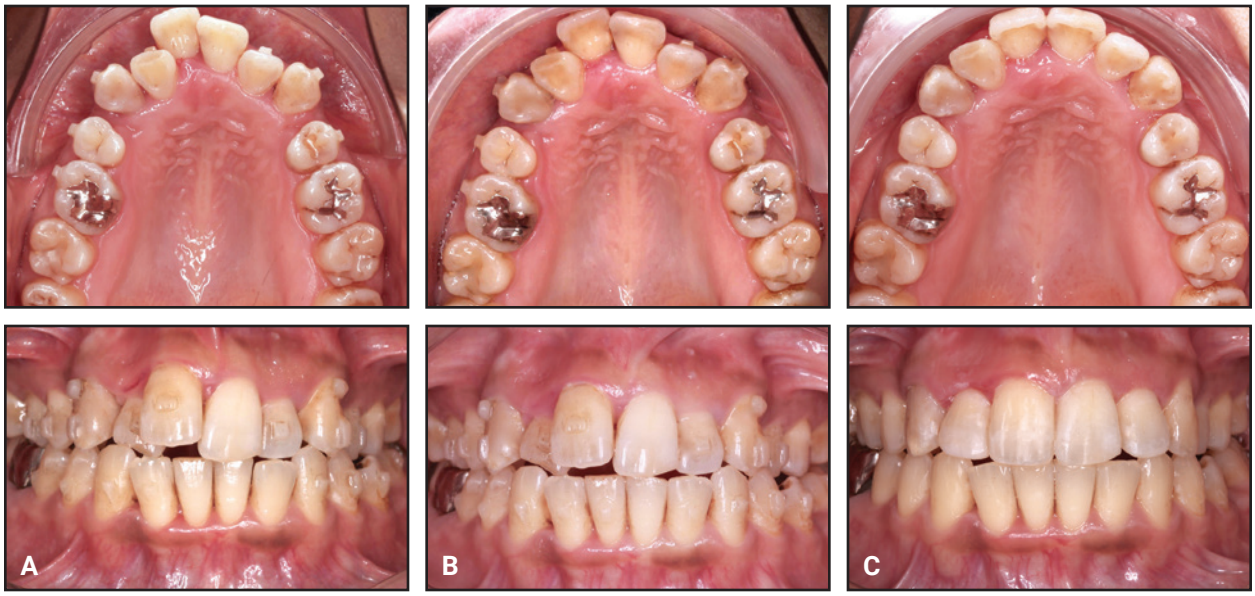

Fig. 5 A. After three months of treatment. B. After four months of treatment. C. After six months of treatment.

months, and all attachments were removed. The treatment phase required 46 sets of aligners, and the refinement phase, 18 sets. The final dentition and alignment were consistent with the pretreatment computer simulation (Fig. 7).

The maxillary extraction spaces were closed, and the upper arch was successfully expanded, addressing the patient's chief complaints of anterior crowding and poor esthetics (Fig. 8, Table 2). The upper and lower midlines were coincident, the 2-3mm overbite and overjet were maintained, and the upper lip appeared natural and relaxed after retraction of the upper incisors. Occlusal stability was achieved, with proper one-to-two occlusal and buccal contacts of the upper and lower molars. Cephalometric measurements were within the normal range (Table 1). The panoramic x-ray showed no root resorption or changes in alveolar bone level, indicating that the condition was stable.

A dental implant was placed in the lower left first-molar location and harmonized with the surrounding tissue, providing a stable occlusion one year after treatment (Fig. 9).

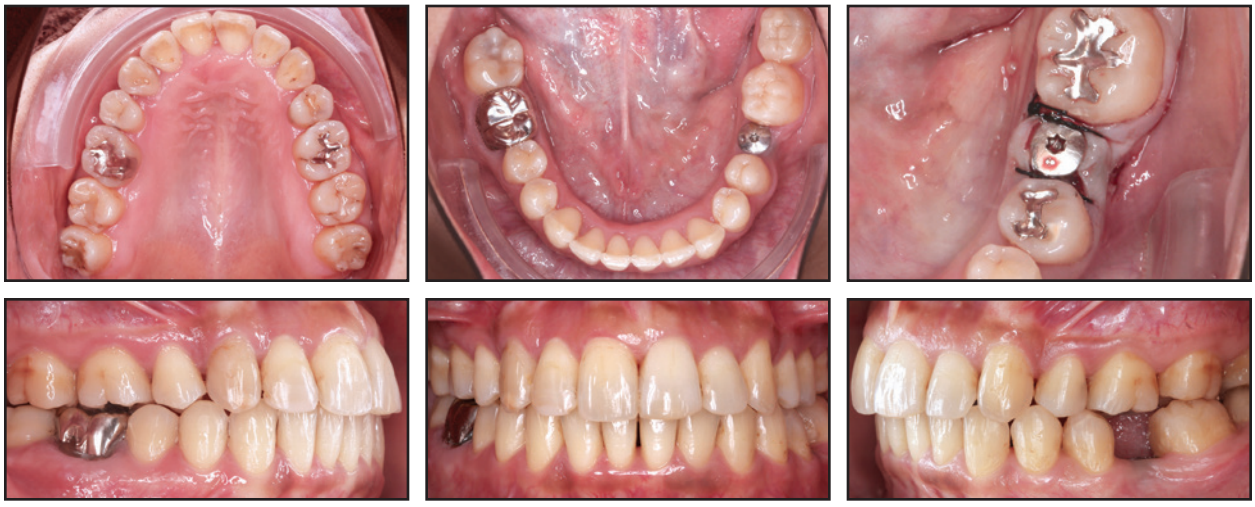

Fig. 6 After eight months of treatment, with space prepared for lower left first-molar implant.

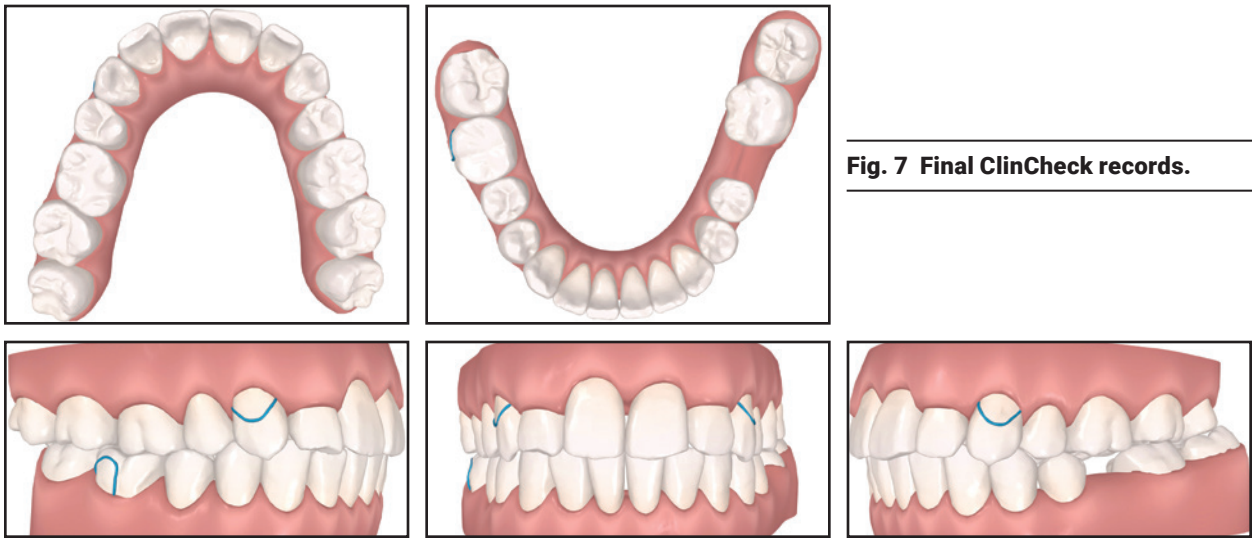

Fig. 7 Final ClinCheck records.

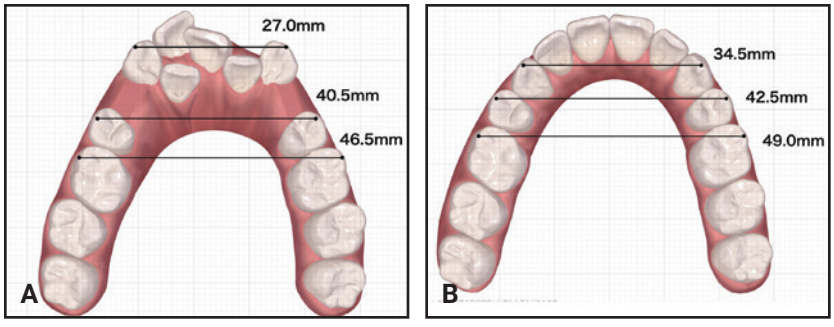

Fig. 8 Upper arch expansion from before treatment (A) to after treatment (B).

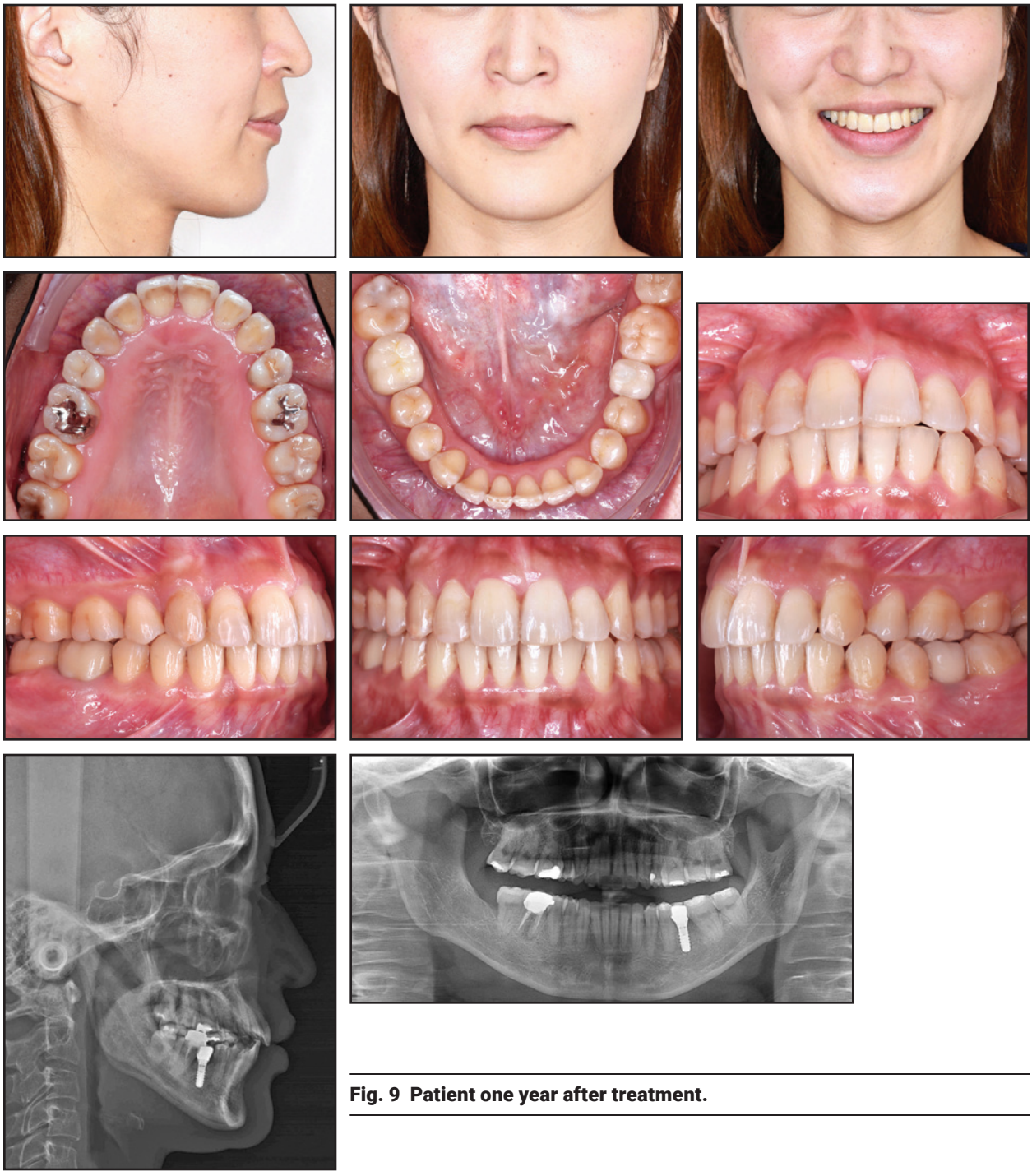

Fig. 9 Patient one year after treatment.

Discussion

Surgical methods such as piezocision[9] and corticision[10] have been proposed for shortening orthodontic treatment. Although these methods do accelerate tooth movement, they are relatively invasive and may lead to discomfort and unfavorable complications.[10] PBM can accelerate tooth movement without causing root resorption or other harmful side effects.[2,11] It promotes bone remodeling by increasing the activity of cytochrome *c* oxidase and the production of adenosine triphosphate by mitochondria.[12-14]

In the present case, clear aligner treatment was shortened to only eight months, in accordance with our previous reports of PBM's accelerating effects.[2] The morphological characteristics of the PBM device were favorable for retraction of the upper anterior teeth using the upper molars for anchorage. The typical bowing effect of the aligners in extraction cases was controlled by appropriate selection and placement of attachments, accurate aligner staging, judicious Class II elastic wear, and optimally planned tooth movement.[1] Successful extraction space closure and stable results were achieved even with the accelerated treatment.

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