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## Case Report

# Dental Implant Treatment after Improvement of Oral Environment by Orthodontic Therapy

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## Abstract

A 57-year-old man presented with mesial inclination of the lower right first molar caused by untreated loss of the second premolar. The occlusal relationship was restored by dental implant treatment following improvement of the intraoral environment by orthodontic therapy. At his initial visit, the interdental spacing in the molar-premolar region was inadequate, as the first molar had mesially inclined into the extraction space of the second premolar. The patient had also lost the second molar and complained of masticatory problems on the right side. It was considered necessary to restore the second molar and improve the occlusal relationship with the first molar to recover occlusal function on the right side. After orthodontic therapy to correct the position of the mesially inclined tooth, occlusal restoration was carried out by dental implant treatment. The patient's clinical condition has remained excellent at over 5 years 2 months post-surgically and the patient is satisfied with the treatment outcome. The combination of dental implant treatment and orthodontic therapy were effective in improving the intraoral environment in this patient, indicating the efficacy of interdisciplinary treatment planning and practice.

Key words: Inclined tooth—Orthodontic therapy—Dental implant treatment—Improvement of intraoral environment—Interdisciplinary treatment

## Introduction

Loss of teeth affects the function of the stomatognathic system, as well as systemic health. This is particularly the case if tooth loss is left untreated over an extended period of

time, as this may cause undesirable movement or tipping of the adjacent teeth or extrusion of the opposing teeth. Malocclusion due to such changes leads to a decline in masticatory function, renders the management of oral hygiene more difficult, and become a factor



Fig. 1 Panoramic X-ray image taken on initial examination

in the development of periodontal disease.

Missing teeth have conventionally been restored with bridges or removable dentures. In recent years, however, implant treatment has become more common<sup>1)</sup>. Implant treatment is superior to conventional prosthetic methods as it enables the dentition to be restored without imposing any additional burden on the abutment teeth. It does place a major burden on patients, however, as it surgically invasive, requires a long treatment period, and is expensive. Moreover whether it is appropriate for and will be effective must be taken into consideration on a case-by-case.

We hereby report a case in which implants were used to restore occlusion after orthodontic therapy to improve the oral environment in a patient with malalignment in the mandibular molar region.

### Case Report

A 57-year-old man was referred to the Division of Oral Implantology, Suidobashi Hospital, Tokyo Dental College, for implant treatment. The patient complained of difficulty in chewing on the right side.

Medical history: he was a non-smoker; no other remarkable findings.

History of present condition: The patient had lost his mandibular right second premolar 10 years earlier due to dental caries and had not had it replaced. In May 2004, he lost the

mandibular right second molar as a result of root fracture. As a result of unilateral loss of multiple teeth, he found difficulty in mastication and consulted his family dentist, who recommended implant treatment. In December 2004, he was referred to the Division of Oral Implantology, Suidobashi Hospital, Tokyo Dental College,

Intraoral findings: the patient had 26 remaining teeth, 2 missing teeth, and 12 occluding pairs of teeth; Eichner classification; A2.

Occlusal status: the molar occlusal relationship on the left was Angle's Class I. However, it was Angle's Class III on the right, because the first molar was mesially inclined and had shifted mesially until it came into contact with the first premolar in the absence of the second premolar. Both overjet and overbite were normal. The midline of the mandibular dentition was shifted to the right with a right canine in Class II relationship.

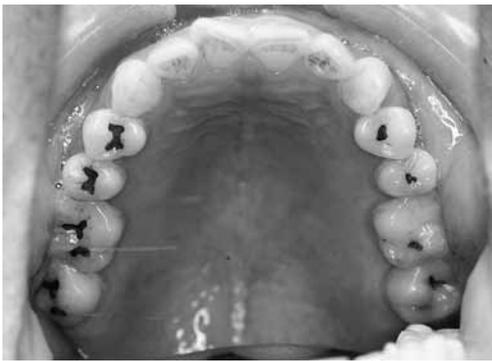
In addition, the maxillary right second molar had no opposing tooth and was somewhat extruded. Except at the sites of the missing teeth, there was no major malocclusion overall, and the maxillofacial morphology was normal.

Panoramic X-ray imaging findings: there was no marked alveolar bone resorption around the remaining teeth, and no malformation in the mandibular right molar region (Fig. 1).

The treatment plan comprised orthodontic treatment to upright the mesially inclined



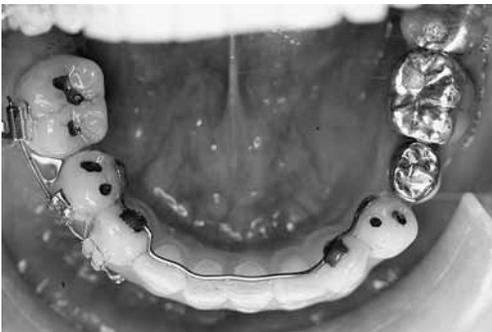
(a)



(b)



(c)



(d)



(e)

Fig. 2 Intraoral photograph taken at start of orthodontic treatment

(a) Right lateral view, (b) Maxillary occlusal view, (c) Frontal view, (d) Mandibular occlusal view, (e) Left lateral view.

mandibular right first molar followed by replacement of the mandibular right second molar. Treatment was initiated in March 2005 with the patient's consent. A partial arch uprighting method was used with brackets bonded to the mandibular right canine, first premolar, and first molar (Fig. 2). To prevent

movement of the canine and first premolar, the left and right canines and first premolars were fixed from the lingual side with a lingual arch bar. After leveling by the partial arch technique, an open coil was used to ensure that sufficient space was created for implant placement, and uprighting of the

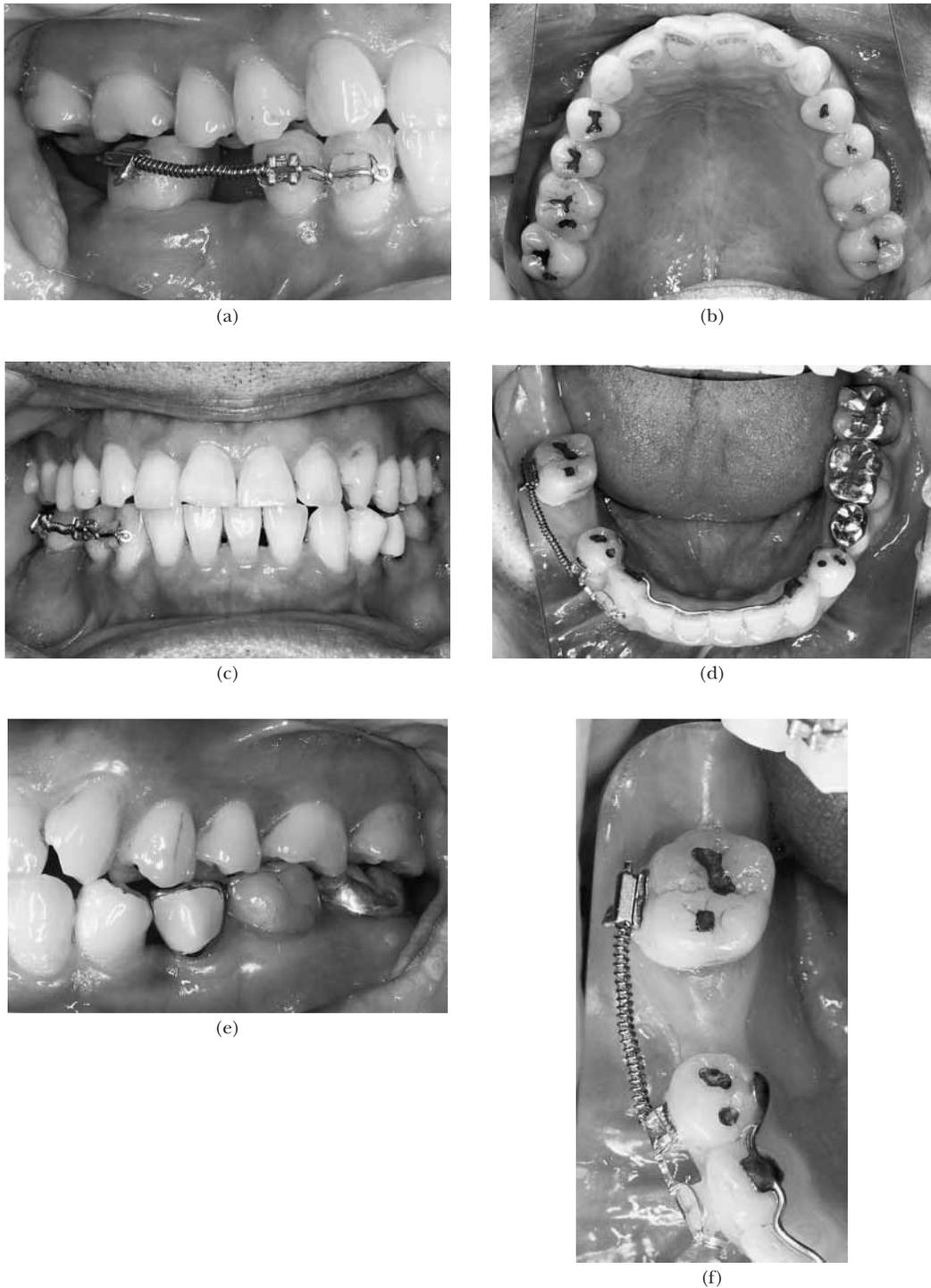


Fig. 3 Intraoral photograph taken at end of orthodontic treatment

(a) Right lateral view, (b) Maxillary occlusal view, (c) Frontal view, (d) Mandibular occlusal view, (e) Left lateral view, (f) First molar after uprighting.



(a)



(b)



(c)

Fig. 4 Diagnostic imaging prior to implant treatment  
 (a) Panoramic X-ray image, (b) CT image of second premolar site,  
 (c) CT image of second molar site.

mandibular right first molar was completed in July 2006 (Fig. 3).

We then evaluated the feasibility of implant placement at the edentulous sites. Diagnostic imaging, including computed tomography (Fig. 4), revealed thick cortical bone and adequate cancellous bone of Type 3 quality in the premolar and molar area based on the classification of Lekholm and Zarb<sup>4)</sup> and no remarkable alveolar ridge resorption. The mandibular canal was almost in the center of the mandible buccolingually and in the inferior 1/3 of the mandible vertically, at a distance of approximately 18 mm from

the alveolar crest to the mandibular canal. General and intraoral evaluation showed that implant treatment was feasible; therefore, the patient consent, we decided to place single implants in the second premolar and second molar regions and restore them with individual crowns.

The implants were placed in October 2006 under intravenous sedation with midazolam and propofol synergistically. After administration of local anesthesia with a 2% lidocaine hydrochloride solution containing epinephrine at 12.5  $\mu\text{g}/\text{ml}$ , crestal incisions were made at the edentulous sites, and full-thickness

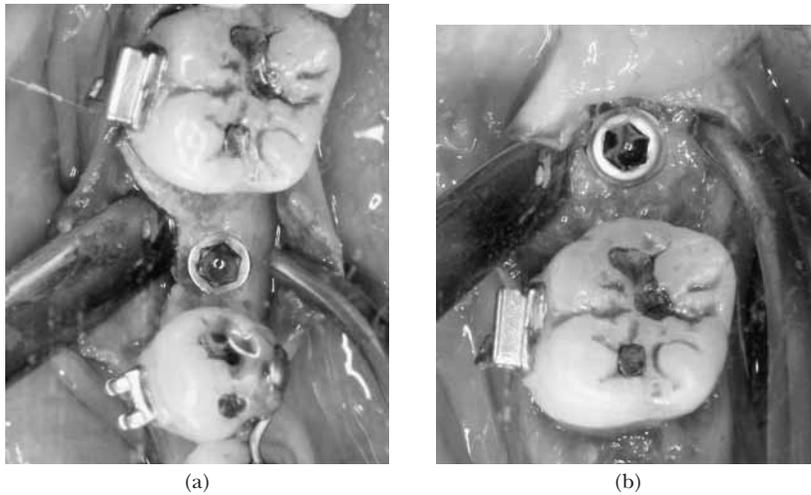


Fig. 5 Insertion of implant  
(a) Second premolar site, (b) Second molar site.



Fig. 6 Panoramic X-ray image taken immediately after implant insertion

flaps reflected. While drilling the implant site, a direction indicator was used to check the orientation of the insertion mesiodistally and buccolingually. After site preparation, a depth gage was used to check whether there were any perforations at the bottom or sides of the insertion socket or whether the bone was palpable. A Tapered Screw Vent implant TSVB13 (3.7 mm in diameter, and 13 mm in length, Zimmer Dental Inc.) and a Tapered Screw Vent implant TSVWB13 (4.7 mm in diameter and, 13 mm in length, Zimmer

Dental Inc.) were placed in the second molar region (Fig. 5). Their insertion torque values were 50 N and 30 N, respectively. Initial stability was excellent, so it was decided to employ a single-stage procedure and connect the healing abutment on the same day (Fig. 6). The patient experienced no major postoperative discomfort or neurological symptoms, and wound healing was uneventful.

After the healing period, screw-retained provisional restorations were fitted to the body of each implant in February 2007. After



(a)



(b)



(c)

Fig. 7 Final restoration fixation

(a) Panoramic X-ray image, (b) Periapical X-ray image of second premolar site, (c) Periapical X-ray image of second molar site.

fixation, the provisional restorations were evaluated to ensure that there was no discomfort during mastication, loosening of the fixation screw, problems in the surrounding tissue, or biting of the tongue or buccal mucosa. Final restorations with a hybrid ceramic facing crown was performed in July 2007 (Fig. 7). The peri-implant bone was subsequently monitored by clinical examination every 6 months and radiographs taken annually.

The patient's clinical condition has remained excellent and no problem have been observed with the implants such as loosening of the fixation screws or significant peri-implant bone resorption on X-ray images obtained

at over 4 years post-surgically. The patient has expressed satisfaction at the treatment outcome (Fig. 8).

## Discussion

If a missing tooth is not restored and the resulting gap left untreated, mesial tipping of the distal adjacent tooth occurs. This may cause dysfunction of the stomatognathic system due to extrusion and premature contact with the opposing tooth. In the present case, the distal molar had tipped mesially, causing malocclusion, because the missing mandibular premolar had not been replaced.



(a)



(b)



(c)

Fig. 8 Peri-implant conditions at approximately 4 years post-surgically  
 (a) Panoramic X-ray image, (b) Periapical X-ray image of second premolar site,  
 (c) Periapical X-ray image of second molar site.

This was assumed to be indirectly responsible for subsequent loss of the second molar due to root fracture, as the mesial tipping had caused changes in occlusal contact and the oral environment, making it difficult to maintain oral hygiene.

Occlusal reconstruction of the missing second molar with a removable denture would not have improved the occlusal status of the first molar. In addition, it would have been difficult to design and maintain an abutment apparatus with adequate support on the mesially tilted first molar, which was adjacent to the missing tooth. Therefore, occlusal reconstruction using a removable

denture was judged to be unrealistic.

We then considered using a free-end bridge with a distal free-end pontic utilizing the first premolar and first molar as abutment teeth. This, however, would have involved compromising the structure of the abutment teeth and possibly a pulpectomy of the first molar due to the extensive tooth preparation required. This option, therefore, was abandoned.

In terms of implant treatment, insertion of an implant body avoiding the root of the first molar would have required a crown with a mesial cantilever. Furthermore, mesially tipped insertion parallel to the tooth axis of the first molar would have required that

occlusal force be offset with respect to the implant body. This option, too, was therefore rejected.

It was thus decided that adequate occlusal restoration of the second molar defect would be difficult while the first molar was mesially tipped, and uprighting of the first molar was considered. Conventionally, orthodontic treatment is recommended for uprighting of mesially tipped teeth. Lundgren *et al.*<sup>6)</sup> reported that after uprighting of 73 mesially tipped teeth there was no evidence of obvious changes in the surrounding periodontal tissues or alveolar bone. In the present case, there was no obvious periodontal inflammation of the tissue surrounding the mesially tipped mandibular right first molar, nor were there any changes in the mesiodistal alveolar crest after uprighting. Uprighting was expected to enable easier maintenance of oral hygiene, and was considered to be effective for the tooth concerned.

Recent advances in implant dentistry and improved procedures have led to better results for implant treatment, with increased clinical application. Because implant treatment imposes a greater burden on both patient and operator compared with a bridge or removable denture, decisions on its use should be made with caution. Conventionally, the criterion for success has been regarded as continued good functionality of the implant over a long period, but in recent years, patient satisfaction (improvement in quality of life) has also been adopted as a criterion for success<sup>5)</sup>. Today, ensuring patient satisfaction requires that problems be considered on an individual basis, and that an appropriate diagnosis and comprehensive treatment plan be made based on the specialist knowledge and skills of all the fields involved. Teamwork by specialists in different fields can be anticipated to ensure the success of complex treatment, and maintain good treatment outcome over the long term.

Carranza and Odont<sup>2)</sup> recommended that orthodontic treatment should be performed after all periodontal treatment has been completed in the formulation of a compre-

hensive treatment plan. However, Goldman and Cohen<sup>3)</sup> stated that orthodontic treatment should be performed during the initial preparation stage, as it is important to improve the oral environment. The importance of preoperative preparation of the oral environment for implant treatment was also pointed out. In the present case, interdisciplinary treatment involved the use of implants to replace the missing teeth after the mesially tipped tooth had been uprighted by means of orthodontic treatment. Four years and 10 months have passed uneventfully since occlusal function was restored. Treatment was successful and the patient has expressed satisfaction at outcome. Long-term follow-up, however, is necessary.

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