Case Report

THE USE OF AN OSSEOINTEGRATED IMPLANT FOR ORTHODONTIC ANCHORAGE TO A CLASS II DIV 1 MALOCCLUSION

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Abstract

This case report describes the use of an osseointegrated implant to maximize anchorage in a 24-year-old female orthodontic patient with an Angle Class II, Division 1 malocclusion. Preadjusted edgewise appliance therapy was performed by extraction of only the maxillary first premolars. The osseointegrated implant was placed in the median-sagittal region of the hard palate for maximum orthodontic anchorage and connected to maxillary first molar bands via a transpalatal arch. Total treatment time was 2 years and 8 months. Cephalometric superimposition revealed the achievement of maximum molar anchorage in the maxilla, resulting in satisfactory occlusal and facial improvements. Histological analysis of the implant-bone interface demonstrated that the fixture was successfully osseointegrated. In conclusion, the osseointegrated implant placed in the median-sagittal palate was shown to be an effective orthodontic system that can be used clinically as a rigid intraoral anchorage

Key words: Osseointegrated implant—Orthodontic treatment—
Orthodontic anchorage—Class II division 1 malocclusion—
Median-sagittal hard palate

INTRODUCTION

In modern orthodontics, anchorage control is critical in achieving treatment goals. Extraoral and intraoral appliances are widely used as anchorage sources, particularly when maximum orthodontic anchorage is needed. However, intraoral appliances exert recip-

cal forces to anchor teeth and can cause untoward tissue remodeling, while extraoral appliances require patient cooperation, making it difficult to ensure solid anchorage with either type of appliance⁷⁾. In recent years, osseointegrated implants have been clinically applied for temporary placement and used for intraoral anchorage^{3-5,8,10)}.

Fig. 1 Pretreatment facial photographs

This case report presents the use of an osseointegrated implant inserted in the median-sagittal region of the hard palate for maximum orthodontic anchorage in a female adult patient with an Angle Class II, Division 1 malocclusion.

CASE REPORT

A 24-year-old female patient visited Tokyo Dental College Orthodontic Clinic with protrusion of the maxillary incisors. She was healthy with no contributing medical history. The facial profile was convex with a protrusive upper lip (Fig. 1). Both arches were narrow, and the maxillary central incisors were mesially rotated. The arch length discrepancy was -6 mm in the mandible and -1 mm in the maxilla. The overbite and overjet were $+6$ mm and $+9$ mm, respectively, with the right first premolars in a scissors bite. The denture midline was deviated 1 mm. The molar relationship was full-cusp Class II on both sides (Fig. 2). The patient had good oral hygiene. The panoramic radiograph revealed horizontal impaction of the mandibular right third molar. Cephalometric analysis showed severely proclined maxillary central incisors and slightly proclined mandibular incisors with no horizontal or vertical skeletal discrep-

ancy (Fig. 3). Based on these findings, the case was diagnosed as dentoalveolar maxillary protrusion with crowding.

The treatment plan included the use of a preadjusted edgewise appliance, maxillary first premolar extraction, and surgical placement of a 5×6 mm osseointegrated implant (Brånemark System, Nobel Biocare, Sweden) in the median-sagittal palate to maximize molar anchorage (Fig. 4). The surgical method was performed according to the principles established by Brånemark *et al.*⁽²⁾. Standard leveling and alignment were performed while osseointegration was awaited, followed by second-stage surgery six months later. A 0.040-inch transpalatal arch (TPA) was soldered to an abutment, which was connected to the fixture. The TPA was then attached to the first molar bands with acrylic resin (Fig. 5). Swelling around the fixture was controlled with careful brushing. Following extraction space closure, the osseointegrated implant and TPA were removed for detailing. The patient complained of no discomfort or pain throughout the treatment period. The appliance was removed after 2 years and 8 months of treatment because satisfactory occlusal and facial improvements had been obtained (Fig. 6, 7). This was followed by retention with maxillary wraparound and mandibular canine-to-canine bonded retainers.

Fig. 2 Pretreatment study models

Superimposition of pre- and post-treatment cephalograms demonstrated no vertical changes in the mandible and 1 mm retraction of the anterior maxillary base. Maximum anchorage of the maxillary molars was maintained mesiodistally and vertically with no change in the molar relationship. The maxillary incisors were retracted 7 mm and intruded 4 mm, while the mandibular incisors were retracted 3 mm and intruded 2 mm (Fig. 8).

The histopathological examination of the removed implant-bone interface showed little inflammatory cell infiltration around the fixture. While the cervical part of the fixture was surrounded by a highly fibrotic connective tissue with a low cell content, the apical half was in direct contact with dense lamellar bone, demonstrating that the fixture was successfully osseointegrated (Fig. 9).

Measurements	Mean $\pm$ S.D.	Patient
Facial angle (deg.)	85.9 $\pm$ 1.69	86
Convexity (deg.)	5.5 $\pm$ 2.93	4
A-B plane (deg.)	-4.3 $\pm$ 1.81	-6
Mandibular plane (deg.)	26.4 $\pm$ 3.83	27
Y-axis (deg.)	64.3 $\pm$ 2.27	68
Occlusal plane (deg.)	8.6 $\pm$ 5.56	9
Interincisal (deg.)	121.9 $\pm$ 3.69	106
L-1 to Occlusal (deg.)	23.7 $\pm$ 5.30	29
L-1 to Mandibular (deg.)	98.2 $\pm$ 4.08	101
U-1 to A-P plane (mm)	9.2 $\pm$ 2.24	13
FH to SN plane (deg.)	5.8 $\pm$ 3.07	5
SNA (deg.)	83.2 $\pm$ 3.44	82
SNB (deg.)	80.4 $\pm$ 3.22	80
SNA-SNB diff. (deg.)	2.8 $\pm$ 1.80	2
U-1 to FH plane (deg.)	115.2 $\pm$ 5.86	126
L-1 to FH plane (deg.)	58.0 $\pm$ 5.98	52
Gonial angle (deg.)	120.2 $\pm$ 4.04	119
Ramus angle (deg.)	85.7 $\pm$ 4.55	88

Fig. 3 Tracing and measurements of pretreatment cephalometric radiograph

Fig. 4 Cephalometric radiograph after insertion of osseointegrated implant

Fig. 5 Intraoral occlusal view after space closing. The maxillary first molars are anchored by the implant throughout the TPA.

Fig. 6 Posttreatment facial photographs

Fig. 7 Posttreatment study models

DISCUSSION

In many of the previously reported cases using osseointegrated implants for orthodontic anchorage, the same implants were subsequently utilized to support superstructures replacing missing teeth. Patients with a complete dentition, however, have little space available within the dental arch for implant placement, limiting the number of indications for orthodontic implants. To solve this

problem, alternative implant sites have been used such as the retromolar^{4,8)} and ramus regions^{6,9)} in the mandible and the mid-palatal area^{3,5,10)} in the maxilla. Bernhart *et al.*¹⁾ stated that the median-sagittal region of the hard palate as a suitable location for implant placement is surgically very well accessible and offers a higher amount of bone support and excellent peri-implant conditions due to the attached mucosa. In Japan, however, there have been few reports on orthodontic treat-

Fig. 8 Composite of pretreatment and posttreatment tracings of cephalometric radiograph. Solid line: pretreatment; dashed line: posttreatment.

Fig. 9 Longitudinal section of the implant-bone interface after two years. A: The cervical part of the fixture was surrounded by highly fibrotic connective tissue with a low cell content (a), the apical half was in direct contact with dense lamellar bone (b). Original magnification $\times 3.125$. B: Higher magnification of boxed area in A. The implant was successfully integrated into the bone. Original magnification $\times 25$. (Toluidine blue stain)

ment using a palatal implant for maximum anchorage.

It is important to ensure an accurate connection between the fixture and anchor teeth to achieve maximum anchorage. The common method reported in the literature^{3,10)} is to solder a TPA to maxillary second premolar bands and connect the TPA with the palatal

fixture via an abutment. With this method, however, the fixture may be overloaded due to inaccuracy of fit between the components. Therefore, we chose maxillary first molar bands with a wider surface area to improve the accuracy of connection. A mesh-base was soldered inside out to the lingual surface of each molar band, and another mesh-base

was soldered to each end of the TPA. The two corresponding mesh-bases were bonded together with a direct bonding material after the TPA was connected to the fixture.

The osseointegrated implant provided the maxillary molars with maximum anchorage not only mesiodistally but also vertically, allowing adequate retraction of the maxillary anterior teeth and bite opening through intrusion of the mandibular incisors without clockwise rotation of the mandible. The use of the implant also eliminated the need for Class II intermaxillary elastic bands, making it possible to retract the mandibular incisors to an ideal position. These are favorable tooth movements that enhance post-treatment occlusal stability and esthetics.

Higuchi and Slack⁴⁾ reported that all of 14 implants inserted into the mid-palatal and the mandibular retromolar areas in humans for orthodontic anchorage were stable during the entire orthodontic treatment period, with no observed mobility. Furthermore, the histomorphometric evaluation made by Wehrbein *et al.*¹¹⁾ indicated that all the implants serving for orthodontic anchorage were well integrated into bone despite the prolonged application of orthodontic loading. In the present case, the palatal implant remained clinically stable throughout the treatment period with no marked inflammatory response in the peri-implant mucosa and was successfully osseointegrated into bone in the histopathological examination.

In conclusion, the osseointegrated implant placed in the median-sagittal palate was shown to be an effective orthodontic system that can be used clinically as rigid intraoral anchorage.

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