Implant-supported removable partial dentures with magnetic attachments using selective laser-sintered frameworks: A Case report

IMAIZUMI N,[1,2)] SUZUKI Y,[1,2)] NAKATA T,[1,2)]
SHIMPO H,[1,2)] KURIHARA D,[1,2)] OHKUBO C[1,2)]

[1)]Dept. of Removable Prosthodontics, Tsurumi University School of Dental Medicine
[2)]Center of Maxillofacial Implantology, Tsurumi University Dental Hospital

Abstract

【Objective】
A removable partial denture framework can now be fabricated with Co-Cr and titanium alloys by selective laser melting (SLM), a rapid prototyping technology. The advantages of this technology are high precision, appropriate mechanical strength, and the ability to make complicated framework shapes. In this case, CAD/CAM technology was used to fabricate a denture framework and bar attachment with magnets for an implant-supported removable partial denture (IRPD).

【Method】
A bar attachment for an IRPD was milled from a pure titanium disk within the wax denture, and the magnetic attachment keeper was placed on it. After the working cast with a bar attachment and the wax denture were both scanned, the denture framework was designed by CAD. The framework was then fabricated by SLM with Ti-6Al-4V alloy powder.

【Results, Discussion】
A titanium milled bar attachment with magnets and a laser-sintered framework were used for the IRPD. Greater retention, as well as increased strength and accuracy, can be obtained using magnetic attachments and CAD/CAM technology.

Introduction

In recent years, CAD/CAM technology has been successfully introduced into restorative dentistry and maxillofacial technology. Moreover, selective laser melting (SLM) rapid prototyping technology can be applied successfully for the fabrication of a removable partial denture alloy framework. The advantages of this technology are high precision, appropriate mechanical strength, and the ability to make complicated framework shapes. This case report describes the fabrication of a denture framework and bar attachment with magnets for an implant-supported removable partial denture (IRPD) using CAD/CAM technology.

Outline of the Case

The patient was a 67-year-old partially edentulous woman with 5 remaining teeth (#17, #23, #25, #26, and #27) in the maxillary arch and 4 missing teeth (#36, #37, #46, and #47) in the mandibular arch. Her chief complaint was an unstable existing maxillary denture. A panoramic radiograph showed severe ridge resorption in the maxillary molar regions (Figs.1, 2).

The patient was informed about the possibility of using a conventional removable partial denture, implant-fixed prosthesis, and IRPD for the maxillary and mandibular jaws. After giving informed consent, the patient selected an IRPD for the maxillary jaw and an implant fixed prosthesis for the mandibular jaw.

Fig.1 Intraoral view before treatment:
A. Frontal view B. Maxillary occlusal view C. Mandibular occlusal view

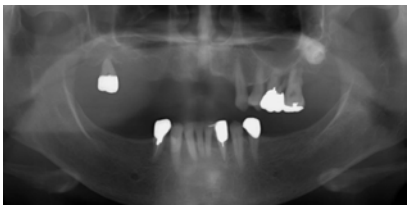

Fig.2 Pretreatment panoramic radiograph

Clinical Procedure

After CT scanning to produce 3D computer-generated images, the position and direction of implant placement were virtually planned using 3D planning software. The simulation data of implant placement were sent to the dental laboratory for the fabrication of the surgical template (Fig.3).

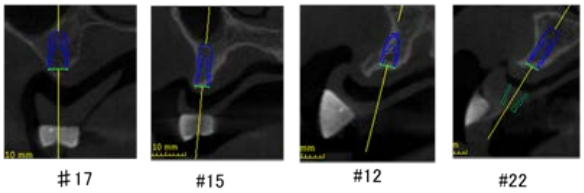

Fig.3 The simulation of implant placement for the maxillary jaw

After #17 was extracted and the surgical template was fixed in the patient's mouth, the implants were placed using the Guided Surgery System (Straumann Japan, Tokyo) (Fig.4). According to the surgical guide, four implants were placed in the #17, #15, #12, and #22 regions in order to minimize the denture displacement under the bite force in the maxillary jaw (Fig.5). In the mandibular jaw, four implants were placed in the #47, #46, #36, and #37 regions for implant-fixed prosthesis (Fig.6). After implant placement, 2 remaining teeth (#26 and #27) were extracted due to severe periodontal disease.

Fig.4 Surgical guide fixed in the mouth

Fig.5 Placement of four implants in the maxillary jaw

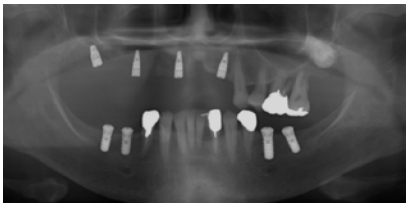

Fig.6 Postoperative panoramic radiograph

After a period of healing, implant-fixed prostheses were fabricated for the mandibular jaw using CAD/CAM. The frameworks of implant superstructures were virtually designed and milled using commercially pure titanium (CP Ti). After implant-fixed prostheses were completed, they were placed on the implant using a retaining screw (Fig.7). In the maxillary jaw, the working casts were produced according to the conventional impression technique. The jaw relationship was recorded, and the artificial teeth were conventionally arranged (Fig.8).

Fig.7 Completed mandibular prosthesis

Fig.8 The artificial teeth were conventionally arranged.

The working cast was scanned by using a laboratory scanner (D2000, 3Shape). The bar attachment was virtually designed within the wax denture using 3D CAD software (Dental Designer, 3Shape) and milled from a CP Ti disk (Figs.9, 10). The keeper of the magnetic attachment（Physio Magnet, NEOMAX）was attached on the bar. After the working cast with a bar attachment and the wax denture were both scanned, the denture framework was virtually designed with 3D CAD software (Dental Lab System, SensAble Technologies) (Fig.11). During the SLM process, the support was attached on the occlusal surface of the denture framework. The framework was fabricated by SLM with 50 μm Ti-6Al-4V alloy powder (Fig.12). After the metal framework was cut from the support, it was finished and polished.

Fig.9 The bar was designed virtually.

Fig.10 The bar was milled from a CP Ti disk.

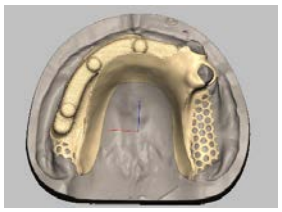

Fig.11 Screen captures of the virtual IRPD framework

Fig.12 The support was attached on the occlusal surface of the framework.

Fig.13 Completed denture framework

Using heat-polymerized PMMA (Acron, GC Corp.), an IRPD with a laser-sintered framework was conventionally completed (Figs.14, 15). The magnetic assembly was connected to the denture base with auto-polymerized resin under occlusal force. Sufficient retention was obtained with a titanium milled bar and magnetic attachments. No clinical problems, such as detachment of the magnetic attachment, decreased retentive forces, and denture breakage, were observed.

Fig.14 Trial placement of the bar with keepers of the magnetic attachment

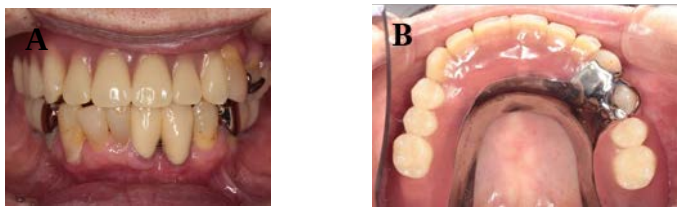

Fig.15 Completed maxillary IRPD: A. Frontal view B. Maxillary occlusal view

Results

Greater retention, as well as increased strength and accuracy, can be obtained using magnetic attachments and CAD/CAM technology.