Troubleshooting implant dentures with magnetic attachments

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Abstract

【Objective】
Two cases of postoperative complications of implant overdenture (IOD) and implant removal partial denture (IRPD) were improved by the use of magnetic attachments.
【Summary of the case】
Case 1: 76-year-old man. After an IRPD was placed in the maxilla at a private dental clinic, the patient came to our clinic with a complaint of dislocation of the artificial tooth; the IRPD had been repaired many times. Increased vertical dimension, new Co-Cr IRPD with magnetic attachments was delivered.
Case 2: 73-year-old man. A maxillary IOD with locator attachments was worn, but he requested re-make due to mastication disorder and denture fracture. Existing implants were placed without parallelism, so an IOD with a bar attachment and a magnetic attachment was fabricated.
【Results and Discussion】
In order for IODs and IRPDs to achieve good results for long term period, the characteristics of the attachments must be exactly understood and the IOD should be carefully designed and fabricated.

I. Introduction

Implant over denture (IOD) and implant removal partial denture (IRPD) are highly effective, even with a small number of implants, and have excellent treatment effectiveness. Therefore, their demand in Japan, a super-aged society, is increasing.

II. Objective

Two cases of postoperative complications of IOD and IRPD were greatly improved by changing the implant superstructure design.

Case report

Case1

1 Patient Information

The patient was a 76-year-old man who presented to our university hospital with a chief complaint of broken dentures and difficulty chewing. At the family dental clinic, four implants were placed in the maxilla, and an IRPD was delivered (Fig. 1). At the first consultation, in 2014, the artificial tooth had detached from the IRPD, and the denture base showed evidence of repeated repairs (Figs. 2, 3). There were no special notes on his general history.

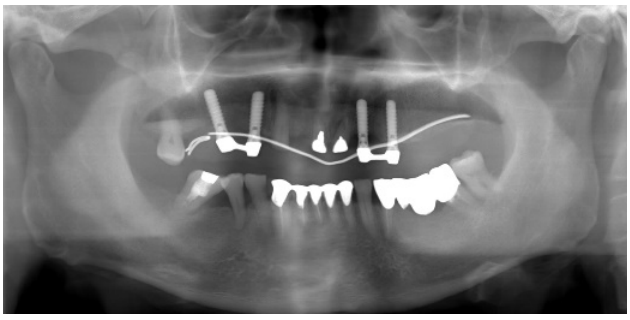

Fig 1. Panoramic radiograph at the first examination

Fig 2. Intraoral views at the first examination

Fig 3. Intraoral photographs without IRPD at the first examination

2 Treatment Procedures

The occlusal vertical dimension of the existing denture was decreased. Therefore, bite raising was first performed using a treatment denture and then an IRPD was fabricated as a definitive denture. For implant attachments, a combination of magnetic and locator attachments was chosen based on comprehensive consideration of the denture space, cleanability, implant placement direction, and retentive force.

1) Since the vertical space on the bar attachment was insufficient, the healing abutment (2 mm height) was replaced (Fig. 4). An acrylic denture with a cast clasp on the maxillary right third molar was delivered as the treatment denture, and 3 mm of the vertical dimension was increased (Fig. 5).

Fig 4. The bar attachment was replaced with a healing abutment.

Fig 5. Vertical dimension of 3 mm was increased using a treatment denture.

2) Using the treatment denture, no symptoms of occlusal discomfort or disharmony were observed in the remaining teeth or temporomandibular joints. Thus, the increased occlusal vertical dimension was deemed adequate. To fabricate the definitive denture, impressions were made using a custom tray and impression copings, followed by recording the maxillomandibular relationship, and try-in of the wax denture. Additionally, a functional generated path (FGP) was recorded (Fig. 6).

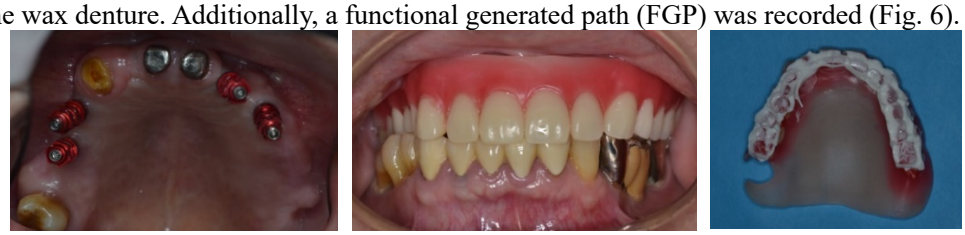

Fig 6. a. Screwed impression copings, b. Wax denture try-in, c. FGP

3) For the definitive denture, a Co–Cr alloy framework with a metal backing was designed so the anterior region would enhance the denture's strength and rigidity. The denture base was designed as a horseshoe shape to minimize the foreign body sensation. As for the retainers, an Aker's clasp was designed for #18, and magnetic attachments were placed on #14 and #23. Locator attachments were selected for #15 and #24 (Fig. 7).

Fig 7. Definitive denture

3 Results

After using the new denture (Fig. 8), there was no pain, and the adaptation of the denture base to the mucosa was favorable. Furthermore, fully bilateral balanced occlusion was provided to suppress denture movement and prevent lateral forces. In the occlusal force examination using Dental Prescale (GC, Tokyo), improved masticatory performance was confirmed (Fig. 9).

Fig 8. Intraoral photograph with denture in situ

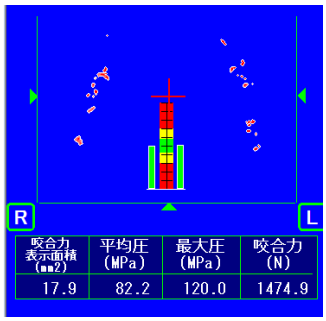

Fig 9. Postoperative Dental Prescale results

Case2

4 Patient Information

The patient was a 73-year-old edentulous man. He had received three implants in the maxilla and two in the mandible at another dental clinic, and IODs were placed (Figs. 10, 11). Subsequently, he experienced ease of removal of the maxillary denture and pain in the mucosa under the mandibular denture. At his first visit, there was evidence of multiple repairs to the maxillary IOD, and the attachment females were detached (Fig. 12). The mandibular denture caused pain in the molar region. His medical history includes a vomiting reflex.

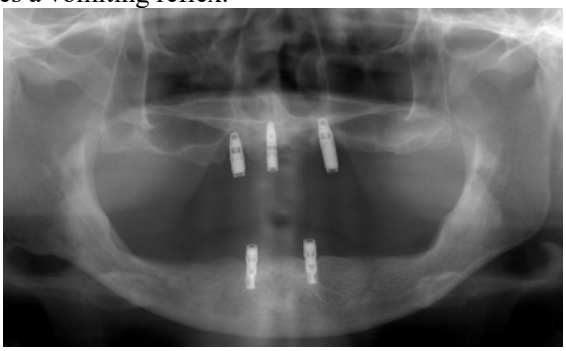

Fig 10. Panoramic radiograph at the first examination

Fig 11. Intraoral views at the first examination

Fig 12. Existing denture with multiple repairs

5 Treatment Procedures

It was determined that the lack of parallelism in the placement of the maxillary implants contributed to the reduced retention of the attachments and dislodgement of the denture. To improve the survival rate of the implants, it was necessary to distribute the load on them. However, the patient declined additional implant placement. Therefore, the implants were connected using a milling bar to reduce the load on each individual implant. On the other hand, a design using both milling bar and attachments would result in insufficient vertical space. Therefore, magnetic attachments were selected on the bar. As both maxillary and mandibular dentures lacked a reinforcing structure directly above the implants, metal-structured dentures with Ti alloy frameworks were fabricated.

1) Initially, a metal verification jig was fabricated on the definitive cast to confirm the accurate positional relationship of the implants (Fig. 13). For impression taking, impression copings and a custom tray were prepared, and an impression was taken using a silicone rubber impression. For the maxillomandibular relationship record, the occlusal vertical dimension was increased by 4 mm, and a wax denture was fabricated and tried in.

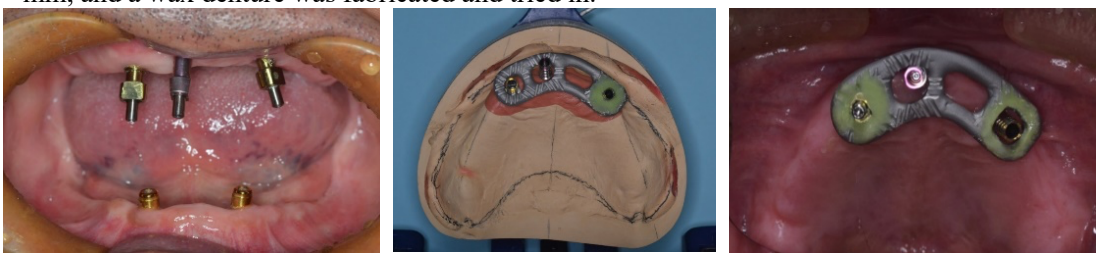

Fig 13. a. Placement of impression copings, b. Verification jig, c. Jig fixed to coping

2) Following the wax denture try-in, 3D data of the wax denture and definitive cast were acquired using a laboratory scanner. The bar was designed on CAD software, while the amount of denture space available was confirmed (Fig. 14). Based on the obtained STL data, the bar was milled from a Ti-6Al-4V alloy disk. The incorporation of magnetic attachments into the milling bar achieved both the distribution of occlusal forces and an improvement in retention. Locator attachments were selected for the mandible (Fig. 15).

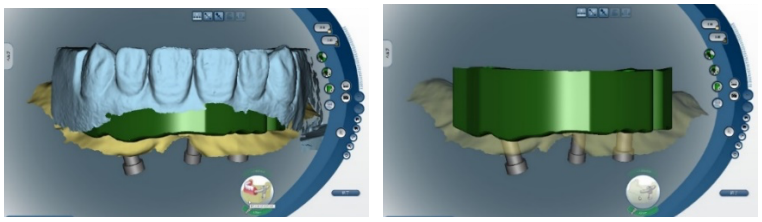

Fig 14. Design of the maxillary milling bar

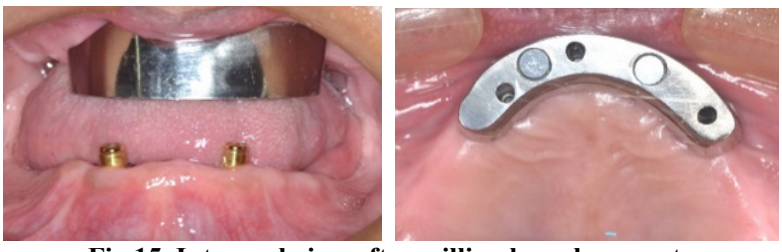

Fig 15. Intraoral view after milling bar placement

3) Following milling bar placement, the framework was fabricated. The cast with the bar attachments was scanned on the lab scanner, and the framework was designed using CAD software. The metal framework was fabricated using additive manufacturing with selective laser melting

(SLM) of Ti-6Al-4V alloy powder using the 3D data (Fig. 16). After the resin pattern for the mandibular framework was fabricated using additive manufacturing, the pattern was cast using a Co–Cr alloy (Fig. 17).

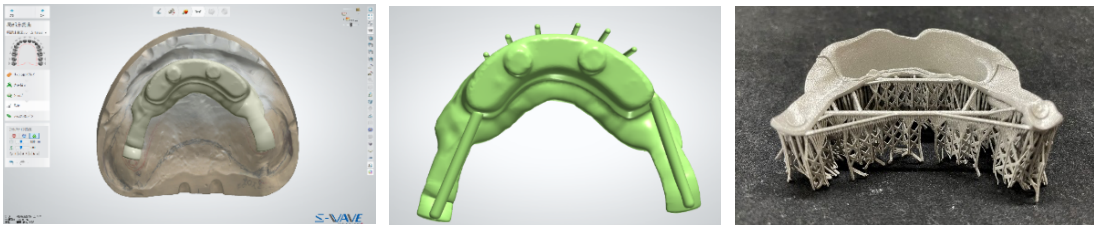

Fig 16. Maxillary framework fabricated using CAD/CAM (additive manufacturing)

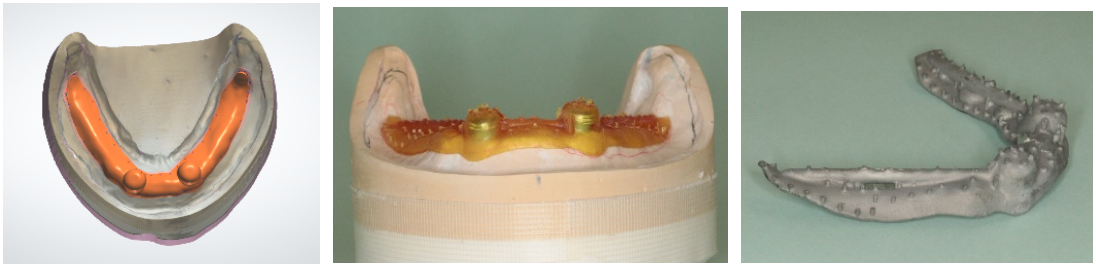

Fig 17. Mandibular Co–Cr framework cast by resin pattern using CAD/CAM (additive manufacturing)

4) The precise fit between the CAD/CAM-fabricated bar attachments and the framework provided robust support and retention. Furthermore, retention was reinforced with magnet attachments. The posterior border of the maxillary denture was shortened to minimize the vomiting reflex. For the mandible denture, the framework was designed to be covered on the attachments with housings to prevent denture fracture (Fig. 18).

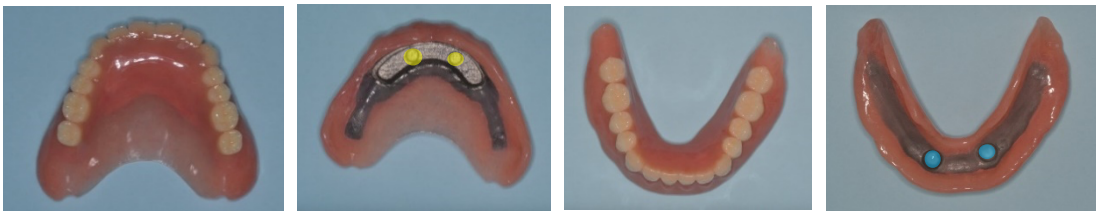

Fig 18. Definitive denture

● : Magnet attachments
● : Locator attachments

6 Results

As compared to the previous dentures, the overjet and overbite relationships were improved, and the esthetic was significantly improved as well. The patient's chief complaints of maxillary denture removal and mandibular denture pain were also resolved. Results of the adaptation and occlusion examinations revealed no areas of discomfort, and excellent adaptation of the denture base to the mucosa was observed (Fig. 19). Dental Prescale examination results showed an approximately five-fold increase in the occlusal contact area and an approximately 6-fold increase in the occlusal force as compared to the existing denture, indicating an improvement in masticatory performance (Fig. 20). Patient satisfaction also improved.

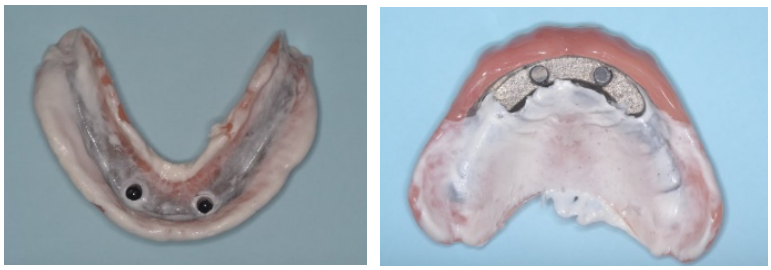

Fig 19. Evaluation of denture fitness using Fit Checker

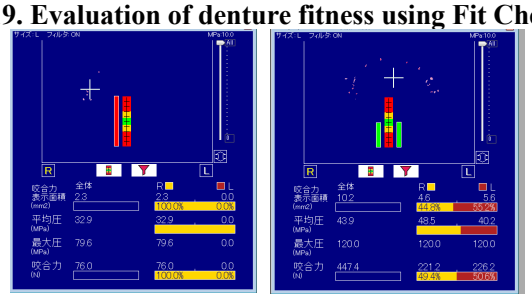

Fig 20. Dental Prescale results (left: preoperative; right: postoperative)

Fig 21. Intraoral view of new maxillary and mandibular IODs

III. Discussions

Maxillary IODs and IRPDs can achieve high treatment effectiveness with a small number of implants. Furthermore, in Japan, which is a super-aging society, the demand for these treatments is expected to increase, as they can adapt to changes even if a patient's independence declines.

However, complications are likely to occur, and additional treatment is required after dentures are delivered. Therefore, although the initial cost of IODs and IRPDs is low, the total treatment cost may be high.

IV. Conclusions

In both cases, no complications—such as implant loss, decreased attachment retention, or denture fracture—have occurred since the delivery of the new dentures. To achieve a favorable long-term prognosis for IODs and IRPDs, it is essential to have a thorough understanding of the characteristics of the attachments and to design highly rigid dentures.