

Digital Fabrication of a Repositioning Jig for Multiunit Abutments Placement: A Dental Technique

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ABSTRACT

An implant abutment repositioning jig (IARJ) is used to ensure easy and accurate placement of angled multiunit abutments (MUAs). This report describes a technique, a digital workflow, and fabrication of IARJ.

Keywords: 3D Printing, Abutments, CAD/ CAM, Complete denture, Dental Implants, Dental prostheses, Edentulism, Full mouth rehabilitation, Rapid Prototyping, Stereolithography.

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BACKGROUND

The implant-supported fixed complete denture (ISFCD) is a predictable treatment option in the restoration of the edentulous arch situations.¹ Advancements in computer-aided design and computer-aided manufacturing (CAD-CAM) have improved the workflow efficiency in ISFCD fabrication.²⁻⁵

Screw-retained ISFCDs are widely used as they are easily retrievable when complications occur and for future maintenance. Multiunit abutments that come in different heights and angulations are used to achieve a favorable screw access for tilted implants and to raise the prosthetic platform above the tissue level. Though MUAs selection can be performed intraorally, the process can be time-consuming and tedious. In the patient situation discussed, an implant-level impression was made and a cast with implant analogs was used to select the MUAs extraorally. The MUAs have multiple possible placement orientations based on the implant connection geometry. For the experienced clinician, orienting or replacing the MUAs intraorally could be a straightforward procedure; however, for a less experienced clinician, this may be time-consuming and challenging. Several techniques have been reported of using a repositioning jig to achieve easy and accurate positioning of MUAs on implants.⁶⁻¹² Wu et al. used¹³ an analog method of fabricating a repositioning device using acrylic resin for placing multiple multiunit abutments. Hess et al.¹⁴ reported the use of a guide to replace a fractured angulated MUA supporting an existing ISFCD. This technique relied on the definitive cast used for ISFCD fabrication being readily available from which the orientation of the MUA to be replaced was determined. An autopolymerizing resin index was fabricated to seat the new MUA in the exact position as the fractured MUA being replaced. If the definitive cast had not been available, additional steps would have been required. This technique paper describes the designing and fabrication of a digital CAD-CAM IARJ by using additive manufacturing.

CASE TECHNIQUE

- Make an implant-level splinted open-tray impression with polyvinyl siloxane (PVS) impression material (Aquadent Light and Heavy Body; Dentsply Sirona) to fabricate a definitive cast to select the appropriate MUA height and angulation.

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- Choose the optimal angulation and height of MUA (Institut Straumann AG) on the implant cast and then use the MUA handles to secure the MUAs in place. The MUA handles remain on the cast and serve as a visual guide to confirm the correct orientation for the MUAs (Fig. 1).

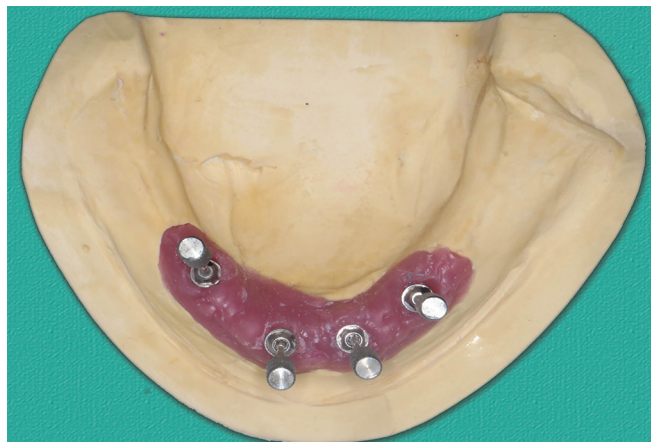


Fig. 1: Definitive cast occlusal view with MUAs in position

- Scan and digitize the definitive cast with abutment handles using a laboratory scanner (D900; 3Shape) in a standard tessellation language (STL) file format (Fig. 2).
- Import the STL file into an open-source software program (Meshmixer, v3.5; Autodesk) to design the IARJ using the specific dimensions of the Straumann MUA's handles, which is 1 mm (Fig. 3).

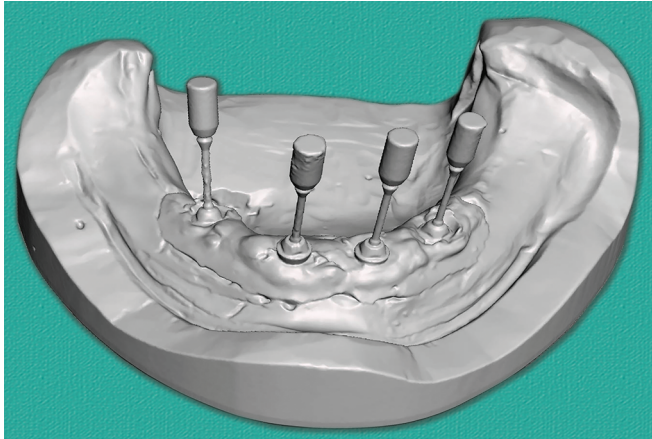
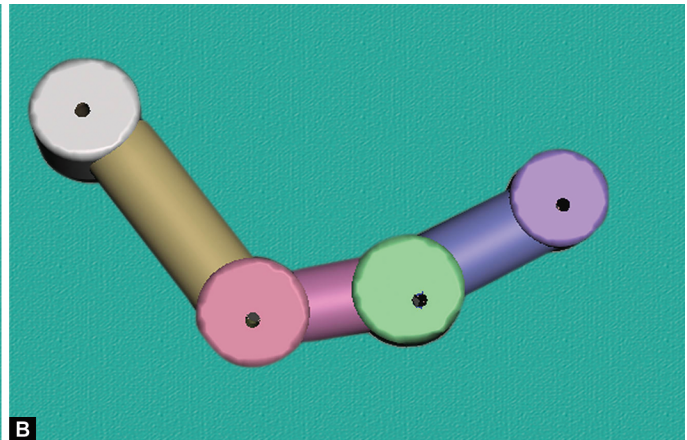
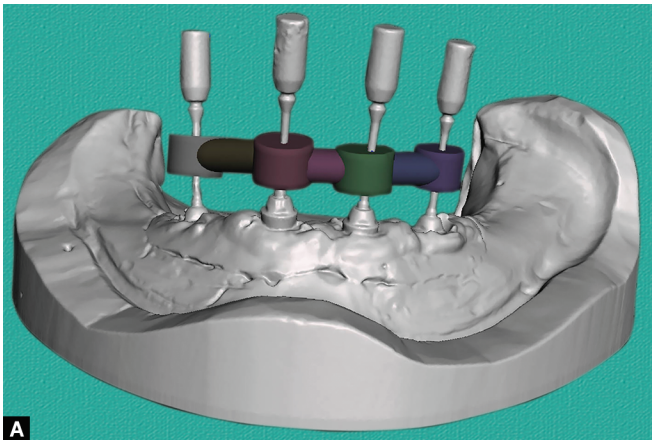
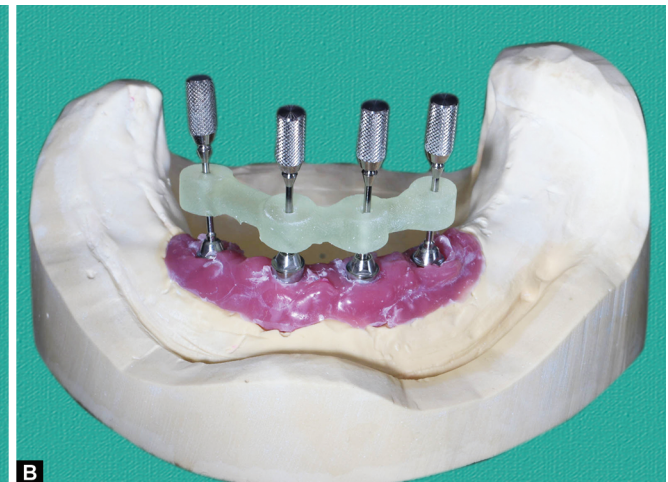
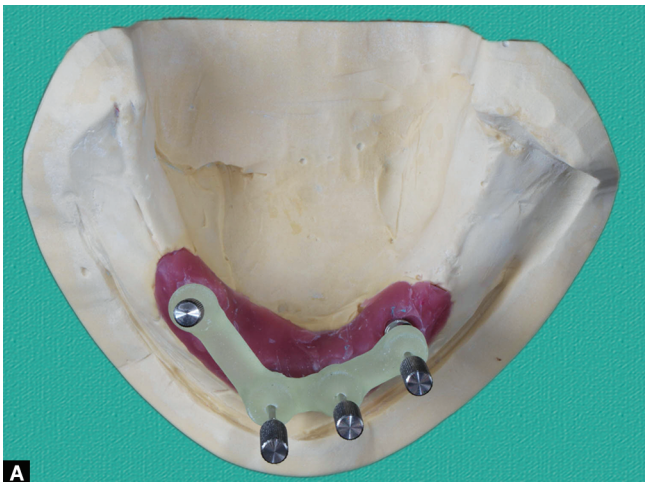


Fig. 2: Digitized view of definitive cast with MUA handles

- Print the IARJ using a 3D printer (Form2, Formlabs, Somerville, MA) with surgical template resin (Formlabs, Somerville, MA) and separate the struts from the 3D printed IARJ.
- Remove the MUA handles from the implant cast and then thread each abutment handle through each orientation hole and replace the assembly on the definitive cast and confirm that the handles are seated correctly on each MUA. Surgical template resins (Formlabs, Somerville, MA) can be added to the MUA's orientation holes, where the MUA's handles are. If the MUA's handles are not secure before placement of the definitive cast with MUA's handles in the light polymerizing unit.
- Place the implant cast with IARJ and MUA's handles in a light polymerizing unit of 405 nm wavelength. Light polymerize the IARJ for 30 minutes based on manufacturer's recommendation (Formlabs, Somerville, MA). The polymerization shrinkage firmly secures the printed IARJ resin to the MUA handles (Fig. 4).
- Remove the IARJ with the MUAs handles and the MUAs from the implant cast and disinfect.
- Place the IARJ using the MUA handles to orient and seat the MUAs intraorally after removing the healing abutments. The angled MUAs orient easily and correctly on the implants by the help of the straight MUAs in place (Fig. 5).
- Orient the handles to the MUAs using the IARJ with the seating verified clinically (Fig. 6).



Figs 3A and B: (A) Frontal view of IARJ digital design on definitive cast. (B) IARJ design with orientation access holes



Figs 4A and B: Implant abutment repositioning jig printed from biocompatible resin (Dental SG; Forms Lab) in a 3D printer (Form2, Forms Lab): (A) Occlusal view; (B) Frontal view

- Identify the screw access holes and then the angled MUA's screws can then be screwed into the implant through the IARJ (Fig. 6).
- Confirm the fit of MUAs by taking periapical radiographs, torque to manufacturer's recommendation, and proceed to abutment-level impression.

DISCUSSION

Digital technology continues to improve the treatment workflow and outcomes. This technique paper reports use of digital technology in the fabrication of a 3D printed IARJ. Easy and accurate position of the MUAs can be achieved with this technique. The slight polymerization shrinkage of the 3D printed resin helps to secure the MUAs handles to the IARJ. This technique is similar to the one reported by Wu et al.¹³ except for the digital method used for fabricating the IARJ. The IARJ can be used for the future maintenance and replacement of any of the MUAs. Various studies have reported the occurrence of dimensional discrepancies from the post-processing protocol used for printed resin.^{15,16} Ammoun et al.¹⁶ reported that there is a dimensional error of <0.18 mm when using a post-fabrication final light polymerization of the 3D printed surgical guide. The polymerization shrinkage of the surgical template resin (Dental SG; Forms Lab) serves to securely splint the abutment drivers that are used to orient each MUA.

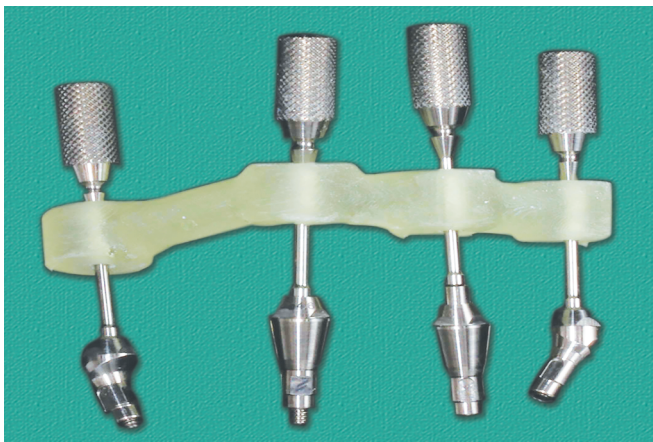


Fig. 5: Extraoral view of IARJ

This shrinkage serves as an advantage for this technique and was serendipitously discovered when final light polymerization was performed of the printed surgical guide with the MUA's handles in place and secured on the abutments of the definitive cast.

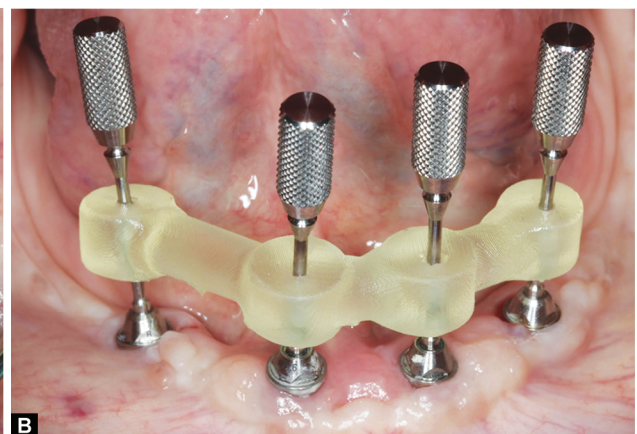
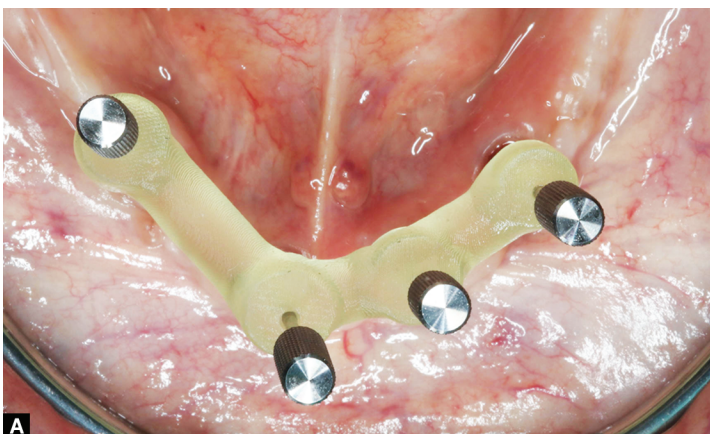
The presented technique has several advantages; it serves as an accurate seating jig for the planned MUA orientation intraorally, and the data of fabrication can be archived electronically for future use either for maintenance or abutment replacement.

CONCLUSION

Use of digital technology in IARJ fabrication offers certain advantages such as an easy archiving STL file, fabrication for future maintenance or replacement of MUAs if needed, and serves easy approach to orient and place fractured or new MUAs. This digital fabrication of IARJ appeared to be alternative and eliminates the conventional resin fabrication method.

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Figs 6A and B: Intraoral view of IARJ: (A) Occlusal view; (B) Frontal view

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