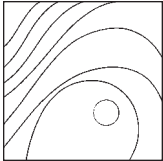


# Integrating Analog and Digital Workflow to Fabricate Implant Mandibular Complete Overdenture with a Milled Titanium Bar: A Clinical Report



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*Implant mandibular complete overdenture (IMCO) is a reliable prosthetic option. However, clinical and laboratory complications are associated with these restorations if not executed properly. In this clinical report, the combination of analog and digital workflow helps minimize the chairside time with fewer visits, which improves efficiency and patient satisfaction.* Int J Periodontics Restorative Dent 2023;43:e111–e115. doi: 10.11607/prd.5975

Attempts have been made to introduce computer technologies since the early 1990s.<sup>1</sup> Monolithic multichromatic CAD/CAM complete dentures possess several advantages, such as better denture retention, better adaptation to the edentulous mucosa, and reduced residual monomer.<sup>2</sup> In addition, the incorporation of CAD/CAM technology into complete denture fabrication has led to reduced laboratory and chairside time.<sup>3</sup> Digital applications of implant therapy include 3D diagnostic imaging, implant planning, fabricating different types of surgical templates, and prostheses.<sup>4</sup>

Several CAD/CAM manufacturers have complete denture-fabrication protocols, requiring specific materials and dedicated tools. According to these manufacturers and some studies, promising results may be obtained.<sup>2</sup> However, with an inexperienced clinician, obstacles have been reported with impressions and arch relation when using the manufacturers' protocols.<sup>5</sup> Treating edentulous arches with implants adds to the overall complexity of the digital workflow, especially during the digital implant scan. For instance, the absence of fixed structural landmarks on completely edentulous ridges makes the superimposing of scans inaccurate for removable prostheses. Different reports were proposed in the literature to overcome

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**Fig 1** Pretreatment (a) facial, (b) occlusal, and (c) panoramic radiographic views.



**Fig 2** The tooth-mold template was attached to the maxillary occlusal rim for the patient to visualize the future set-up of their anterior teeth.

this issue in the edentulous maxilla.<sup>5</sup> To the present author's knowledge, no technique was suggested in the literature to overcome the obstacle of making a complete digital workflow to fabricate an implant mandibular complete overdenture (IMCO) with a milled titanium bar.

The purpose of this report is to present a combination of analog and digital workflows to fabricate IMCO with a milled titanium bar for a patient with inadequate removable prostheses.

## Clinical Report

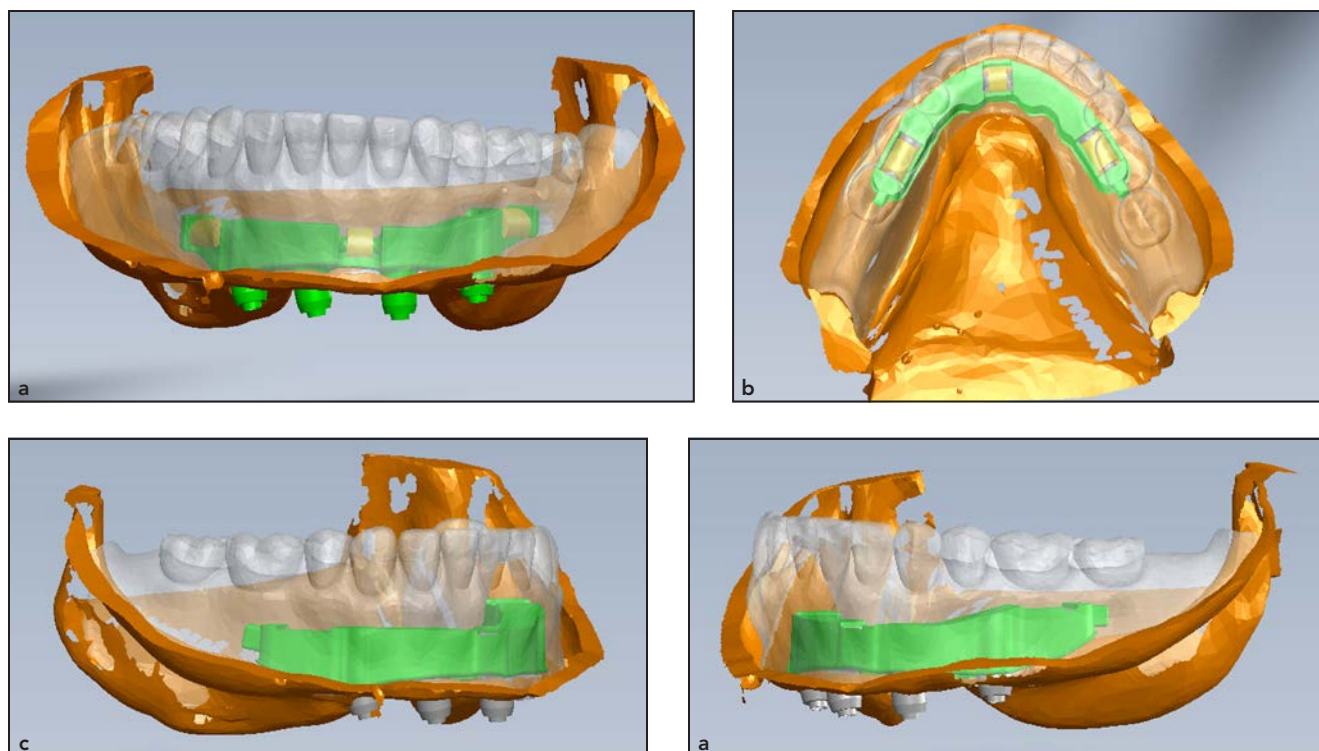
A woman presented to the Department of Prosthetic Dental Sciences, complaining that, "My dentures are unstable. I hate those clips under my lower denture; they're not holding it at

all." The patient was 64 years old with no medical issues reported (blood pressure = 126/71; pulse = 70; and respirations = 17/minute). There was no pronounced facial asymmetry or muscle tenderness, and she had an oval facial form and exhibited a convex soft tissue profile. At presentation, the patient had 2-year-old prostheses attached to four mandibular implant locators with poor height selection (Fig 1). The oral mucosa appeared to be inflamed and irritated. In addition, the patient had pain in the area of mental foramen while using the prostheses due to severely atrophic residual ridges. Radiographic examination showed a normal bony pattern with no abnormalities for the surrounding structure.

Preliminary impressions using an alginate material (Jeltrate Plus, Dentsply Sirona) were made to fab-

ricate preliminary casts. Custom trays were made for both arches with acrylic resin (Triad, Dentsply Sirona). The mandibular implants were splinted with self-cure acrylic resin (Pattern Resin, GC America) for an open-tray impression. Polyvinyl siloxane impression material (Examix NDS, GC America) was used to impress both arches and then poured into type III stone (Microstone, Whip Mix). Maxillary and mandibular occlusal rims were made to assess the patient's occlusal vertical dimension, esthetics, and phonetics. A small tooth-mold template (AvaDent) was attached to the maxillary record base for the patient to visualize the future anterior teeth set up (Fig 2), followed by centric relation and facebow records using polyvinyl siloxane interocclusal registration material (Exabite II NDS, GC) to orient the maxillary arch to the terminal hinge axis.

Casts were articulated on an adjustable articulator (Hanau Modular Articulator 194, Whip Mix), then scanned in centric relation using a digital scanner (NobelProcera, Nobel Biocare). The CAD/CAM bar was designed according to the patient's implant positions and prosthetic space; it was made with a taper between 4 and 6 degrees and three



**Fig 3** (a) Facial, (b) occlusal, (c) right-side, and (d) left-side views of the digital bar design.

bar anchorage systems (Hader, Preat) for better retention, then sent to the lab (NobelProcera Innovation Center) for fabrication. The metallic superstructure was fabricated of cobalt-chromium alloy to seal the borders and minimize food impaction, and it was made to accommodate the Hader clips anchorage system (Fig 3). Then, the records and the milled bar were sent to AvaDent for virtual set-up of the teeth. An experienced lab technician made the virtual teeth set-up, then reviewed and approved it (Fig 4).

Both prostheses were milled from cross-linked PMMA material (XCL-1, AvaDent) (Fig 5). The milled titanium bar was tried on, and the seating was verified (Fig 6). During the same visit, both the maxillary complete denture and IMCO

were delivered (Fig 7). Adjustments were made by applying pressure-indicating paste (PIP, Mizzy). Prostheses were then delivered to the patient, and the occlusion was modified. The patient was happy, and she was seen 24 hours later for a recall visit.

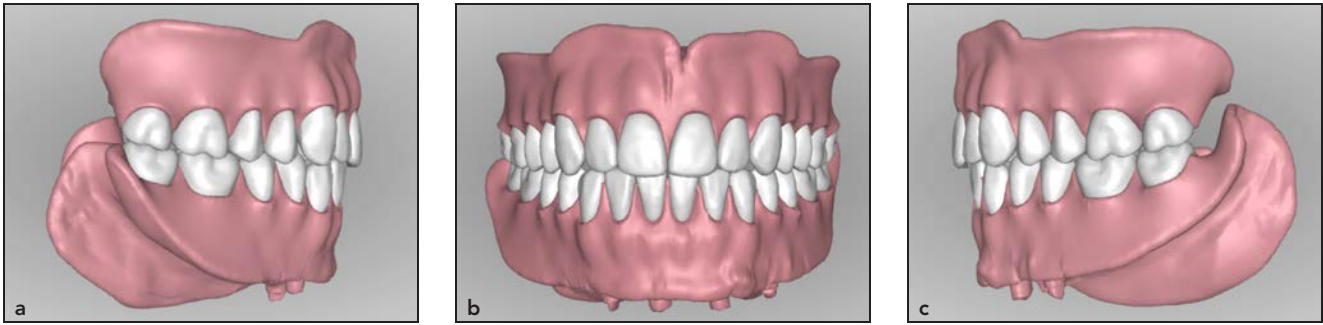
### Discussion

The prosthodontist's experience may affect the patient's treatment choice. Therefore, providing the patient with thorough information regarding the treatment options and limitations may help to achieve a satisfactory outcome. In a systematic review by Fitzpatrick, there was a strong association between diagnostic mistakes and a lack of infor-

mation about complications that occurred.<sup>6</sup>

Placing implants in the edentulous mandible provides the prosthesis with retention, stability, and support.<sup>7</sup> Treating the edentulous mandible with two implants was suggested in the 1980s. The McGill consensus suggested that as a minimum treatment objective, mandibular overdentures assisted by two implants should be the first option for completely edentulous patients.<sup>8</sup> No significant differences were found in the literature regarding patient satisfaction between solitary or splinted attachments or between two or four implants,<sup>9-11</sup> nor were there significant differences regarding the masticatory forces of either method.<sup>12,13</sup> However, there are indications for more than two implants

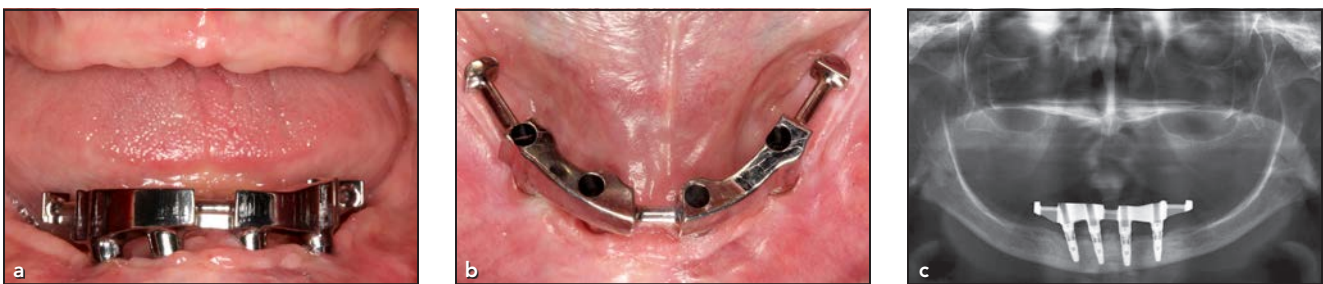




**Fig 4** (a) Right-side, (b) facial, and (c) left-side views of the digital design of the final prostheses.



**Fig 5** (a) Maxillary and mandibular final prostheses. (b) Maxillary and (c) mandibular intaglio surfaces.



**Fig 6** (a) Facial, (b) occlusal, and (c) panoramic radiographic views of the milled titanium bar.



**Fig 7** (a) Right-side, (b) facial, and (c) left-side views of the final prostheses after placement.

and a bar attachment, such as the present clinical report. The patient presented with sensitive mucosa over the mental foramina region and a severely resorbed mandibular ridge. A bar design with cantilever extension improves support, minimizes the pressure on the mental foramen, provides a high level of stability against lateral forces, and improves retention.<sup>14</sup>

Careful clinical assessment, examination, and detailed treatment-planning discussions help provide the patient with the needed treatment. The present patient had high expectations regarding prosthesis retention and stability. Having a 5- to 6-degree taper of the titanium bar could help minimize the rotational movements and allow it to behave similar to a fixed prosthesis, thus minimizing the amount of wear associated with the anchorage system.<sup>15</sup> Fabricating removable prostheses, especially with bar-type anchorage systems, can be technique-sensitive, which may increase the likelihood of complications. Acrylic teeth fracture and debonding can be minimized with CAD/CAM complete dentures; however, the higher cost is one of the limitations.<sup>16</sup>

## Conclusions

Clinical challenges may occur when using digital technology. This report describes a clinical method that combines digital workflow and analog workflow to treat patients with edentulous ridges.

## Acknowledgments

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