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TECHNIQUES

Digital planning for implant retained overdentures

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Abstract

Digitally planned implant placement is quickly becoming a standard for guided implant placement due to greater accuracy and predictability. The Digital Workflow can optimize the implant position by enabling the dentist to access the quality and quantity of the bone, soft tissues, and the surrounding anatomic structures. This method results in a final restoration with increased stability, retention, comfort, and ultimately better masticatory function for the patient.

Keywords Edentulous patient · Implant overdentures · Guided implant placement · 3D-printed guide

Quick reference/description

Patients with complete edentulism who wear conventional dentures frequently complain about the lack of stability of the prosthesis, specifically the mandibular denture. Denture instability creates a feeling of insecurity, inefficient mastication, and all in all dissatisfaction with the prosthesis. Advances in implant dentistry have allowed a switch from conventional complete denture to implant-supported overdenture for oral rehabilitation of edentulous patients. The McGill consensus statement in 2002 and other multiple studies state that the mandibular implant overdentures should be the first treatment of choice for edentulous patients. Implant supported mandibular overdentures may be a preferable option due to several advantages such as: chewing efficiency, masticatory bite force, and increased patient satisfaction. Decreased resorption of the residual ridge when implants are present has been shown in some studies. Improved stability of dentures is known to increase patient satisfaction and their quality of life.

To achieve long-term success with overdentures, implants should placed parallel to each other and perpendicular to the occlusal plane. It is very difficult to achieve these requirements without using a surgical template for implant

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placement. The purpose of this article is to introduce a digital workflow for surgical planning of a two-implant retained overdenture.

Indications

Upon discussion with the patient and clinical exam, the following conditions may be indicative of a need for an implant-supported overdenture:

- Atrophic mandibular ridge
- Patient discomfort with lower complete denture; noticeable reduced chewing ability and retention with lower complete denture
- The association of the metric, phonetic (Silverman and Pound technique), and esthetic methods assess the VDO and demonstrated that current prostheses shows a reduction of the vertical dimension of occlusion with an increase in perilabial wrinkles and the upper teeth were barely visible in the rest position.
- The musculature of the cheeks appear unsupported by the old prosthesis, and the entire face has visibly lost tone (Fig. 1)
- Prosthodontic Diagnostic Index (PDI) class III, IV

Materials and instruments

- Markers (CT-SPOT® 119—Beekley Medical)
- CBCT
- 3D printer
- coDiagnostiX, DentalWings

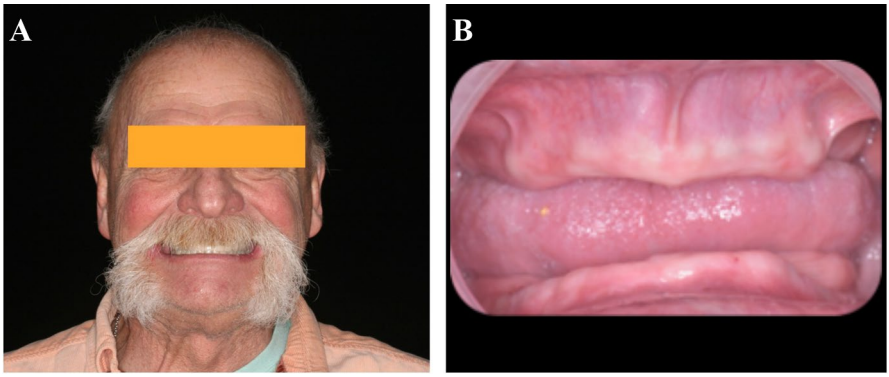

Fig. 1 **a** Extraoral smile picture showing old prosthesis. **b** Intraoral picture showing upper and lower alveolar ridges

Procedure

1. New interim dentures were fabricated at the correct vertical dimension. Phonetics and esthetics with the dentures were satisfactory to the provider and the patient. It is critical to ensure that the minimum required thickness for the future lower overdenture (for locators is 8.5 mm) can be achieved. The occlusal scheme chosen for this case was Balanced Occlusion and it was verified before being sent to the lab for processing of dentures (Fig. 2).
2. In preparation for a CBCT scan, Six Markers (CT-SPOT® 119—Beekley Medical) were placed on each denture (markers were also placed on maxillary denture because patient wanted to know if the upper bone could be eligible for implants after the lower overdenture will be finished) distributed in a way that they do not overlap each other and occupied as many parts of the denture possible.
3. Dual Scan CBCT was performed. (3D Accuitomo 170, MCT-1, EX 1/2 F17, Morita) This consists of: (a) dentures were scanned separately. (b) The patient was scanned wearing the dentures and in full occlusion (this has to be verified before starting the CBCT by either the provider or the radiologist). Dual scan protocol with coDiagnostiX™ did not include the use of cotton rolls or other material between upper and lowers dentures because we wanted to maintain the vertical dimension of the new dentures during the digital planning.
4. The planning software (coDiagnostiX, DentalWings) converted the CT scan files of the denture (DICOM files) and allowed to merge the two scans by matching and aligning the markers manually, so that the prosthesis was visible over the available osseous anatomy. The virtual planning strategy was to bypass the mandibular canals and mental foramina and make use of all available bone. The minimum vertical and horizontal space requirement for implant supported overdenture with Locator attachments was verified utilizing digital tools. Vertically, 8.5 mm from the osseous level to the superior surface of the acrylic resin is the minimum thickness. This number comes from the following measurements: 1.8 mm from the osseous level to the shoulder of the implant, 1.5 mm for the shortest abutment including the bevel, 3.2 mm for the attachment and processing patrix, and 2 mm of acrylic resin above the attachment. Horizontally, 9 mm is the minimum space required, because the attachment is 5.0 mm in width and 2.0 mm of acrylic resin is required on either side of it [11, 12]. For this case, the vertical space was 15 mm and two implants were planned between the lateral and canine position. It is critical to plan the parallel position of the implants with no angulation for the future locator abutments without a virtual planning (Fig. 3).
5. A surgical guide was virtually designed using implant planning software (coDiagnostiX, DentalWings). The mandibular denture was used as the template for the fully tissue supported surgical guide with the purpose of verifying the occlusion and final position of the implant (Fig. 4). The surgical guide was 3D printed (FormLabs 2, Formlabs) using Dental SG Resin (FormLabs) and post-processing steps were done following manufacturer's protocol.
6. Metal sleeves were inserted passively into surgical guide holes corresponding to the implants sites. Intra oral try-in is done for accuracy and functional verification.

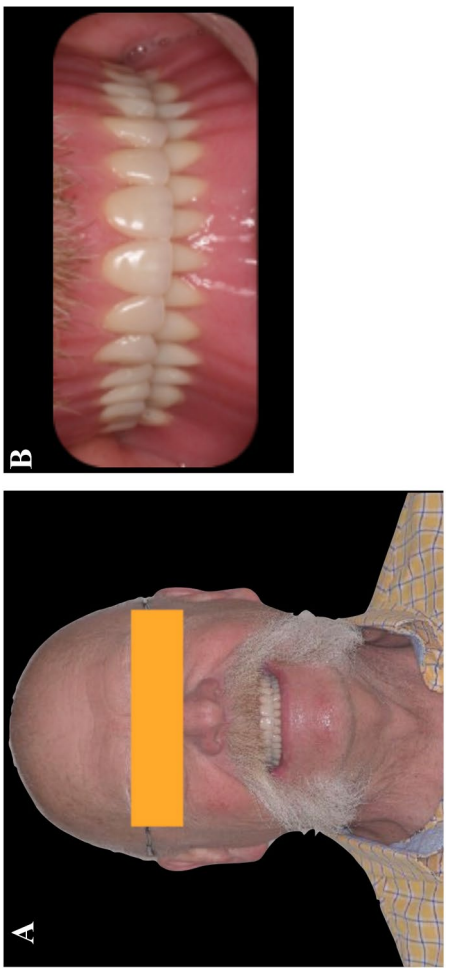

Fig. 2 **a** Patient wearing new set of upper and lower complete dentures. **b** VDO was restored. Esthetics and function were improved

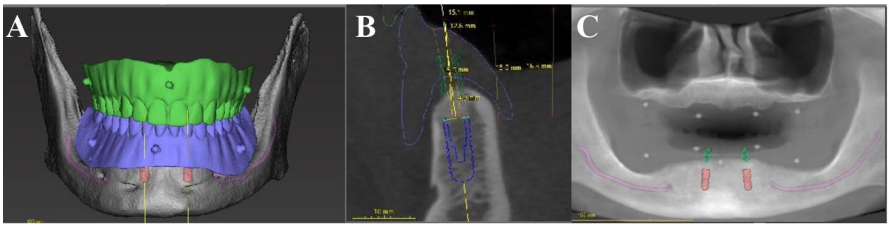

Fig. 3 **a** DICOM files were imported to the coDiagnostiX software. **b** Sagital view, verification of minimum vertical space requirement for implant-supported overdentures with Locator attachments (8.5 mm)11.12. **c** Panoramic view showing position and parallelism of lower implants

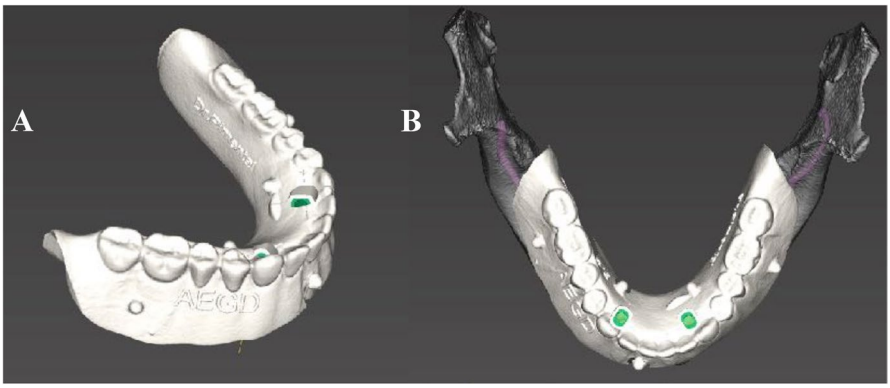

Fig. 4 **a** Surgical guide virtually designed following implant planning for two implant retained mandibular overdenture. **b** Occlusal view, the emergence was between lateral and canine

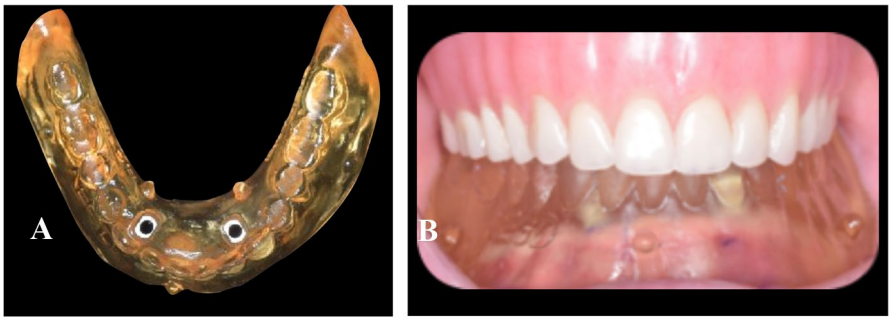

Fig. 5 **a** 3D-printed guide. **b** Intraoral try-in

The surgical guide should be polished and gas sterilized prior to implant surgery. (Fig. 5: metal sleeves 2.8 diameter).

Conclusion

Modern prosthetic dentistry has been broadly used for improvement of implant-supported dentures. The use of simple digital workflow prevents complications and errors that would happen with the free-hand surgical placement of implants. Also, it will prevent inaccurate lab procedures that can occur in traditional methods. The use of digital surgical guides would make it possible to have accurate and predictable results with less appointments for our patients. When fabricating a denture through the digital route, an accurate temporary or final restoration could be milled.

Pitfalls and complications

- Accesibility to coDiagnostiX software for implant planning and design of surgical guide. However, there are some free softwares available online.
- Some phases of the described workflow require a learning curve by the clinical operator regardless the software used.
- Availability of 3D printer to fabricate surgical guide
- Cost of treatment
- Medical history of patient that cause contraindications for surgery

Further reading

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