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A radiographic template for a two-implant mandibular overdenture using the patient's existing denture

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Abstract

This article introduces a technique for modifying an existing mandibular complete denture for use as a radiographic template with a radiopaque light-activated calcium hydroxide (Ca(OH)₂) preparation. This allows prosthetically-driven treatment planning and surgical placement of 2 implants to support the existing mandibular denture.

INTRODUCTION

The 2002 McGill consensus statement on overdentures suggested that a 2-implant supported overdenture may represent the minimum standard of care for the treatment of patients with a completely edentulous mandible.¹ Similarly, in 2009, the British Society for the Study of Prosthetic Dentistry (BSSPD) and a panel of experts in the prosthetic rehabilitation of completely edentulous patients reiterated this finding (York consensus).² In a recent review of the literature supporting both the McGill and York consensus statements, the 2-implant overdenture was held to represent a cost-effective treatment.³

Accurate diagnosis and implant placement is dependent on radiographic templates.^{4,5} Traditional radiographs, such as panoramic and periapical films have been found to be of limited diagnostic value owing to their 2-dimensional nature.⁶ The development of computed tomography (CT) assessments enabled cross-sectional views of the recipient sites for implant placement. However, they are expensive and deliver a relatively high radiation dose to the patient.⁷ More recently, cone beam computed tomography (CBCT), allows the capture of cross-sectional images at lower radiation doses. Moreover, when compared to conventional CT, the quality of the images obtained from bony structures is superior when using a CBCT.^{7,8}

Numerous detailed designs for radiographic templates have been published that address the radiographic approaches used in diagnosis and treatment planning for dental implants.^{4,9–11} Although varied in type and materials used, the ultimate aim of each of these designs is to enhance the collection of accurate and precise records of the operative site(s). Traditionally, treatment planning for mandibular overdentures has involved laboratory fabrication of a clear acrylic resin replica of the denture incorporating barium salts,⁹ gutta percha,¹⁰ or metal bearings⁴ placed at the proposed sites for implant placement.¹¹ However, this approach involves a considerable expenditure of time and money.

TECHNIQUE

a) Radiographic template fabrication

Ensure that the existing mandibular denture can be seated comfortably on the alveolar ridge and is in occlusal harmony with the maxillary denture and seated in maximum intercuspation (MI). Immediately before CBCT assessment, extrude a 2-mm wide vertical ribbon of radiopaque, light-activated, calcium hydroxide liner (Ultra-Blend Plus; Ultradent

Products, Inc., Utah) onto the facial, lingual cameo surfaces and extending in the same vertical plane onto the intaglio surface in a line that coincides with the distal line angle of the mandibular canine (Fig. 1). Document the location of the marking on the denture to allow for the transfer of this location during the surgical procedure. Light-activate using an appropriate light-emitting diode (LED) light according to manufacturer's instructions (Fig. 2). Following the CBCT acquisition, mechanically remove the light-activated $\text{Ca}(\text{OH})_2$ ribbon from all surfaces where applied by using a scaler or other hand instrument.

b) Diagnostic planning

Review the acquired CBCT by using a 3-dimensional viewer (Planmeca Romexis Viewer version 2.3.0.R; Planmeca Oy, Helsinki, Finland) to make all the determination before implant placement.

Orient the image in such a way that the vertical plane is perpendicular to the axis of the ridge, for optimal accuracy when measuring available bone dimensions for implant placement. For treatment planning purposes, move the cross-sectional slices in 3 different planes (Sagittal, Vertical and Horizontal) towards the following positions: Displace the sagittal and vertical planes on the viewer so that they intersect at the implant prospective site, which coincides with the radiopaque marking of the $\text{Ca}(\text{OH})_2$ ribbon. Finally, place the horizontal plane at the level of the mental foramen in order to evaluate the distance between the prospective implant site and the mental foramen (Fig. 3).

On the vertical cross-section, determine the available bone height and width as well as the restorative space, which is represented by the distance between the crest of the ridge and the most coronal $\text{Ca}(\text{OH})_2$ radiopaque marking (Fig. 4). Finally determine the bucco-lingual angulation of the implant bed in relation to the alveolar contour. Based on this information, determine how much crestal alveolar bone reduction is necessary in order to accommodate the minimal restorative space needed for the prosthetic rehabilitation. For example, a Straumann Tissue Level Standard Plus Implant (Institut Straumann AG, Basel, Switzerland) with a Locator (Zest Anchors Inc., Calif) attachment incorporated in a mandibular overdenture requires a minimum of 7.3mm to 8.3mm (1.8mm of smooth implant collar +1mm for the soft tissue collar built in the Locator abutment+ 2.5mm Height of denture cap which includes the male Locator+ 2–3mm of acrylic resin). Finally, using the shape of the alveolar ridge as a reference, determine the appropriate angle of the implant bed preparation in the bucco-lingual dimension. As an example, figure 4 illustrates that the axis of the implant bed will be parallel to the lingual cortical.

If needed displace the site of the implant osteotomy based on the anatomy observed on CBCT and then measure this displacement in relation to the radio-opaque reference marking.

c) Surgical procedure

On the day of surgery, use the patient's mandibular denture to transfer the location of the radiopaque markings (distal line angles of the canine) used during the CBCT acquisition. Mark these sites in the intaglio of the mandibular denture using a Dr Thompson's color transfer applicator (Great Plains Dental Products Co. Inc., Kans) (Fig. 5)

Reposition the denture in the patient's mouth with slight pressure in order to impress the mucosa with the reference point markings from the prosthesis intaglio (Fig. 6).

Incise the mucosa and slightly elevate a mucoperiosteal flap to mark the alveolar crest with a small round bur at the sites where the mucosa has been impressed. Alternatively, if the site

has been displaced during the CBCT based treatment planning, mark the alveolar crest at the desired distance taking the color marking on the mucosa as a reference point (Fig. 7).

Elevate a full thickness flap before proceeding with alveoloplasty, implant bed preparation and placement according to the predetermined length, diameter and angulation (Fig. 8). The depth gauge and/or direction indicator placed in the implant bed and positioned toward the palatal cusp or cingulum of the opposing natural or prosthetic tooth ensures correct restoratively driven implant placement.

SUMMARY

The goal in placement of radiographic markers for use in treatment planning of dental implants using cone-beam computed tomography is to provide accurate and reliable diagnostic results. This article describes a rapid and highly diagnostic technique for template preparation utilizing the patient's existing denture onto which a light-activated radio-opaque compound has been temporarily placed. The diagnostic work-up is then translated into the patient's mouth on the day of surgery.

The presented technique has the advantage to avoid any supplemental cost and treatment time related to the fabrication of a radiographic/surgical template using a duplicate of the patient's denture. All diagnosis components are obtained with the patient's own denture. One limitation is represented by the fact that this method does not guide the surgeon in a restrictive way during the osteotomy, thereby, allowing for potential implant misplacement if the surgeon does not control the osteotomy in relation to the existing prosthesis and opposing dentition. In conclusion, the relative simplicity and cost-effectiveness of the presented technique is counterbalanced by a required prosthetically-driven implant placement, which may be more technique sensitive as compared to implants placed through a restrictive surgical guide.

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Fig. 1.
Application of radio-opaque reference marks at distal line angle of canines.

Fig. 2.
Prosthesis with the reference markings on cameo and intaglio surfaces of prosthesis.

Fig. 3. Screenshot from 3D-viewer with slices oriented to plan implant placement at distal site of mandibular right canine.

Fig. 4. Presurgical determinations including available bone width (6.0mm) and length (14.0 mm). Distance from crest of alveolar bone to most coronal point of radio-opaque marking represents restorative space available (8.4mm).

Fig. 5.
Sites of previous radio-opaque markings transferred to intaglio using a color transfer applicator.

Fig. 6.
Radio-opaque reference markings transferred to patient's alveolar mucosa.

Fig. 7. Implant site (at distal site of mandibular left canine) marked using a round bur. Notice that implant site was determined to be 8mm distal to radio-opaque marking based on CBCT examination.

Fig. 8.
Implants placed.