CAD/CAM Implant Suprastructures: Accuracy, Durability and Precision

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Abstract

Traditional methods for implant prosthetic frame fabrication have been complicated by the process utilized to construct the frameworks. The casting method has been shown to complicate passive fit to the implant fixtures due to shrinkage and expansion of the materials used to construct the prosthesis. Additionally, castings not providing homogeneous masses of metal and microbubbles in the cast metal are very common leading to potential weak points in the prosthesis. In recent years, technology has allowed CAD/CAM processes to virtually create these frames eliminating the expansion and contraction seen in castings. As these structures are milled from solid blocks of homogenous metal, bubbles are eliminated from the final prosthesis thus providing stronger frameworks. This article will discuss the pitfalls of traditional methods and the benefits of CAD/CAM implant fixed and bar-overdenture prosthetics.

Keywords: Implant prosthetics, CAD/CAM, Hybrid, Bar-overdenture.

INTRODUCTION

Traditionally, implant prosthetic frameworks are fabricated using a wax and cast method. As each step of the process has potential inaccuracies due to polymerization shrinkage or expansion, achieving a true passive fit can be difficult. Combined with microporosity seen in all cast metals, potential weak points may lead to failure of the prosthesis during functional loading over time (Fig. 1).1

CAD/CAM processes are now used in implant prosthetics allowing fabrication of prosthetic frameworks from solid metal blocks containing no porosity. Additionally, as these milled frameworks are fabricated at implant level there are intermediate parts (i.e. abutments or gold portion of UCLA) that can be potential weak spots that under load can fracture. Thus, a stronger more accurately fitting prosthesis is provided with the CAD/CAM process (Fig. 2).2

MASTER MODEL VERIFICATION FOR IMPLANT SUPRASTRUCTURES

Accuracy begins with the master model and flows through the final product. If the master model does not exactly represent the implant positions intraorally then achieving a passive fit with the CAD/CAM suprastructure would not be clinically possible. It is imperative that the master model be verified prior to any scanning of the implant platforms

Fig. 1: Microporosity leading to failure of a cast framework

Fig. 2: CAD/CAM implant suprastructures provide lab and clinical advantages
so that the milled structure once completed will not require any modifications (i.e. cutting, laser welding) to achieve a passive intraoral fit.3

**Single Step Procedure**

This method requires more chair time but will help eliminate a patient visit. The verification stent is made intraorally then picked up in the impression to be sent to the lab.4-6 This is easily performed by connecting the open tray impression heads intraorally with either a self cure (i.e. GC pattern resin, GC America, Alsip, IL) or the author’s preferred choice of a light curable resin such as Triad Transheet or Triad Gel (Dentsply Prosthetics, York, PA).7 It is recommended to do this in short segments to minimize any polymerization shrinkage of the final verification stent. The stent should encircle the mid-section of each impression head and be bulky enough that flexure is not possible after removal. The stent should be removed and reinserted to verify passive fit prior to taking the impression. If passive fit is not noted, section the stent and relute it intraorally and pick this up in an impression for the lab to correct the master model.

**Two Step Procedure**

This method is suitable when the practitioner prefers less chairside time. An open tray impression is taken using a combination of a medium body PVS and a PVS putty. This is sent to the lab and a soft tissue model is fabricated. The lab then constructs a verification stent on the model which is returned to the practitioner for intraoral try-in and accuracy check of the master model. If the stent be passive fitting the lab then proceed with fabrication of the CAD/CAM framework. If the stent does not fit passively, the practitioner will need to section the resin stent and relute it intraorally and pick this up in an impression for the lab to correct the master model.

**Implant Suprastructures: The Lab Process**

Upon the master model, the lab sets denture teeth on a plastic base in the ideal position (Fig. 3). The master model and setup are sent to Compartis ISUS (Dentsply Prosthetics, York, PA), who scans the soft tissue model to capture the implant platform orientation and position. A second scan is performed with the wax try-in on the model. Both scans are merged to produce a virtual model showing the buccal-lingual, mesial-distal and gingival-occlusal zone that the frame must fit within to restore the case (Fig. 4).

Using this information, ISUS creates a virtual prosthetic framework which is emailed back to the lab to approve or modify the design prior to milling (Fig. 5). CAD/CAM milling is performed on either a solid block of titanium or chrome cobalt, depending on the lab preferences. The prosthesis frame is returned to the practitioner for intraoral try-in to verify fit (Fig. 6). The practitioner then verifies the occlusion and it is recommended to take a new intraoral occlusal record with the prosthesis frame in place. The prosthesis is returned to the lab, which then completes the prosthesis either by
adding denture teeth to the acrylic base, fusing porcelain directly to the framework or constructing individual crowns that are luted onto the framework (Fig. 7). The selection of which method and material used to complete the case is at the discretion of the lab and practitioner.

CONCLUSION

CAD/CAM implant prosthetics provide stronger frameworks than the traditional cast or solder/laser weld techniques. Porosity is eliminated in the metal or potentially weak areas seen in traditionally fabricated prosthesis providing better durability clinically (Fig. 8). From a lab perspective, with labor being the biggest component cost to prosthetic fabrication, outsourcing the framework fabrication assists the lab in controlling costs and improving the profit margin while providing high quality work to their practitioners.

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REFERENCES