Easier Implant Restoration: *CAD/CAM Generated Implant Abutments*

Ara Nazarian, DDS

Private Practice
Premier Dental Center
Troy, Michigan
Phone: 248.457.0500
Fax: 248.457.0501
Email: ara20002@comcast.net

Abstract

Computer-designed and -generated implant abutments offer restorative dentists alternative ways of restoring implants compared to present restorative techniques. Standard implant prosthetic techniques rely on implant level impressions and casting technology for component fabrication. Other techniques have included shaping or reduction of a stock component by either lab or dentist. Speaking to dental providers at my seminars and lectures, I have found that many dentists are looking for alternative ways to restore implants in a fast, easy, and predictable manner. In fact, some dentists I have spoken to avoid restoring implants because they feel too overwhelmed with the selection, technique, and protocol for restoring implants. Because of this, some of these providers do not offer implants as a treatment alternative.

I have found that implant abutments generated by computer-aided design and computer-aided manufacturing (CAD/CAM) can be more precise than those created using traditional casting technology. This increased accuracy has specific application to implant dentistry, where precision of components may affect implant longevity, prosthetic success, and ease of restoration. After reading this article, the reader should be able to recognize and understand the CAD/CAM application in the dental field when restoring implants.

The continual evolution in the field of implantology has provided the restorative dentist with changes in implant design, taper, surface coating, and even surgical placement. Such improvements enable dentists to provide consistent and predictive restorative results.

A dental implant has 3 main components: the fixture, which anchors the implant to the jawbone; the abutment, the part that screws into the fixture and holds the crown in; and the crown, which replaces the coronal portion of the tooth. In my opinion, the most challenging stage of the procedure for the restorative dentist is fitting the abutment.

In the past, there have been 2 main types of abutments available for restoring implants: stock or prefabricated abutments and custom cast abutments.[1] Stock titanium abutments are available from many major implant manufacturers in a variety of shapes, sizes, and angulations. They are adjusted or modified manually, either at the laboratory or in the office, to adapt the shape according to the position of the implant and the patient's individual anatomy.

When there is an inadequate volume of metal for proper reduction to establish margin definition, anti-rotation, and emergence profile necessitated by patient differences in tissue height and width, stock abutments offer fewer options. Depending on the location of the implant to the surrounding dentition or other implants, the abutment may need to be asymmetrical to gain parallelism. In other words, stock abutments may not have enough metal on either side to compensate for the implant that was placed in a non-ideal location. Although many successful restorations have been fabricated on stock abutments, severe limitations exist because of the size and shape of the stock abutments.

Custom cast abutments (CCA) or UCLA abutments, which are fabricated from a plastic waxing sleeve, offered another type of abutment for the restorative dentist. This sleeve was modified by the technician to establish proper contours and emergence profile to compensate for any misaligned implants. Using the lost wax technique, the plastic sleeve is invested and cast into the alloy of choice.[2] In my experience, I have found that a CCA can be labor intensive, costly, and may contain porosities in the casting. Its success is directly related to the skill of the laboratory technician. However, CCA and UCLA abutments also have been wonderful restorative alternatives that have enabled me to deliver excellent results.

Computer milled abutments are the next evolution in abutment fabrication. Some of these systems currently on the market include Encode (3i), Procera (Nobel Biocare), and Atlantis (Atlantis components). These abutments are milled from a block of titanium or zirconium, making them extremely strong, compatible with a specific implant, and without porosity inherent with the lost wax method.[1,3] Unlike the other CAD/CAM systems mentioned that are implant specific, the Atlantis abutment system can be used with any implant.

As with other techniques, a fixture level transfer impression is required to locate the spatial and rotational position of the implant intraorally. As soon as a working cast is fabricated with a soft-tissue model and the lab analogs are in place, the cast is scanned optically to generate exact 3D images of the region. This includes the location of the analog and its antirotational feature. Through a patented process developed by Atlantis Components, Inc., a computer system views the adjacent and opposing dentition, surrounding tissue levels, and implant location to design an ideal, anatomically correct virtual abutment for the edentulous space, accounting for all alignment and size requirements.

The restorative dentist and lab technician can then design the abutment with certain guidelines that make the seating process easier and ensure the long-term success of the implant-abutment crown complex. The software program for Atlantis Abutments suggests setting the margins in relation to the free-gingival margin with the following defaults:

1. facial/buccal—1.0 mm subgingival
2. interproximal—0.75 mm subgingival
3. lingual/palatal—0.5 mm subgingival.

After inspection on the computer screen, the virtual abutment designs are sent to a Computer Numerical Control milling machine to manufacture the correct abutment from a block of titanium alloy. The move from stock and custom abutments to CAD/CAM abutments has had a positive impact on both patients and dentists, and may represent the future of abutment fabrication.

Case Presentation

A woman presented to the practice with a loose bridge extending from tooth No. 12 to No. 15 (Figure 1). The abutment teeth for this fixed unit were teeth Nos. 13, 14, and 15, whereas the pontic was tooth No. 12. On closer examination and radiographic interpretation, it was very clear that there was a vertical fracture in tooth No. 13, and failing root canals and lesions in teeth Nos. 14 and 15. The radiographs also revealed that these teeth had been previously endodontically treated (Figure 2). While probing, certain areas around the abutment teeth had 10 mm to 11 mm readings indicating the areas of fracture and disease. All risks, benefits, and alternatives were reviewed with the patient regarding the recommended treatment.

The treatment discussed and accepted by the patient involved surgically removing the abutment teeth along with the bridge and then placing implants to restore the area to proper form and function. The patient was referred to an oral surgeon for atraumatic extractions and bone grafting followed by placement of 4 implants 4 to 6 months later. Before the surgical implant appointment, diagnostic models were made and mounted on an articulator. A diagnostic wax-up of the upper left quadrant was produced to an ideal contour and occlusion. A surgical template was fabricated from the diagnostic wax-up to allow for

Figure 1—Preoperative full-face view of patient.

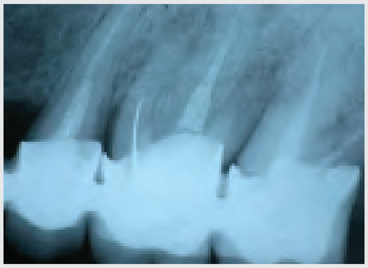

Figure 2—Radiograph of problematic teeth.

Figure 3—Surgical guide used by oral surgeon for placement of implants.

Figure 4—Occlusal view of implants placed for teeth Nos. 12 through 15.

Figure 5—Occlusal view of Atlantis abutments on working model.

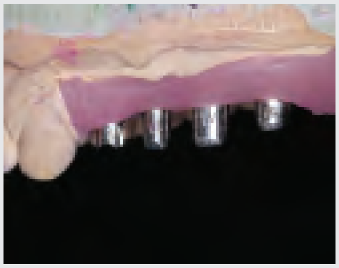

Figure 6—Lateral view of abutments on working model.

assistance during placement of the implants.[4]

Once the oral surgeon had removed the abutment teeth and placed bone grafting material, the area was allowed to heal for about 4 months. After the area healed, the surgical guide was used to place 4 OSSEOTITE Certain implants (3i) to the level of bone (Figure 3). Our goal was to place the implants so that their long axis lined up with the desired root position and that the emergence of the crown from the gingiva looked natural.[5,6]

Approximately 90 days after the surgical placement of the implants, radiographs were taken to determine healing and osseointegration. The Odyssey Laser (Ivoclar Vivadent) was used to make a small access to uncover the implants with little or no hemorrhage so the impression could be made at that same appointment.[7] The cover screws were removed (Figure 4), and the fixture level impression copings were placed for a closed tray impression using Take 1 polyvinyl siloxane material (Kerr Corporation) in a custom fabricated tray for the entire arch. Before taking the impression, it was essential to confirm full seating of the impression copings by taking a periapical x-ray. As soon as the impression was accepted, the impression copings were removed and the healing caps were placed over the implants.

The final impression, an opposing model, a bite registration, photographs, and diagnostic wax-up were sent to the dental laboratory (Town and Country Dental Studios). The rest of the restorative process was to be completed in the dental laboratory. In this case, Atlantis abutments were selected for the abutments and porcelain fused to high noble metal was selected for the restorations. With an implant level impression, the dental laboratory prepared a standard master cast and submitted the preoperative master cast together with the opposing cast and bite to the Atlantis Components. Using a virtual design process, Atlantis Components then created the patient specific abutments. Dental casts were then scanned, creating a virtual model so that a virtual abutment was created per the prescription of the restoring dentist and lab (Figure 5). A rigid index made of Duralay material (Reliance Dental Manufacturing Company) aided in the precise transfer of abutments from the model to the mouth. Also, the abutments were labeled on the facial aspect with an engraving of the appropriate tooth number for easier identification (Figure 6).

At the cementation appointment, the healing caps were removed one at a time, and the Atlantis abutments were seated using the Duralay index (Reliance Dental Manufacturing Company) to assist in the precise placement of the abutments (Figure 7). A periapical radiograph was taken to confirm full seating of the abutments. The screw access was then closed with sterile cotton along with placement of a composite. Next, the crown restorations for teeth Nos. 12 through 15 were removed from the model and tried in confirming full seating with an x-ray (Figure 8). Once everything was verified for an accurate fit, the restorations were seated using Maxcem cement (Kerr Corporation) (Figure 9).

As seen in the postoperative pictures and x-rays, the patient was very pleased with the esthetic result of the implants and their corresponding restorations (Figures 10 and 11). Also, the cosmetic and functional results achieved at the gingival abutment crown interface were impressive (Figures 12 and 13). The patient was so pleased with her restorations and implants that she made an appointment to have her maxillary anterior teeth veneered to complete her smile.

When restoring more than one implant, it is imperative to maintain a

Figure 7—Occlusal view of abutments in the mouth.

Figure 8—Occlusal view of crowns on working model.

Figure 9—Occlusal view of crowns seated in the mouth.

Figure 10—Postoperative full-face view of patient.

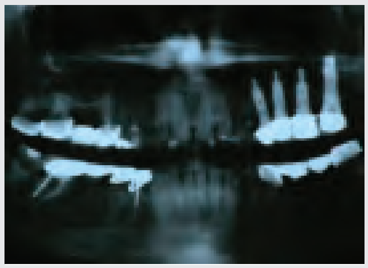

Figure 11—Postoperative panorex of implants with restorations.

Figure 12—Retracted view of area with healing abutments.

Figure 13—Retracted view of area restored with implants and restorations.

high degree of parallelism amongst the multiple abutments in order to achieve an accurate fit of the restorations. These worrisome issues of parallelism and passivity are overcome by the computer-milled abutment process, adding another level of confidence for dentist, surgeon, and patient.[1,3] Using this system, the virtual abutment created through CAD/CAM can be evaluated for proper morphology before the milling process. When accepted by the restoring dentist, the final abutment has proper emergence, gingival contours, and contact points to promote healthy papilla formation. In other words, Atlantis Abutments provide the restorative dentist simplicity, precision, and time savings.

Conclusion

Computer-milled abutments have been shown to have significant advantages compared to stock and custom cast abutments. These advantages include overall simplicity, reduction in the number of impressions, accuracy of fabrication, ability to create duplicate abutments, ability for accelerated treatment protocols, superior fit of copings to the abutment, significant reduction in chair time associated with the restoration phase, and a decrease in cost, especially with multiple abutments.

Acknowledgment

A special thanks to Dr. Gregory Thomas, the oral surgeon who placed these implants, and Town and Country Lab for fabricating the Atlantis abutments and crown restorations.

References

1. Ganz SD. Computer-milled patient-specific abutments: incredible quality with unprecedented simplicity. *Pract Proced Aesthet Dent*. 2003;15(8 Suppl):37-44.
2. Kasuga T, Nogami M, Abe Y. Titanium phosphate glass-ceramics with silver ion exchangeability. *J Am Ceram Soc*. 199;82(3):765-767.
3. Adams MW. Computer-designed and milled patient specific implant abutments. *Dent Today*. 2005;24(6):80-83.
4. Osorio J. Use of the Atlantis abutments in restorative practice speeds time to function and aesthetics. *Dental Implantol Update*. 2000;-11(8):57-62.
5. Smukler H, Castellucci F, Capri D. The role of the implant housing in obtaining aesthetics: Part 2. Customizing the peri-implant soft tissue. *Pract Proced Aesthet Dent*. 2003;15(6):487-490.
6. Tarnow D, Elian N, Fletcher P, et al. Vertical distance from the crest of bone to the height of interproximal papilla between adjacent implants. *J Periodontal*. 2003;74(12):1785-1788.
7. Miyasaki M. No Laser? Here's what you're missing. *Dental Economics*. February 2002; 70-74.
8. Shillingburg HT, Hobo S, Whitsett LD, et al. *Fundamentals of Fixed Prosthodontics*. Chicago, Ill: Quintessence Publishing; 1981:79.