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IMPLANTS

Computer-Designed and Milled Patient-Specific Implant Abutments

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Any realistic appraisal of the history of education of dental implants would lead to the conclusion that the tradition has been a general increase in complexity with a concomitant decrease in profitability for the restorative dentist. The large number of restorative component options from dental implant manufacturers, the lack of any kind of standardization among the multiple systems available, the variability in laboratory fees associated with this lack of standardization, and the lack of dental school-based training for the bulk of today's practitioners have all led to underutilization of the science of osseointegration in the modern dental practice.

In contrast to the above, typical clinical procedures for the fabrication of crowns and fixed partial dentures (bridges) are well-understood by today's restorative dentist. Regardless of the material used, standardized procedures exist that allow restorative dentists to achieve predictable, consistent, profitable, and excellent results. The marketing concept pursued by many dental manufacturers is to market their implants as being restored as easily as dentists restore teeth with crown and bridge procedures. Unfortunately, because of the aforementioned variability, this varies greatly from manufacturer to manufacturer.

In crown and bridge procedures, the dentist shapes the tooth to create an abutment. The execution of that design is governed by 4 principles[1]:

(1) preservation of tooth structure;

(2) retention and resistance;

(3) structural durability; and

(4) marginal integrity.

In essence, by preparing the tooth, the dentist creates a patient-specific abutment with control of the contour, margins, and angulation of the tooth. Depending on the situation, accomplishing this requires significant chair time for the dentist. A different situation exists with dental implant procedures. The implant abutment is the transgingival connection from the implant to the restoration—it mimics the prepared tooth in crown and bridge procedures. The abutment is not generally created by the dentist; it is generally supplied by the dental laboratory or an implant manufacturer. Several choices exist:

(1) stock abutments—preset abutments, both straight and angled, and

(2) custom abutments—patient-specific abutments.

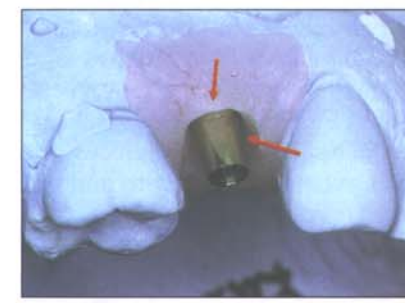

Figure 1. Stock abutments may provide an acceptable margin depth below the tissue on the buccal, but because of the gingival collar area, interproximal margin depth may be excessive.

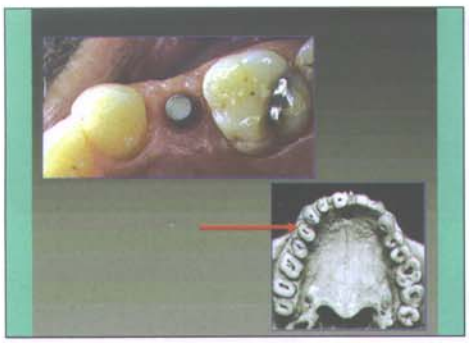

Figure 2. Stock implant abutments are round; teeth are not.

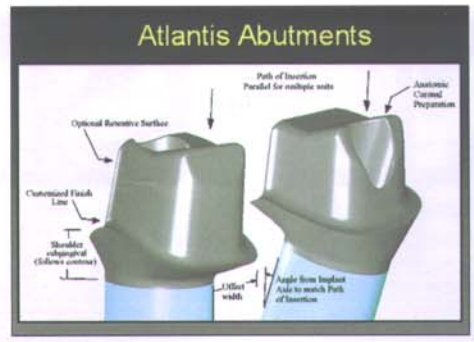

Figure 3. Atlantis Abutments.

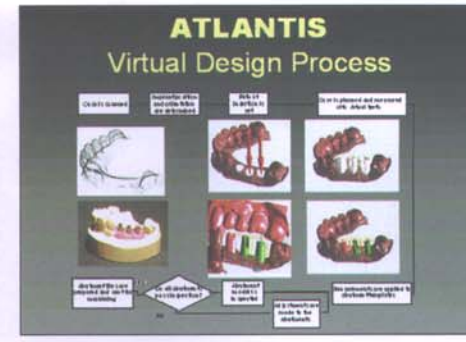

Figure 4. Atlantis design process.

Figure 5. Atlantis GoldHue Abutment.

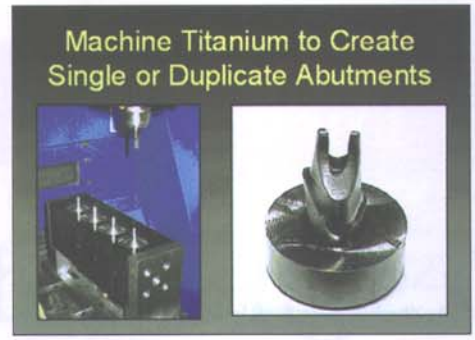

Figure 6. Milled titanium abutments.

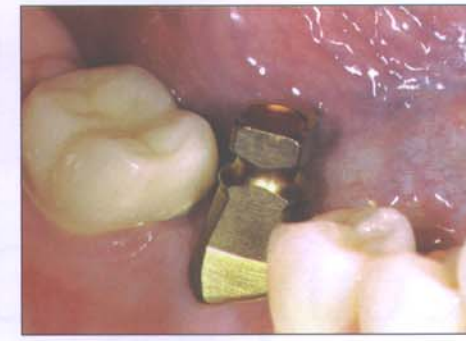

Figure 7. Implant-level impression—traditional protocol.

Stock abutments from dental implant manufacturers have long been popular with restorative dentists because of their reduced cost in comparison to custom abutments. However, their low cost is offset by the challenges they create:

(1) Many stock abutments have preset margins that may create problems with cement removal in interproximal areas (Figure 1).

(2) Many stock abutments provide an inadequate emergence profile due to their round shape—teeth are not round (Figure 2).

(3) Stock abutments are specific to the manufacturer with no standardization between implant systems. If a dentist restores multiple implant systems, then he or she must be familiar with multiple stock abutments.

(4) Limited control of contour, margin placement, and angulation is possible with most stock abutments.

Dental laboratory-fabricated custom abutments have long been utilized to overcome some of the shortcomings of stock abutments. The use of UCLA abutments is well-documented in the fabrication of custom abutments.[2]

Obstacles to the widespread use of custom abutments include the following:

(1) cost;

(2) technical consistency and precision—technique sensitive; and

(3) lack of a titanium interface with the underlying dental implant.

Cost of the final restoration is an issue in dental implant treatment because of the variability in the component parts (transfer/impression post, implant analog, abutment, and abutment screw). This variability in cost from manufacturer to manufacturer means that a dentist can restore 2 dental implants in the same location using implants from 2 different manufacturers and have widely varying costs—and therefore profitability. One key practice management step in making dental implant procedures profitable is to develop a fee for the procedure based on the time that is required to complete the procedure and then charge separately for the implant components. This removes the variable in the cost of any implant restoration and allows a consistent level of profitability.

Technical consistency, precision, and a titanium interface are now readily available to all restorative dentists. Technology now exists that allows a restorative dentist to restore any of the most popular dental implant systems the same way with a level of excellence and time-savings previously unknown in implant dentistry. Computer-designed and computer-manufactured titanium abutments (Atlantis Components, Figure 3) allow a dentist to restore dental implants faster and easier than traditional crown and bridge procedures with simplicity, excellence, and profitability.

TRADITIONAL PROTOCOL—ATLANTIS ABUTMENTS

By placing an impression/transfer post on a traditionally placed single-stage or 2-stage implant, the restorative dentist obtains an implant-level impression. This allows the rest of the restorative process to be completed in the dental laboratory. With an implant-level impression, the dental laboratory prepares a standard master cast and submits the preoperative master cast together with the opposing cast to Atlantis Components. Atlantis Components, by virtue of a "virtual" design process, creates the patient-specific abutments (Figure 4). Dental casts are scanned, creating a virtual model so that a virtual abutment can be created per the prescription of the restorative dentist. The restorative dentist and lab technician have total control over the abutment margins, just as he or she would have with a tooth preparation. Instead of exerting control with a diamond in a high-speed handpiece, control is exerted via the pen and pre-

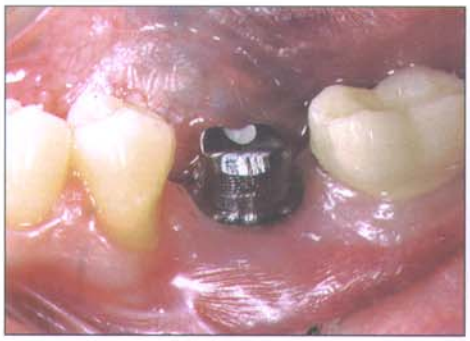

Figure 8. Atlantis Abutment.

Figure 9. Crown on Atlantis Abutment.

Figure 10. Atlantis Abutments.

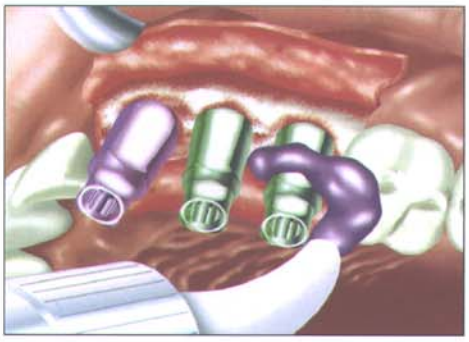

Figure 11. Indexing.

Figure 12. Atlantis Abutment, provisional, provisional placed on implant, soft-tissue healing around abutment/provisional, final crown on Atlantis Abutment.

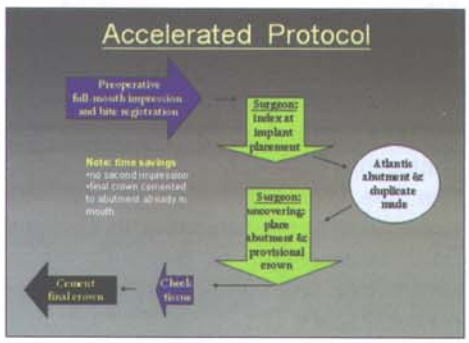

Figure 13. Clinical sequence for accelerated protocol.

scription pad.

The software program for Atlantis Abutments sets the margins in relation to the free gingival margin with the following defaults:

(1) facial/buccal—1 mm subgingival;

(2) interproximal—0.75 mm subgingival; and

(3) lingual/palatal—0.5 mm subgingival.

As previously stated, Atlantis Abutments allow the restorative dentist to have total control of margin design and placement. Restorative dentists can enter their own preferences, customizing the above defaults to create a truly patient-specific abutment. Typically, this is accomplished by an understanding of the patient's periodontal biotype:

(1) thick, flat periodontal biotype or

(2) thin, scalloped periodontal biotype.

A thick, flat gingival architecture is more stable and resistant to change than is a thin, scalloped gingival architecture. By the very nature of its thickness, it's also easier to mask the abutment-crown interface. Therefore, in the aesthetic zone, many times the Atlantis margin defaults are adequate to gain a natural, aesthetic result. A thin, scalloped gingival architecture poses more of an aesthetic challenge. It would not be unusual to set margins in the following manner in such a situation for an Atlantis Abutment:

(1) facial/buccal—2 mm subgingival;

(2) interproximal—1.5 mm subgingival; and

(3) lingual/palatal—1 mm subgingival.

Placing the margin farther subgingivally in the thin biotype allows the abutment-crown interface to be masked and lessens the potential need for abutment margin modification prior to completion of the final restoration. Masking the abutment in thin tissue is further aided by the use of the Atlantis GoldHue Abutment—a gold-colored abutment (Figure 5). This significantly improves the cervical color of the restoration in thin tissue and allows the use of an all-ceramic restoration.

Depending on the manufacturer of the dental implant, the Atlantis Abutment is milled from a solid blank of titanium (Figure 6) to fit the proprietary prosthetic platform. The milled, patient-specific abutment, mimicking a perfect tooth preparation, is returned to the dental laboratory for fabrication of the final restoration. The restorative dentist then places the abutment on the implant, sets the abutment screw to the manufacturer-recommended torque, and cements the final restoration. Excellent fit, contour, and margins are possible with a minimum of chair time by way of a simple, implant-level impression (Figures 7 to 9). Atlantis Abutments provide a simple process for the restoration of even the complex aesthetic dental problem (Figure 10).

ACCELERATED PROTOCOL—ATLANTIS ABUTMENTS

Beyond the "traditional" technique described above, the benefit of a computer-designed, computer-manufactured abutment is the ability to manufacture an exact duplicate abutment—Atlantis Gemini Abutments. This allows the development of an accelerated technique, whereby the position of the implant is indexed (Figure 11) at the time the implant is placed (via recording the position of an impression post/transfer with an impression, indexing with a rigid impression material, or luting with acrylic resin). That position is then transferred to a preoperative cast. With the position of the implant prosthetic platform now recorded, an Atlantis Abutment can be fabricated along with a duplicate Atlantis Gemini Abutment. The dental laboratory can fabricate a provisional restoration to fit one abut-

ment. At the time of uncovering for a 2-stage implant or after bone maturation for a single-stage implant, the surgeon can place one Atlantis Abutment with the provisional as a custom-healing abutment. This allows the tissue to heal to the ideal dimensions of the final restoration.

Meanwhile, the duplicate Atlantis Gemini Abutment can be utilized by the laboratory to fabricate a final restoration. If the soft tissue heals as predicted and the margins of the Atlantis Abutment are acceptable, at the seating appointment for the final restoration the provisional is removed and the final restoration is placed, all without removing or replacing the abutment (Figure 12). A final restoration has been fabricated without the restorative dentist needing to obtain a final impression. In 2 short visits, restorative treatment has been completed (Figure 13).

With the significant time-savings noted with this technique, a restorative dentist could charge the same fee for a crown, regardless of whether it is for a tooth or an implant. By charging for the individual components used (transfer post/impression post, analog, Atlantis Abutment, screws, etc) an implant procedure becomes much more profitable than a crown and bridge procedure due to the significant savings in time, and an extremely high-quality product is produced at the same time.

While Atlantis Abutments are not tooth structure, they do provide the remaining 3 principles of tooth preparation that restorative dentists use to guide them in the preparation of natural teeth: retention and resistance form, structural durability, and marginal integrity. Additionally, Atlantis Abutments provide the restorative dentist simplicity, precision, and time-savings. These factors lead to excellence, and consistent excellence leads to profitability. The restorative dentist remains in control of the design of the abutment, and a titanium abutment is designed that mimics the preparation of a natural tooth that a dentist would perform. Because of the ability to manufacture exact duplicates, final restorations can be fabricated without the necessity of taking a final impression—an option not available in traditional crown and bridge procedures. Excellent fit, contour, angulation, and margins are possible. Implant restorations are no longer as easy as traditional crown and bridge procedures—they are easier.✦

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