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Screw Retained: The Future of Implant Dentistry!

INTRODUCTION

Our industry seems to have come full circle. What was once considered old and outdated is now considered new and exciting! This statement accurately describes the evolution we have seen in implant dentistry over the last 2 decades.

In the early 2000s, most of our implant-retained restorations were either screw-retained or restored with a stock abutment. Screw-retained options allowed for retrievability, but the screw access, especially in the anterior zone, caused unpredictable aesthetic results. Stock abutments solved the screw access issues but, in turn, caused emergence and retrieval issues. These limited restorative options caused us to treat many of our implant patients with some trade-offs. The onset of computer-aided design (CAD) abutments revolutionized the way we restore implants, and, although retrievability remained an issue, for the first time we had a restorative option capable of treating our patients with both aesthetics and function.

The advantages of using a CAD abutment over a stock abutment have been well documented.[1] This technology allows us to create an anatomically correct abutment with restorative margins that follow the tissue. It also allows for fabrication and design to be done more predictably and with greatly increased efficiency.

Over the last few years, we have seen a multitude of studies pointing to a direct correlation between cement and periimplantitis. This has created a shift in how we judge the effectiveness of our implant restorative options, causing a need for a viable screw-retained option.[2] Most clinicians and technicians would agree that the ideal restorative option for dental implants is an aesthetic, screw-retained solution directly restored into the implants.[3] Until the launch of Angulated Screw Access (ASA) from Atlantis abutments (Dentsply Sirona Implants), controlling the screw access while restoring without the use of additional correction abutments was simply not possible. Combining this screw-access-correction technology with the exceptionally predictable CAD design of an Atlantis suprastructure (Dentsply Sirona Implants) milled in a cobalt-chromium (CoCr) alloy finally allows us to create what could be the ultimate implant restorative option.

CoCr by the Numbers

It is just as important to evaluate intraoral material choices by how they will interact within the human body and implant interface as it is to judge a protocol's relevance by its aesthetics, functionality, and fit. In this article, we will evaluate the material's intraoral feasibility as well as the predictability of the restorative process.

Accuracy

The superior accuracy of milled suprastructures in comparison to cast frames has been well researched and documented.[4] Studies have shown that frames milled in CoCr are up to 90% more accurate than casted structures. With an average 50% reduction in weight, combined with superior strength and predictable processing, CoCr makes for an exceptionally functional material.

Biocompatibility

To answer the biocompatibility question, it is best to refer to some of the extensive research done on the subject in the orthopedic industry. One of the biggest concerns with using a

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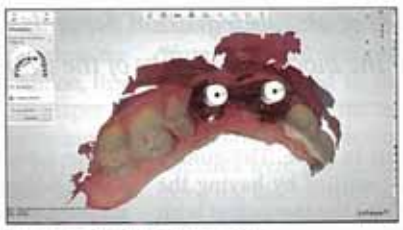

Figure 1. The digital impression.

Figure 2. The open-tray impression.

Figure 3. The soft-tissue model.

Figure 4a. The tooth try-in for structure design.

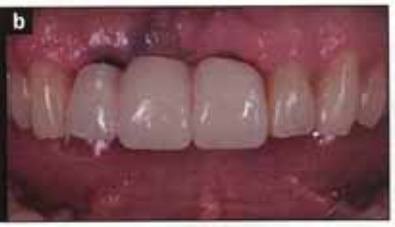

Figure 4b. The tooth position was established.

Figure 5a. The natural flare of anterior implants, corrected with Angulated Screw Access (ASA) (Dentsply Sirona Implants).

Figure 5b. The Atlantis ASA.

Figure 5c. The angulated screw access correction.

Figure 5d. The digital dual scan for design.

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nonprecious material intraorally is biocompatibility. Most of those issues were caused by the addition of nickel in the the alloy makeup. CoCr alloys are currently used in both the orthopedic and dental fields. They are very similar in alloy composition, and neither contains any nickel or beryllium elements. The major elements making up the alloys currently used comprise cobalt (C), chromium (Cr), smaller amounts of tungsten (W), and molybdenum (Mo). This makeup only differs slightly, depending on the application, manufacturer, or processing technique. There are multiple studies in the orthopedic industry evaluating biocompatibility concerns when utilizing CoCr in metal-on-metal hip replacements.[5] Many of these studies evaluate the effect that wear debris, generated under function, has on the surrounding tissue. This wear debris measures from tens of nanometers to submicron sizes and is suspected of being responsible for the tissue discoloration noticed around some sites. CoCr alloys used in dentistry, although similar in alloy makeup to those used in orthopedics, are not exposed to the wear friction causing wear debris that, in turn, is suspected of causing biocompatibility issues. Furthermore, the alloys are almost completely wrapped in dental ceramics and have limited tissue contact. Because the fixed hybrid substructure is not exposed to movement, there is no alloy-on-alloy friction and, therefore, no wear is able to cause these abrasion particles, which are thought to have a biocompatibility effect on the surrounding tissue in orthopedic use.

Titanium/CoCr Alloy Coupling Corrosion

As the CoCr substructure is seated into a titanium implant interface or abutment, this alloy coupling could potentially cause crevice corrosion. It is vital to confirm this alloy interaction to be stable and that it will not cause crevice corrosion. In vitro studies using electrochemical open-circuit potential measurement testing and potentiostatic passive film-corrosion measurement have shown CoCr/titanium couplings to be stable.[6]

Ceramic Compatibility

The biggest concern for ceramists in working with a nonprecious alloy is the possible negative coefficient of thermal expansion (CTE) and, in some cases, an excessively thick oxidation layer. These factors cause bonding issues and problematic interactions between the alloy and layering ceramics. Too much oxidation can cause greening of the ceramics, and an incompatible CTE can have a negative influence on how the layering ceramic(s) will react, especially under multiple firing cycles. Dental CoCr, used by most manufacturers, falls well within the acceptable range of 14.0 to 14.9 µm/mK. Comparing this CTE to manufacturers' suggested CTE ranges shows that most popular ceramics fall well within this CTE (ie, Jensen Dental's Creation Ceramics, from 13.9 to 14.6 µm/mK; Shofu Dental's Vintage Halo, from 13.8 to 15.0 µm/mK; and VITA North America's VMK Master, from 13.8 to 15.2 µm/mK). We have found that firing ceramics with this alloy is extremely predictable, even under multiple firings.

Atlantis Suprastructures

A fixed hybrid, restored with CoCr and screw access and correctly using ASA, can be processed at either the implant or abutment level. Atlantis suprastructures support most implant systems on the market today, meaning the hybrids can also be restored efficiently in cases with multiple implant systems.

Figure 6a. Bucco-lingual parameters.

Figure 6b. An accurate metal support.

CLINICAL PROTOCOL

First Appointment

The clinician first needs to capture an implant-level impression via either a digital impression system (Figure 1) or via a physical impression technique using a vinyl polysiloxane impression material (Figure 2). The laboratory team then fabricates a soft-tissue model (Figure 3) and a wax-supported tooth try-in on an acrylic base.

Variation 1: The lab team can also fabricate an implant-supported bite rim to establish a bite and model a verification jig. Although valuable in posterior applications, most smaller anterior cases will not require an implant-supported bite rim. A traditional metal framework try-in can be used in lieu of a verification jig.

Variation 2: If the patient has an acceptable temporary or partial flipper, a model of this approved tooth position can be used as a study cast to assist in fabricating the Atlantis suprastructure.

Second Appointment

The clinician does a tooth try-in (Figure 4) to determine patient expectations as well as to establish the bucco-lingual corridors and incisal edge position. This tooth try-in will be duplicated and used as a copy-mill design structure for the final CoCr suprastructure. An accurate tooth try-in contributes to precise metal support and this, in turn, contributes to the long-term success of the prosthesis. The tooth try-in will also be used by the ceramist as a study cast for tooth position, shape, and shade.

Variation 1: The clinician verifies model/impression accuracy by seating the model verification jig in the mouth. The clinician registers a bite with the supplied implant-supported bite rim. The lab fabricates an implant-supported tooth try-in on an acrylic base.

Variation 2: If the patient has an acceptable temporary or partial flipper, a model of this approved tooth position can be used as a study cast to assist in fabricating the alloy Atlantis support suprastructure. No tooth try-in or model verification appointment is necessary in this case.

Atlantis Fabrication: The models and tooth try-in are shipped from the dental laboratory to Atlantis suprastructures for design and milling of the final metal support structure. Dentsply Sirona Implants will return a digital work-up (Figure 5) of the case to the lab for potential changes and final approval. Once approval is received from the lab, Dentsply Sirona Implants will mill the support structure (Figure 6) and return to the lab.

Third Appointment

A metal framework try-in (optional) is done to verify model accuracy and fit. To reduce the possibility of internal connection implants creating undercuts, the Atlantis suprastructure does not engage the hex of the implants (Figure 7). Seating is verified by complete integration between the internal

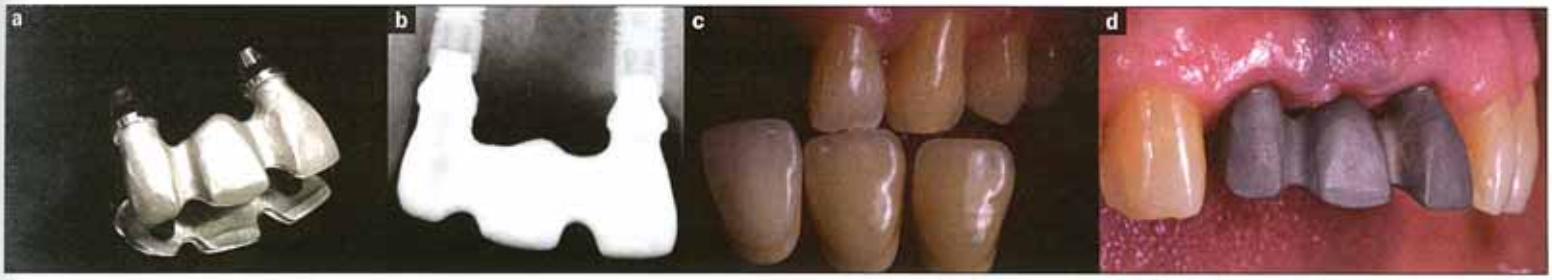


Figure 7a. The metal structure for try-in.

Figure 7b. Verifying fit.

Figure 7c. Digital shade photos are shared with the laboratory team.

Figure 7d. Framework try-in and model verification.

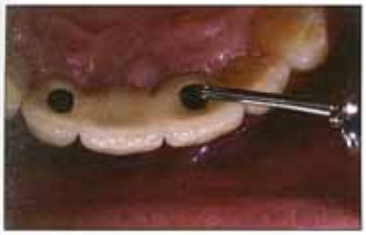


Figure 8. The lingual access achieved with ASA.

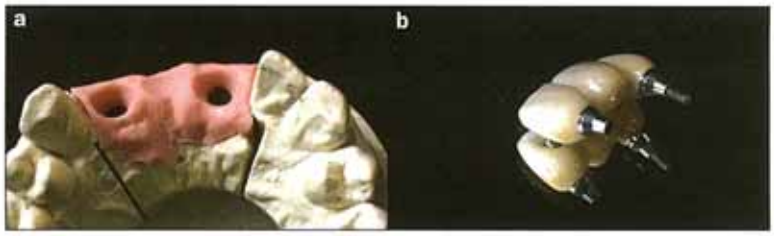


Figure 9a. The soft tissue on the model was carefully adjusted to contour the soft tissue for the pontic.

Figure 9b. The completed prosthesis (in-lab) with the ovate pontic.

axial wall of the implant and the external axial wall of the structure. Digital pictures allow for high-resolution close-ups that help our ceramists with exceptional shade decisions, even for our out-of-town patients.

Variation 1: A tooth try-in is used to establish desired bucco-lingual parameters, tooth shape, and shade.

Fourth Appointment

The lingual access that was allowed by using the ASA feature for Atlantis suprastructures can be seen in Figure 8. Special care had been taken in the pontic area to shape the soft tissue (Figure 9) by adjusting the model for an ovate design. Our ceramist (Yunsoo Kim, master ceramist at Absolute Dental Services, Durham, NC) carefully shaped the pontic to allow for a natural emergence from the tissue. Final delivery was done, demonstrating the precise match of the patient-approved tooth try-in (Figure 10).

In some cases, it should be noted that it may be necessary to add pink porcelain to mimic the soft tissue, create a natural emergence, and control the coronal length of the teeth (Figure 11).

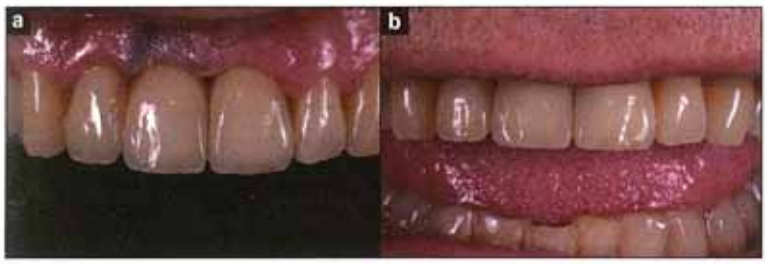
Variation 1: An optional metal framework try-in can be done. If the model is verified, then no metal try-in is required.

Fifth Appointment

The final delivery of Variation 1 was performed.

CLOSING COMMENTS

The challenge of this case was to replace the patient's missing teeth Nos. 7, 8, and 9 and to create good aesthetics with a stable occlusion. Grafting bone and tissue was a major challenge. It was difficult to successfully create papillae, appropriate interproximal contact lengths, and a natural appearance. And lastly, accomplishing all of the above with a screw-retained prosthesis to allow for retrievability without the need for dental cement was a challenge that was overcome with the ASA feature for Atlantis suprastructures.✦



Figures 10a and 10b. The completed prosthesis.

Figure 11a. In some patients, pink porcelain that will mimic the soft tissue needs to be applied to create natural emergence and to control the coronal length of the teeth. (Pictured: a preoperative photo of a case that required the addition of pink porcelain.)

Figure 11b. Pink tissue was added by the lab team to compensate for tissue deficiencies.

Figure 11c. The pink porcelain addition mimics soft tissue at delivery.

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Mr. Rensburg graduated under full scholarship with a 4-year baccalaureate degree from Pretoria Technical College in Pretoria, South Africa, in 1992. He is certified with a national diploma (ND) in technology and specialized with an national higher diploma (NHD) in fixed prosthetics. He is a member of the PEERS prosthodontic association, registered with the National Association of Dental Laboratories and the North Carolina Dental Laboratory Association, and certified by the South African Dental Technicians Council. He has specialized in fixed dental prosthetics, with an emphasis on dental implants, since the early 1990s. As a CE-accredited speaker since 2002, he has presented at almost 1,000 events across the United States, including at the Academy of Osseointegration and the World Summit Tour, and is the author of multiple published articles. He can be reached at (844) 293-2371 or via the website absolutedentallab.com.

Disclosure: Mr. Rensburg is an accredited CE speaker with Dentsply Sirona Implants and Atlantis suprastructures.