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Implant-Supported Fixed Restorations for the Partially Edentulous Arch

By Prof. Gregor-Georg Zafiropoulos & Assoc. Prof. Moosa Abuzayda, UAE

When restoring a partially edentulous arch with an implant-retained fixed restoration (fixed partial denture, FPDs), several procedural steps may influence the fit and function of the framework. These include: 1) the correct transfer of the implant position, 2) the correct transfer of vertical height and maintenance of the maxillo-mandibular relationship, 3) the determination of an optimal occlusion, and 4) the selection of implant abutments with the correct shaping and angulation.[1,2] The described method allows the accurate transfer of the implant position and the recording of the interocclusal relationship using transfer key and electroformed gold copings.

Figure 1. Impression system. L: titanium impression post placed on the implant, R: plastic impression coping. B: Impression system in situ.

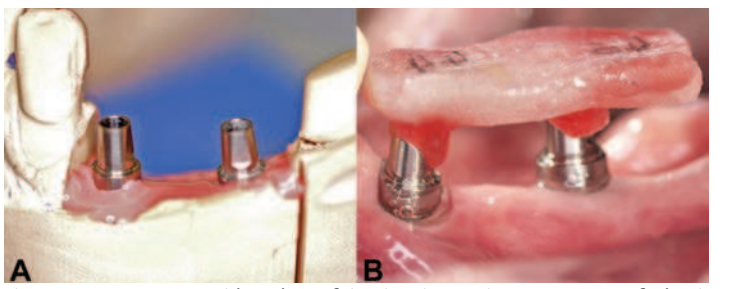

Figure 2. A: Master cast with 2nd set of titanium impression posts; B: Transfer key in situ.

Case

A 62-year-old man with a partial edentulism of the left posterior mandible presented for implant placement and prosthetic restoration. Teeth #34–36 had been extracted due to root caries 5 years previously. Two screw cylinder implants (straight line, 3.75 mm diameter, 11.5-mm length; Dentegris, Duisburg, Germany) were placed manually at a torque of 35 Ncm in the areas of teeth #19 and #21, following a two-step surgical protocol.

The implants were uncovered 8 weeks after placement, system specific healing abutments were placed, and a closed-tray impression was taken using a transfer system consisting of a titanium impression post (TImP) and a plastic impression coping (pickup, Dentegris; Fig. 1). For impression, a polyether material (Impregum; 3M ESPE, St. Paul, MN, USA) was used. To ensure that the titanium impression posts remained in the exact same position, they were left on the implants until the interocclusal relationship was recorded (1 day later).

The master cast was fabricated using system-specific implant analogs and a new set of TImPs (Fig. 2A). The cast was used to fabricate. For fabrication of a transfer key, resin copings were made on top of the TImPs (pattern resin; GC America, Inc., Alsip, IL, USA) and connected to each other using a light-curing resin (tray pink transparent; Omnident, Rodgau, Germany; Fig. 2B). The transfer key was placed on TImPs in patient's mouth and a bite registration was made in centric occlusion using pattern resin (Fig. 3B). The TImPs were then removed from the implants and the healing abutments were replaced. The casts were placed into the articulator using this transfer key and bite record. In the case presented here, customizable abutments (PTIR, platinum-iridium; Dentegris) were used casted with CrCo alloy (Fig. 3A). Over the implant abutments, were fabricated: 1) a resin transfer key (pattern resin; GC America, Inc., Alsip, IL) and 2) electroformed gold copings (AGCs; AGC Galvanogold, 0.25-mm thickness; Wieland, Pforzheim, Germany; Fig. 3B).[3–5]

The master cast with the mounted implant abutments and AGCs in place was scanned, and a mock-up from clear poly(methyl methacrylate) (PMMA; Zenotec; Wieland, Pforzheim, Germany) as well as a temporary FPD from colored PMMA were milled (Fig. 4).

At the next clinical session, the implant abutments were mounted on the implants using the transfer key and torqued to 35 Nm, the AGCs were placed on the abutments (Fig. 5) and the fit of the abutments was assessed with x-rays (Fig. 6). The mock-up from clear PMMA was placed over the electroformed copings, and the occlusion was checked (Fig. 7). A bite registration was made and a final impression was taken over the electroformed copings and the mock-up using a polyether material (Impregum; 3M ESPE; Fig. 8A). After the impression had been taken, the abutments were left in the patient's mouth and the temporary FPD from colored PMMA was placed on them using temporary cement (TempBond; Kerr, Orange, CA, USA; Fig. 08B).

In the dental laboratory, a final master cast was made using the mock-up and electroformed copings to transfer the position of the gold implant abutments (Fig. 09A). The metal framework was milled from a CrCo alloy (Zenotec NP; Wieland, Pforzheim, Germany) and veneered with porcelain (Vintage MP; Shofu, Ratingen, Germany; Fig. 09B). Afterthen, the gold copings were fixed into the framework (AGC Cem; Wieland, Pforzheim, Germany). The final FPD was fixed over the implant abutments using a temporary cement

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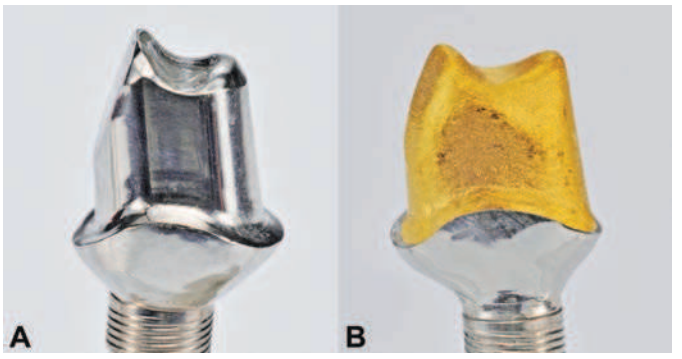

Figure 3. A: Customized implant abutment. B: AGC splaced onto the implant abutment.

Figure 4. A: Mock-up milled from clear PMMA. B: Temporary FPD milled from colored PMMA.

Figure 5. AGCs in situ.

Figure 6. Radiographic assessment of the fit of the implant abutments.

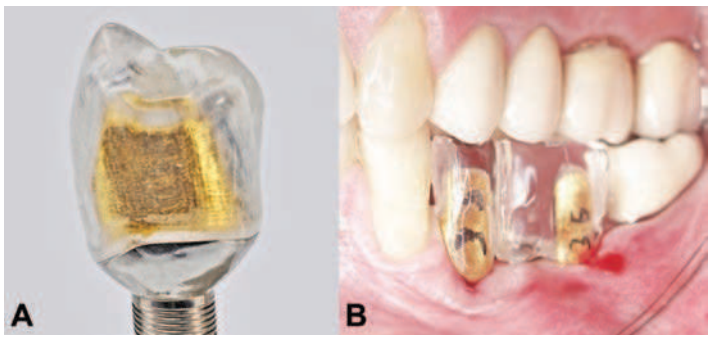

Figure 7. Mock-up and the AGCs placed on the implant abutment. A: Fitting mock-up and AGCs in the lab. B: in situ.

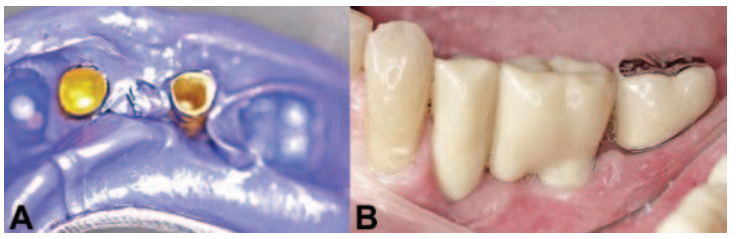

Figure 8. A: Final impression over the mock-up and the gold copings. B: Temporary FPD in situ.

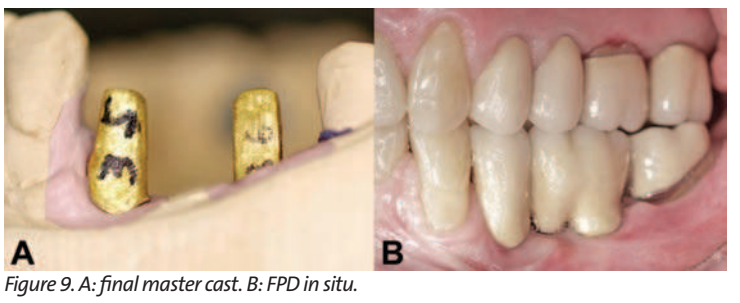

Figure 9. A: final master cast. B: FPD in situ.

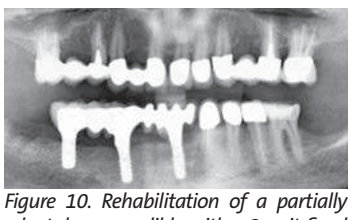

Figure 10. Rehabilitation of a partially edentulous mandible with a 8-unit fixed bridge supported by 3 implants. A: orthopantomograph.

(Implant Provisional; Alvelogro Inc., Snoqualmie, WA, USA).

Discussion

Several clinical steps significantly influence the success of the restoration, including the accurate recording of the interocclusal relationship, the transfer of the correct implant position, occlusal forces and the passive fit of the framework.[6] In the case described in this report used customized implant abutments, prefabricated titanium can also be used. However, customized abutments (casted or CAD/CAM milled) allowed the achievement of more ideal angulation, height, diameter, and shape. Such optimization improved the ability to address problems related to interocclusal and interproximal distances, implant angulation, and related soft-tissue responses.

Although this report has described the fabrication of a three-unit FPD supported by two dental implants, this technique can also be used for the rehabilitation of larger partially edentulous areas with multiple-unit FPDs retained on more than two implants (Fig. 10). The abutments were not removed after mounting and torquing until the final restoration was fitted and placed. Thus, the position of the abutments remained unchanged, eliminating errors that might occur during repeated attachment of the abutments for various test fittings of the restoration. A proper fit of a restoration requires the accurate transfer of the intraoral implant position to the master cast and a precise fit to the abutment can be achieved with AGCs.[7,8]

The use of a mock-up allows not only the evaluation of FPD fit, occlusion, and shape but also the fabrication of an exact final master cast, because the AGCs remain in a fixed position while impressions are taken. Furthermore, any necessary change in shape or occlusion can also be made on the mock-up and transferred to the final denture.

Although this technique requires one or two more clinical treatment sessions than other traditional techniques, this does not represent a real disadvantage given the superiority of the final result. The disadvantages of this method include the higher cost and the need for a very skilled laboratory technician.

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Interview: “The future of ceramic implants is really bright for many reasons”

By DTI

When it comes to materials used in implantology, titanium and titanium alloys have always been the material of choice. However, recent advancements in the functionality of ceramic implants have positioned them as a viable, metal-free alternative with antiallergenic properties and greater aesthetic appeal. The International Academy of Ceramic Implantology (IAOCI) is an association entirely dedicated to ceramic and metal free alternatives to metal-based implants. Dental Tribune Online spoke with the President and co-founder of the IAOCI, Dr. Sammy Noumbisssi, about the association’s mission, as well as current trends in the field of ceramic implantology.

Dental Tribune Online: How have ceramic implants progressed since their initial development in the late 1960s?

Dr. Sammy Noumbissi: Ceramic implants were born out of a desire for a material that would appear similar to natural teeth and be just as functional. They were a response to early concerns about the long-term stability and health effects of metal alloys being embedded in bone and exposed to the oral environment. Early ceramic implants were mostly made of one ceramic compound, such as alumina or zirconia. They were all monocrystalline in composition and were initially found to be vulnerable to functional stresses or premature structural breakdown. Alumina was prone to fracture and zirconia displayed low temperature degradation and poor suitability to the high humidity in the oral environment.

Starting in the mid-1980s, advances in manufacturing and technology led to the development of ceramic composites. These composites were made by combining specific and different bioceramics that were known to have unique physical and chemical properties. These advances created new and more structurally stable polycrystalline bioceramics with greatly improved functional properties. This is how we developed dental implants that are made of ceramic composites, such as alumina-toughened zirconia and hot isostatic-pressed yttria-stabilized zirconia.

In terms of design, the early implants, for the most part, were one-piece designs. This was because during the initial testing of the implants, structural failures migrated to the connection area between the implants and the abutments. Around 2014, ceramic implant manufacturers started releasing two-piece cemented zirconia implants. This signaled a new era in ceramic implantology, because the flexibility that was once only available with titanium implants had finally come to ceramic implants. More recently, two-piece, screw-retained ceramic implants with metal and metal-free screws have been developed, no longer limiting them to cementable restorative options.

What are some of the issues associated with metal implants, and are these negated with ceramic implants?

Metal implants are well researched, documented and have been very successful. There is a multitude of implants on the market and with that has come along different manufacturing protocols. As a result, we have observed a steady increase in alloy elements added to titanium in order to improve its physical properties. The problems begin when the metal implant, highly alloyed or not, is subjected to functional stresses, galvanism, body fluids and the harsh

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oral environment. Galvanism is the most important, but often ignored problem. All dentists are taught in dental school not to mix dissimilar metals in the oral cavity—nevertheless, this rule is consistently violated with implants. We have implants connected to all kinds of alloyed abutments, screws, crowns and copings even when they come from the same manufacturer. Galvanic corrosion occurs and studies have shown that in the process, metal ions get released into the surrounding soft tissue, bone, lymph nodes and even distant organs.

Corrosion also come from mechanical functional stresses that induce cracks and pitting of the metal and breaches in the oxide layer. Zirconia ceramic implants, alternately, do not conduct electricity or heat, are non-corrosive and retain very little biofilm and plaque in comparison to metals. Furthermore, studies have also shown better vascularization, soft-tissue health and apposition with zirconia in comparison to titanium.

What is the success rate of ceramic implants?

Ceramic implants today, in my experience and for many fellow ceramic implantologists, have the same success rate as titanium implants. They are now as versatile as metal implants thanks to the evolution in design, surface enhancement protocols and biomaterial improvements. Various treatment modalities are applicable with ceramic implants. Immediate placement, immediate temporization, full-arch and full-mouth rehabilitation can be performed with excellent and predictable outcomes. I, however, believe that adopting ceramic implants should be accompanied by a minimum amount of training or shadowing from an experienced clinician, even if one has experience with titanium implants.

Given that ceramic implants are a viable alternative to titanium, why do many dental professionals still regard them with skepticism?

The early stages of ceramic implants were so difficult and controversial so much so that a stigma regarding their viability and functionality still persists. I would rather ask this question: "Why aren't there more dentists placing ceramic implants despite evidence of their viability?"

This is the case for a few reasons. Metal implants have a very strong background and the cost of manufacturing zirconia is still pretty high. All of the major implant manufacturers (with the exception of Straumann) do not have a ceramic implant on the market, let alone in development. Furthermore, the cost of production and pricing of titanium implants have decreased, making them more accessible to dentists and patients.

I would also add that dental materials are evolving very fast and dental schools and graduate programs are lagging in educating their students on the capabilities and applications of these new materials. I often have conversations with dental academics, professors and new graduates and unfortunately, for the most part, there is a distorted view and misunderstanding of zirconia. To many, accepting zirconia as a restorative material is an easier exercise than recognizing it as an implant and implantable material, but I have seen this changing rapidly over the last couple of years.

Where do you see the field of ceramic implantology heading?

The future of ceramic implants is really bright for many reasons. Patients increasingly ask for safer, less invasive solutions, as well as metal-free alternatives for teeth repair or replacement. Dental attitudes and understanding of zirconia and bioceramics are slowly, but steadily evolving, with a definite shift toward biological and inert materials. There has also been a shift in the healthcare industry towards wellness, wellbeing and providing therapies that have little to no side effects. As I previously mentioned, some of the larger players in the implant industry are incorporating or have already adopted ceramic implants in their product line, either by development or by corporate acquisitions. A quiet, but major shift is happening in implant dentistry.

Dr. Sammy Noumbissi is the founder of the International Academy of Ceramic Implantology. (Photograph: Dr. Sammy Noumbissi)

What prompted you to establish the IAOCI?

The IAOCI was created to provide a platform where ceramic implant adopters and believers can exchange ideas, experiences and engage in clinical and scholarly conversation. The other primary objective was to reach out and help our colleagues better understand bioceramics and realize that metal-free implants are a viable and proven alternative. With the help of our supporters and through our other educational activities, we plan to establish a research fund in 2017 to support graduate dental students and residents who elect to conduct projects involving ceramic implants.

The IAOCI will be hosting its Sixth Annual World Congress in Miami, Florida. What can dental professionals expect from the event?

We are fortunate, honored and privileged to have Prof. Sami Sandhaus, a pioneer and forefather of ceramic implantology, as our keynote speaker. The theme of our congress in February 2017 is "Evidence-Based Ceramic Implantology – Where Are We Today?" For three days, the congress will host a gathering of the world's foremost authorities in ceramic implantology and dental bioceramics. Our speakers will share data gathered over 10, 15 and even 20 years regarding ceramic implants. They will also cover zirconia as an implant material, its behavior under function, its biocompatibility, immunocompatibility and superior hygiene properties, and the lack of galvanic activity, corrosion and ion release in ceramic implants.

We will also be offering surgical and prosthetic workshops on implant systems from the top three industry players. This is a great opportunity for current users, non-users and even skeptics to come and listen to 15 world-renowned and published experts present and share their experiences and expertise around ceramic implants. DT

Thank you for the interview.

Interview: "Implant failure is a failure for both the dentist and the patient"

By Marc Chalupsky, DTI

Originally from Syria, Dr Iyad Estoiny obtained his master's degree in fixed and removable prosthodontics in France before moving to Dubai in 1997. An implantologist and general dentist at GMCClinics in the heart of Dubai, Estoiny also focuses on prosthodontics and aesthetic and laser dentistry. In an interview with Dental Tribune Middle East, the implant specialist spoke in favour of proper oral hygiene and individual prophylaxis training, two areas of dental care that are essential for long-term implant success.

Dental Tribune Middle East: You are originally from Syria. How was the dental training at your school?

Dr Iyad Estoiny: I received my DDS in 1991 from Tishreen University in Syria. There are four dental schools in Syria, along with many practitioners. A number of Syrian dentists have moved to the UAE because of their good dental knowledge. The dental education is still excellent in Syria.

Can you summarise the state of oral health in Dubai?

As Dubai is a multicultural city, one sees problems from all over the world. Some patients are highly motivated in terms of their oral hygiene, while one has to put in a great deal of effort with some others. In terms of oral hygiene, I have seen that people have started to become aware of dental problems and products. In the last five years, people have become more focused on beauty and aesthetics, which in turn has led to a higher interest in healthy teeth.

We also have an overwhelmingly young population in this country; consequently, there are only a few older dentists here. Eighty per cent of expats are young. This means that one does not see any advanced periodontal problems, but one does increasingly see stress-related bruxism, which in turn leads to periodontal problems.

How would you evaluate the market for oral hygiene in this region?

The market here is competitive and small. We do not sell the products, but give it to patients. If they like it, they can buy it at the pharmacy. This has worked well. For us, it is important to ensure that patients have the correct interdental brush size. This means that we tell them what size they need. A dental hygienist or periodontist usually gives instructions and explains everything. One always needs to determine the correct sizes and give proper instructions.

Dr. Iyad Estoiny, GMCClinic (on the left)

As an implant specialist, what do you think about prevention?

There does not seem to be a strong connection between implantology and prevention at first, but just look at the problem of peri-implantitis. One needs to treat peri-implantitis as a bacterial problem and thus one must give clear instructions for cleaning, which involves interdental brushes and mouthwashes. Prevention is always the golden rule for any implant. If I do not see good oral hy-

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giene in my patient's mouth, I do not place the implant. I wait for a couple of months for the oral hygiene to improve. If I consider it acceptable, then I place the implant.

How do you deal with implant failure?

Implant failure is a failure for both the dentist and the patient. It is a headache for dentists, and in the worst case, patients will not be able to enjoy a beautiful smile. Periodontal treatment and oral hygiene are important before and after every implant placement. Before and after surgery, I usually explain oral hygiene and motivate my patients. Just recently, I placed an implant in an 84-year-old patient. Six months after placement, I have seen improvement owing to interdental brushes.

Oral hygiene treatment is mostly taken care of by dental hygienists. Most larger clinics employ at least one dental hygienist and it seems that Dubai citizens make extensive use of them. Is there a good partnership between hygienists and dentists?

There is very good cooperation. I am not interested in cleaning and my dental hygienist is not interested in placing implants. We are both happy to do our work. The profession of dental hygienist does not exist in some countries, such as in France, where I lived for a long time. There, the dentist cleans and polishes for 10 minutes. Here, our appointments last for 45 minutes. We explain to the patient how to perform the necessary post-operative care.

How do you explain it usually?

We simply show them how to brush their teeth and interdental spaces properly. If one just prescribes a certain toothbrush to patients on a piece of paper without instructing them, they will likely go to the pharmacy and buy a different one. If you give it to them, let them try it and help them use it correctly, the possibility of the patients buying the correct brush is higher.

You completed a programme on individually trained oral prophylaxis (iTOP). What was your impression?

I did the iTOP programme a year ago. Although I liked the programme a great deal, we have still seen that not all patients take the time and really apply what they have learnt. Some patients are really motivated and sit down with us to learn more about the system. The dentist and dental hygienist then work together. In today's fast-paced world, we need to convince patients that they have to take care of individual prophylaxis. For dental hygienists and dental students, iTOP gives dental professionals a gradual awareness of how to provide oral hygiene for their patients. I think that iTOP for students will work well for future dentists. DT

Thank you very much for the interview.

New implant releases antimicrobial drugs to fight infections

By DTI

LEUVEN, Belgium: Bacterial and fungal pathogens can form a biofilm on dental implants that is resistant to antimicrobial drugs like antibiotics. As a result, these implants pose a significant risk of infection. A multidisciplinary team of researchers at KU Leuven in Belgium has developed a dental implant that gradually releases such drugs from an integrated reservoir. The antimicrobial liquid could help prevent and fight infections.

"Our implant has a built-in reservoir underneath the crown of the tooth," explained lead author Dr Kaat De Cremer. "A cover screw makes it easy to fill this reservoir with antimicrobial drugs. The implant is made of a porous composite material, so that the drugs gradually diffuse from the reservoir to the outside of the implant, which is in direct contact with the bone cells. As a result, the bacteria can no longer form a biofilm."

In the laboratory, the implant was subjected to various tests for use with chlorhexidine, a universal mouthwash with a powerful antimicrobial effect. The study shows that the Streptococcus mutans bacterium, a major contributor to tooth decay, is prevented from forming a biofilm on the surface of the implant when the reservoir is filled with the mouthwash. Furthermore, biofilms that were grown beforehand on the implant could be eliminated in the same way. This indicates that the implant would be effective in terms of both preventing and curing infections. This study, titled "Controlled release of chlorhexidine from a mesoporous silica-containing macroporous titanium dental implant prevents microbial biofilm formation", was published online in January in Volume 33 of the European Cells and Materials journal. DT