PERSONAL APPROACH AND PHILOSOPHY OF THE BDT PROTOCOL

By Ricardo Schäfer

A long-term solution in implant-assisted rehabilitations.

Based on Phil Reddington's original idea.
Research carried out with Dr. Diego Bechelli

One of the greatest challenges that dental implantology has had to face since its advent was the possibility of developing a system which not only fulfills the aesthetic and functional requirements of the patients but also guarantees its longevity. That is why designing a prosthesis system that can anticipate future failures and repair them without forcing the patient to undergo the installation procedure again is a very complex task.

The appearance of Bonding has revolutionized the approach of dental treatments. Minimally invasive dentistry is no longer a novelty but a priority for professionals who want to achieve long-lived results that enables the patient to move more slowly to the next prosthetic cycle.

The rehabilitation of a bruxist patient through a root canal treatment done as prevention or by cementing a metal post and subsequently doing the same with a crown on each of his teeth is now considered an invasive procedure which leads to even greater tooth wear and weakening of the already damaged dental tissue. Nowadays these patients are being rehabilitated reconstructing the missing parts with ceramic fragments bonded to the dental remnants it being an onlay, an inlay or a veneer . A real dentistry revolution!

From the laboratory this led to an evolution in their answers, accompanying in that way the new clinical needs. This originated the application of three words that, in my opinion, guide our actions when selecting the materials to use for each purpose:

Biomechanics: Our restorations must satisfy the patient's functional needs and fulfill the concepts of dental occlusion respecting the morphology.

Bioemulation: Since the moment of their construction the restorations must function in the same way as the tissue they are replacing.

Biomimetics: These are the optical characteristics that our restorations need to have so as to integrate into the dental substrate.

From this perspective the BDT protocol (Burnout Denture Tooth), Phil Reddington's creation, has brought about a new way to approach complex rehabilitation works on implants as it can channel in one structure these three concepts described above: Biomechanics, Bioemulation and Biomimetics.

Now we are going to analyze this protocol explaining each part in order to understand their specific functions.

Firstly, to make the connections in our prosthesis, we are placing titanium TiBase directly into the implants, achieving passivity through them when cemented to the bar confectioned in PEEK, thus creating better stability at the same time.

Gold material in this step of the protocol is PEEK (Polyetheretherketone), a highly-resistant thermoplastic containing 4000-MPa elastic modules, which makes it an outstanding material for absorbing forces, preventing them from being transferred to the implant, making this material behave alike to the bone as it has a very similar elastic module, which allows this prosthetic design to comply with bioemulation and biomechanics concepts.

Secondly, we have the crowns, which are made of ceramic, as it is the material that so far has the most similar behavior to dental enamel, and are cemented to the Peek structure, thus complying with the concepts of bioemulation and biomimetics.

Thirdly, and lastly, we have the gum design, which will be done after cementing the crowns to the structure and will be layered with high-load laboratory resins, this being where compression discharges will be exposed, which could result in chipping or breaks, which can be easily repaired in the office without the patient needing to do without the prosthesis for one or several days during this process.

Laboratory Design (Step by step)

Once the impressions have been received, we will produce our working models. We know we are in a transition point between analogic and digital (scanned intraorally) impressions. However, today, analogic impressions still give us greater peace of mind when it comes to define passivity of our models for implant prosthesis.

When the models have been manufactured, to test precision and passivity, we will create corroboration keys that will be clinically tested on the patient. Thus, it gives us a certain basis which is the first law in the starting point of any type of implant-assisted prosthesis, understanding that, contrary to natural teeth, implants do not have a periodontium so there is no margin of tolerance. FIG 1.

FIG 1. Creation of definitive working models

Once the model has been proven, we will continue with its digitalization, a process which can be done with ScanBodies over the model, or by scanning the model with the TiBase in position and creating the design on them.

In the pictures of Figure 2, we carry on with the second option for digitalization, as at that moment, there was no library corresponding to the TiBase used in the case. I would like to clarify at this point that the speed with which CAD technology moves forward meant that in a short period of time we had libraries of all the implants available in the market to create wholly digital protocols.

exocad

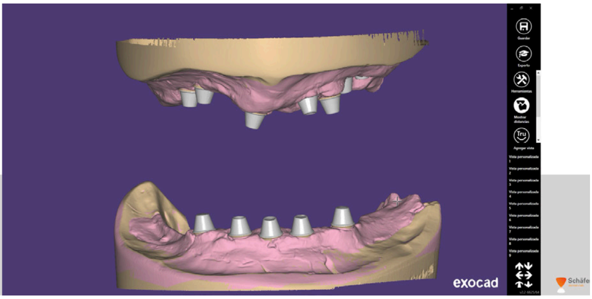


FIG 2. Digitalization of model with corresponding TiBase

Helped by software design programs, such as Exocad in this case, we will create the prosthesis design following all esthetic and functional parameters. For this step, we will be able to take advantage of the incorporation of 2D imaging using the Smile Creator module to have more references to help diagnose and thus obtaining a better, more accurate design. FIG3

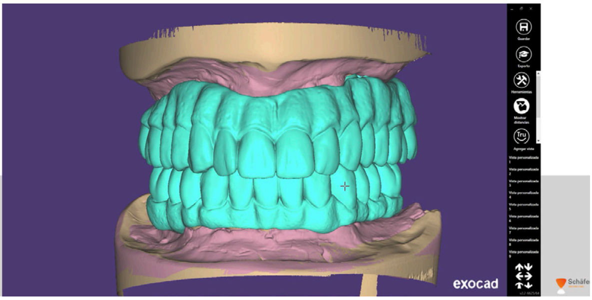


FIG 3. Digital design of the prosthesis.

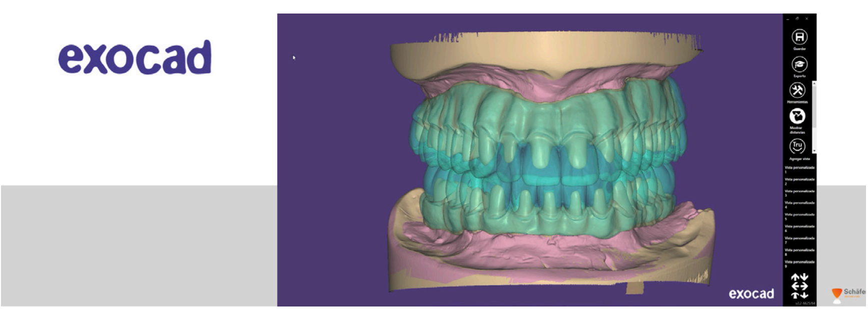
Once the design is done, an HTML file is sent to the clinician via email, which will allow them to have a preview of the design and indicate any corresponding modifications at their discretion.

When the whole team is satisfied with the result, the design will be printed, and so the created mock-up will be tested on the patient, assessing the aesthetic, phonetic and occlusal points to confirm if it works properly. Likewise, by doing this, we check the adaptation of the future prosthesis to the soft tissues. This is a very sensitive and relevant step as it is when all necessary corrections on the design can be carried out so as to avoid doing so later on the final piece, which will be delivered in the next step. FIG 4

FIG 4. Mock-ups printed in resin to check occlusal, aesthetic and phonetic points..

Once final approval by the patient's clinician has been obtained, we will be able to make our definitive prosthesis.

Firstly, we will do our design of the Peek substructure which arises from a reduction of the original design. This will create the space for the stumps, taking into account that afterwards the future crowns will be cemented on them and also considering the necessary reduction for the future construction of the gum with resins. FIG5



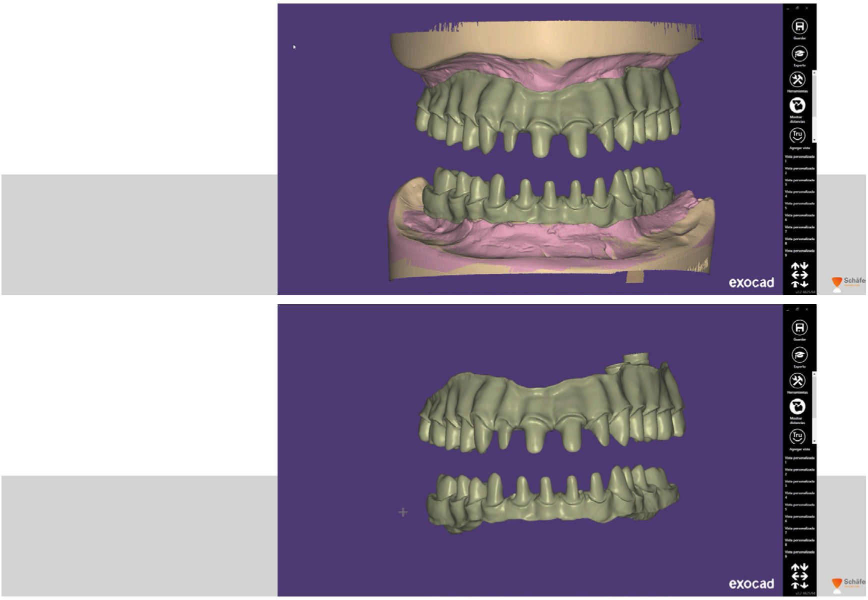


FIG 5. Mock-ups printed in resin to check occlusal, aesthetic and phonetic points..

We mill the Peek structure using Motion 2 of Amann Girrbach and Peek's Juvora blanks. Once the milling is done, we check the adjustment of the titanium TiBase. FIG 6

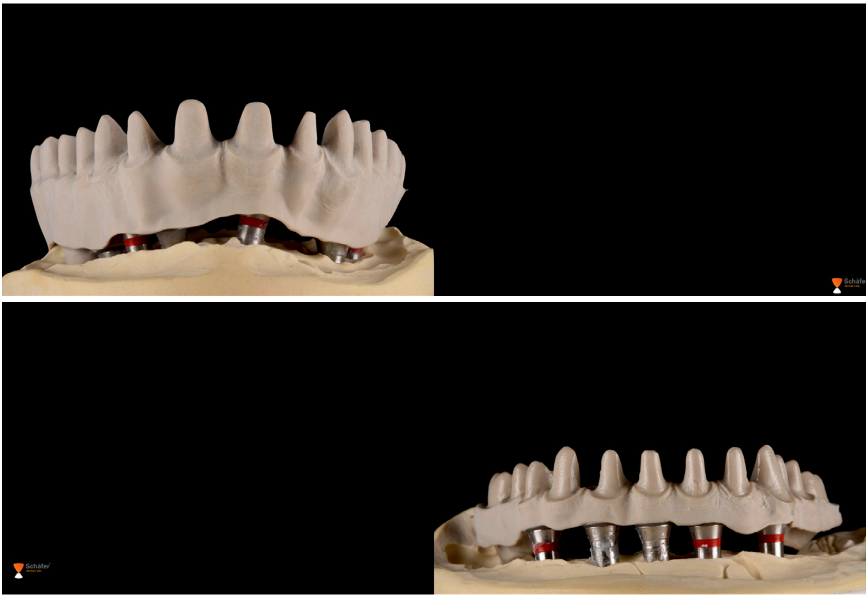


FIG 6. Milling of Peek structure with cemented TiBase.

Considering the limiting factors when milling large structures, we will perform a manual adjustment. In this case, on the design of the stumps to have the exact shapes we need for the posterior cementing of the crowns, checking the insertion axis, the occlusal spaces, and gingival pockets. An important thing to take into account in this step is to always overextend the gingival limit so that it allows us, with the already cemented crowns, to cover the interphase with the gum resins and thus achieve a proper bonding between both for posterior hygiene. This forces us to do a scan of this structure to be able to create the design of the crowns on each of the stumps. FIG 7

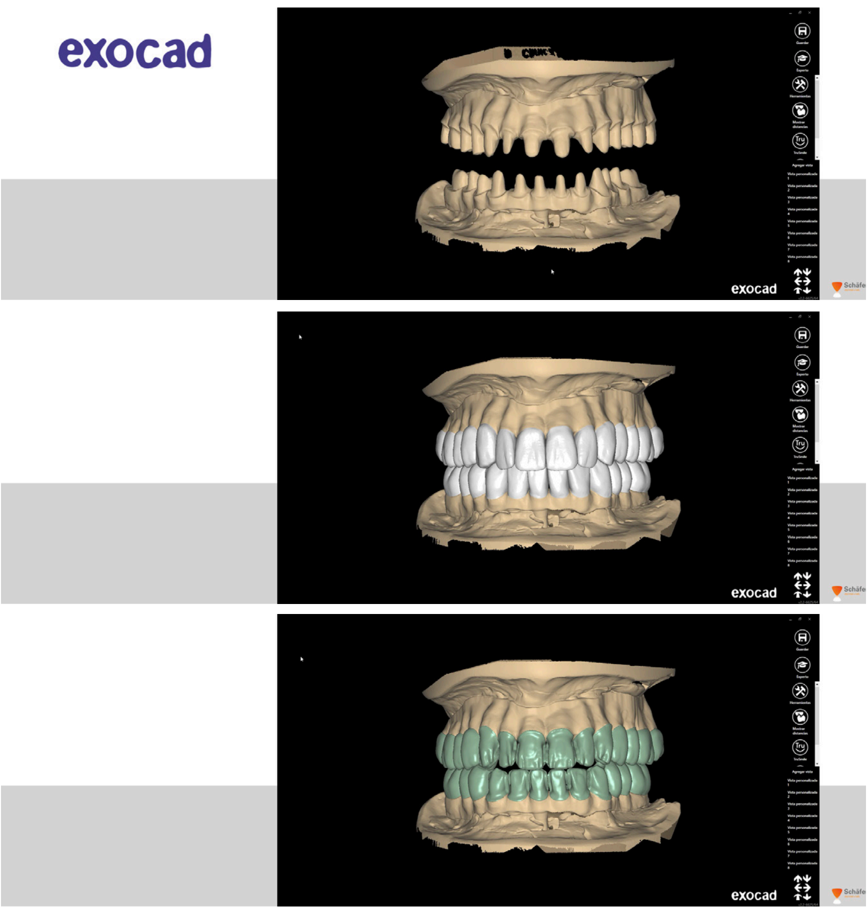


FIG 7. Design of definitive crowns on Peek structure stumps.

For the confection of the crowns, we divide it into two strategies:

For the posterior we did monolithic staining crowns, using, in this case, EmaxPress Multi ingots and Ivocolor (Ivoclar Ivadent) systems.

For the anteriors CutBack technique was chosen, using EmaxPress ingots (Ivoclar Ivadent) and afterwards layering with Emax Ceram system (Ivoclar Ivadent). FIG 8

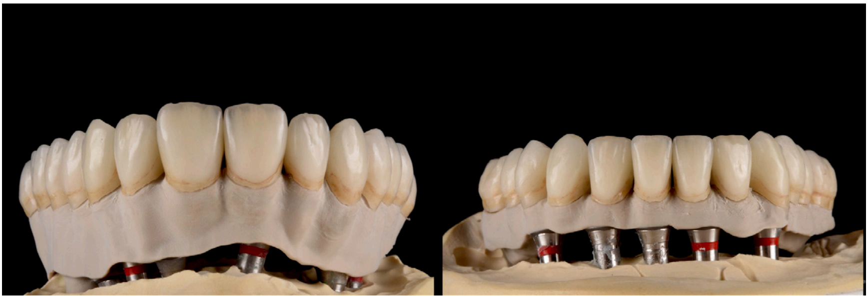


FIG 8. Stained and layered crowns placed on the Peek structure.

Once the crowns are done, we will continue with the cementation of them to the peek structure.

For this, it is necessary to be clear on bonding protocols in the different surfaces to be treated and thus, avoiding bonding failure after the prosthesis has been installed.

First of all, it is important to understand that two different surfaces will be bonded so the bonding step for each one are different, and that, in turn, each of the surfaces gets a surface treatment and then a conditioning to receive the cementing agent. Surface treatment is achieved in different ways, depending on the composition of the surface. It can be done through a micromechanical treatment, such as sandblasting, or through chemical interaction that is achieved with the application of an acid; once the surface is treat, it is conditioned

with a bonding agent.
This type of structure is complex as it involves joining different surfaces: Peek/Titanium – Peek/Ceramic – Peek/Resins.
Peek Surface can be treated in three different ways:

1-Sandblasting with aluminum oxide, 120 mesh at 2.5 bar.

2-Using Piranha mixture (70% sulfuric acid + 30% hydrogen peroxide) for 30 seconds.

3- Aquacare: Aluminum oxide 53 micron, at 4 bar and medium-low water flow. En this case, we have done the micromechanical retentions by using Aquacare and have conditioned the surface with Vision Link, a primer containing 10-MDP, from Bredent.

FIG 9. Stained and layered crowns placed on the Peek structure.

Treatment of Titanium Surface:

Sandblasting at 2.5 bars and aluminum oxide 50 micron. Primer containing 10-MDP molecule; in this case, we used Z Primer by Bredent.
Treatment of Ceramic Surface:

Hydrofluoric acid for 20 seconds for disilicates and between 90 and 120 second for feldspar.

Neutralization with sodium bicarbonate.

Washing and drying.

Placing of Bonding Agent: in this case, Silano Ceramic Primer by Bredent was used. FIG10.

FIG 10. Treatment of ceramic Surface with hydrofluoric acid IPS Ceramic Etching Gel, Ivolclar Vivadent. And conditioning with K-Primer (Silano), Bredent.

The cement chosen for all interphases was DTK Kleber opaque by Bredent.

FIG 11. Cementing of ceramic crowns to the Peek structure.

Once the cementing step has been carried out, we will move onto the final phase, which consists in coating the gum area in which we will imitate soft tissue with resins. To do so, we will prepare the whole surface of the Peek structure to receive the resin, repeating the same procedure:

Aquacare to achieve mechanic retentions and primer colocation for Peek. FIG12.

FIG 12. Treatment and reconditioning of Peek structure to receive resins.

With the placement of the resins layers, we are trying to imitate the elements that make up the soft tissue we are replacing, which are the following:

Alveolar mucosa: this area has more irrigation and thus it is redder, it is smooth and vascularization can be seen.
Attached gingiva: We will notice the typical orange peel texture, being closer to the bone the colour is paler.
Free gingiva – This area makes up the gingival rims and is usually more translucent and smooth.
FIG 11: Cementing of ceramic crowns to the Peek structure.

FIG 12: Treatment and reconditioning of Peek structure to receive resins.
The production of the different parts that make up the gingival architecture were made with Ceramage resin by Shofu. FIG 13.


CERAMAGE
F-GUM-R


F-GUM-V
F-GUM-Br


CERAMAGE


CERAMAGE
CERAMAGE

After correct polymerization, we will perform the finishing of the prosthesis with a manual polish abiding the polish protocol suggested by the manufacturer.

FIG 13: Final protocol aspect of polish.

Conclusions

The production of this type of design will allow us to anticipate issues that might arise, knowing clearly which the most vulnerable point are, and at the same time, plan an effective solution, in a simple way and without creating discomfort to the patient when repairing it, just as it was expected at the time of diagnosis.

Knowing that sooner or later, any type of restoration we perform will present an issue, we will be prepared so that when the time comes, it does not surprise us as we will know exactly which issues might arise and thus, appropriate solutions for each of them.

List of Possible Issues and Solutions:

- Decementation of TiBase from the bar: Recement TiBase.

- Wear in the resin in the gingiva or gum: Repairing and/or repolishing the surface.

- Fracture in one the ceramic crowns: As they are produced individually, they are treated as a single teeth. Carving, impression, provisionalization and subsequent cementing of the new crown.

Regarding the PEEK structure, it is virtually unbreakable. Although depending on some extreme designs, it might present some issues, in reality, this is not a common scenario, but it is tragic as there is no solution.

Even though there are not many studies in this regard, casuistry witnessed among us laboratory workers has been showing positive results for Peek.

For the creation of our Base Structure, we already have different options such as Pekk by Pekkton or BioHPP by Bredent, which are materials with improved properties compared to PEEK. Thus, we can assure that, over time, improvement of materials in terms of their biomechanics, bioemulation and biomimetic properties will give us more and better answers to our designs and greater predictability to our prostheses.

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