Fabrication of a customised implant abutment using CAD/CAM: A solution specific to each clinical case

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The multiplicity and sophistication of the offering in the field of prosthetic elements in implantology allow the practitioner to make a choice appropriate to the clinical particularities of each case. If the practitioner chooses a standard implant abutment, the dental technician will have to make adjustments, which implies considerable losses in precision and time. Moreover, with such abutments it is difficult to create an anatomical emergence profile because it cannot be modified and the base of the abutment cannot be changed. This observation is equally applicable to the angulation, which might even be selected by default.

A customised abutment created with CAD/CAM is the most accurate and simplest solution for an optimal result. The abutment is individually designed in order to ensure the homothety of the thickness of the materials and therefore the overall strength of the prosthesis. The dental technician has in this case maximum freedom in terms of design in order to create an abutment with the optimum emergence profile and angulation. In this manner, the abutment is specifically designed and fabricated for each patient.

Titanium has been established in dental implantology as the reference material owing to its biomechanical properties and its biocompatibility. Today, we are able to benefit from over 40 years of clinical and experimental experience in implantology. Customised abutments can be fabricated from titanium, zirconia or hybrid materials, such as a combination of titanium and zirconia, which in certain clinical circumstances improves the aesthetics of the visible areas while respecting the requirements of biocompatibility and biomechanics.

Seating a four-unit bridge on three anatomical implant abutments

Clinical case

A 40-year-old male patient presented for treatment. He had no particular medical conditions or any contra-indications concerning the placement of implants. In 2009, the patient had undergone a sinus lift (an increase of the maxillary bone volume and the displacement of the sinus membrane to ensure implant success by increasing the height of the available bone) at a hospital prior to the placement of implants to replace teeth 15–17. The post-operative sequelae (pain, oedemas, etc.) resulted
in the patient being entirely opposed to another intervention of this kind on the opposite side of the mouth.

During an appointment in October 2011, I was able to persuade the patient to accept implant treatment. I suggested first removing the three-unit bridge on teeth 23–25 and then extracting the roots of teeth 23 and 25, as well as seating of a denture on the day of the extraction, followed by placement of three implants in regions 23–25, the extraction of tooth 26, and seating of a four-unit bridge as the final prosthetic solution.

As the height of the available bone around tooth 26 was insufficient, I would not place an implant in that area but a tooth extension (a sinus lift would otherwise have been essential). The treatment plan was accepted by the patient two weeks later, and teeth 23 and 25 were extracted at the end of the month.

The patient was seen on 10 January 2012 for implant placement: two implants (NobelReplace RP, Nobel Biocare) with a diameter of 4.3 mm and a length of 13 mm for regions 23 and 24, and one implant (NobelReplace WP) with a diameter of 5 mm and a length of 10 mm for region 25. Tooth 26 was extracted on the same day without placement of an implant as already mentioned.

In May 2012, implant-level impressions were taken (open-tray impression technique), and the patient’s occlusion was recorded using silicone and a bite tray. Owing to the constraints related to the angulation of the implants in regions 24 and 25, I opted for titanium abutments. The angle of the implant in region 23 allowed for the insertion of a titanium–zirconia abutment for good gingival grip and a better aesthetic result.

Ten days later, two titanium abutments (AnA T, Laboratoire Dentaire Crown Ceram) and one titanium–zirconia abutment (AnA Tz, Laboratoire Dentaire Crown Ceram) were screwed onto the implants at a torque of 35 N, and sealed with Fig. 4. CAD/CAM at the laboratory showing the framework according to the abutments.

In the images, the CAD/CAM process is illustrated for the design of the abutments. The laboratory stage involved the fabrication of customised implant abutments using computer-aided design and computer-aided manufacturing (CAD/CAM) technology. The timing and procedure are detailed, from the patient’s acceptance of treatment to the final implant placement and securing of abutments.

Figs. 2 & 3. CAD/CAM at the laboratory for design of the abutments.

Fig. 5. X-ray control of the abutments placed.

Fig. 6. Panoramic X-ray view and 3-D simulation of the implants.
composites. An adjustment check of the contact points and of the occlusion was performed, followed by cementation of a ceramic bridge with a zirconia framework. A follow-up visit took place three days later.

**Technique**

For this case, it was possible to use abutments made from different materials according to the angulation of the implant: titanium for the pronounced angulations, and a combination of titanium and zirconia for the angulation with no particular constraints. It would have been equally possible to use a titanium abutment for the implant in region 23 but I opted for the titanium–zirconia abutment to obtain a better aesthetic result in the anterior region: brightness, translucency and no visible metal margin.

Customised CAD/CAM prosthetic elements and abutments respect the dental anatomy and allow extremely precise seating of a bridge on implants. Periodontal maintenance is therefore easier owing to easy access with a toothbrush because of the predetermined interdental spaces.

The simplicity of the process saves a considerable amount of time: no adjustments are necessary, the bridge is seated immediately, the occlusion is usually ideal, and greater accuracy can be achieved. In addition, only two appointments are necessary: one for impression taking and another for seating of the bridge.

**Dental technician’s perspective**

When the laboratory (Laboratoire Dentaire Crown Ceram) received this case, we were asked to create three customised anatomical abutments with a titanium interface for an individual and more precise fit, respecting the requirements of biocompatibility and biomechanics, and a coronary part in zirconia for a better aesthetic result.

Once the moulds had been cast, we determined that the considerable angulation of the implants in regions 24 and 25 and their shallow position in the tissue posed difficulties regarding the design of titanium–zirconia abutments. However, Dr Lachkar explained to us that in this case (i.e. the patient’s reluctance to undergo pre-implant surgery) he was forced to place the implants in the bone available and not necessarily in the ideal situation according to a prosthetic plan.

In this case, the titanium interface would have considerably exceeded the buccal surface and it would therefore have been necessary to reduce it. The bonding surface would therefore have been limited, which would have resulted in a great loss of mechanical resistance. We thus decided to use a titanium abutment manufactured from a single block and specially made to allow for such substantial angulations for teeth 24 and 25. For tooth 23, the implant angle allowed for a titanium–zirconia abutment, which was preferred to a titanium abutment for a better aesthetic result.

**Figs. 7 & 8** The abutments in situ. Note the slight blanching of the gingival mucous membrane, indicating good subgingival adaptation.

**Figs. 9 & 10** Final result.

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