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

**Author:** Dr Thierry Lachkar, France

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 choses 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 homoeoty 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 bio-mechanics.

**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 contraindications concerning the placement of implants. In 2009, the patient had undergone a sinus lift (an increase of 5 mm and a length of 10 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 digital information 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–zirconia abutment to obtain 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 composite. 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 greater accuracy can be achieved. In addition, only two appointments are necessary: one for impression taking and another for seating of the bridge.

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Guided implant surgical placement with CAD/CAM CEREC crown

Author: Dr Nilesh Parmar, UK

Guided surgery has been around for a long time. However, very few dentists in the United Kingdom place implants using surgical guides. The reasons for this are multiple, ranging from dentists not wanting to follow the procedure, or not having confidence in the procedure, the increased costs of guide fabrication, and the time delay and extra appointments needed to obtain a fully functional and reliable surgical guide.

In this case report, I shall demonstrate a surgical guide manufactured in-house using the CEREC Bluecam (Sirona). These guides do not require any impressions to be sent to a third party and can be made rather cheaply in the surgery within around 30 minutes. The guide can then be used in conjunction with specific drill keys, which are compatible with the guided surgery drill sets from all leading implant manufacturers.

In this particular case, Facilitate (Astra Tech/DENTSPLY Implants) was used to place the implant. Once the implant was osseointegrated, the final restoration was fabricated chairside using the CEREC MC XL milling machine (Sirona) and an IPS e.max CAD block (Ivoclar Vivadent).

Case report
A young female patient had lost tooth 36 a few years ago and wanted an implant solution. Her medical history was clear and she had a mildly restored dentition with no current dental pathology. Her BP/ES scores were low, with excellent oral hygiene.

The patient was scanned using the CEREC Bluecam and a proposal for the missing tooth was created. A calibrated CBCT scan of the lower jaw was taken using GALILEOS (Sirona) with a CEREC Guide reference body and thermoplastic over the edentulous area. The reference body is identified by the software and a virtual implant placement along with the CEREC crown proposal is imported into the software. This allows the clinician to place the implant virtually, with reference to the ideal final crown position. In this case, it was deemed that a screw-retained restoration would be desirable; hence, the screw-access hole was positioned through the centre of the crown.

Once the implant position had been decided, the information was ported to the CEREC software and using a CEREC Guide Bloc a drill body was milled by the CEREC MC XL milling machine. Once this has been milled, it will lock tightly into the thermoplastic drilling template. At this point, the surgical guide is complete and can be used on the patient.

In this particular case, an Osseo-Speed TX implant (DENTSPLY Implants) (4.0 × 11 mm) was placed using the surgical guide. The patient was prepared in accordance with a standard sterile protocol and the area anaesthetised as one would for a regular implant placement. The surgical guide snaps firmly over the existing teeth, expanding over- and undercuts, becoming a very stable surgical guide. The patient healed with no pain, no swelling and no discomfort. The post-operative long-cone periapical radiograph corresponded well with the preoperative planning with an ideal angulation for a screw-retained crown. After two months of healing, a fixture-level open-tray impression was taken and cast using an Astra Tech replica. A standard metal abutment was manufactured

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Contact Info

He has a master's degree in Prosthetic Dentistry from the Eastman Dental Institute and a master's degree in Clinical Implantology from King's College London. He is one of the few dentists in the UK to hold a degree from all three London dental schools and recently obtained his Certificate in Orthodontics from the University of Warwick. His main area of interest is dental implants and CEREC CAD/CAM technology.

Nilesh runs a successful five-surgery practice close to London and is a visiting implant dentist at two Central London practices. Nilesh has a never-ending passion for his work and is well known for his attention to detail and his belief that every patient he sees should become a patient for life. He offers training and mentoring to dentists starting out in implant dentistry. More information can be found on his website, www.drnileshparmar.com; Twitter: @NileshRParmar; or Facebook: Dr Nilesh R. Parmar.
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In cortical bone are less by 20% while the stresses are less by about 40%. The stresses and displacements were significantly higher in the two implant model due to having two close holes, which results in weak area in-between.

**Conclusions**

This study showed various results between cortical and spongy bone. It was expected that the maximum stresses in the cortical bone was placed in the weak area between the two implants. In addition to be higher than the case of using one wide implant. Although the middle part of spongy bone was stressed to the same level in the two cases, using two implants resulted in more volume of the spongy bone absorbed the load energy** which led to reduction of stress concentration and rate of stress deterioration by moving away from implants. That is considered better distribution of stresses from the mechanics point of view, which may result in longer lifetime. Porcelain coating showed less stress in case of two implants, longer life for the brittle coating material is expected. Contrarily more stresses were found on the gold crown placed on two implants due to its volume reduction (less material under the same load). This is clearly seen in increasing stresses on the two implants, that more load effect was transferred through the weak crown to the two implants. That showed maximum stresses in the area under the crown, while the wide implant showed maximum stresses at its tip. Looking to energy** absorption and stress concentration on whole system starting from coating to cortical and spongy bone, although the stress levels found was too low and far from cracking danger, the following conclusions can be pointed out: the total results favourise the two implants in spongy bone and the wide implant in the cortical layer, but the alveolar bone consists of spongy bone surrounded by a layer of cortical bone. It’s also well known that according to the degree of bone density the alveolar bone is classified to D2,3,4 in a descending order. So, provided that the edentulous abutments, the final crown was screwed directly onto the implant and a final check for contacts and occlusion was done.

This process shows just how far CAD/CAM technology has come. An implant can be planned, inserted and restored all in-house, using the current available technology. The final result is equal to any laboratory-based restoration, albeit for simple units. The process does have its limits in terms of multiple-span bridges and placement of multiple implants, especially in edentulous areas.

**Summary**

Restoration of single molar using implants encounters many problems; mesio-distal cantilever due to very wide occlusal table is the most prominent. An increased occlusal force posteriorly worsens the problem and increases failures. To overcome the overload, the use of wide diameter implants or two regular sized implants were suggested. The aim of this study was to verify the best solution that has the best effect on alveolar bone under distributed vertical loading.

Therefore, a virtual experiment using Finite Element Analysis was done using ANSYS version 9. A simplified simulation of spongy and cortical bones of the jaw as two co-axial cylinders was utilized. Full detailed with high accuracy simulation for implant, crown, and coating was implemented. The comparison included different types of stresses and deformations of both wide implant and two regular implants under the same boundary conditions and load application.

The three main stresses compressive, tensile, shear and the equivalent stresses in addition to the vertical deformity and the total deformities were considered in the comparison between the two models. The results were obtained as percentages using the wide implant as a reference. The spongy bone showed about 5% less stresses in the two implants model than the one wide diameter implant. The exceptions are the relatively increase in maximum compressive stresses and deformations of order 12 % and 3 % respectively.

The stresses and displacements on the cortical bone are higher in the two implant model due to having two close holes, which results in weak area in-between. The spongy bone response to the two implants was found to be better considering the stress distribution (energy absorbed by spongy bone**). Therefore, it was concluded that, using the wide diameter implant or two average ones as a solution depends on the case primarily. Provided that the available bone width is sufficient mesio-distally and bucco-lingually, the choice will depend on the type of bone. The harder D1 types having harder bone quality and thicker cortical plates are more convenient to the wide implant choice. The D2 types consist of more spongy and less cortical bone, are more suitable to the two implant solution.

**Contact Info**

Dr Thierry Lachkar is a dental surgeon (Paris Diderot University) and has been a practitioner for 15 years. He is a general practitioner and he works at a dental surgery in Paris. He has specialist postgraduate training in conservative dentistry and in endodontics. He can be contacted at drlachkar@yahoo.fr.

Editorial note: A complete list of references is available from the author.

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**Figure 10:** Final result.

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**Figure 7A & B:** Spongy bone deflection in vertical direction (A) wide implant; (B) two implants.

**Figure 8A & B:** Cortical bone deflection in vertical direction (A) wide implant; (B) two implants.

**Figure 9:** Strain energy = area under stress strain curve.

**Figure 10:** Equation 2 (stress energy).