Guided implant surgical placement with CAD/CAM CEREC crown

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 occlusal shift. Her BPE 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 cephalometric CBCT scan of the lower left side was obtained and a 4 mm healing abutment was placed immediately. A high primary stability of 40 Ncm was obtained and a 4 mm healing abutment was placed immediately. 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 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 platform through which to drill. The Facilitate soft-tissue punch was used to remove the overlying soft tissue, and a standard drilling protocol using the Sirona drill keys was followed.

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 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. Once this has been milled, it is imported into the software. This allows the clinician to place the implant virtually, with reference to the ideal final crown position.

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 followed.

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was inserted into the replica and cut back by 3 mm from the occlusal table. This was then powdered and scanned using the CEREC Bluecam, and an IPS e.max CAD C 14 block was milled. The CEREC 4.2 software was instructed to mill a hole that corresponded to the screw-insertion path on the abutment. This was finished using a high-speed diamond bur with copious irrigation. The crown was glazed and sintered, allowed to cool and bonded to the abutment using Variolink II (Ivoclar Vivadent). 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 the technology develops, with further advances being made, the scope of what is possible for the implant dentist is always expanding.

**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.

The stresses and displacements on the cortical bone are higher in the two implant model due to 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.

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 0.3 % respectively.

The stresses and displacements on the cortical bone are higher in the two implant model due to 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 spong 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 D₃ types having harder bone quality and thicker cortical plates are more convenient to the wide implant choice. The D₃ types consist of more spongy and less cortical bone, are more suitable to the two implant solution.

**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.

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