Customised AD/CAM abutments and crown made of zirconium dioxide

In dental practice all-ceramic restorations have experienced enormous growth for years now. In Germany over two million all-ceramic restorations were inserted in 2006 after all, metal-free restorations are highly popular with patients. In implant prosthetics as well there is a distinct trend towards the use of all-ceramic systems.

In implant dentistry long-term success and a predictable aesthetic outcome depend on the position of the implant and – where indicated – on the use of augmentative procedures. Recently, however, numerous studies have been pointing to the fact that instead of the implants themselves it is more often the prosthetic superstructure which is crucial to long-term success. With regard to biological and mechanical properties considerable importance must be attributed to the abutment as the interface between the crown and the intraosseous implant.

For highly aesthetic restorations the manufacture of ceramic abutments and metal-free superstructures has been recommended for some time now. However, fabricated implants are still dominated by aluminium oxide ceramics, which are still available from some manufacturers, are far too weak and often lead to an unsuccessful outcome. From our experience they are therefore now regarded as obsolete. The superior properties of high-strength zirconium dioxide ceramics, a framework material with universal applications, has brought about a paradigm change in implant prosthetics. We have been providing implant patients with metal-free zirconium dioxide superstructures for six years now without exception.

Zirconium dioxide ceramics: material properties

Owing to its monophase crystalline nanoscale yttria-stabilised zirconium dioxide a superior flexural strength of 900 MPa to 1,000 MPa. This offers plenty of reserve for using the material as an absolutely tension-free outcome depend on the free framework material in position of the implant and – where indicated – on the use of augmentative procedures. Replants themselves it is more of-centrally new lately, however, numerous properties considerable importance for abutment as the interface between the crown and the intraosseous implant.

In the case of metal abutments dark metal parts can become exposed, especially in cases of gingival recessions and degradations of crestal bone (Fig. 1). Ceramic abutments allow light transmission into the gingival sulcus, thus preventing the grey of opaque metal parts from showing through the peri-implant tissue. Even if the mucosa is thick at 2.5 mm, the abutment has an influence on the shade perceived of the covering mucous membrane. Customised zirconium dioxide abutments are the best way of ensuring predictable aesthetics.

Owing to required for substan- tial material grinding the processing of prefabricated build-ups made of zirconium dioxide, alu- minium oxide or titanium is prob- lematic. If the ceramics over- heat, cracks occur in the microstructure of the material. In ad- dition, reproducibility is always very time-consuming because it has to be performed manually. In the case of cast mesostructures made of precious metal it is often not possible to budget for the cost, and the use of large quantities makes it difficult to create a pore-free cast. With zirconium dioxide the dental technician has, for the first time, a material at his disposal whose absolute homogeneity is not altered by further processing.

In the case of customised CAD/CAM abutments and zirconium dioxide crown frameworks the ZENO® Tre System (DentalDesign, Wieland, Pforzheim, Germany) has proved reliable. After the surplus was ground away and the entire build-up was given a high polish.

Inserting of the customised healing abutment into the soft tissue has to be displaced conservatively. For this purpose was screwed in slowly while applying gentle pressure. Owing to a tube-shaft connection the wth implant is prevented from rotating over a total length of at least 4 mm. The insertion into the sulcus ensures positional stability without a retaining screw. Consequently, with this procedure as well – as with all the other steps – there is no need to provide manual protection against rotation. With many other makes of implant sys- tem this simple procedure is not possible because of the build-up only stop just above the shoulder of the implant, deep in the sulcus.

Taking the final impression

After 14 days the final impression was taken using an impres- sion post customised in the dental laboratory, under absolute irrita- tion-free conditions. For the closed impression we use Impregum™ (3M Espe, Seefeld, Ger- many). The standard impression post was customised with GC® Pat- tern Resin LS (GC Europe, Leu- ven, Belgium) and when the im- pression was taken the implant position the scan restoration is screwed into place above the respective abutment crowns. Positioning the scan build-up

Zirconium dioxide crowns: aesthetic properties

For highly aesthetic restorations we use a zirconium dioxide superstructure which is crucial to long-term success. With regard to biological and mechanical properties considerable importance must be attributed to the abutment as the interface between the crown and the intraosseous implant.

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Owing to required for substan- tial material grinding the processing of prefabricated build-ups made of zirconium dioxide, aluminium oxide or titanium is problematic. If the ceramics overheat, cracks occur in the microstructure of the material. In addition, reproducibility is always very time-consuming because it has to be performed manually. In the case of cast mesostructures made of precious metal it is often not possible to budget for the cost, and the use of large quantities makes it difficult to create a pore-free cast. With zirconium dioxide the dental technician has, for the first time, a material at his disposal whose absolute homogeneity is not altered by further processing.

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ensures perfect allocation even in confined gaps. On the order sheet created the design can be freely selected to suit requirements: first the build-up is defined and then the crown is mounted. On request an anatomical crown can also be designed with PMMA, with the aid of which the veneer is made later by the CAO (Computer Aided Overpress) method.

When designing, first of all the transition is defined between the build-up and the crown (Fig. 11). This area should not be made deeper than 1 mm subgingivally because the cement surplus has to be removed under visual control. Now the emergence profile is finished off (Fig. 12). In doing so it is possible to keep the point of implant emergence much slimmer and only allow greater width at the top. The cross-section provides a good overview here. The 3D view is displayed in the adjacent window. When the parameters have been defined, build-up can commence.

The program indicates the basic shape of a molar. However, it can be replaced by any other shape of tooth, for example, only a premolar will fit the gap. The build-up can be customised quickly; its size can be increased or reduced by dragging the corners (Fig. 15). It can also be completely moved. By turning at the arrows the build-up can be tilted and adapted to the line of the crown. For the extent of the groove a preset can be selected. Then material can be applied or eroded.

Now the screw diameter is defined. Here it is possible to widen the screw opening to suit requirements so that the screwdriver is not guided too closely (Fig. 14). After completing this operation the computer blocks out the screw opening and proposes the prep line for the crown. The cement gap is also defined. Manual customisation by the technician is possible here as well (Fig. 15). Owing to the option of scanning the opposite jaw and displaying it on the monitor, when designing a cusp-supported crown the occlusal space can be measured out accurately for the veneer porcelain. If an anatomical crown is to be made of resin by the CAO method, it is now first brought into position. Owing to deformation

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points the shape can be properly adapted to the antagonist. Making the tooth seemingly abraded is therefore feasible. Only when the anatomic design has been finalised is the crown computed in such a way that it represents an anatomically reduced shape (Fig. 16).

Finally the data is saved and three data records are generated (Fig. 17). This way each element can be milling from a different material. For the build-up we have selected the pre-shaded ZEN 0® Zr Discs B2 (Fig. 18). The latter were also re-shaded with Zircolor in order to obtain a dental neck in the shade A 5.5. The crown itself was milled from an unshaded Disc (Fig. 19) and then brought up to shade A 2 with the dye Zircolor. The overpress crown was milled from ZEN 0® PMMA Discs (Fig. 20). After fusion there are three parts available with excellent fit (Fig. 21). Cementing is again performed with Super Bond C&B. The titanium connector was blasted with the aid of the Ro-cator™ system (3M Espe) and conditioned with silane solution ESPE™ SIL. The emergence profile was high-polished. For this purpose we use diamond burs of various grain sizes. An optimum transition is achieved by affixing the crown margin to the build-up direct. Valuable production time is saved by simultaneous fusion of crown and build-up.

In the present case study two crowns were made on the build-up: one for conventional veneering by means of ZIROX® veneer porcelain (WIELAND) and another for overpressing with the ceramic PressX™ Zr (WIELAND). The crown made of PressX™ Zr is chiefly made on a machine. We prefer it as a low-cost alternative to the all-ceramic crown. Since the finishing of the PMMA crown is performed with a relatively large tool (diameter 1 mm), the fissures are finished with a smaller contour. Shading the structures reduces the light transmission capacity of the crowns to a certain extent. Light refractive takes place in the extrinsic dye, which is why this technique is reserved for the posterior region.

Sources of error

Since patients with implant-borne restorations can bite firmly again and attachment of the implant abutments is not (rigidly) as with teeth, masticatory forces are enormous. It is therefore important for the dental technician to model the zirconium dioxide coping with cusp support in order to ensure that the layer thickness of the veneer porcelains is consistent. Here the ZEN 0® Tec system provides reliable, flexible design and monitoring options. For example, ceramic fractures, so-called chipping, can be avoided. In order to allow perfect light transmission through the crown into the ceramic abutment down to the subgingival area we do not use opaque glass ionomer cements or zinc phosphate cements in the aesthetically relevant region. They would cause the cement margin to be revealed. Apart from causing technical difficulties, the use of prefabricated abutments constitutes the risk of positioning the shoulder too far subgingivally. As a result, this area cannot be monitored. Fractured parts of cement remain, this causes perimplantitis (Fig. 25).

Conclusion

Whilst there were no clinical studies available during the initial phase of making restorations with zirconium dioxide, there are now results from several multi-centre long-term studies. CAD/CAM restorations made of zirconium dioxide prove to be just as reliable as the golden standard. However, especially in implant dentistry
they allow a quantum leap in terms of biocompatibility and aesthetics. By optimising the software, improving milling strategies, increasing the level of automation and extending the range of materials available some systems, including the ZENO® Tec system, have succeeded in raising the level of economy and precision substantially. In this instance

![Image](72x360 to 208x450)

**Fig. 23:** Customised ZENO® abutment

![Image](72x475 to 209x562)

**Fig. 22:** CAO crown

![Image](72x719 to 209x839)

**Fig. 21:** Fitted components just after cementing, with accurate epigingival shoulder.

![Image](72x850 to 208x971)

**Fig. 20:** Milled PMMA crown for the overpress technique.

![Image](73x732 to 209x839)

**Fig. 19:** Milled ZENO® crown.

![Image](73x863 to 208x971)

**Fig. 18:** Milled framework for the resin cement.

![Image](223x363 to 816x914)

**Fig. 17:** Custom-made ZETO abutment with accurate epigingival shoulder.

![Image](224x1016 to 361x1106)

**Fig. 16:** Periimplantitis caused by remnants of cement and far subgingival transition from the standard abutment to the crown.

**Fig. 15:** Milled ZENOdent.

![Image](327x1022 to 416x1073)

Dr. med. dent. Hartmut von Blanckenburg (Hanover, Germany) n 1991 registration as a dentist n 1994 doctorate awarded n since 1993 joint practice with Dr. Herbert Pucha n 1998 four years of further training: dentistry diploma awarded by the Academy of Naturals n first user of the ZEICON system in prosthodontics and implant dentistry in Germany n 2002 development of a dental preparation set for CAM/CAM restorations with zirconium dioxide frameworks n numerous technical publications and lectures Contact: info@ztorus, frei-umflussende-zahnheilkunde.de

**Fig. 14:** Periimplantitis caused by remnants of cement and far subgingival transition from the standard abutment to the crown.

**Fig. 13:** Periimplantitis caused by remnants of cement and far subgingival transition from the standard abutment to the crown.

The flexible design software does not limit dental technicians or dentists in their many different decisions to be taken with regard to treatment and design. In addition, particularly in the combination of implant dentistry and metal-free prosthetics made of zirconium dioxide frameworks, the fact that the ZENO® Tec system is fully compatible with the implants in the WiLal system is of inestimable importance to patients, dentists and dental technicians.

**Fig. 12:** Milled ZENOdent.

**Fig. 11:** Milled ZENOdent.

**Fig. 10:** Milled ZENOdent.

**Fig. 9:** Milled ZENOdent.

**Fig. 8:** Milled ZENOdent.

**Fig. 7:** Milled ZENOdent.

**Fig. 6:** Milled ZENOdent.

**Fig. 5:** Milled ZENOdent.

**Fig. 4:** Milled ZENOdent.

**Fig. 3:** Milled ZENOdent.

**Fig. 2:** Milled ZENOdent.

**Fig. 1:** Milled ZENOdent.

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**Fig. 25:** Periimplantitis caused by remnants of cement and far subgingival transition from the standard abutment to the crown.

**Fig. 24:** Custom-layered ZENO® crown.

**Fig. 23:** Customised ZENO® abutment with accurate epigingival shoulder.

**Fig. 22:** CAO crown.

**Fig. 21:** Fitted components just after cementing, with accurate epigingival shoulder.

**Fig. 20:** Milled PMMA crown for the overpress technique.

**Fig. 19:** Milled ZENO® crown.

**Fig. 18:** Milled framework for the resin cement.

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