Individual CAD/CAM abutments on ceramic implants

Dr Frederic Hermann, M.Sc., Switzerland

Full-ceramic systems have been successfully established in the field of dental technology as well as in oral surgery.[1] The necessity of being able to offer patients metal-free restorations has continuously increased in recent years.[2] Owing to a genuine two-piece design, the newer generation of ceramic implants allows for successful restoration concepts similar to titanium implants. The reconstruction of an edentulous space in the upper jaw with simultaneous, transcrestal sinus floor elevation by using three CERALOG® implants will be described in the following case report.

Case presentation

In January 2015, the 42-year-old patient desired a holistic and metal-free reconstruction of the teeth, which were either missing or in need of restoration (Fig. 1). The bridge in region #15–17 had been removed by his family dentist a few years ago and the gap situation had not been prosthetically restored since (Fig. 2). The patient had already gathered restoration information and thus desired his missing teeth to be replaced with ceramic implants. The assessment of the radiological findings indicated an adequate bone width with simultaneously reduced bone height, which was caused by alveolar bone resorption and maxillary sinus pneumatisation. A wide zone of attached mucosa existed in the anticipated area of implant emergence. The case-related risk classification by means of SAC criteria revealed an A classification (A=advanced; Table 1).

In a preoperation consultation, the patient was informed in detail about the intended procedure and the possible risks. The special features of ceramic implants were particularly addressed. On the one hand, the present research situation, the role as a “maverick technology” and the alternative to titanium implants were addressed, while the positive biological, immunological and tissue-compatible aspects were discussed on the other hand.

Prior to the surgical procedure, the areas in need of restoration in the second and third quadrants were restored with full-ceramic bridge reconstructions as well as with a CAD/CAM-manufactured lithium disilicate crown in region #14. The prosthetically oriented implant positioning was digitally planned to achieve the highest clinically possible predictability of treatment success. Thus the three digitally designed crowns were overlaid with the DVT data according to the intraoral scanning method (Fig. 3). The positions, axial alignments and the lengths of the three implants were determined with the aid of planning software (Fig. 4). Since there is still no guided solution for the implant system utilised here, an orientation template was made in the laboratory on the basis of the accumulated planning data reproducing the anatomical marginal boundary of the teeth to be replaced as well as the alignments. The template could be exactly supported by the adjacent teeth (Fig. 5).

Implantation

The crestal incision was made after performing successful infiltration anaesthesia with preceding surface anaesthesia. It was carried out in a slightly palatally oriented manner and continued paramarginally vestibular around tooth #18. No distal vertical relief incision was made, in order not to reduce the blood supply in the flaps. After the

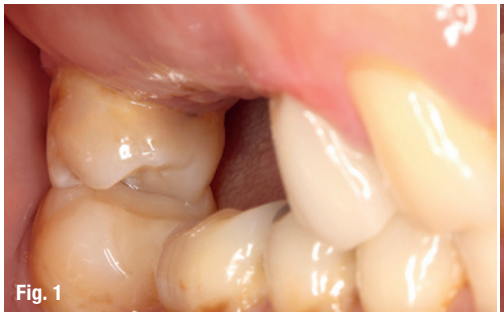


Fig. 1

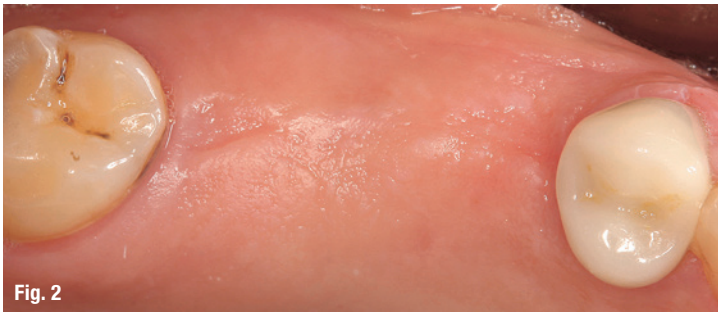


Fig. 2

Figs. 1 & 2: Initial intraoral situation.

	low risk	moderate risk	high risk
1. health status	good	treated	bad
2. smoking (p/day)	0	0–10	>10
3. oral hygiene/compliance	good	moderate	bad
4. periodontal status	good	moderate	bad
5. aesthetic demands	low	moderate	high
6. level of the smile line	low	moderate	high
7. gingival biotype	thick	moderate	thin
8. infection	no	chronical	acute
9. distance bone to contact point	<5 mm	5.5–6.5 mm	>7 mm
10. restorative status of the neighbour teeth	no		restored
11. width of the gap	single >7 mm	single <7 mm	>2 teeth
12. soft tissue condition	intact	reduced	defect
13. bone volume	no defect	horizontal defect	vertical defect
14. time of surgery	late	early	immediate
15. loading time after surgery	>2 months post-op	1 weeks – 2 months	immediate

Table 1: Assessment of medical findings and risk classification by means of SAC criteria.

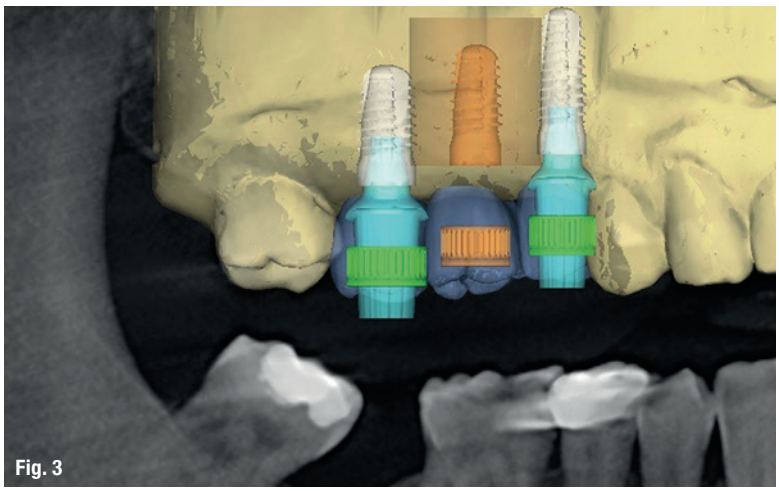


Fig. 3

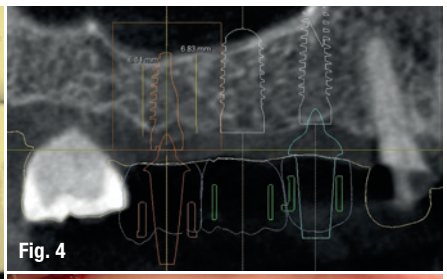


Fig. 4

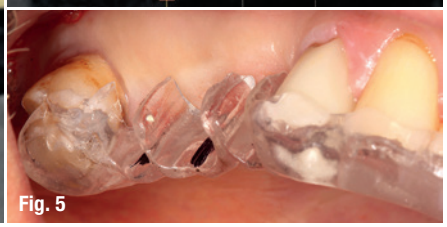


Fig. 5

Fig. 3: 3-D planning: overlay of datasets. **Fig. 4:** Planning visualisation. **Fig. 5:** Try-in of the drilling template.

preparation of the mucoperiosteal flap, the position of the implant was marked on the bone using the triangular drill and orientation template.

In the next step the pilot drill holes were created reaching slightly beneath the maxillary sinus floor, as in the following step the sinus floor was to be elevated using the osteotome technique. The axes of the drilled hole were examined with the aid of directional indicators and the implant site was expanded according to the surgical protocol (Figs. 6–8).

The indirect technique for augmenting the sinus floor through the drill holes was for the first time described by Tatum in 1986 and modified by Summers in 1998 on

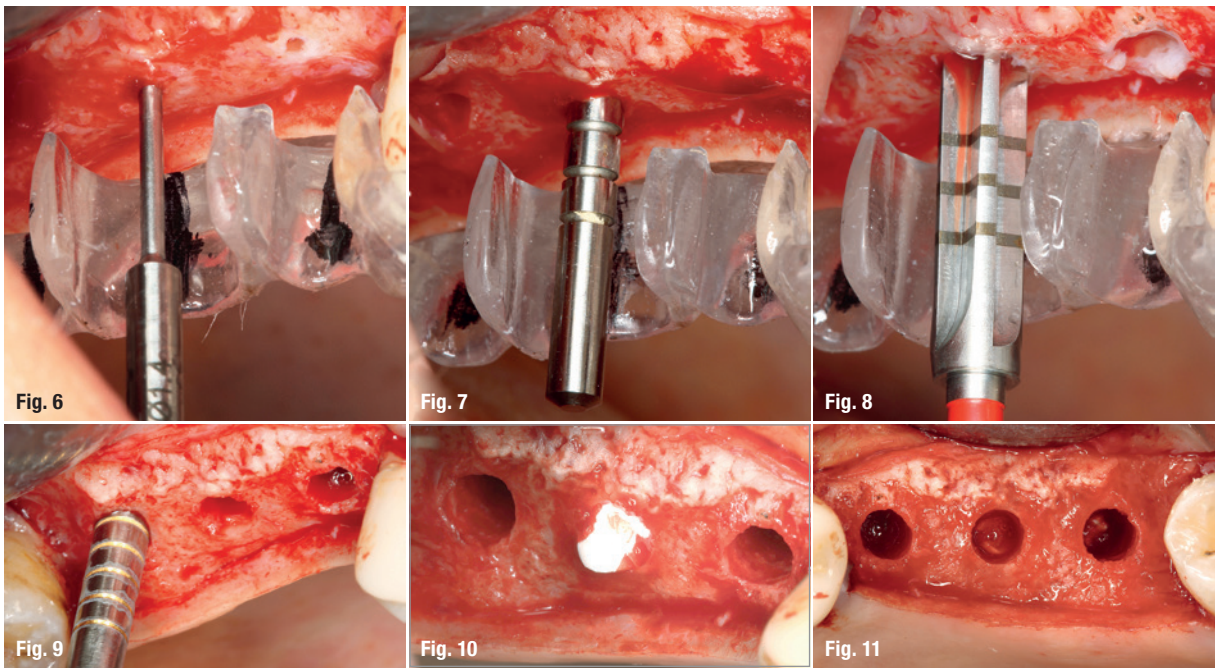


Fig. 6: Definition of the implant positions. **Fig. 7:** Paralleling pin. **Fig. 8:** Red extension drill. **Fig. 9:** Minimally invasive osteotome-aided sinus lift in region #17. **Figs. 10 & 11:** Application of collagen fleece beneath the Schneiderian membrane.

the basis of the osteotome technique.[3–5] A systematic review of specialised literature revealed that this approach is predictable, and has low incidence for intraoperative as well as postoperative complications.[6] The fracture of the sinus floor beneath the drill holes was initiated with an osteotome (Stoma) according to the implant diameter (Fig. 9). With the aid of the Piezon technology and specifically angled miniature sinus curettes, the Schneiderian membrane stayed always in touch with the bone and was carefully lifted under visual control (surgical microscope). Collagen fleece (PARASORB, RESORBA) was inserted through the drill holes in region #16 and 17 and carefully applied over the implant site in order to prevent a perforation of the Schneiderian membrane (Figs. 10 & 11).

Thread cutting was performed to avoid overheating the bone while inserting the zirconium dioxide implants, which have lower thermal conductivity than titanium implants (Fig. 12). The implants (CERALOG® Hexalobe, CAMLOG) of 8 mm in length were inserted manually at a controlled maximum torque of 35 Ncm and a maximum insertion speed of 15/min (Fig. 13). The design of the connection was optimally adapted to zirconium dioxide. The power transmission occurred radially with the insertion device. A predetermined breaking point in the device shields against an excessively high-torque value and therefore against excessive pressure which could initiate fractures in the implant or necrosis in the bone (Table 2).

The design of the implants utilised here was beneficial to the existing low bone height, thereby preventing the possibility of slipping into the maxillary sinus. Zirconium dioxide implants are manufactured in a ceramic injection-moulding (CIM) process obtaining a dual surface. The surface texture in the neck region is less coarse than in the enossal region favouring soft tissue apposition, whereas the surface in the enossal region is optimised for osseointegration. The implants were inserted about 0.5 mm supracrestally and primary stability was achieved at 25 Ncm (Fig. 14). After the insertion of the implants, the collagen fleece was situated apically like a screen above the implants in region #16 and 17, which were protruding two to three millimetres into the sinus floor. A blood clot formed in the created cavity favouring regeneration into stable bone through the formation of growth factors during implant healing.[7] The intraosseous, periodontal bone defect in region #18 was filled with a pure phase beta-tricalcium phosphate (Fig. 15).

Mixed with patient blood taken from the surgical site the porous synthetic granulation can be easily applied. After about six to nine months the material regenerates into stable cortical bone. After sealing the implants with the cover cap made of polyether ether ketone (PEEK), tension-free wound closure was performed with two mattress sutures and multiple simple interrupted sutures (Fig. 16). Further, a radiographic control image was taken (Fig. 17).[8] The patient left the practice with a renewed reference regarding postoperation behaviour focusing on care and non-strain.

Suture removal was performed during the two-week check-up showing well and irritation-free wound healing. The patient appeared six months later for implant exposure. The implants in region #15 and 16 were exposed

AWI

AWI Circonia Implants: now available in gingiva color.
For better results in esthetic relevant areas.

G-Line

www.WITAR.de

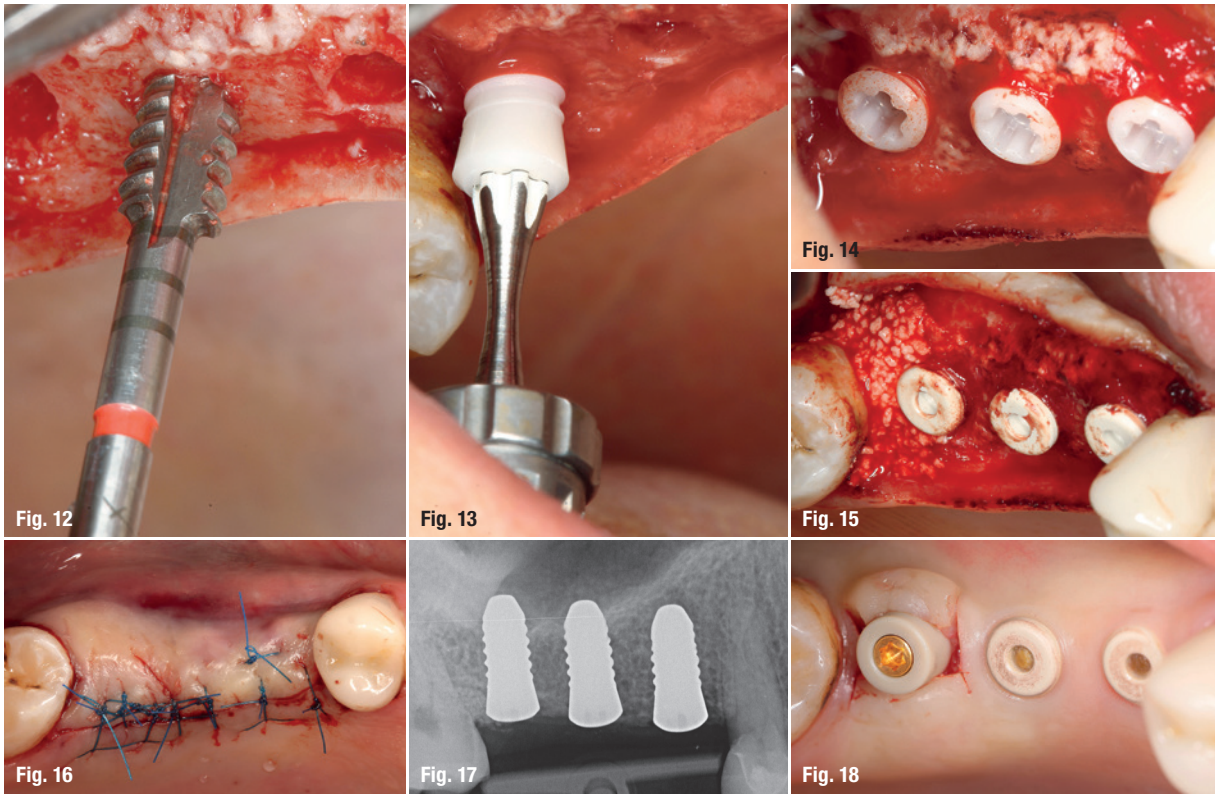


Fig. 12: Thread cutting. **Fig. 13:** Implant insertion in region #17. **Fig. 14:** Implants inserted at 0.5 to 1.0 mm supracrestally. **Fig. 15:** Guided bone regeneration (GBR) of intraosseous periodontal bone defect. **Fig. 16:** Tension-free wound closure. **Fig. 17:** Postoperative radiographic control image. **Fig. 18:** Six-months post-op exposure surgery.

with a stab incision, the cover cap was removed and the PEEK gingiva former was screwed on with the aid of a holistic screw for shaping the gingiva. The soft tissue around the implant in region #17 was pre-prosthetically thickened by preparing a mucosa flap and shifting it into vestibular direction. This shaping with a 2.5 mm high gingiva former was also performed without any additional suture being necessary (Fig. 18).

Definitive restoration

The implants and the jaw situation were moulded for the production of individual definitive full-zirconium dioxide abutments. For taking the impressions according to the open tray technique the gingiva formers were screwed off and the PEEK impression posts were inserted. Some practice is necessary to control the exact fit during the subsequent radiographic control image, since the material is only marginally radiopaque (Figs. 19 & 20).

The master model with a removable gingival mask was produced in the laboratory. Scan posts were screwed on and the morphology of the implant as well as the gingiva was digitally recorded. The data compiled from the wax-up was merged with the model data, and three individual abutments were designed in consideration of material thicknesses and the anatomical coronal-emergence profiles.

Six days after order placing, the laboratory received the CAD/CAM-manufactured abutments. The design of the internal connection was adapted to zirconium dioxide and ensured an optimal distribution of the forces involved. Owing to the limitations of milling radii the full-zirconium dioxide abutments (DEDICAM®, CAMLOG) were made with platform switching. The abutments were screwed on in the laboratory and the subgingival parts were checked for hygienic capability (Fig. 21).

Another important step was the reliable prosthetic crown restoration. For this purpose, prototypes were made from polymethyl methacrylate by 3-D printing on the basis of already existing STL datasets. The occlusion, contact points, hygienic capability as well as shape and aesthetics can be checked intraorally during a prototype try-in with these cost-effective synthetic crowns. Owing to the integrated platform switching and the occlusal structure height, the coronal emergence profile in region #16 could not be optimally aesthetically solved (Figs. 22 & 23). As zirconium dioxide has a lower accumulation of plaque and the subsequent hybrid-abutment crown would be easy to clean in this area, this situation was assessed as clinically acceptable.[9,10] Owing to consistent prosthetic backward planning, the zirconium dioxide crowns—which are to be buccally veneered later—could be made with an integrated occlusal screw

4TH ANNUAL MEETING OF ISMI

22 & 23 June 2018
Hamburg, Germany—EMPIRE RIVERSIDE HOTEL

BOOK ONLINE /
CONGRESS PROGRAMME

www.ismi-meeting.com

Theme:

The future of implantology—ceramics and biology

Organisation/Registration:

OEMUS MEDIA AG
Holbeinstraße 29 | 04229 Leipzig | Germany
Phone: +49 341 48474-308 | Fax: +49 341 48474-290
event@oemus-media.de | www.oemus.com

ISMI | INT. SOCIETY OF METAL FREE IMPLANTOLOGY

Fax Reply +49 341 48474-290

☐ I would like to receive further information on the 4TH ANNUAL MEETING OF ISMI.

Title, Surname, Name

E-mail address (for digital programme)

Stamp

CI 1/18


Fig. 19

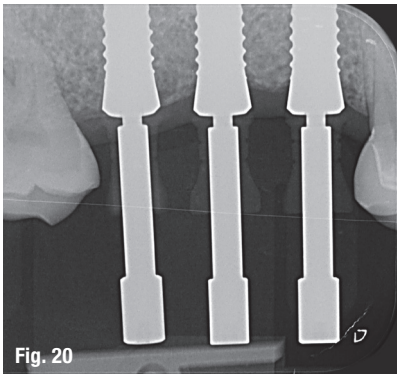


Fig. 20

Fig. 19: Lateral view of impression posts. **Fig. 20:** Radiographic control image.

access channel. After crown finalisation, they were adhesively attached to the abutments in order to produce one-piece fully anatomical hybrid-abutment crowns. The hybrid-abutment crowns were inserted into the mouth with titanium screws at a torque of 25 Ncm after function and aesthetics had been controlled.

Cement residues have been repeatedly discussed in literature as being the cause of an emerging mucositis or peri-implantitis. This risk was eliminated with the screw-retained solution. The screw access channels were initially filled with sterile Teflon tape and then sealed with methacrylate-free composite (Fig. 24).

During follow-up appointments at one and six weeks after the insertion of the full-ceramic implant restoration the soft tissue proved to be stable and irritation-free. The osseointegrated ceramic implants and the osseously regenerated periodontal defect mesial of region #18 were apparent on the radiographic control image (Fig. 25). The patient was very satisfied with the holistic rehabilitation of his oral situation.

Discussion

The patient demand for ceramic implant restorations is undisputedly increasing.[2] The aesthetic and health-related needs of patients should be considered in the treatment concept. In doing so, clinically proven systems provide us with certainty. A dual surface roughness without mechanical finishing is created through the modern manufacturing process known as CIM. Adapted to the soft-tissue cells, the neck region exhibits a roughness with an average roughness value of 0.5 micrometres and the enossal region exhibits a roughness of 1.6 micrometres. As a result, outstanding osseointegration properties can be attained.[11,12]

Abutments made of the high-performance polymer PEKK are offered as a standard for two-piece implants. In medical technology, the material is used in areas with high load levels. PEKK is biocompatible and has a great degree of strength. Because of the chemical composition and ductility these abutments cover the entire implant platform, including the circular slanting bevels. A uniform choice of materials is guaranteed with the option of individual, CAD/CAM-manufactured full-zirconium dioxide abutments. Owing to the milling geometry, the full-zirconium dioxide abutments can only be made with integrated platform switching. The choice of abutment used for the reconstruction should be defined during the implant positioning, as the abutments influence the vertical position of the ceramic implant.

When setting the PEKK abutment on the shoulder, the implant platform should be placed between 0.5 and 1.5 mm supracrestally. In case of thick gingiva (> 3 mm), supracrestal placement is possible with zirconium dioxide abutments. However, owing to platform switching a slightly subcrestal or epicrestal positioning is advantageous for the prosthetic emergence profile if adequate bone supply is available (Table 2). The connection is secured with the aid of a titanium screw or a holistic gold screw, which does not have any connection to the oral environment when embedded in the overall construction. Today, the genuine two-piece design of the implant system offers similar treatment procedures as with titanium implants.

For successful treatment therapy 3-D planning by means of DVT datasets has become established in the dental practice. The optimal prosthetically oriented position of implants can be determined through a template-guided or template-oriented surgery and the digitally designed reconstruction. After successful osseointegration, the intraoral structures can be scanned or conventionally moulded. With the aid of a laboratory scan and the open STL datasets the abutments can be designed and com-


Fig. 21

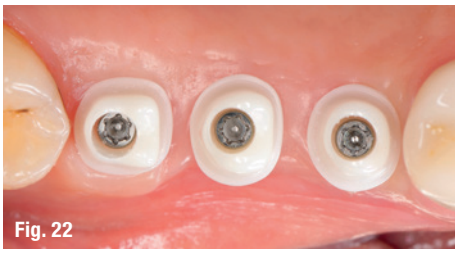


Fig. 22

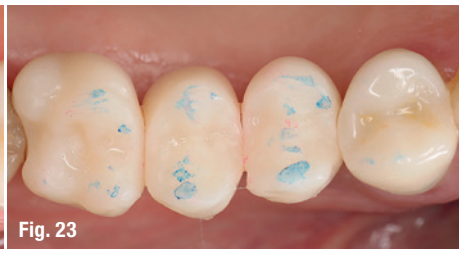


Fig. 23

Fig. 21: Abutments on the model. **Fig. 22:** Try-in of the abutments. **Fig. 23:** Occlusion control and adaptation of prototypes.

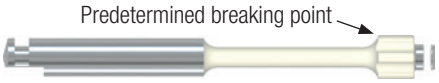
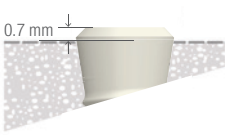
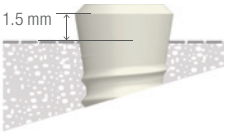
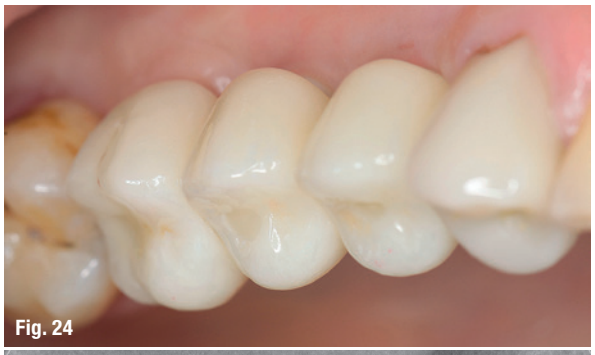
Thermal conductivity	The insertion device for Hexalobe® implants is equipped with a predetermined breaking point, which: – prevents excessive torque and excessive load, – breaks with excessive load, and – prevents damage on the implant. 
Primary stability/ protocol	The drilling protocol depends on bone quality. – CERALOG® has no self-tapping thread Pre-tapping a thread is strongly recommended in case of hard bone (D1/D2). The following torques have to be noted: – maximum torque of 35 Ncm, and – maximum speed of 15/min.
Positioning	Individual DEDICAM® full-zirconium dioxide abutment: owing to the integrated platform switching, the implant should be positioned epicrestally.  The PEKK abutments completely contain the platform's circular bevel. The implant can be placed supracrestally between 1.5 and 0.5 mm.  The use of a profile drill is recommended in epicrestal placement. – controlled expansion of the implant bed in the crestal region
Prosthetic portfolio	Components for crown and bridge restoration: – PEKK (straight and angled) – DEDICAM® abutment

Table 2: Factors to be noted for the insertion of CERALOG® implants.

Literature

missioned via the DEDICAM® production service. The material-dependent exact milling data are only stored in the CAM production. After a controlled sintering process lasting over three days, a precise fit to the internal configuration of the implant is attained. Subsequently fully anatomical crowns or crown frameworks are produced in a dental laboratory or by means of a production service provider and individually veneered by dental technicians.



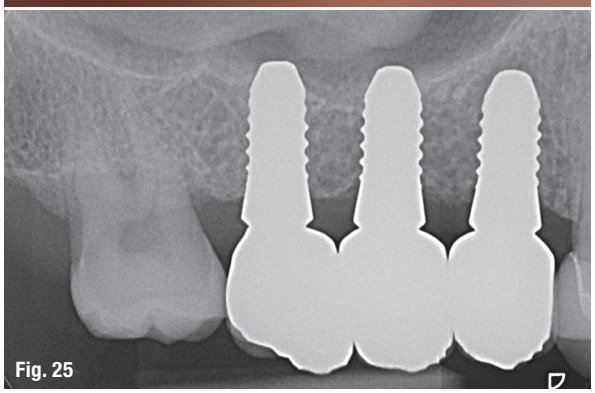


Fig. 24: Lateral view of the inserted implant crowns. **Fig. 25:** Radiographic control after insertion of the final prosthetics. The regenerated intraosseous defect in region #18 mesial has to be noted.

Currently the prosthetic portfolio for two-piece ceramic implants is still limited, thus the indications for restoration with fixed crowns or smaller bridge reconstructions are still limited. Prosthetic components for removable restoration concepts will be available in the near future.

Conclusion

In summary, it can be stated that two-piece ceramic implants are a safe and biologically interesting alternative to existing titanium implants and represent a sensible addition to the implantological treatment spectrum of a dental practice. Thus, in order to reach clinical success with metal-free implants it is important to determine correct indications and to properly consider the ceramic-specific properties.

contact

Dr Frederic Hermann, M.Sc.
TEAM 15 – Dental Practice
Poststr. 15
6300 Zug, Switzerland
info@team15.ch
www.team15.ch

Author details