Elimination of a free-end gap in the maxilla

Application of zirconium dioxide implants

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Patient demand for metal-free implant solutions is constantly increasing. While titanium implants are biocompatible and well tolerated, some studies have shown a presence of titanium oxide loads in the body after implantation.[1,2] Inflammatory reactions of varying severity, depending on genetic susceptibility, have been detected in some patients.[3] In comparison, fewer cases of such reactions were observed for zirconium dioxide particles. A further advantage of zirconium dioxide implants is their good tissue compatibility. In the following article, a patient case is presented in which two-piece zirconium dioxide implants were integrated into a free-end gap in the maxilla.

Ceramic implants have been on the market for many years. Their share in the total dental implant market has, however, remained modest, owing to experiences made in the 1980s and 1990s with fractured ceramics—especially with one-piece aluminium dioxide implants, the so-called Tübingen and Munich immediate implants—and owing to the lack of scientifically based data at that time.[4]

Extensive materials research over the past several years has resulted in a newer generation of yttria-stabilised tetragonal zirconium dioxide, defining the new industry standard. Its advantages include its applicability in crown and bridge technology and as an abutment material. As the material's stability for implants thus no longer poses a challenge, the focus has turned to the internal surface quality of zirconium dioxide, which was identified as a potential source of osseointegration issues, and to a reversible screw-retained two-piece implant.

Newer, high-tech manufacturing processes, such as injection moulding, aiming to achieve a surface structure for zirconium dioxide implants that is well tolerated in bone, are now considerably increasing confidence in this technology.[5] If one interprets the current developments correctly, owing to these new materials, we will soon be able to offer long-term implant treatment and stability for patients with special, partly medically justified needs.

Examination and treatment planning

A 38-year-old female patient came to our practice with a free-end gap in the second quadrant. As the rest of the

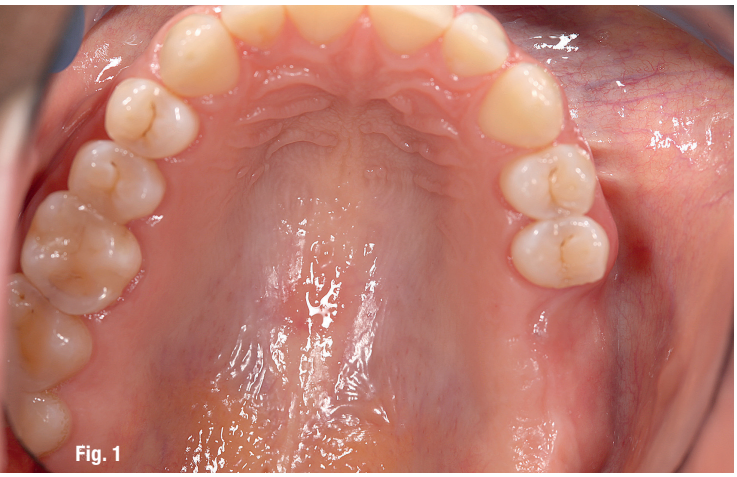


Fig. 1

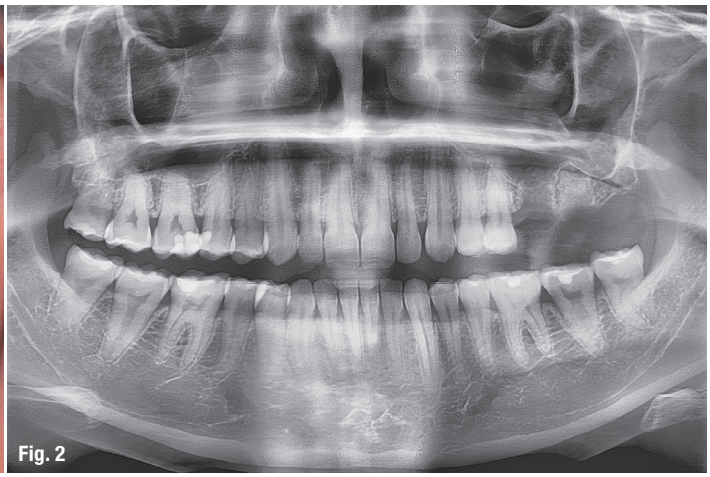


Fig. 2

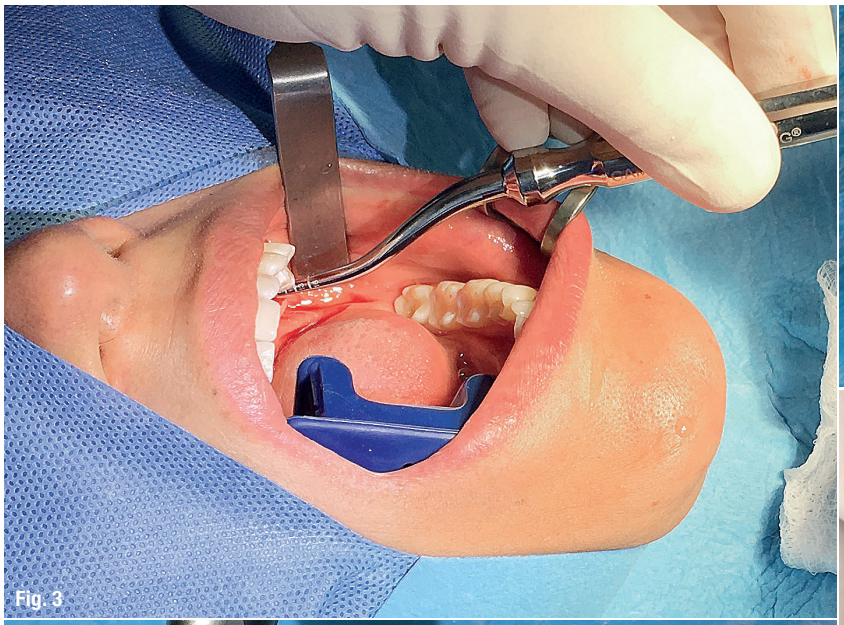
Fig. 1: Initial situation: free-end gap in the left maxilla (teeth #26–28 were missing). **Fig. 2:** The radiograph demonstrated sufficient bone height in the maxillary sinus area for insertion of two implants.

teeth were completely intact, she desired a fixed, metal-free restoration to replace the two missing molars. After in-depth consultation regarding implant treatments, including advising her of the limited documentation regarding research on zirconium dioxide implants, restoration with two-piece implants (CERALOG Hexalobe, CAMLOG) was planned. The radiograph showed sufficient alveolar bone height to insert two 10 mm implants without having to lift the sinus floor (Figs. 1 & 2).

Implant bed preparation by bone condensation

After ridge incision and preparation of a mucoperiosteal flap, the implant position was marked with a round bur. A pilot drill (2 mm) was used to position the implant axis to an approximate depth of 6 mm, and the implant position was checked with a paralleling pin. As the bone quality in the distal maxilla proved to be very soft, the bone site was prepared using osteotomes, thus achieving primary stability by condensing the bone. An additional advantage of using osteotomes was that the Schneiderian membrane was not penetrated, which might otherwise have occurred when carelessly operating with burs. The implant sites were prepared with osteotomes according to the implant diameter of 4 mm. As one implant was to be placed in almost epi-crestal position, the implant bed was drilled to the complete implant length of 11.5 mm in this case (Fig. 3).

After preparation of the implant sites had been completed, the implants were removed from the sterile packaging with the insertion tool and prepared for insertion (Figs. 4 & 5).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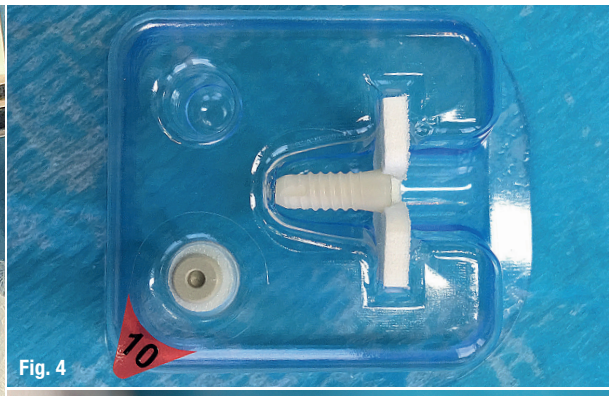

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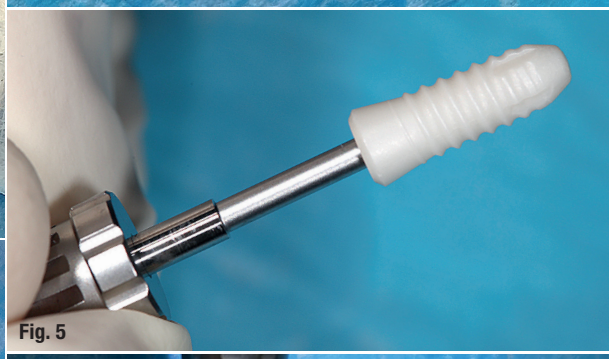
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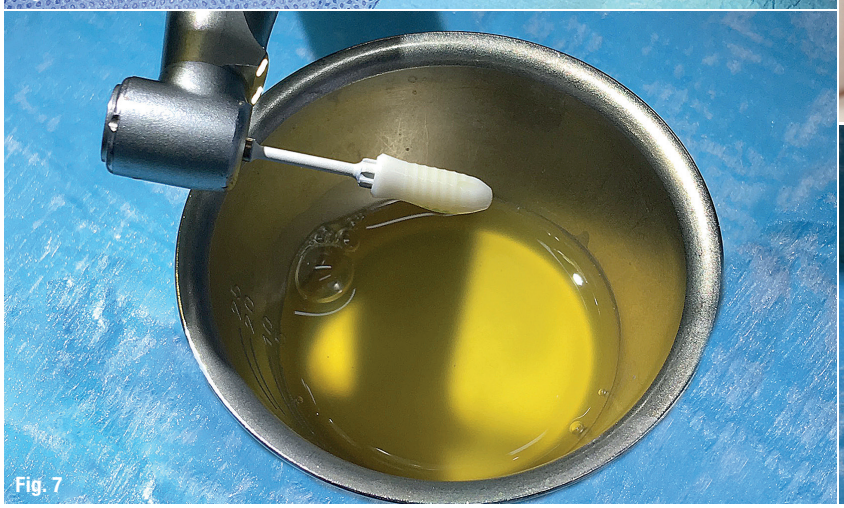
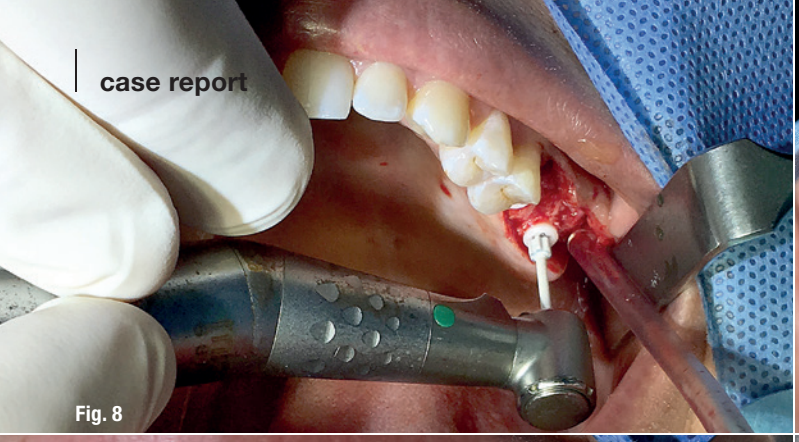


Fig. 7

Fig. 3: The bone site was prepared with osteotomes in order to condense the soft bone in the distal maxilla. **Fig. 4:** An implant in its sterile packaging. **Fig. 5:** The insertion tool connected to the interior of the all-ceramic implant. **Fig. 6:** The mechanical option for implant insertion. **Fig. 7:** Before insertion, the implants were wet with growth-promoting PRGF liquid.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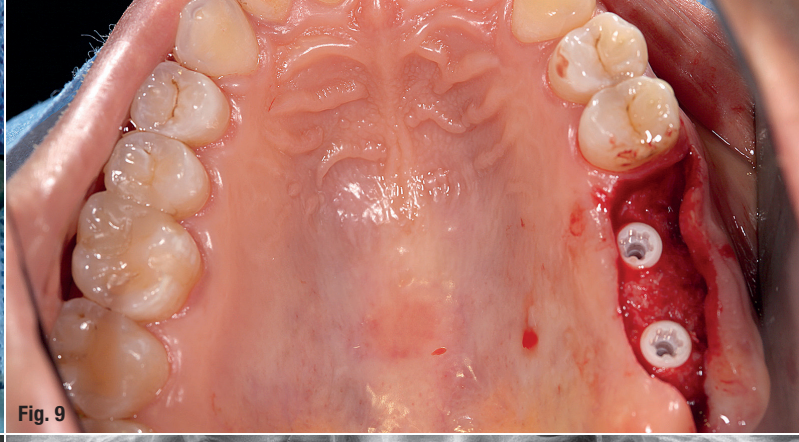
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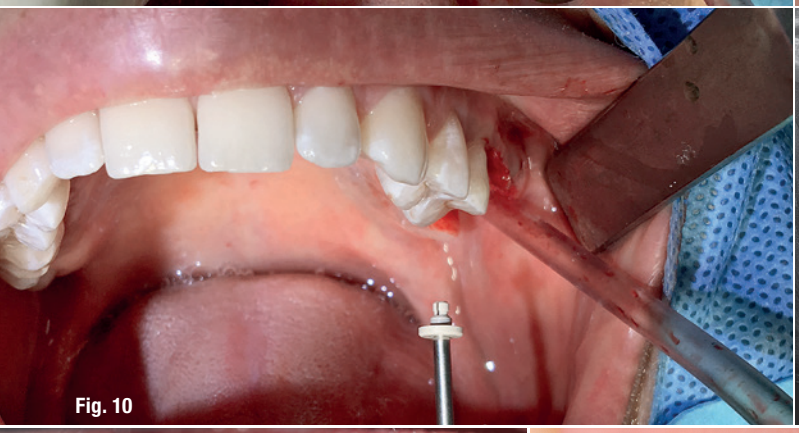
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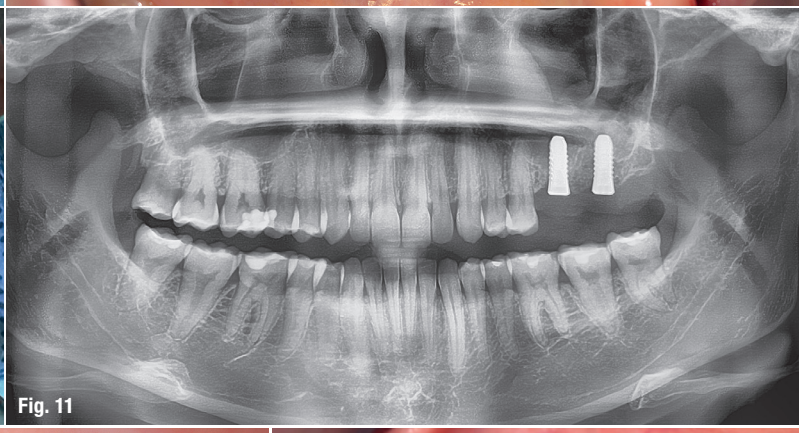
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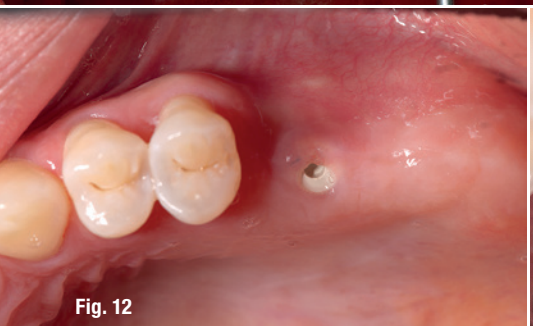
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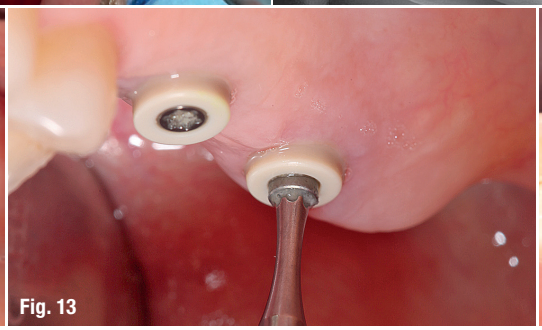
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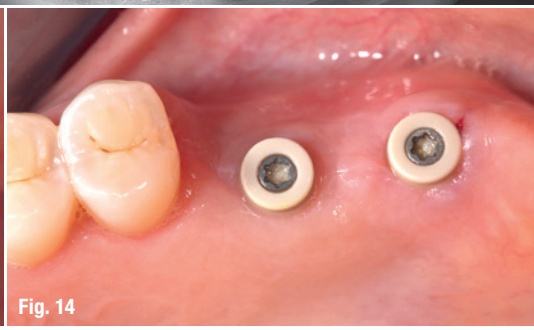


Fig. 14

Fig. 8: Too great an insertion torque must be avoided when inserting zirconium dioxide implants. **Fig. 9:** The correctly positioned and stable implants prior to wound closure. **Fig. 10:** The implants were sealed with the healing caps. **Fig. 11:** The post-op radiograph showed the position of both implants in regions #26 and 27. **Fig. 12:** At the time of implant uncovering, the implant in region #26 was already partially exposed. **Fig. 13:** Gingiva formers were inserted to shape the soft tissue. **Fig. 14:** Occlusal view of the two gingiva formers directly after the implant uncovering surgery.

Epicrestal implant positioning

Prior to inserting the implant, the surface was wet with the bone-activating cells of the PRGF (plasma rich in growth factors) liquid. At the author's practice, the innovative PRGF procedure, which uses the patient's own growth factors to accelerate the healing process and to reduce complaints and the risk of complications, is applied in all implantations, independent of the material characteristics (Figs. 6 & 7).

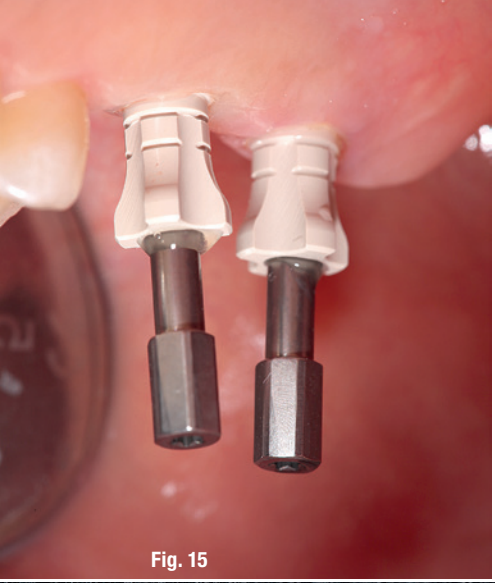
As zirconium dioxide is a poor heat conductor, it is important to insert zirconium dioxide implants slowly and without pressure. The implantation was carried out at a defined maximum torque of 35 Ncm and 15 rpm. The implants were positioned minimally supracrestally, placing the implant shoulder approximately 0.5 mm above the alveolar bone (Figs. 8 & 9).

The healing caps were clicked into the implant interface as protection from the ingrowth of bone and soft tissue. The mucoperiosteal flap was repositioned tension-free and sutured over the healing cap in order to prevent saliva entering. Subsequently, a control radiograph was taken (Figs. 10 & 11).

Regions #26 and 27 being in the non-visible area of the maxilla, it was decided not to place an interim restoration in order to protect the implants. The healing of both implants occurred without complaints. The patient did not show any atypical symptoms. The healing duration of ceramic implants is still a topic of discussion. In comparison with titanium implants, however, longer healing periods are suggested.

Minimally invasive uncovering

The implants were uncovered after 14 weeks. In addition to physical and visual examination, a radiograph was taken to control implant healing. Owing to soft-tissue resorption, the healing cap of the implant in region #26 had become partially exposed (Fig. 12).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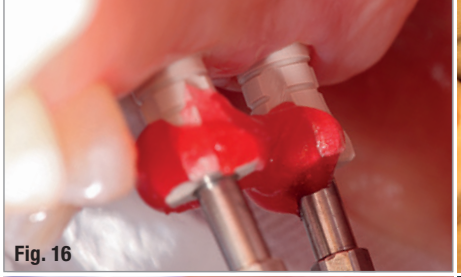
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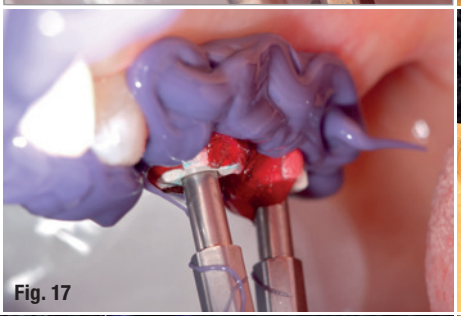
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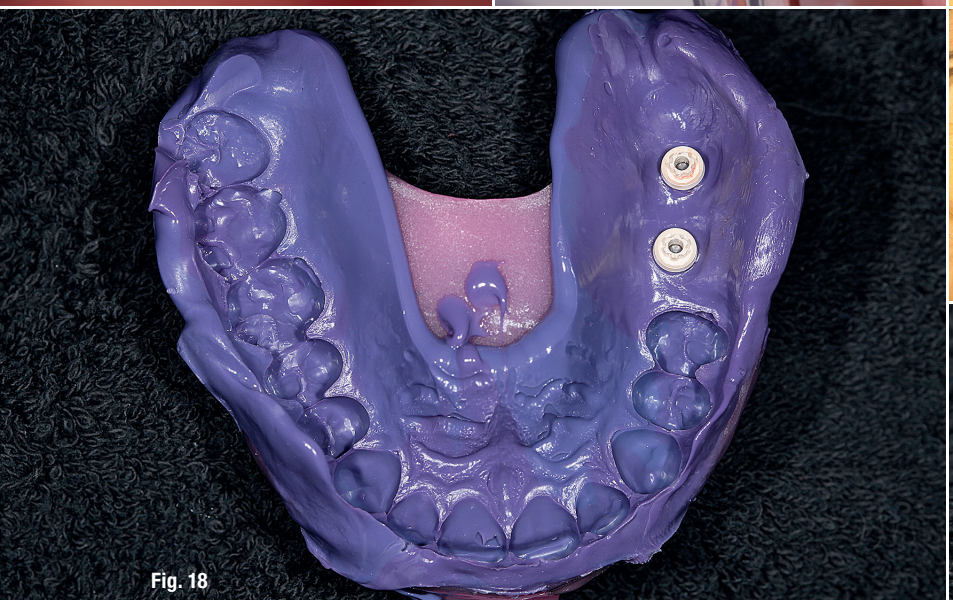
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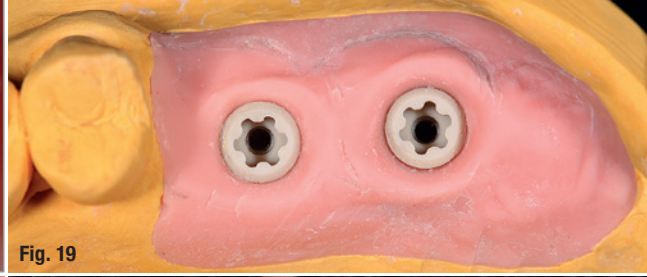
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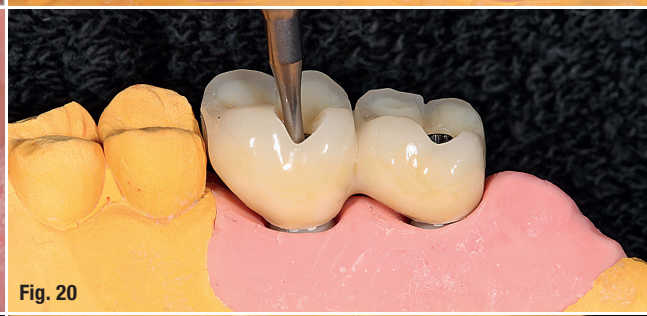
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Fig. 21


Fig. 22

Fig. 15: Posts for the open-tray technique were chosen for impression taking. **Fig. 16:** The impression posts were intraorally splinted with pattern resin to ensure the accurate transfer of the implant positions. **Fig. 17:** The screw length of the impression posts enabled easy intraoral uncoupling. **Fig. 18:** The impression taken of both implants using the open-tray technique and precision impression material. **Fig. 19:** The master model with the removable gingival mask. The shape of the soft tissue is clearly discernible. **Fig. 20:** The milled, interlocked crowns were glued to the PEKK abutments. **Fig. 21:** The accurately positioned screw access channels. **Fig. 22:** The accurate transition of the crowns to the PEKK abutments.

The implant uncovering was performed in a minimally invasive manner, without using the flap technique. Access to the healing caps was obtained via stab incision. They were then removed and 2.5 mm high gingiva formers were inserted to shape the peri-implant soft tissue (Figs. 13 & 14).

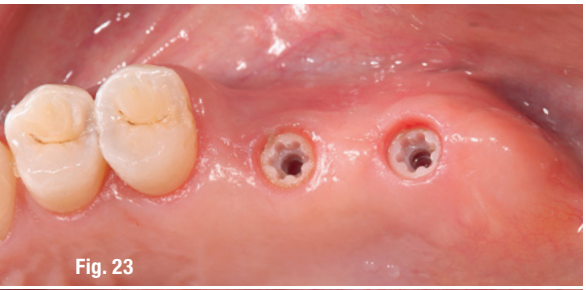
Only one week after implant uncovering and mucosal healing, impressions were taken using impression posts for the open-tray technique. According to the Berlin concept, connecting the impression posts is recommended in cases of planned prosthetic splinting with several implants located next to one another. Pattern resin (GC) was used for splinting during impression taking in order to avoid any transfer errors (Figs. 15 & 16).

In the subsequent workflow, a conventional impression taking method with an individual tray was selected. This procedure guarantees highly precise transfer of the implant positions to the dental laboratory. This highly precise impression technique may be time-consuming to perform, but it guarantees reliable, results-oriented further processing in the laboratory, ensuring the quality required for CAD/CAM processing technology (Figs. 17 & 18).

Prosthetic reconstruction

The exact transfer of the position of the implants and the surrounding soft tissue is absolutely paramount when creating a model in the laboratory. After the laboratory analogues had been unscrewed, the material for the detachable gingival mask was injected and after it had cured the impression was cast in plaster (Fig. 19).

The master model of the maxilla and the opposing model of the mandible were mounted in the articulator using a facebow and a bite register, and both PEKK abutments were shortened according to the occlusion. The crowns should be interlocked and screwed in directly. The situation was scanned, and the crowns digitally designed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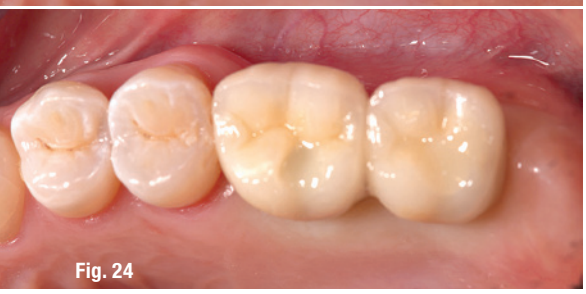
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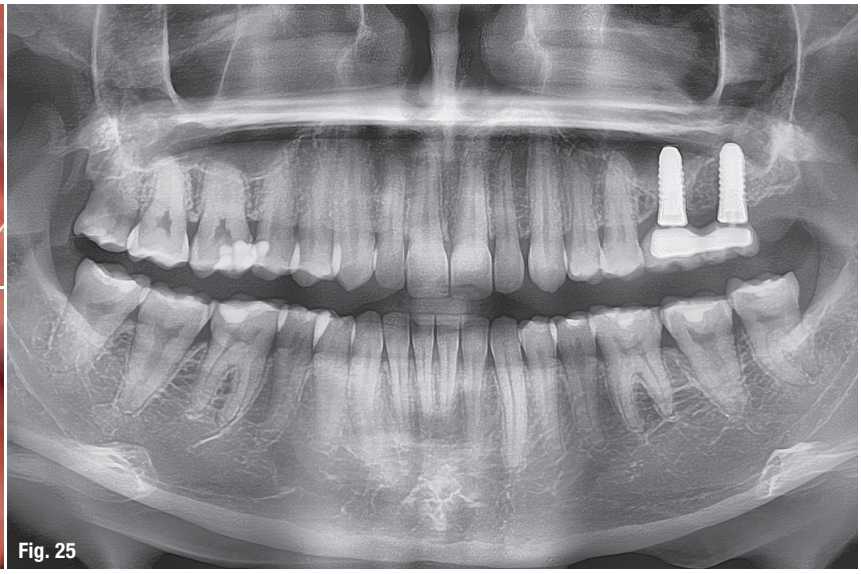
Fig. 25

Fig. 23: Stable soft-tissue situation before the crowns were inserted. **Fig. 24:** After insertion and functional and aesthetic control, the screw access channels were sealed. **Fig. 25:** As PEKK is not radiopaque, some time and experience are required to analyse the control radiograph.

and produced from zirconium dioxide. The crowns were finalised after glaze firing. Both the crowns and the PEKK abutments were activated and subsequently glued to the model. Ensuring easy hygienic care of the implant crowns was of particular importance (Figs. 20–22).

Overall, the production of the two occlusally screw-retained crowns was achieved without any difficulties. In spite of the new materials and system parts, this case was also treated proficiently and routinely by the dental technician.

Subsequently, the crowns were inserted into the patient's mouth. A very well-healed intraoral situation was apparent. The crowns were inserted and screwed in with titanium abutment screws at a defined torque of 15 Ncm. After the final functional and aesthetic control, the screw access channels were sealed using cotton pellets and a composite (Sinfony, 3M ESPE; Figs. 23–26).

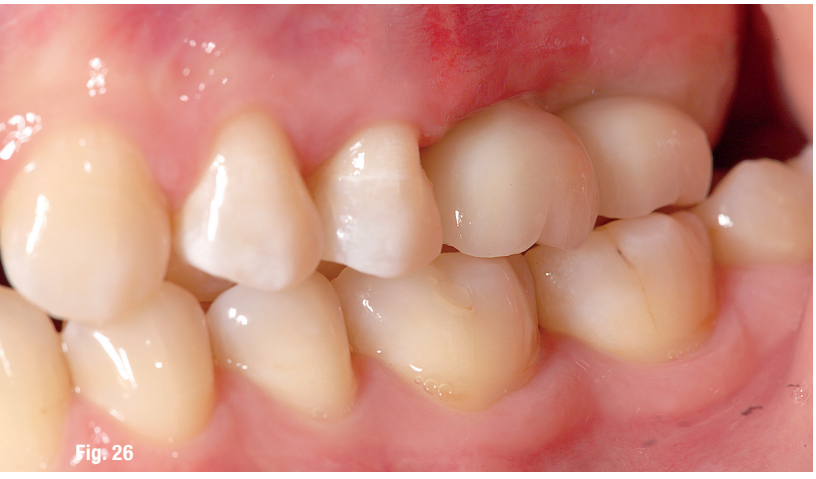
Fig. 26

Fig. 26: Final inspection of the inserted crowns at regions #26 and 27.

Conclusion

Throughout the entire treatment process, no problems occurred in the application, performance and handling of this implant system. Also, from the executing master dental technician's perspective, the system was successful and user-friendly.

This two-piece implant provides implantologists with a scientifically well-documented and easily applicable alternative to conventional titanium implants. The user-friendly system creates confidence in this new choice of material in the implant market. One of the advantages of ceramic implants is the material's good tissue compatibility regarding osseointegration, gingival adaption and low plaque accumulation.

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Literature

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