Rehabilitation of an atrophic mandible with 3D-planning

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Introduction
Patients with fixed restorations in the form of large-span bridges often wish to keep a fixed solution, even if the distal bridge abutments are lost. Prosthodontists advise a shift in treatment to a removable prosthetic. This is owing to lack of knowledge of current possibilities regarding bone augmentation and implantation. The argument that implant-borne (fixed) restorations promise quality of life, appeal and youthfulness is ignored. As a consequence, removable restorations are only partially accepted and result in patient dissatisfaction in the long term. The desire for permanent rehabilitation remains. The opportunity for prompt placement of an implant and, if necessary, augmentation of the posterior section of the lower jaw to react preferably in a more a favorable resorption class, is missed.

Initial situation
A 71-year old female non-smoker in good general and nutritional state, presented with multiple prosthetic restorations in the maxilla, consisting of bridges and single crowns with different lengths of time. The mandible revealed an insufficient telescope / attachment retained by a crown block 43 to 32. Tooth 43 was destroyed by caries under the crown and had a treated root canal (Fig. 1). The patient requested rehabilitation with a fixed prosthesis. As a result of years of wearing removable prosthetics, the mandible revealed an atrophy pattern absorption class 5 to 6 on the right and Cawood Class 4 on the left.¹

Procedure
Treatment planning: Bone augmentation with autologous material from the retromolar/corpus region of the respective sides and time-delayed implantation was discussed with the patient. She requested a pre-operative 3D image (Fig. 2) to clarify the necessity of augmentation. 3D planning with coDiagnostiX for implant placement and immediate restoration via multi-base abutments was recommended following augmentation.

Surgical procedure: The patient requested a full anesthetic during bone augmentation. This was followed by the typical incision of the gingival margin and appropriate mesial and distal relief. Once the dimension of the host site had been determined, the corresponding mandibular ramus and/or corpus site was selected.

After determining the dimensions and the morphology of the bone graft, the mono-cortical bone block was harvested from the donor region²,³ by piezo-surgery⁴ (Fig. 3). Using a Safescraper⁵, this was thinned down extraorally to a final thickness of 1 mm. The thinned block served as biological membrane to stabilize the particulate bone material

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vestibularly and orally. First, a cortical lamella was fixed occlusally over the osteosynthesis retaining screws in gliding holes (Fig. 4). This lamella was lined with cortical chips soaked in venous, autologous blood. To secure the graft, it was covered with a further lamella vestibularly, which was fixed with osteosynthesis retaining screws (Fig. 5).

This was followed by fully tightening the screws inserted in the gliding holes of the occlusal lamella to compress the particulate graft. This was followed by wound closure with sutures. On the left side, augmentation was performed by applying the tongue-in-groove principle6,7,8 (Figs. 6 – 8). The antibiotic clindamycin 600 mg was administered as short...
infusion and continued orally over 6 days [1-0-1]. After coDiagnostiX planning (Figs. 9, 10), the osteosynthesis retaining screws were removed after 4 months and the implants placed. Tooth 43, which had been destroyed by caries, was removed on the right. Immediate implantation was performed using a Straumann® Bone Level implant (Ø 4.8 mm, L 12 mm).

Straumann® Bone Level implants (Ø 4.1 mm, L 10 mm) were inserted in positions 044 and 046 (Fig. 11). On the left, three Straumann® Bone Level implants were placed as delayed implants (regio 33 a Straumann® Bone Level implant made of Roxolid® Ø 3.3 mm, L 14 mm, regio 34
and 35 each, a Straumann® Bone Level implant Ø 4.1 mm, L 10 mm) (Figs. 12 – 15). All implants had the surface specification SLActive®.

Temporary immediate restoration: all implants were fitted with multi-base abutments 0° with a gingiva height of 4 mm (Figs. 16, 17). An NC multi-base abutment Ø 4.5 was used for the NC-Roxolid® implant. The terminal implants were fitted with RC multi-base abutments Ø 6.5. Impression taking was performed with a foil technique tray® (Fig. 18) with color-coded impression components (Fig. 19).

The laboratory-made temporary prosthesis (Fig. 20) was
screw-retained occlusally via integrated temporary copings (Fig. 21). The screw channel was sealed with a foam pellet soaked in 0.1% CHX gel and a light-curing composite. The temporary restoration remained in place for 6 months (Fig. 22).

**Final restoration:** The existing metal-ceramic veneer crowns in regio 32 to 42 were removed and the teeth prepared again. For impression taking, the impression posts were laboratory-customized to correspond with the gingiva emergence profile created by the multi-base components.
This was followed by a single-session, two-phase impression using the double mixing technique with a polyether impression material\textsuperscript{11,12} (Fig. 23) and corresponding color shade selection.

In order to continue supporting the ideally shaped soft tissue (Figs. 24, 25), a decision was made in favor of CAD/CAM-fabricated, customized abutments made of zirconium dioxide. The basal component of the future mesostructures was designed such, that the gingiva is supported optimally and creates an ideal transition of the implant connection to the bridge contour. Following a pronounced temporary break, one no longer needs to expect changes to the gingival margin.

Thus the future crown margin was placed only 0.5 mm
non-irritant PEMA in a trough-shape final design. Then the final restorations were inserted (Fig. 34).

**Conclusion**

The safety of the surgical methods and the augmentation materials used was of the highest priority in the patient information and treatment. The choice was therefore in favor of the body’s own materials. This ruled out the risk of infection for the patient as well as immunological rejection of the transplant. “In its cancellous form, autologous bone (...) is superior to all other bone substitutes with regard to its biological value, and is still considered (...) today to be the “gold standard” among augmentation materials.” In addition, autologous bone is partially osteogenic and osteoconductive.

sub- and epi-gingivally. The wax model (Fig. 26) on auxiliary parts, which correspond to the implant connection, is digitalized using the Straumann® CS2 Scanner. After data transmission, the fabrication of the individual abutments is performed in the Straumann milling center. To ensure the required fit and the stability needed for the molar region, one-piece zirconium dioxide abutments (Figs. 27, 28) were fabricated.

After a few days, the dental technician received the patient-specific abutment for further processing. In the next step, a Zerion® veneering framework is designed using CAD/CAM and fabricated following data transmission. (Figs. 29, 30). The zirconium dioxide abutments were inserted at a torque of 35 N/cm (Figs. 31, 32).

The OPG shows the situation 18 months after implantation (Fig. 33). The screw channels will filled with non-irritant PEMA in a trough-shape final design. Then the final restorations were inserted (Fig. 34).
When choosing the implant system, the focus was on the greater safety and better predictability in the early treatment phase with immediate loading. As a result, only an implant system with the SLActive® surface was an option. Studies show that the SLActive® surface demonstrated 60% more boneimplant contact after two weeks compared with the SLA® surface. Prompt, early loading with Straumann® SLActive® implants gives a survival rate in excess of 97% after one year.

Computer-aided, template-guided surgery via CoDiagnostiX™ was used to place the implant. The procedure shows average horizontal deviations between the final and the planned position to 1 mm.

Patients nowadays demand minimally invasive surgery, the shortest healing time possible and optimal esthetic results. Clinicians, on the other hand, are not only looking to satisfy their patients’ expectations, but also to obtain predictable long-term results. Both demands can only be achieved through precise planning and appropriate execution with excellent teamwork, as well as an implant product portfolio which offers perfectly matched components, from 3D planning to the final restoration.

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