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 retain a fixed solution, even if the distal bridge abutments have been lost. Yet prosthodontists advise a shift in treatment to a removable prosthesis. This is due to a 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 immediate placement of an implant and, if necessary, augmentation of the posterior section of the mandible to address resorption is missed.

Initial situation
A 71-year-old female non-smoker in a good general and nutritional state presented with multiple prosthetic restorations in the maxillae, consisting of bridges and single crowns placed at different times. The mandible revealed an insufficient denture. Tooth 43 had been 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 prostheses, the mandible revealed an atrophy pattern of resorption Class V–VI on the right and Cawood Class IV on the left.1

Procedure

Treatment planning
Bone augmentation with autologous material from the retromolar region/corpus of the respective sides and delayed implantation was discussed with the patient. She requested a pre-operative 3D image (Fig. 2) to clarify the necessity of augmentation. Three-dimensional planning with coDiagnostiX (Dental Wings) for implant placement and immediate restoration via Multi-Base Abutments (Straumann) was recommended after augmentation.

Surgical procedure
The patient requested general anaesthetic during bone augmentation. This was followed by the typical incision of the gingival margin and appropriate relieving incisions. Once the dimensions of the receiving 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, a monocortical bone block was harvested from the donor site 2, 3 by piezo-surgery 4 (Fig. 3). Using a Safescraper (Meta Advanced Medical Technology), 5 this was thinned down extraorally to a final thickness of 1 mm. The thinned block served as a biological membrane to stabilise the particulate bone material 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 autologous venous blood. In order 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 into 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 technique 6–8 (Figs. 6–8). Clindamycin 600mg was administered as a short intravenous infusion and continued orally over six
days. After coDiagnostiX planning (Figs. 9&10), the osteosynthesis retaining screws were removed after four months and the implants placed. Tooth 45, 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 4.1mm, L 10mm) were inserted in positions 44 and 46 (Fig. 11). On the left, three Straumann Bone Level implants were placed (in position 55, a Straumann Bone Level implant made of Roxolid; Ø 5.5 mm, L 14mm; in positions 54 and 55, Straumann Bone Level implants; Ø 4.1mm, L 10mm; Figs. 12-15). All implants had the SLActive surface specification.

**Temporary immediate restoration**

All implants were fitted with 0 degree Multi-Base Abutments with a gingiva height of 4mm (Figs. 16&17). A Narrow CrossFit Connection Multi-Base Abutment (Ø 4.5mm) was used for the Narrow CrossFit Connection Roxolid implant. The terminal implants were fitted with Regular CrossFit Connection Multi-Base Abutments (Ø 6.0mm). Impression taking was performed with a foil technique tray (Fig. 18) with colour-coded impression components (Fig. 19).

The laboratory-made temporary prosthesis (Fig. 20) was screw retained occlusally via integrated temporary coping (Fig. 21). The screw channel was sealed with a foam pellet soaked in 0.1 per cent chlorhexidine gel and a light-curing composite.10 The temporary restoration remained in place for six months (Fig. 22).

**Final restoration**

The existing metal-ceramic veneer crowns in positions 52 to 42 were removed and the teeth prepared again. For impression taking, the impression posts were laboratory customised to correspond with the gingival emergence profile created by the Multi-Base Abutments. This was followed by a single-session, two-phase impression using the double-mix technique with a polyester impression material11 (Fig. 25) and corresponding colour and shade selection.

In order to continue support of the ideally shaped soft tissue (Figs. 24 & 25), a decision was made in favour of CAD/CAM customised abutments made of zirconium dioxide. The basal component of the future mesostructures was designed such that the gingiva would be supported optimally and create an ideal transition from the implant connection to the bridge contour. After 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 sub- and epigingivally.12 The wax model (Fig. 26) on auxiliary parts, which corresponded to the implant connection, was digitalised using the Straumann CEREC Scan CS2 scanner. After data transmission, the fabrication of the individual abutments was performed in the Straumann milling centre. In order to ensure the required fit and the stability needed for the molar region, one-piece zirconium dioxide abutments (Figs. 27 & 28)14, 15 were fabricated.

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The wax model was clamped to the abutments and the cast was made using the accurate processing of clear material. The technician received the patient-specific abutment for further processing. In the next step, a zircon veneering framework (Straumann) was designed using CAD/CAM and fabricated after data transmission (Figs. 29&30). The zirconium dioxide abutments were inserted at a torque of 55Ncm (Figs. 31&32).

The dental panoramic tomo gram shows the situation 18 months after implantation (Fig. 33). The screw channels were filled with non-irritating PEMAX in a trough-shaped final design. 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 decision was therefore in favour 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.”16 In addition, autologous bone is partially osteogenic and osteoconductive.14

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 have proved 60 per cent more bone-implant contact17 with the SLActive surface after two weeks compared with the SLA surface.18 Immediate loading of Straumann SLActive implants achieves a survival rate in excess of 97 per cent after one year.19

Computer-aided, template-guided surgery via coDiagnostiX was used to place the implants. The procedure shows average horizontal deviations between the final and the planned position to 1 mm.20
Patients nowadays demand minimally invasive surgery, the shortest healing time possible and optimal aesthetic results. Clinicians, however, 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 that offers perfectly matched components, from 3D planning to the final restoration.

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Editorial note: A complete list of references is available from the publisher.

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