Autogenous bone block grafts, bone grafting material or a combination of both can be used to restore an implant site of adequate dimensions in an atrophied maxilla. If the vertical height of the bone is inadequate in the posterior region, a sinus floor lift is often indicated to stabilise the implants safely.

In the case presented here, surgical treatment based on Prof. Fouad Khoury's biological concept for bone grafting using a combination of autogenous bone block grafts and particulate bone chips is described.

The case report also describes the layering technique as part of a sinus floor lift in conjunction with bone grafting material. The objective of the treatment is a restoration with long-term stability and a good aesthetic result. An implant-supported bar-latch design based on Dr Friedrich-Wilhelm Pape's prosthetic concept (Schellenstein concept) was used.
case report _restoration of atrophied maxillae_

**_Initial situation_**

The 60-year-old patient was referred to the practice with a telescopic restoration on natural abutment teeth 11, 21, 22 and 23. Crown and bridge restorations were used in the mandible; however, teeth 21 and 22 could not be preserved and were extracted. Abutment teeth 11 and 23 could not be preserved, but served as abutments for the temporary restoration until fabrication of the final prosthetic restoration.

In the premolar region specifically, pronounced horizontal and vertical bone defects that required comprehensive augmentative measures were identified in the preoperative 3-D CBCT images (Figs. 1–4).

**_Surgical treatment_**

The surgical treatment consisted of three procedures, each performed at three-month intervals. In the first procedure, performed under general anaesthesia, a FRIOS MicroSaw (DENTSPLY Implants) was used to harvest a bone block from the retromolar region of the right mandible (Figs. 5 & 6). The harvested bone plate was thinned and then placed at a distance using osteosynthesis screws (micro-screw, Prof. Khoury and stoma) for horizontal expansion of the right maxilla and the resulting space was filled with particulate autogenous bone chips (Fig. 7).

Particulate bone causes an increase in the surface and therefore better vascularisation of the augmented bone. In the second quadrant, an external sinus floor lift was performed based on the layering technique (Fig. 8). A slow resorbable phycogenic bone grafting material (FRIOS Algipore, DENTSPLY Implants) was placed in the cranial region, while the caudal region was filled with autogenous bone chips. This arrangement of bone grafting material and autogenous bone chips meant that the implants were placed in approximately 10 mm of autogenous bone, accelerating the healing phase. With this technique, the bone grafting material introduced in the cranial region prevented rapid resorption due to the pressure of the maxillary sinus.

The sinus window was covered by a non-resorbable membrane made of medical-grade material. The area is prepared for filling with particulate autogenous bone chips.

**Fig. 5.** Bone block harvesting with the FRIOS MicroSaw.
**Fig. 6.** Thinning of the harvested bone block.

**Fig. 7.** The thinned bone block placed at a distance. The area is prepared for filling with particulate autogenous bone chips.
**Fig. 8.** Sinus floor lift. The surgical site is filled with FRIOS Algipore.
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A mucoperiosteal flap was used for soft-tissue coverage in which the periosteum was slit to ensure tension-free closure over the grafted bone.

In the course of this first procedure, four XiVE implants (DENTSPLY Implants) were inserted into regions 12, 22, 24 and 26 (Fig. 11).

After three months, as part of the second surgical procedure, the previously augmented area was opened. The site appeared to be well regenerated and vascularised. In the procedure, two additional XiVE implants in regions 14 and 16 were inserted, resulting in a total of six implants available with uniform abutment distribution in the maxillae as a basis for later prosthetic restoration (Figs. 12–15).

After another three-month healing phase, the last surgical procedure exposed the implants...
by means of an apical sliding flap. The natural mucogingival junction was then restored and gingiva formers inserted (Figs. 16–18).

**Impression**

The soft tissue took three weeks to heal around the gingiva formers. For the prosthetic treatment phase, four appointments were necessary for completion of the final restoration based on Dr Pape’s prosthetic concept. In the first session, an impression was taken with the repositioning technique with transfer copings inserted into the implants (closed-tray impression) and an initial impression taken with a stock tray (Fig. 19).

This impression was used in the laboratory to fabricate an initial cast and to prepare a second impression using the pick-up technique. The impression posts were rigidly attached to the cast using PATTERN RESIN (GC). This index was separated again between the implants in the laboratory and the impression posts were placed in the patient’s mouth in the second session (Fig. 20).
The separation gaps were reconnected intraorally with PATTERN RESIN to ensure high precision for the second impression (Impregum, 3M ESPE) by stiffening of the posts (open impression with custom tray). In the laboratory, a master cast with a gingival mask was fabricated and a tooth set-up prepared for aesthetic try-in (Fig. 21).

**Prosthetics**

In the third prosthetic session, the wax try-in (aesthetic try-in) was carried out on the patient. The master cast, related antagonist bite impression and tooth template were sent to the milling centre in Hasselt in Belgium for fabrication of the CAD/CAM framework (ATLANTIS ISUS, DENTSPLY).
Implants). The dental technician can use the free ATLANTIS ISUS Viewer software in the laboratory to view in 3-D and finalise digitally the bar design proposed by the milling centre. The bar was then milled from cobalt–chromium at the milling centre and the restoration shipped to the dentist’s private laboratory. Owing to the precision of the impression and industrial fabrication, the bar framework exhibited a tension-free fit and served as the basis for fabricating the final superstructure in the laboratory.

In the final session, before positioning the finished restoration, the fit of the bar in the patient’s mouth was checked using the Sheffield test. The fit of the bar again appeared tension free, allowing the bar to be permanently screwed to the implants (Figs. 22–24).

The primary splinting of the implants by the bar gives the restoration great stability in the augmented bone in particular. Owing to the uniform distribution of the implants in the ridge and creation of a large support polygon, good force distribution across the implants is possible, which in turn achieves a good long-term result. Because the bar construction is screw-retained, the risk of leaving excess cement in the peri-implant region, which poses the risk of peri-implantitis and should not be underestimated, according to the latest studies, is avoided.

The removable palate-free prosthesis is provided with latches (MK1 attachment) on both sides to anchor the prosthesis to the bar firmly. The latches counteract pull-off forces and prevent abrasive wear on the bar when the canine guidance is set and the resulting friction loss of the bar-latch design (Figs. 25 & 26).

Conclusion

Owing to primary splinting of the implants with a bar construction and the large support polygon created, maximum stability is achieved directly in the augmented bone. In atrophied maxillae, it is often observed that the maxillae are smaller than the mandible owing to centripetal shrinkage. The advantage of the bar restoration over a telescopic restoration with regard to this problem is the decoupling of tooth and implant position. The bar can be placed in front of the alveolar ridge and, despite an unfavourable initial situation, still achieve good occlusion and lip support.

The bilateral latches for this restoration give the patient direct control of the anchoring of the restoration and thus a feeling of security. In addition, access for cleaning is not affected in any way because the restoration is removable. The use of latches takes into account the patient’s desire for a fixed restoration and the requirement for long-term stability, which is the basis of the easy-to-clean design. Furthermore, the removable restoration allows quick and easy repair, and chipping is never an issue because ceramics are not used.

Unlike a fixed restoration, no aesthetically or phonetically compromising cleaning channels are required. The cleaning channels of fixed implant bridges often make it difficult for patients to form the ‘s’ sound. This can bring into question the success of the entire restoration because it can make the patient feel uncomfortable and insecure owing to speech impediment. In contrast, the restoration presented here does not affect pronunciation at the buccal plate.

The final restoration exhibits a functional, aesthetically pleasing, and phonetically unimpaired result that meets the patient’s wishes. Therefore, this treatment concept is a good option for restoration of edentulous atrophied maxillae.

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

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