Rehabilitation of the edentulous posterior mandible

Augmentation and implantation in a two-stage approach

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Patient demand for fixed tooth replacements is increasing worldwide. However, in order to provide implant-supported restorations for partially or completely edentulous patients, often bone defects resulting from atrophic changes must first be addressed.

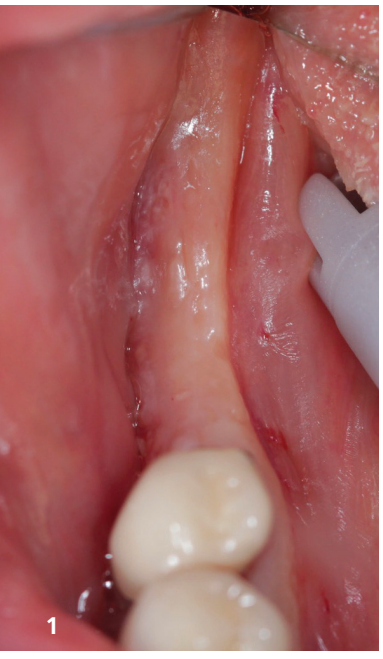
In the following, a clinical case is described, in which the author first augmented both sides of the edentulous posterior mandible of a patient and then placed two-piece zirconia implants (Patent™ Dental Implant System, Zircon Medical Management) once the sites had successfully healed. In clinical studies, the implant system used for this case has shown high survival rates, stable marginal bone levels and a favourable soft-tissue reaction, including in grafted sites.[1,2] Additionally, in an independent nine-year study—the first long-term study on two-piece zirconia implants—it demonstrated healthy and stable hard and soft tissue, no fractures, and no peri-implantitis even in the posterior region, which is subject to higher occlusal loads.[3] Therefore, it is well suited for the indication described in this case.

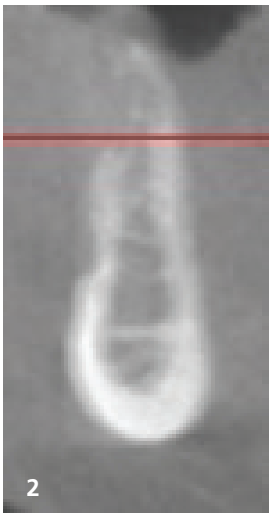
Initial situation

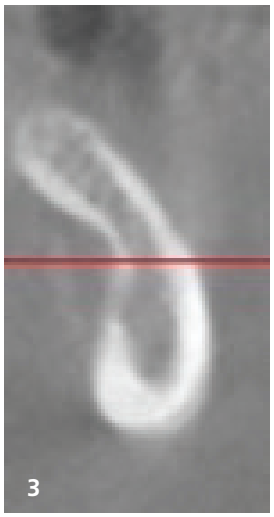
The female patient, aged 57, first presented to the INTEGRA clinic in Luxembourg in the autumn of 2021, complaining about an insufficient removable telescopic restoration in the left and right posterior mandible that had become mobile and impaired her masticatory function as a result. The patient expressed her desire for fixed dental restorations. Clinical examination revealed an atrophied alveolar ridge in the left and right molar areas with a relatively high mouth base (Fig. 1). Radiographic examination confirmed that the alveolar ridge was too narrow on both sides to have implants placed immediately (Figs. 2 & 3).

Preoperative planning

Treatment would first involve bilateral augmentation of the edentulous alveolar ridge using particulate bone grafting material to create sufficient bone volume (particularly in width) for the placement of implants. After successful healing, two-piece implants were planned to be placed in regions #47, 46, 45, 36 and 37 for transmucosal healing. After successful osseointegration, the glass fiber posts serving as prosthetic build ups were







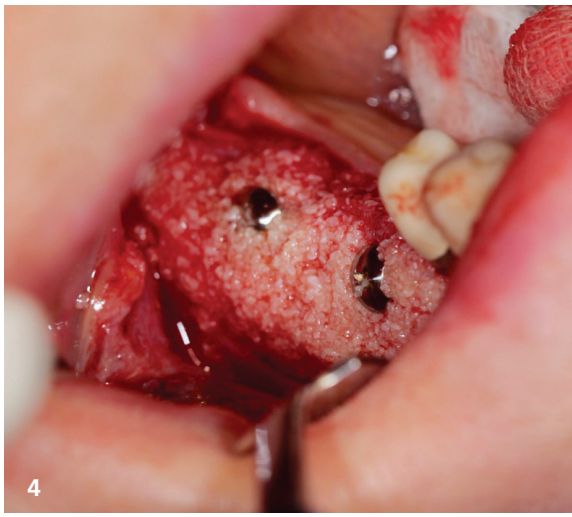


Fig. 1: Initial clinical situation of the right side. The ridge was too narrow for implant placement. **Fig. 2:** Initial radiograph of the right side. Cross section at approximately the level where the first implants were to be placed behind the premolars. **Fig. 3:** Initial radiograph of the left side showing the medially converging ridge and substantial atrophy. **Fig. 4:** Intra-op view of the right side during augmentation. Umbrella screws *in situ*.

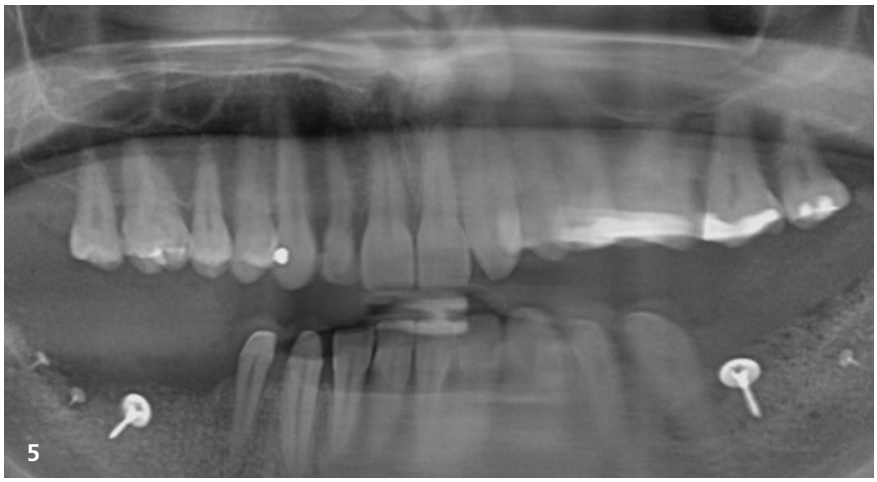


Fig. 5: Radiographic view after augmentation. Radiopaque umbrella screws and titanium pins visible.

planned to be cemented intraorally and restored with single crowns. The surgical treatment was started in February 2022 and completed by the cementation of the final single crowns in January 2023.

Alveolar ridge augmentation

The patient was prescribed azithromycin (500 mg/day) to start three days before the surgery and continue three days thereafter. The patient's venous blood was collected chairside and processed into autologous blood concentrate (platelet-rich fibrin [PRF] system according to Choukroun). After local anesthaesia, a mucoperiosteal flap was prepared in the left molar area. Two umbrella screws were inserted for spatial stabilisation of the particulate bone grafting material (Fig. 4). Thereafter, sticky bone, a mixture of PRF and porcine bone grafting material (Apatos, OsteoBiol), was introduced into the defect to reconstruct the alveolar ridge vertically and horizontally. A cortical bone lamina of porcine origin (Cortical Lamina hart, OsteoBiol) was placed on top and then covered with a PRF membrane from the patient's blood plasma. Titanium pins were then inserted to stabilise the membranes. Thereafter, the surgical site was sutured closed using a modified mattress suture and an interrupted suture.

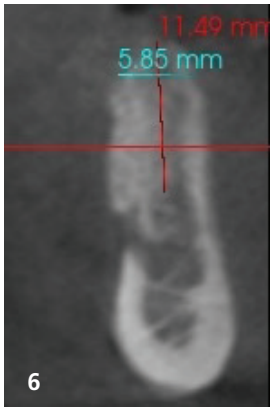
The procedure described was repeated for the right molar area (Fig. 5). Additionally, in order to thicken the attached gingiva, a tunnel was prepared in this area, into which a resorbable collagen matrix (Geistlich Fibro-Gide, Geistlich Pharma) biologised with hyaluronic acid (hyaDENT BG, Regedent) was inserted. As a result of this, an increase in the volume of keratinised gingiva was observed in this area after healing.

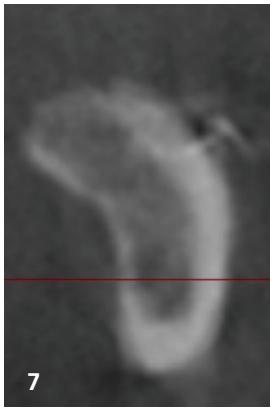
Implant placement

After the successful bilateral reconstruction of the posterior mandible and a complication-free healing period of five months, the second surgical procedure was carried out. At this point, sufficient bone volume was available for the placement of the planned implants (Figs. 6–8). After administration of local anaesthesia, osteotomies were prepared in regions #47, 46, 45, 36 and 37 according to the implant manufacturer's surgical protocol, and five two-piece implants (4.5 × 11.0 mm into regions #47–45, 4.1 × 11.0 mm into region #36 and 5.0 × 11.0 mm into region #37) were inserted using the manufacturer's insertion tool and positioned equigingivally (Fig. 9). An insertion torque of 25 Ncm was not exceeded. Thereafter, the 3C connections of the implants inserted were filled with an addition-cured silicone, the sites were sutured, and the implants were left to heal transmucosally.

Prosthetic restoration

After a successful healing period of four months, an intra-oral scan of the entire arch, including the 3C connections of the integrated implants, was taken (3Shape; Figs. 10–12). The implant head serves as the scan body in this process. At this time, healthy and stable soft-tissue conditions were observed around the implants. Based on the scan data, a model was printed in the dental laboratory, the glass fiber posts were prepared on it using analogs for printed models (PMA, Elos Medtech) and the single crowns made of lithium disili-





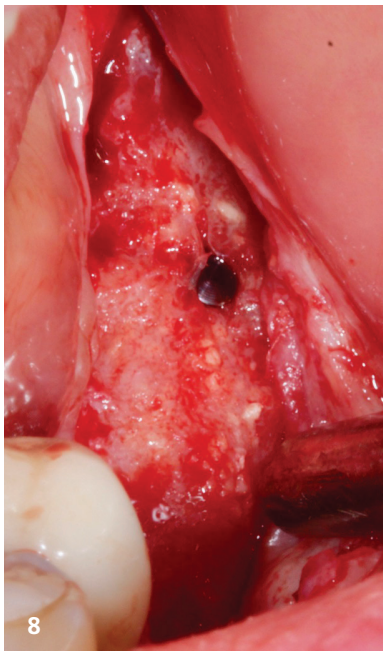


Fig. 6: Radiograph of the right side five months after augmentation. Cross section showing the reconstructed ridge and well-vascularised and denser bone. **Fig. 7:** Radiograph of the left side five months after augmentation. Cross section showing the broadened jawbone. Titanium pin for membrane fixation visible. **Fig. 8:** Intra-op view before implant placement showing successful reconstruction of the jawbone. Vital and well-vascularised bone.

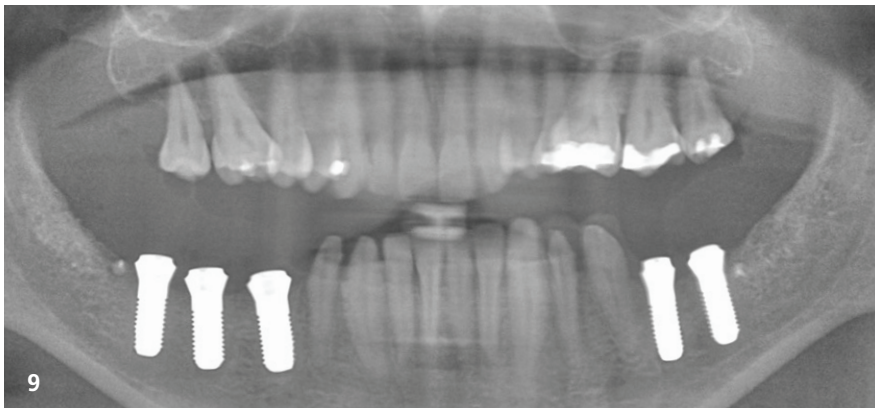


Fig. 9: Radiograph after implant placement (#47, 46, 45, 36 and 37). Due to a lack of space, an off-label use of a ⌀ 4.1 mm implant was chosen for position #36, which is not in line with the instructions of the manufacturer. To compensate for the off-label placement and ensure long-term function, the crown in #36 was sized as a premolar (see Fig. 14).

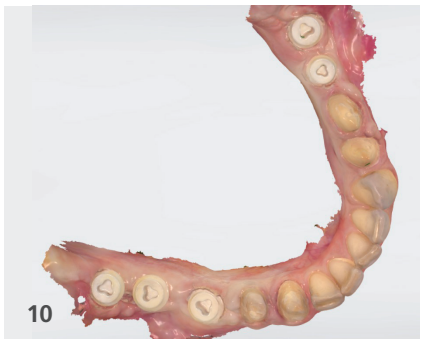


Fig. 10: Intra-oral scan of the entire arch, including the implant connections, after four months of healing.

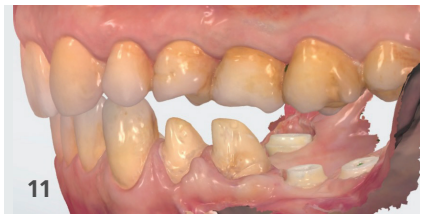


Fig. 11: Scan of the left side showing occlusion and prepared teeth #34 and 35 for crown placement.

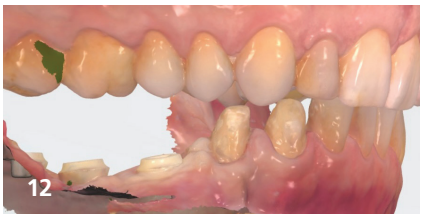


Fig. 12: Scan of the right side showing prepared teeth #43 and 44 for crown placement and interocclusal distance of the implant connections to the opposing teeth.

cate glass-ceramic (IPS e.max, Ivoclar) were finalised (Figs. 13 & 14). During the next treatment session, the 3C connections of the integrated implants were cleaned, and a dual-polymerising cement (RelyX Unicem, 3M) was applied to the tips of the prepared glass fiber posts before inserting them into the connections (only a small amount of cement was used to ensure that the posts reached the bottom of the connections properly; Figs. 15 & 16). The cement was then light-polymerised under axial pressure. Subsequently, the final single crowns were cemented (Figs. 17–21).

Discussion

In order to avoid stressing the bone in the area of the implant bed, an implant insertion torque of 25 Ncm was not exceeded in this case. If implants are not immediately loaded, there is no need for a higher torque. To ensure that the implants osseointegrate properly, patients must be instructed not to interfere with the area with their tongues, thereby inducing micromovements, and to consume predominantly soft foods for a duration of six weeks after surgery. Osseointegration, that is, implant stability, is measured by means of the Periotest (Medizintechnik Gulden) after four to five months of healing in the case of augmented bone. If values of –3 or lower are achieved at this time point for the implants, they can be safely restored and loaded.

In addition, it is vital to insert Patent™ Implants at the equigingival level to avoid compression of the cortical bone and consequently minimise bone resorption or remodeling that would result from placement at a deeper level.[4] Thanks to the very rough endosseous surface of this zirconia implant system, predictable osseointegration can be achieved.[5]

In this case, single crowns instead of splinted crowns were cemented to facilitate effective oral hygiene for the patient, particularly with the use of dental floss. However, in some cases, long-term provisional restorations made of acrylic that are splinted and then progressively loaded are recommended as a strategically safe procedure. Furthermore, when prosthetically restoring zirconia implants, strict attention must be paid to reducing occlusal contact points compared with natural teeth (secure canine guidance). An im-

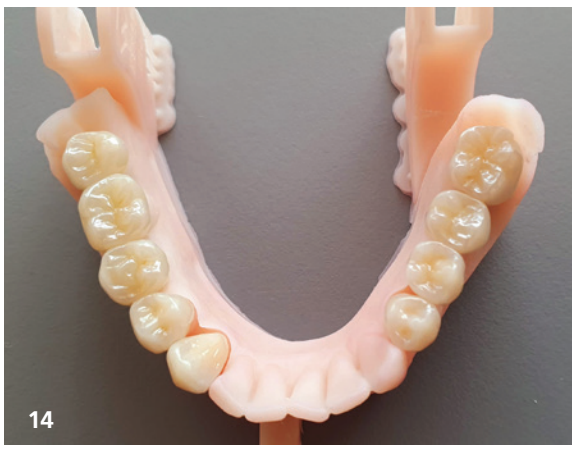


Fig. 13: Glass fiber posts prepared on the 3D model using model analogs. **Fig. 14:** Individual crowns finalised on the 3D model using model analogs.

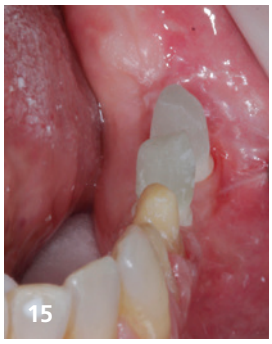
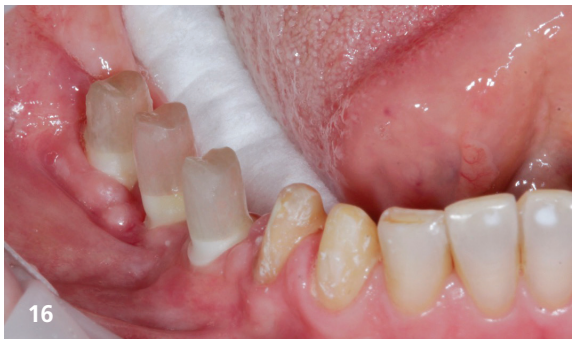
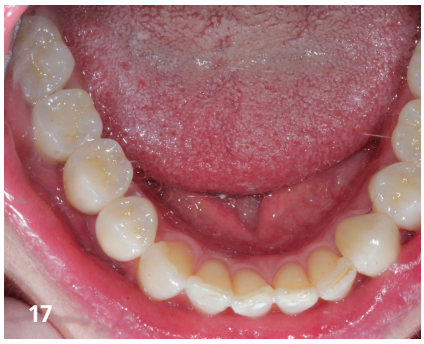
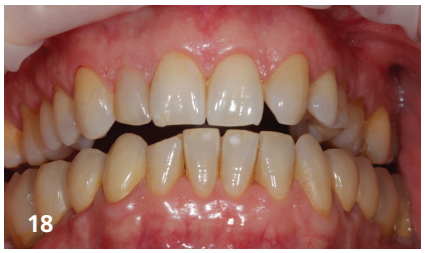
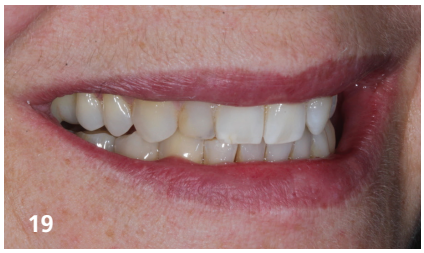
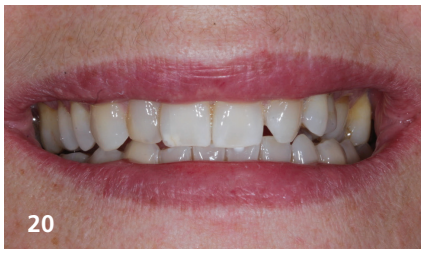
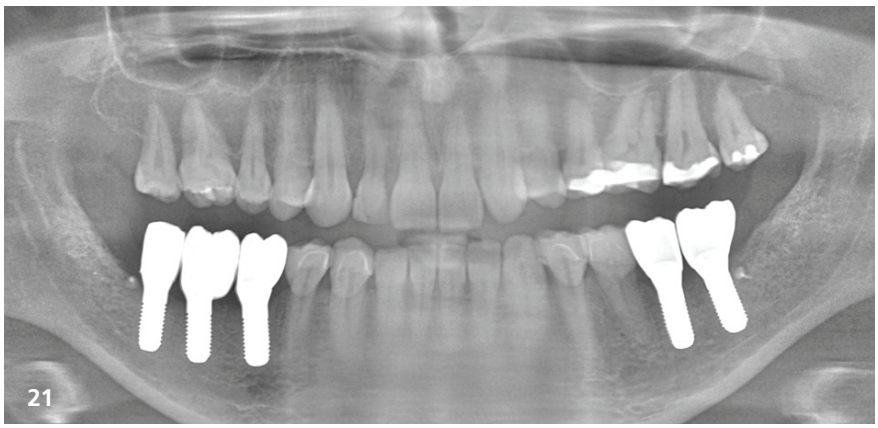








Fig. 15: Clinical view after cementation of the prepared glass fiber posts on the left side. **Fig. 16:** Clinical view after cementation of the prepared glass fiber posts on the right side. Evident increase in the volume of keratinised gingiva as a result of the soft-tissue management in this area. **Fig. 17:** Occlusal view of the cemented single lithium disilicate crowns. **Fig. 18:** Frontal intra-oral view of the cemented single crowns. **Fig. 19:** Harmonious integration of the final single crowns. **Fig. 20:** Happy patient with fixed tooth replacements for improved function and quality of life. **Fig. 21:** Final radiograph.

plant–crown ratio of 2:3 to 1:3 should be aimed for.

Moreover, particularly in bruxism and difficult occlusal conditions, a restorative material with physical properties that largely correspond to those of natural teeth should be chosen for the superstructure in order to minimise the risk of chipping. The use of lithium disilicate crowns is recommended, since they offer favourable material properties compared with monolithic zirconia crowns and the material is almost comparable to tooth enamel regarding hardness.[6–12]

Conclusion

Studies suggest that using porcine bone grafting material can enable reconstruction in a predictable and patient-friendly way.[13–19] This is corroborated by the results of this case, in which the resulting bone was well structured and vascularised and ideally suited for implant placement. Furthermore, the two-piece implant system used represents a scientifically sound and valid treatment option for fixed dental restorations.[1–5] In an independent long-term study, it was found to maintain the stability and health of the hard and soft tissue in the posterior region.[3] It was therefore ideally suited for the indication described.

Literature

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