Is autologous bone irreplaceable?

Bilateral vertical bone augmentation using allogeneic and autologous bone plates in the mandible

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Introduction

Tooth loss due to endodontic or periodontal problems is generally associated with loss of bony structures. The consequent insertion of an implant demands the restoration of bony structures, which is a procedure of varying complexity.[1] Bone block transplantations and guided bone regeneration (GBR) have demonstrated predictable and successful outcomes as therapeutic methods for alveolar ridge augmentation in dental implantology.[2] Autologous bone transplants are generally accepted to be the gold standard in augmentation surgery.[3,4]

3D reconstruction, or the shell technique, is a specific form of autologous bone grafting. Thin cortical bone blocks are initially used to restore the contours of the alveolar ridge, and the resulting gaps are then filled with autologous bone chips.[1,5] The short- and long-term results after augmentation with the aid of the shell technique have demonstrated low complication rates and a stable bone volume even ten years after surgery.[6–9]

In addition to using the shell technique, there is the possibility of reducing resorption processes by combining block transplantation with GBR.[10,11] With full block transplants, it has been shown to be possible to reduce the resorption between augmentation and implantation to 5.5–7.2%.[10–12] In one study, the result was stable ten years after implantation, only 0.8% further resorption occuring.[12] Disadvantages of this method, however, were found to be a high dehiscence rate of 9.5–27.2% and integration of the xenogeneic bone substitute material into the connective tissue rather than the bone.[10,11] For this reason, De Stavola and Tunkel's method modified the procedure so that the augmentation was carried out using the shell technique, which led to a significant reduction in resorption.[13] Additional GBR with xenogeneic bone substitute material and collagen membrane was then performed during the implantation session. With this method, known as "augmentative relining", an additional bone gain of 17% could be achieved. Clinically and radiographically, the incorporation of the biomaterial into the regenerated bone was demonstrated. There was no further resorption of the regenerated bone up to the point of prosthetic restoration.

There is a great desire to avoid bone harvesting, both on the part of the patient and the practitioner, so most dentists working in implantology try to avoid autologous bone harvesting. Another, more serious, disadvantage of autologous bone transplantation is the limited amount of bone available intra-orally.

Allogeneic bone materials seem to be the closest to autologous bone transplants in clinical applications.[14]

Figs. 1 & 2: Slight elongation of the maxillary posterior teeth.

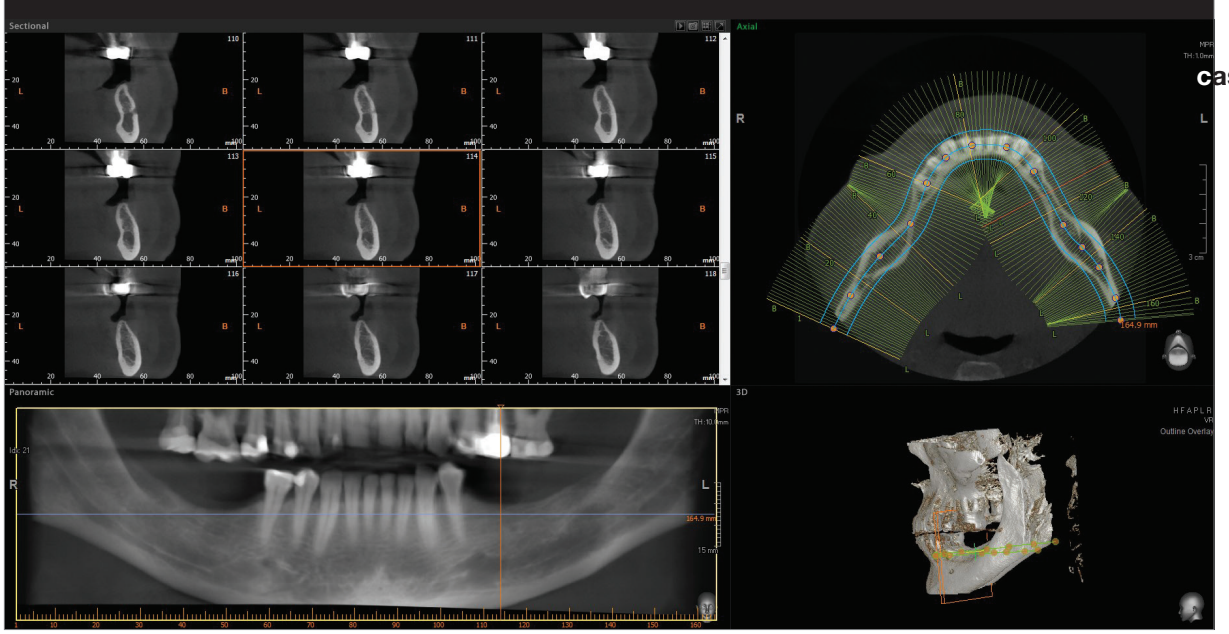


Fig. 3: Pre-op CBCT scan showing vertical bone defects in the third and fourth quadrants.

Allogeneic full block transplants are, however, subject to similar resorption processes to autologous full block transplants.[3, 10, 11, 15, 16] The complication rate is also higher with allogeneic full block transplants than with autologous bone transplants.[17] However, a split-mouth case series showed that the use of cortical allogeneic bone plates produces results that are equivalent to those of autologous bone plates in terms of regeneration, resorption and complication rates and thus could solve the problem of insufficient intra-oral bone availability and reduce morbidity.[18]

In this case report, a patient with a limited amount of bone available intra-orally underwent vertical bone augmentation and two-stage implantation with augmentative relining on both sides of the lower jaw. One half of the jaw was treated with autologous and the other side with allogeneic bone plates. There was equivalent healing on both sides without complications and only a low rate of resorption.

Initial situation

A 60-year-old female patient was referred for implantation with bone augmentation. Her general medical history showed no particular features that would restrict the surgery. There was a bilateral free-end situation in the lower jaw with teeth #47, 46, 35, 36 and 37 missing and a vertical bone defect of approximately 5 mm in loss of height. There was slight elongation of the maxillary posterior teeth, which, after consultation with the referring dentist, was corrected by grinding (Figs. 1 & 2). The preoperative CBCT scan confirmed the vertical bone defects in the third and fourth quadrants (Fig. 3).

Treatment planning

In order to place implants in the correct prosthetic position, vertical augmentation would be absolutely essential. The amount of bone that had to be harvested could not be gained in just one retromolar bone harvesting area. Therefore, the patient was advised to undergo one bone block harvesting and have the other site rebuilt with allogeneic bone plates. The sequence of the treatment would be as follows:

1. bone harvesting from the right retromolar area;
2. 3D vertical bone augmentation in the fourth quadrant utilising the shell technique with autologous bone plates and chips;
3. 3D vertical bone augmentation in the third quadrant utilising the shell technique with allogeneic struts and autologous bone chips;
4. four months of healing;
5. insertion of implants in regions #47, 46, 35, 36 and 37, combined with augmentative relining using collagen membranes and deproteinised bovine bone mineral particles;
6. four months of healing;
7. second-stage surgery with Kazanjian vestibuloplasty, combined with step incision on both sides; and
8. rehabilitation after six weeks.

Surgical procedure

At the start of the procedure, a bone block was harvested from the right retromolar area (Fig. 4) with the aid of a micro-saw and was then split lengthwise using thin diamond disks. These plates were thinned to a thickness of about 0.5 mm with a Safescraper Twist (Geistlich Pharma), and autologous bone chips were collected at the same time. The plates obtained in this way were fixed buccally and lingually in regions #47 and 46 with four micro-screws (Fig. 5). The resulting bony envelope was next filled with the autologous bone chips with the application of slight pressure (Fig. 6). Finally, blunt mobilisation of the floor and a periosteal incision were performed in the buccal region in order to enable the augmented area to be covered.

The augmentation then took place in the third quadrant. To this end, two allogeneic bone plates (maxgraft cortico, Straumann) were first opened and immersed in sterile saline solution for 10 minutes. During this time, the flap was prepared in regions #35–37 (Fig. 7). The

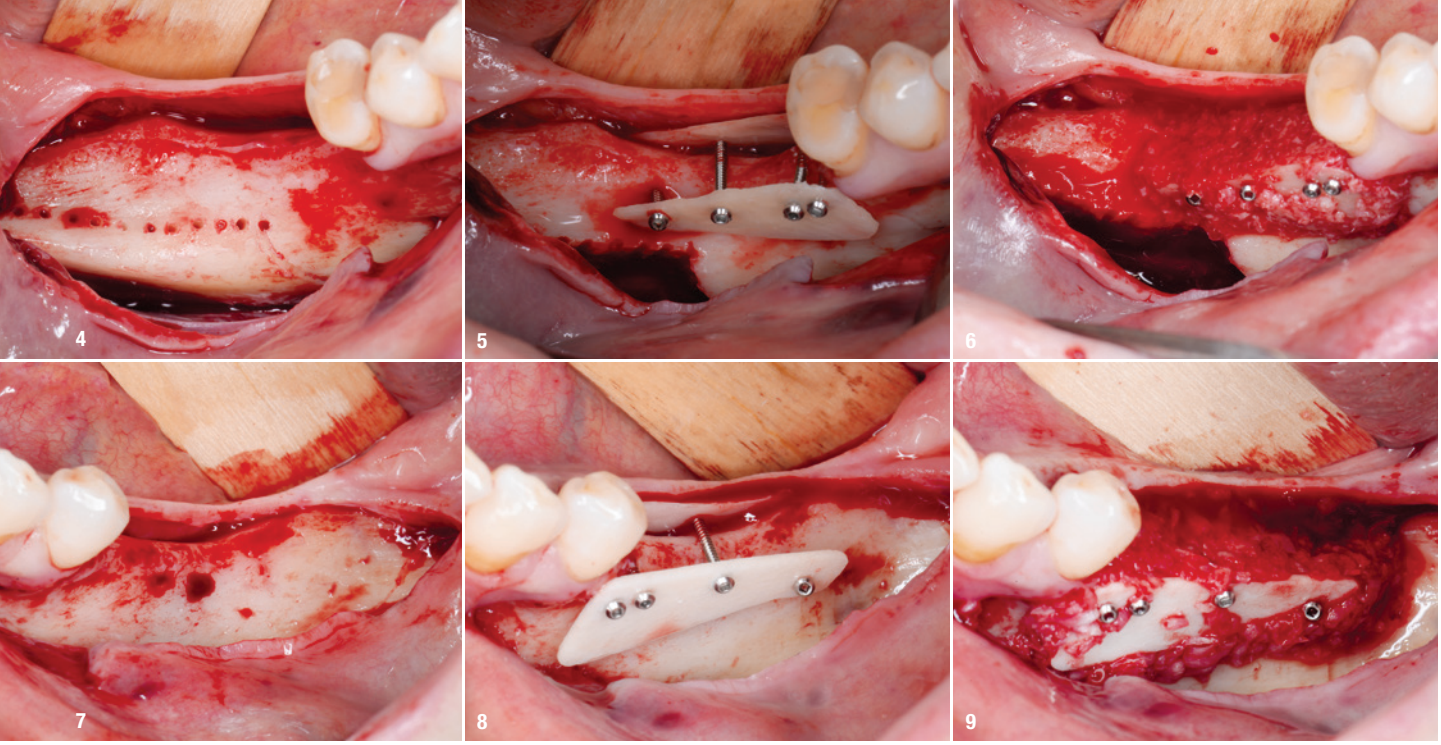
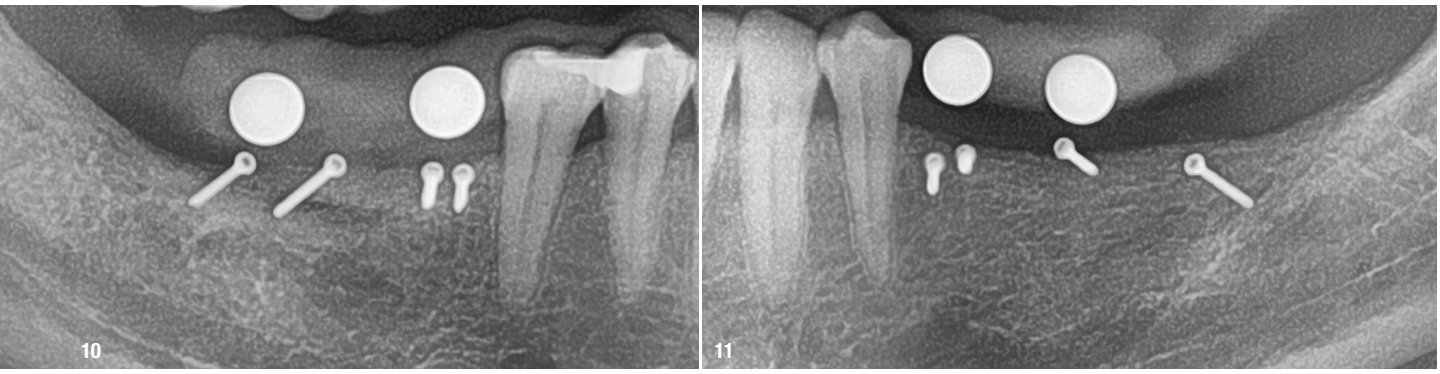
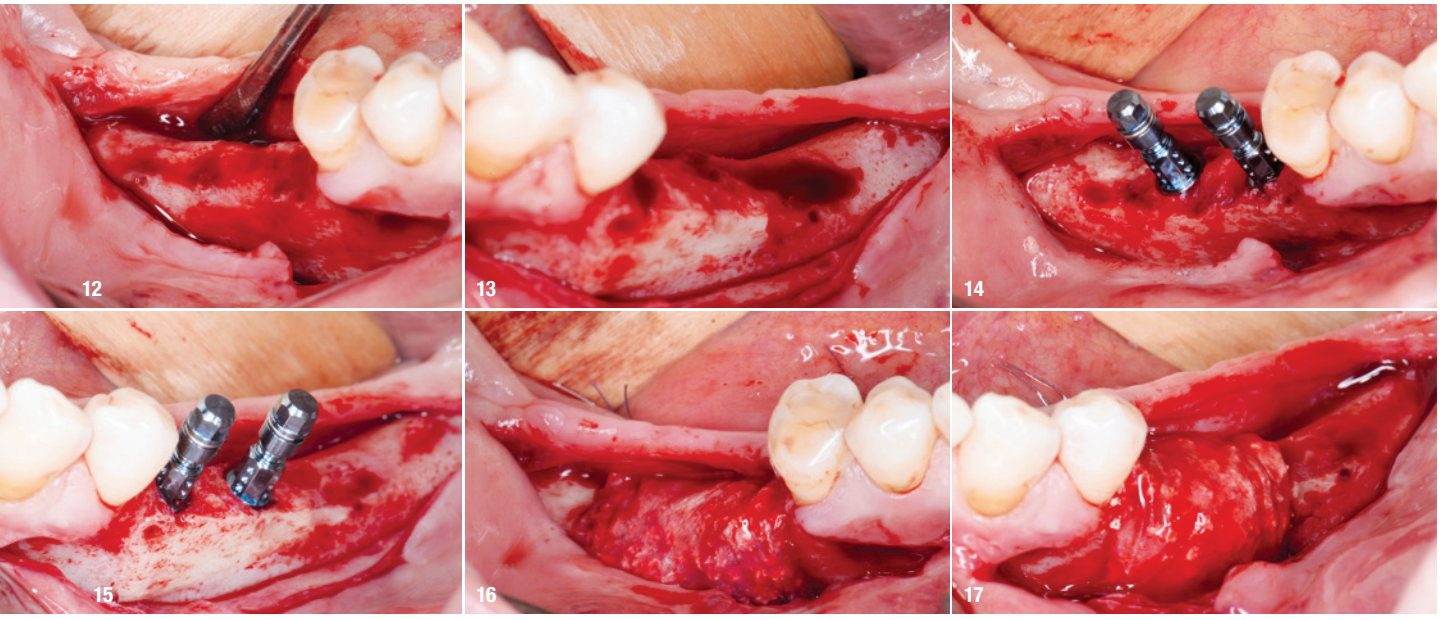


Fig. 4: Retromolar bone harvesting in the fourth quadrant. **Fig. 5:** Buccal and lingual fixation in the fourth quadrant. **Fig. 6:** Filling of the bone bed in the fourth quadrant. **Fig. 7:** Initial situation after opening in the third quadrant. **Fig. 8:** Buccal and lingual fixation in the third quadrant. **Fig. 9:** Filling of the bone bed in the third quadrant.



Figs. 10 & 11: Panoramic radiograph with reference balls after a four-month healing period.



Figs. 12 & 13: After removal of the micro-screws after crestal incision and flap raising. **Figs. 14 & 15:** Sufficient bone availability in the buccal and lingual areas, with a thickness of approximately 1–2 mm. **Figs. 16 & 17:** Membrane secured with resorbable sutures on the lingual side of the flap.

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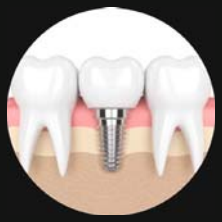

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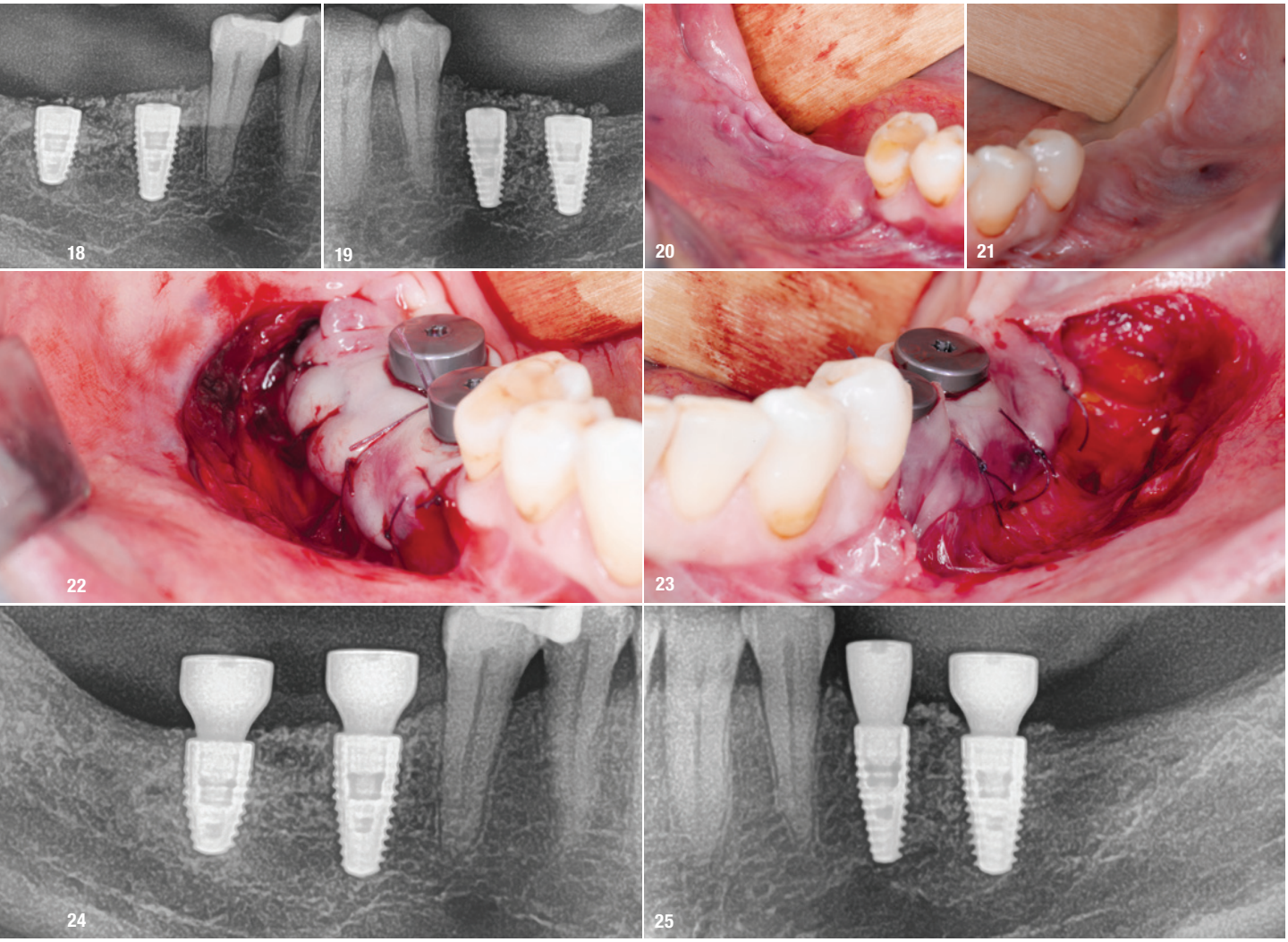
allogeneic bone plates were divided according to the anatomical situation and fixed buccally and lingually in the third quadrant using four micro-screws (Fig. 8). The resulting cavity was then filled with autologous bone chips that were left over from the augmentation in the fourth quadrant (Fig. 9). The wound was closed analogously to the procedure in the fourth quadrant.

After a four-month healing period, a panoramic radiograph with reference balls revealed a clear vertical bone gain after four months in both quadrants (Figs. 10 & 11). The third and fourth quadrants were reopened before implantation. To this end, the micro-screws were removed on both sides after the crestal incision and flap raising (Figs. 12 & 13). Straumann Bone Level Tapered implants (SLActive) were then inserted in region #35 (diameter: 4.1 mm; length: 10.0 mm), 46 and 36 (diameter: 4.8 mm; length: 10.0 mm) and 47 (diameter: 4.8 mm; length: 8.0 mm) according to the manufacturer's instructions. After the implants had been inserted, sufficient bone was seen to be available in the buccal and lingual areas, having a thickness of approximately 1–2 mm (Figs. 14 & 15). After buccal incision of the periosteum, a collagen membrane was attached to the apical periosteum with resorbable sutures. The alveolar ridge section was then covered with bovine bone material with a layer thickness of one particle size (1–2 mm). The membrane was secured with resorbable sutures on the lingual side of the flap (Figs. 16 & 17). The final step was the plastic covering of the augmentative relining (Figs. 18 & 19).

After a healing period of four months, the implants were exposed. As the area had been augmented twice, there was a lack of keratinised tissue in the region of the implants (Figs. 20 & 21). Consequently, a vestibuloplasty according to the Kazanjian technique was performed.[19,20] To this end, after the initial preparation of a supramuscular mucosal flap, the muscle was sharply separated from the periosteum in an apical direction. The mucosal



Figs. 18 & 19: Close-ups from the post-op dental panoramic tomogram after implantation and guided bone regeneration from augmentative relining in the third and fourth quadrants. **Figs. 20 & 21:** Tissue after a healing period of four months. **Figs. 22 & 23:** Conical gingival formers with diameters of 5.0 mm in region #35 and 6.5 mm in regions #47, 46 and 36. **Figs. 24 & 25:** Post-op situation on the panoramic radiograph.

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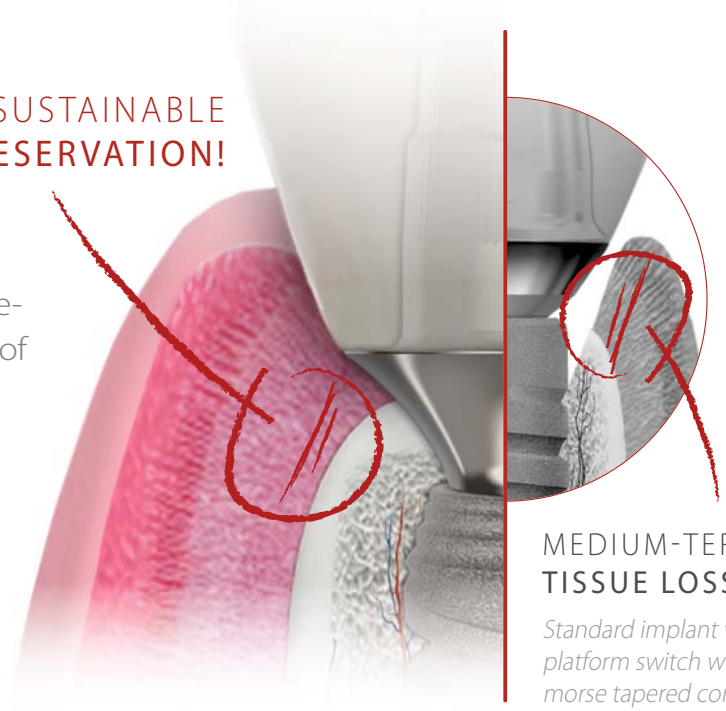

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Figs. 26–29: Stable peri-implant bone conditions and sufficient keratinised tissue, clinically free of inflammation, after a six-week healing period.

flap was secured to the periosteum with resorbable sutures. Finally, the implants were exposed by stab incisions. Conical gingival formers with diameters of 5.0 mm in region #35 and 6.5 mm in regions #47, 46 and 36 were used as healing abutments (Figs. 22–25).

Prosthetic procedure

After a healing period of six weeks, the prosthetic restoration was carried out by the referring dentist. The final check-up showed stable peri-implant bone conditions and sufficient keratinised tissue, clinically free of inflammation (Figs. 26–29).

Treatment outcomes

The augmentative relining technique can also be carried out with allogeneic bone plates. No clinical problems were observed in association with this procedure, and there were signs of good integration of the xenogeneic bone substitute into the augmented bone.

Recommendations

In cases of limited vertical bone availability, when the patient requests a fixed restoration on the posterior area of the mandible, the shell technique for bone augmentation is our first choice, as it offers high predictability combined with low complication and resorption rates. Usually, the patient chooses whether to opt for allogeneic or autologous bone shells. In the case of bilateral sites that need to be treated, we often choose the combined approach, as we can easily harvest enough autologous bone chips without a second bone harvesting site in order to reduce morbidity and provide a better patient experience. In my daily practice, the allografts have proved to perform equally effectively as autografts in terms of complication and resorption rates with less morbidity.

Dr Jochen Tunkel

Literature

about the author

Dr Jochen Tunkel completed his dentistry degree at the University of Würzburg in Germany in 1998 and specialised in periodontics through the German Society of Periodontology in 2003 and in implantology through the German Association of Oral Implantology and European Association of Dental Implantologists in 2004. In 2006, he obtained a master of oral medicine in implantology at the International Medical College, associated with the University of Münster in Germany. He taught periodontics at the Münster university hospital from 2004 to 2015 and has worked in a joint private practice in Bad Oeynhausen in Germany since 2007. His practice is accredited by the European Centers for Dental Implantology and is a Straumann centre of dental education. Dr Tunkel is an International Team for Implantology fellow and speaker, and a visiting and supervisory consultant at the German Association of Oral Implantology, German Society of Periodontology and academy for practice and science, a provider of further dental training.

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