Horizontal ridge augmentation and implantation

A two-stage GBR procedure

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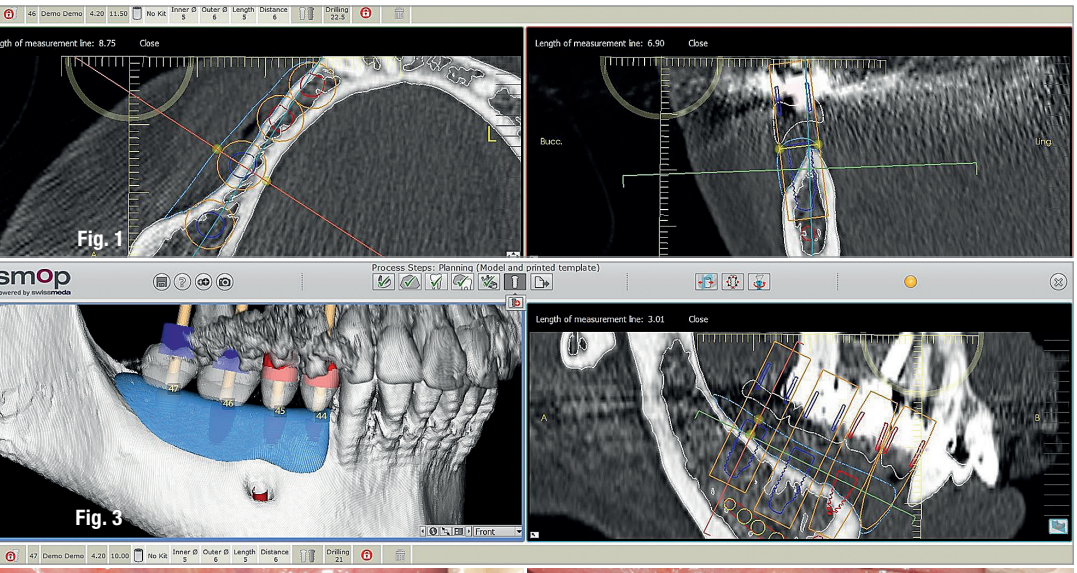
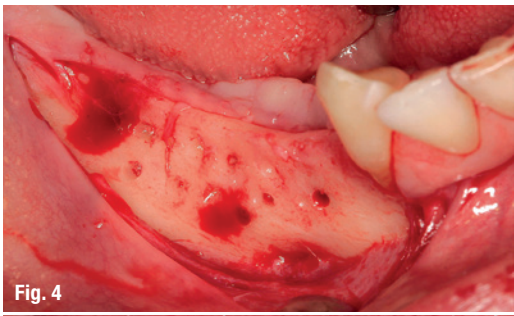
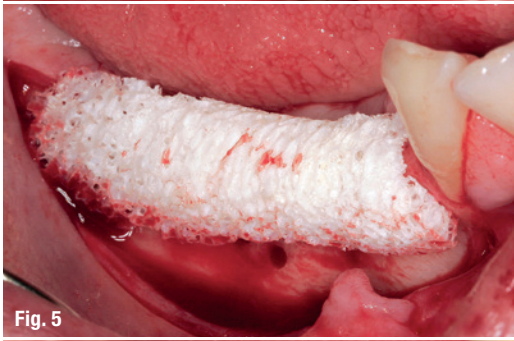
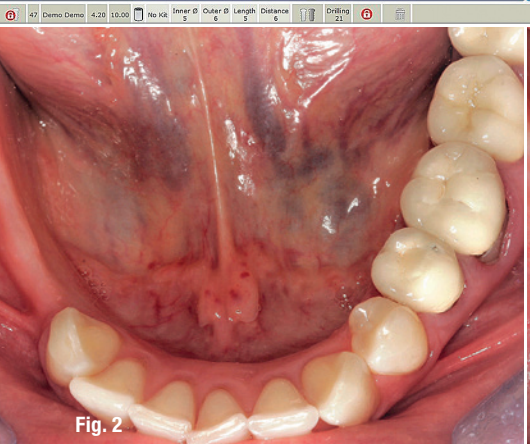
Introduction

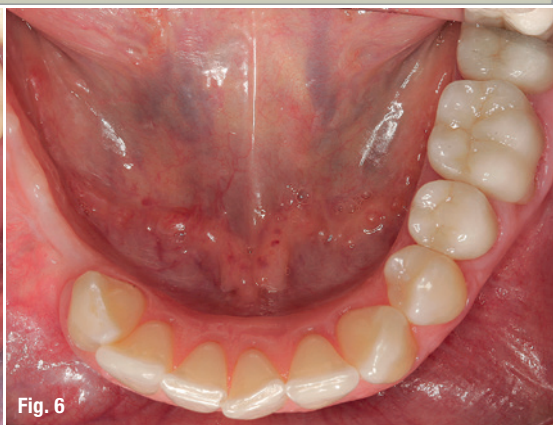
Atrophy of the mandibular bone caused by premature tooth loss due to periodontal or endodontic problems can often be found in posterior areas. Problems associated with implantation in these cases often arise owing to limited bone height or width of the mandible, and several treatment options have been suggested to gain enough bone for a stable implantation and achieve an aesthetically good result.[1] In clinical practice, freeze-dried bone allograft (FDBA) blocks have been used for alveolar ridge augmentation with promising results, offering patients a less-invasive treatment alternative to autogenous bone blocks, with no donor site morbidity and no second

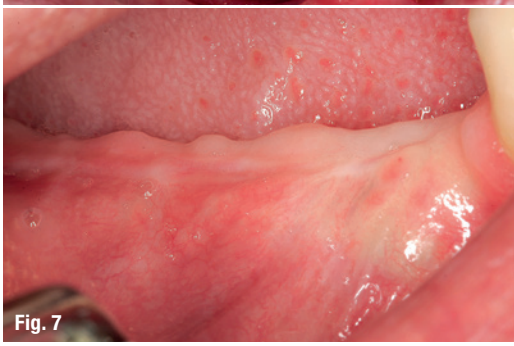












Figs. 1 & 2: Radiographic and clinical examination revealed limited bone availability. **Fig. 3:** Pre-op digital planning of the surgery. **Fig. 4:** Perforation of the cortical layer of the recipient site. **Fig. 5:** The customised allogeneic block fitted on to the recipient site. **Figs. 6 & 7:** Clinical situation six months after the first procedure.

surgical site.[2–4] Nowadays, customised allogeneic bone blocks can be produced using computer-aided design/computer-aided manufacturing (CAD/CAM) technology, enabling a shorter surgery time, as manual block adjustment during surgery becomes unnecessary, and thus, enhancing patient comfort.[5,6] This case report describes a two-stage guided bone regeneration (GBR) procedure using a customised allogeneic bone block as a first step to increase the horizontal mandibular bone width. In a second step, special newly designed implants (Straumann BLX with Roxolid material and the SLActive surface) were inserted to achieve good primary stability.

Initial situation

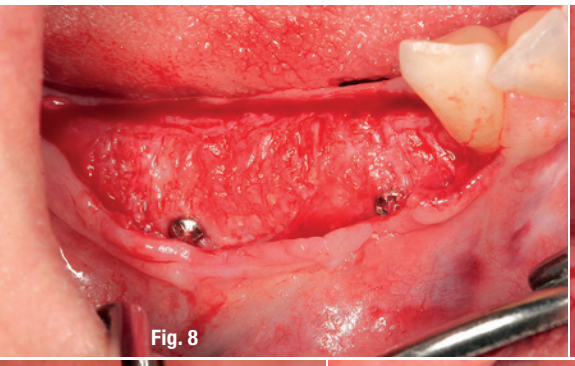
A 42-year-old woman presented with the wish for a fixed prosthetic restoration in the lower jaw. The initial clinical and radiographic examination showed an atrophic jaw with limited bone availability for implantation (Figs. 1 & 2). Several treatment options for a two-stage GBR procedure to regain an optimal horizontal width for further implantation were discussed with the patient. In the end, because the patient refused autologous bone augmentation, treatment with a customised CAD/CAM FDBA (maxgraft bonebuilder, botiss biomaterials), followed by placement of Straumann BLX implants, was determined.

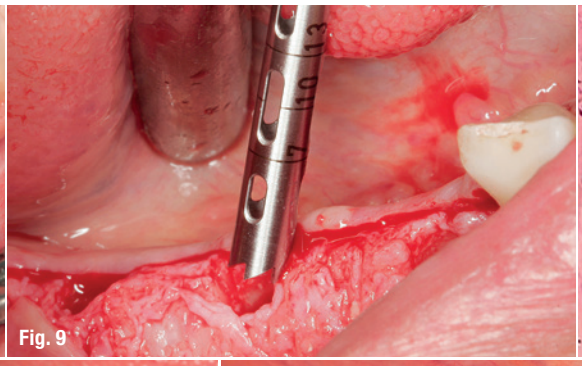
Planning

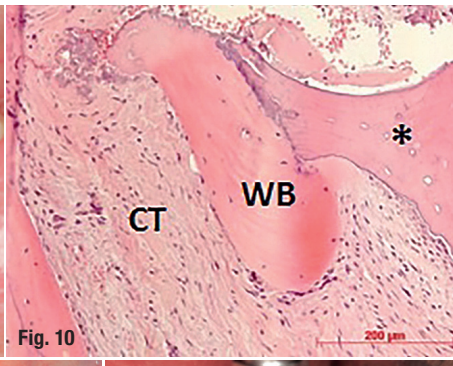
A CBCT scan was taken and forwarded, in the DICOM format, to botiss biomaterials to design the customised allogeneic bone block. Botiss virtually designed the allogeneic bone block on a 3D reconstruction of the patient's defect (Fig. 3). After review of the block design and approval by the surgeon, the maxgraft bonebuilder block was milled from processed (Allotec process, Cells+Tissuebank Austria) cancellous bone from femoral heads of living donors.

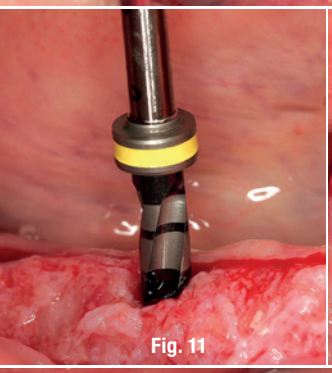
Surgical procedure

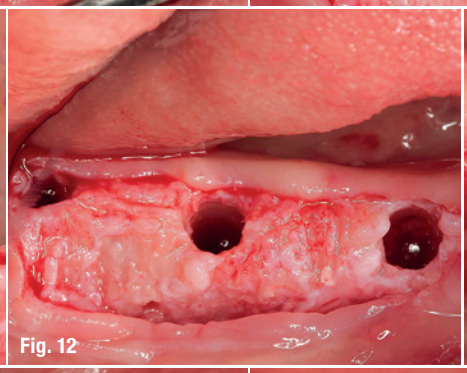
The GBR procedure was performed under local anaesthesia. A full-thickness vestibular flap with mesial

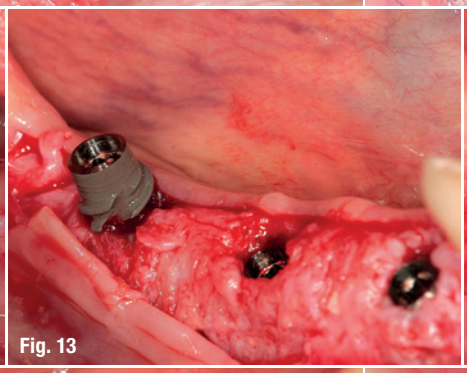


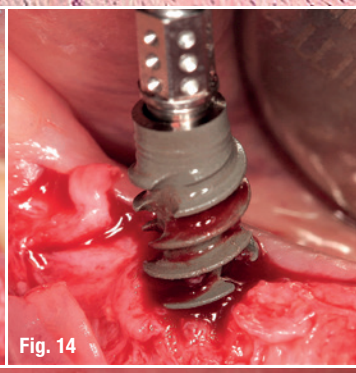


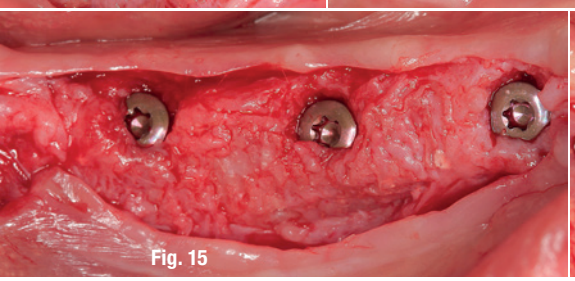












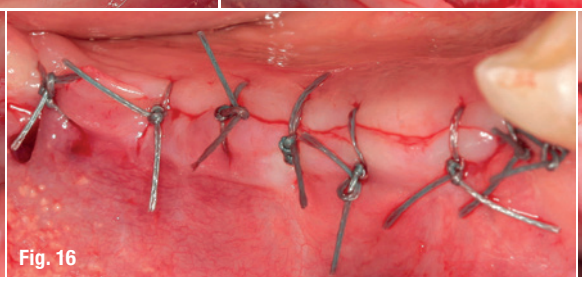
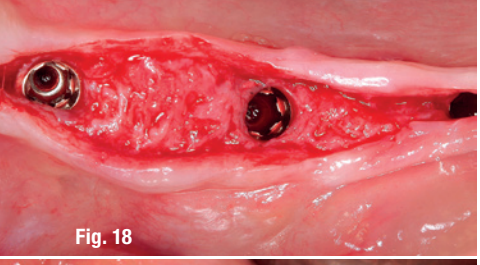


Fig. 8: The fixation screws were removed. **Fig. 9:** A bone core biopsy was taken. **Fig. 10:** The histology of the biopsy. WB = woven bone; * = allograft material; CT = connective tissue. **Figs. 11–14:** Placement of the Straumann implants at bone level. **Fig. 15:** The implants were covered with closure caps. **Fig. 16:** The surgical site was closed with sutures. **Fig. 17:** Uncovering of the implants after three months.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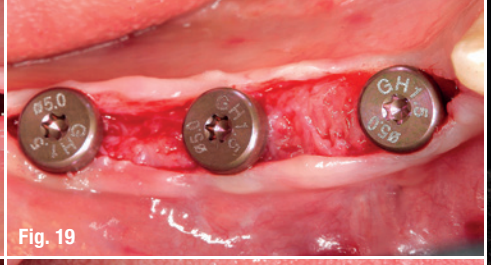
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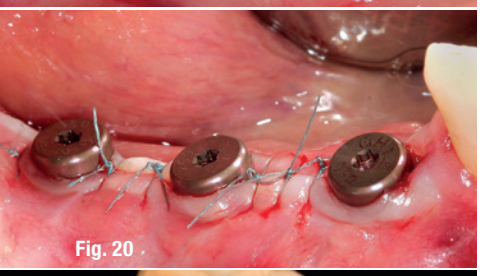
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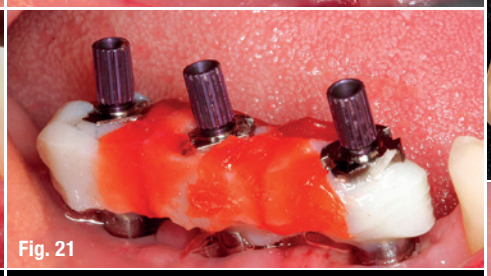
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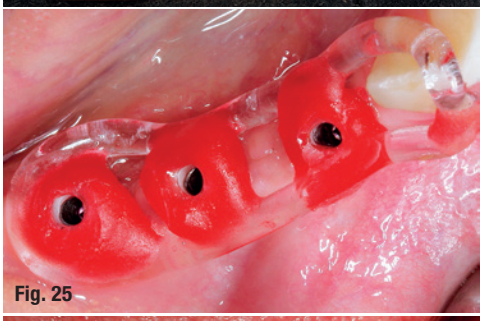
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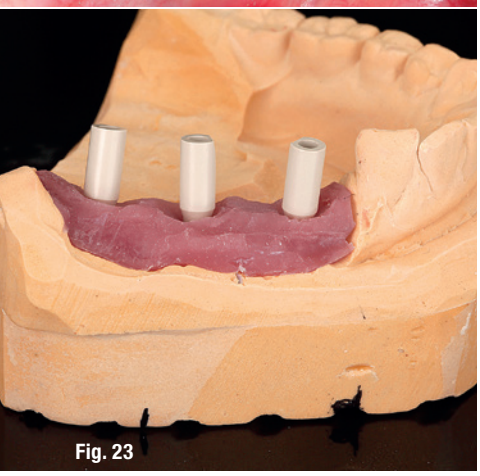
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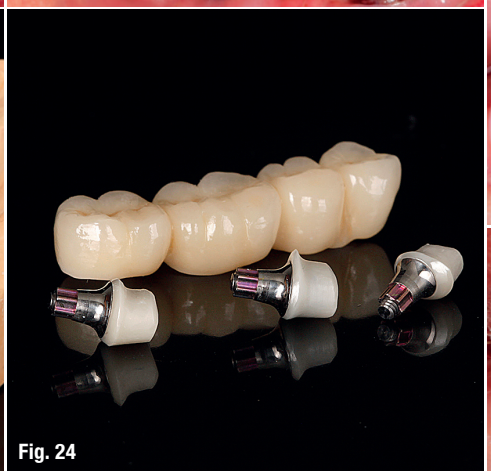
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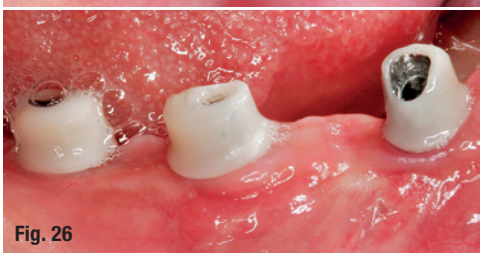
Fig. 26

Figs. 18 & 19: Healing abutments were placed. **Fig. 20:** The surgical site was closed with sutures. **Fig. 21:** Impressions were taken. **Figs. 22 & 23:** Individual abutments were manufactured. **Fig. 24:** Straumann Variobase abutments. **Figs. 25 & 26:** Acrylic with a pattern resin-modified key was used.

relieving incisions was raised. The lingual tissue was carefully dissected from the residual bone down to the mylohyoid muscle while protecting the neurovascular tissue by avoiding any sharp incision. Thus, the lingual tissue was mobilised in the buccal direction for proper soft-tissue management. The cortical layer of the recipient site was perforated using a small round bur to promote bleeding and accelerate revascularisation of the graft (Fig. 4). The customised allogeneic block fitted exactly on to the recipient site and was rigidly fixed to the mandible with 1.25 mm wide and 8.00 mm long screws (Fig. 5). Mesial and distal areas were contoured using xenogeneic bone substitute material (cerabone, botiss biomaterials). The surgical area was covered with a pericardium collagen membrane (Jason membrane, botiss biomaterials), which was fixed to the local bone using titanium pins. The flap was adapted and sutured using a 4/0 non-resorbable suture material. An apically positioned lateral mattress suture secured the muscle tension of the flap to achieve a tension-free wound closure. Sutures were removed at 14 days post-operatively.

After six months of uneventful recovery and healing, the patient presented for the implantation procedure (Figs. 6 & 7). At re-entry, the fixation screws were removed and a bone core biopsy was taken for histological analysis (Figs. 8 & 9). Biopsy slides were stained with haematoxylin and eosin stain, and the histological examination of the material obtained at re-entry showed the ongoing remodelling process of the FDBA block. Newly formed bone (woven bone) was found to be in close contact with the allograft material, surrounded by connective tissue, demonstrating the material-mediated bone regeneration (Fig. 10). Three Straumann BLX implants of 4.5 mm in diameter and 10.0 mm in length were inserted at bone level after measurements at locations #47, 46 and 44 (Figs. 11–14). The implants were covered with regular base (RB) closure caps, and the surgical site was closed with a 4/0 suture material (Figs. 15 & 16).

After three months, the implants were uncovered by a crestal incision. The closure caps were covered in places by new bone (Fig. 17). This shows the vital potential of the newly generated bone in this area. RB and wide base healing abutments were inserted (diameter of 5.0 mm, gingival height of 1.5 mm), and the soft tissue was approximated with a 5/0 non-resorbable suture material (Figs. 18–20).

Prosthetic procedure

After three weeks of healing, the impression was taken with splinted RB impression posts. An open-tray technique was performed in order to avoid dimensional changes during the transfer to the master model. An individualised open tray for the impression was used with polyether impression material (Impregum Penta, 3M

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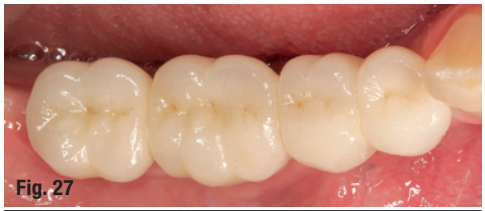
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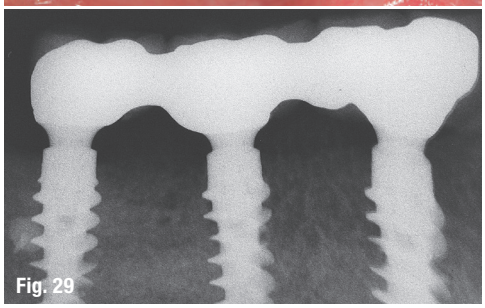
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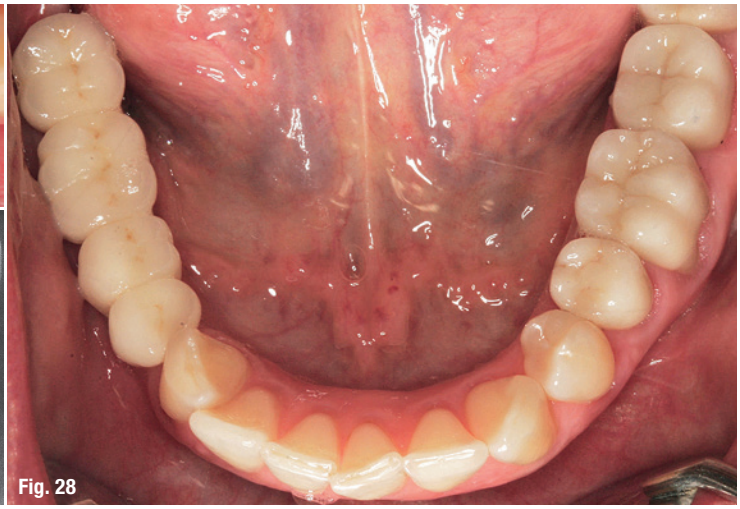
Fig. 28

Figs. 27 & 28: Clinical situation ten months after implant placement. **Fig. 29:** The post-op radiograph.

ESPE; Fig. 21). The individual abutments were created using a Straumann Variobase abutment with zirconia (Figs. 22 & 23). This abutment provides dental laboratories with the flexibility to create customised abutments (Fig. 24). The preferred workflow was in-laboratory milling. The abutment combines the benefits of the original Straumann connection and the unique Straumann engaging mechanism. An acrylic with a pattern resin-modified key was used to determine the correct position of the abutments in the patient's mouth (Figs. 25 & 26). Follow-up ten months after implant placement showed well-preserved gingival contours (Figs. 27 & 28).

Results

After successful integration of the prosthetic work, a zirconia and ceramic layered bridge was fixed with glass ionomer cement. A check radiograph revealed a perfect fit of the prosthetic work (Fig. 29).

Conclusion

The BLX implants achieved an optimal primary stability. BLX drills allow for adaptation of the implants' primary stability by making intermittent movements during the bed preparation. From this perspective, this implant is very easy to use in different segments of bone length and bone density characteristics, as in this case.

The two-stage GBR procedure using a customised FDBA block was able to fulfil the patient's wish for a fixed dental restoration without harvesting autologous bone, avoiding additional surgical sites for bone harvesting. CAD/CAM technology produced an optimally fitting allogeneic bone block, reducing the surgery time, as no manual adjustment of the block was necessary, and thus, also reducing patient discomfort. The augmentation procedure gained significant horizontal bone width for successful implantation. With its special thread design, the BLX implant chosen here showed excellent cutting and fixation properties in such different bone situations over the length of the implant, where more dense residual bone meets newly generated bone tissue. During uncovering, the newly formed bone tissue was even growing on top of the closure caps in places, showing the excellent remodelling properties of the allograft material.

Overall, this case demonstrates that, while being far less invasive, allogeneic block augmentation, especially the customised allogeneic bone blocks, facilitates bone augmentation procedures for the surgeon and the patient. At the same time, these long-lasting implant solutions offer maximum comfort for the patient.

Literature

about the author

Germany-based **Dr Orcan Yüksel** graduated from Goethe University in Frankfurt on the Main in Germany and Istanbul University in Turkey in 1987. Since 1993, he has owned a dental clinic and education centre specialised in dental aesthetics and oral implantology. Today, he works as a private practitioner in a joint practice in Frankfurt on the Main.

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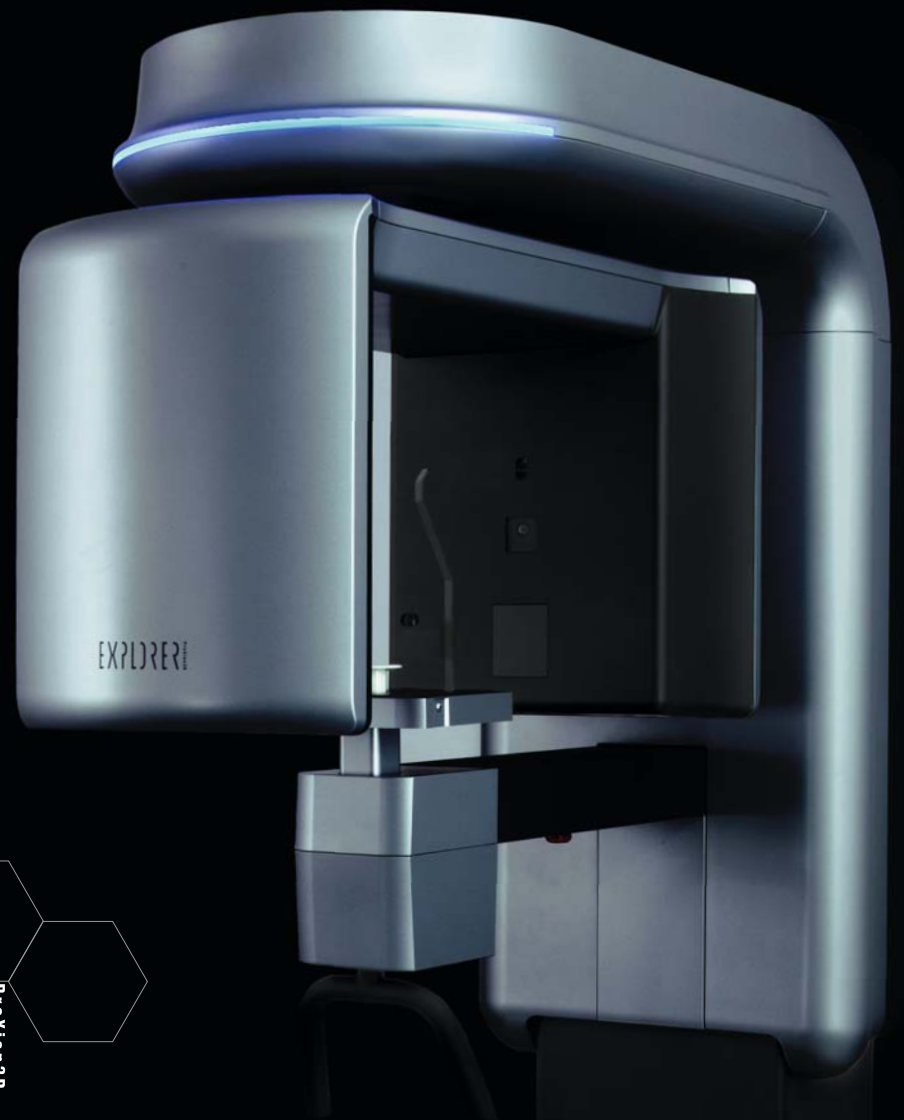

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