Horizontal bone augmentation by means of preshaped titanium mesh—a five-year follow-up

Drs Leonardo Muzzi, Roberto Montauti & Elisa Romanelli, Italy

Regenerative therapy in implantology (guided bone regeneration) represents a procedure of daily use for the reconstruction of peri-implant hard tissues both contextually and pre-implantation. The reconstruction of the bone volumes represented a clinical and biological challenge to re-establish both the correct intermaxillary relationships altered by severe bone atrophies, and the restoration of tissue volumes capable of guaranteeing a better aesthetic result of the prosthetic implant rehabilitation. The use of autologous bone grafts for the reconstruction of large lost bone volumes has been considered the gold standard since the 1990s.[1] The introduction in the last two decades of filling biomaterials and barriers of different nature has prompted research towards less invasive techniques capable of reducing the morbidity of regenerative surgery but equally guaranteeing the reconstruction of volumes necessary to achieve the desired clinical and aesthetic result.[2]

These techniques can be applied both before and during the implant placement. The use of biomaterials (alone or mixed in different percentages with autologous bone), together with membranes (resorbable and non-resorbable) can simultaneously provide both a curtain effect capable of maintaining a stable clot and prevent the migration of epithelial cells to the clot itself in favour of osteoblastic cells instead. The stability of the clot is related both to the consistency of the filling material used and to the rigidity and fixation of the barrier used.[3] The use of absorbable barriers without intrinsic rigidity requires the use of biomaterials with a good physical consistency that makes up for the lack of support offered by the barrier; these barriers do not require a second intervention for their removal.

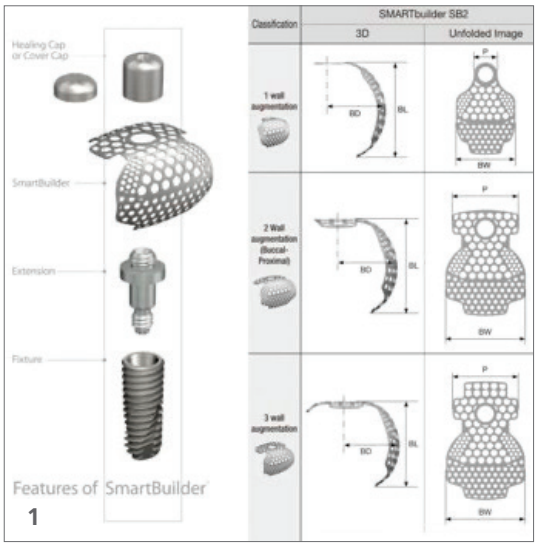


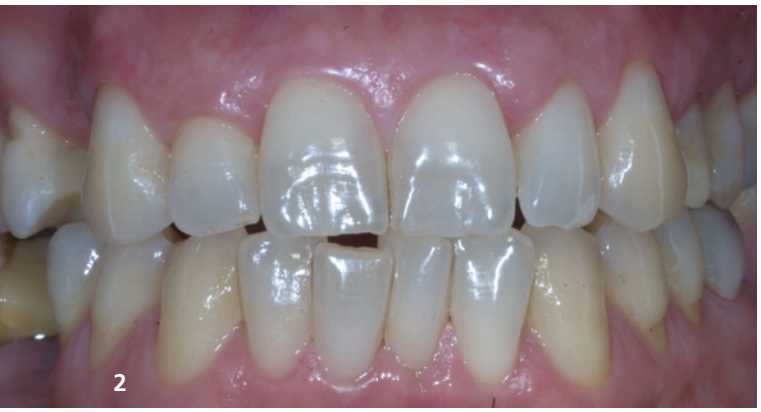
Fig. 1: For this case study the Osstem product SmartBuilder was used, which is now available under OssBuilder.

Numerous authors have evaluated the effect and stability of the results obtained using different techniques and different biomaterials. Jung et al. evaluated the GBR result at five years by comparing the use of DEPROTEINISED bovine bone and resorbable membrane in PEG (test) versus DEPROTEINISED bovine bone and resorbable membrane in bovine collagen (control).[4] The results show a five-year gain of 4.3 ± 1.5 (SD) mm and 4.8 ± 2.6 (SD) mm for the test and control group respectively (P = 0.493).

Conversely, non-absorbable barriers (PTFs, PTPE reinforced barriers) often equipped with support scaffolds, offer greater rigidity capable of guaranteeing undisturbed underlying healing but require a second surgical access for their removal. Canullo et al. using

N2	Pat	Gender	Age	Site to be	implant
	MG	M	53	1.4	4 x 11.5

Table 1: Patient's features.



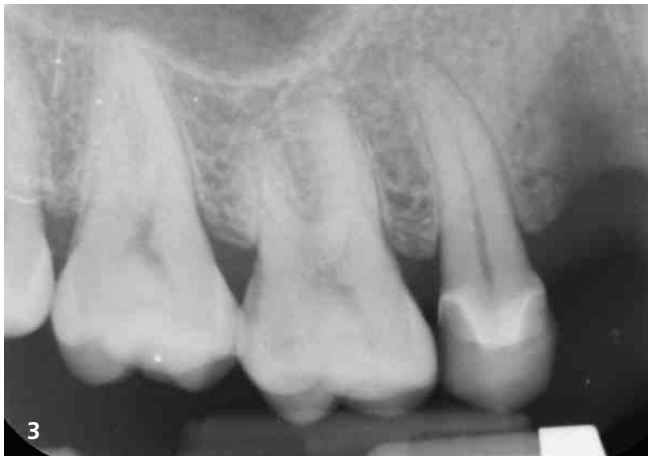


Fig. 2: Pre-op clinical situation. **Fig. 3:** Radiographic image of the area.

hydroxyapatite and non-resorbable PTFE membranes reinforced with titanium, found a bone gain of 5.61 mm and a marginal bone resorption of 0.98 mm at two years of follow-up.[5]

Numerous authors have also proposed the use of titanium mesh for the reconstruction of large bone volumes over the years.[6,7] Pieri et al. using titanium mesh and autologous bone and DE-PROTEINISED bovine bone mix showed a survival rate of 100 per cent and a mean bone resorption of 1.37 ± 0.32 mm at two years.[6]

As already mentioned, the stability of the clot is linked to various factors including the correct and stable fixation of the barrier used. This need has prompted research towards the development of different systems to block the barrier used in the desired position (such as screws, pins of different materials, biological fixatives, or fibrin glue).

A preformed titanium mesh locking system has recently been developed using the same fixture during the contextual implant placement (SmartBuilder, Osstem).

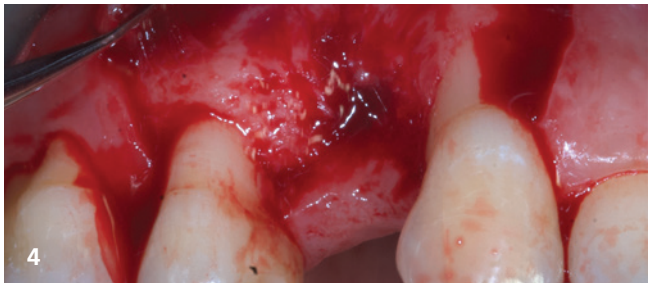
These meshes, supplied in different shapes and sizes, use a system of screws in order to directly block the mesh on the head of the fixture, thus ensuring both the rigidity and the immobility of the system. This method allows both submerged healing and transgingival healing depending on the type of fixation screw used (Fig. 1).

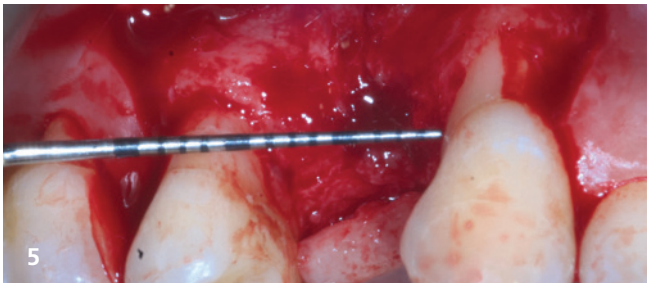
A 50-year-old, male patient, non-smoker who needed bone reconstruction contextual to implant placement in area 14 was selected in a private dental practice (Table 1).

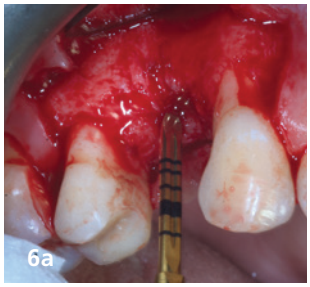
The medical history resulted completely negative (ASA 1).[7] The clinical examination highlights the lack of tooth 14, extracted a few months earlier and a marked horizontal resorption of the corresponding edentulous area. The radiographic examination shows a simultaneous vertical bone resorption with reduction of the bone levels in the centre of the bone crest and on the distal aspect of the tooth 13 (Figs. 2 & 3).

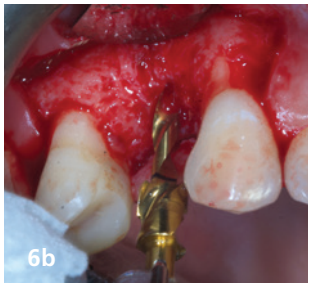
Surgical technique

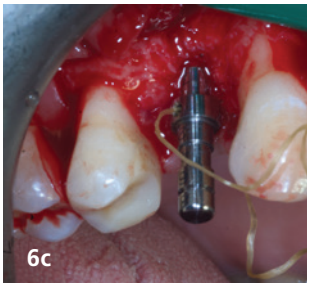
After anaesthesia (Articaine with vasoconstrictor 1:100.000) a full thickness mucoperiosteal flap is raised in the corresponding











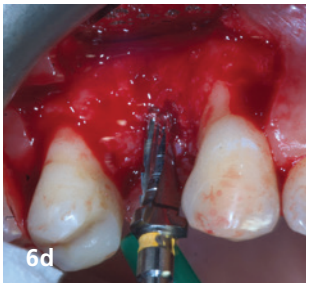
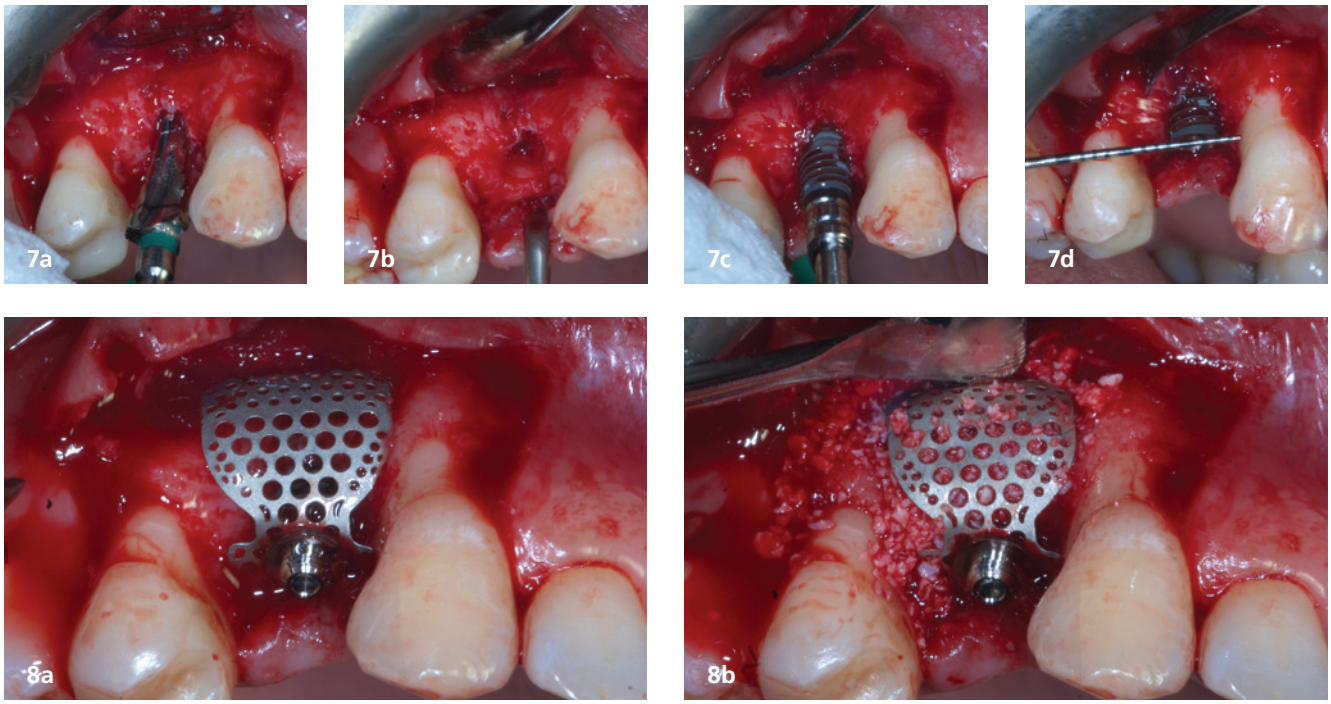


Fig. 4: Raised flap with vertical incisions. **Fig. 5:** Measurement of the defect. **Figs. 6a–d:** Site preparation.



Figs.7a–d: Implant positioning. **Figs.8a & b:** Bone grafting and SmartBuilder positioning using the dedicated fixation screw.

area in order to visualise the site and the defect. The flap is completed by two release incisions in order to subsequently be able to passivate it (Fig. 4). The defect is completely skeletonised and intraoperatively, a careful assessment of the residual bone levels is carried out with a periodontal probe in order to correctly position the fixture (Fig. 5).

The preparation of the implant site and the positioning of the fixture (TSIII, Osstem) are performed in a three-dimensionally correct position with a 4 mm residual dehiscence (Figs. 6 & 7).

GBR is performed using DEPROTEINISED bovine bone and preformed mesh titanium (SmartBuilder, Osstem®). The mesh is fixed with a fixing screw of the diameter corresponding to the implant, which locks the grid to the head of the fixture; then a protective cap of the same screw is applied on top (Fig. 8). A collagen membrane was applied on the top of titanium grid (Fig. 9). A primary closure was obtained by releasing the flap (Fig. 10).

After six months a second surgery phase was performed (Fig. 11) and a provisional crown, in order to allow tissue maturation, was applied (Fig. 12). After one month from provisional, a definitive screw-retained zirconia crown was applied (Fig. 13) and then the patient was enrolled in a maintenance programme.

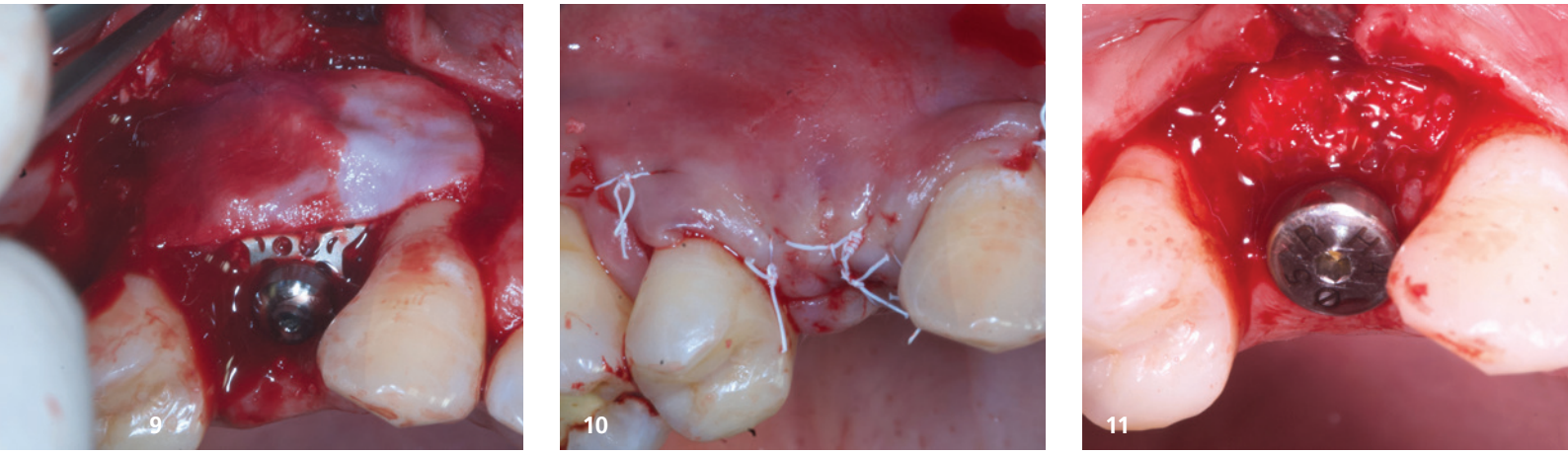


Fig. 9: Collagen membrane applied over the mesh. **Fig. 10:** Sutured flap. **Fig. 11:** Regenerated tissue after SmartBuilder removal and seating of healing abutment.

Measurement	1 mm	2 mm from	3 mm from	4 mm from	Mean
mm	0.8	1.6	2	2.1	1.625

Table 2: Five years CBCT measurement of regenerated bone.

The control visit after six years, showed a good integration between tissues and prosthesis (Fig. 14). The occlusal vision show the good maintenance of the volume obtained (Fig. 15). At this time a CBCT was performed.

Measurements

The Patient was submitted to a CBCT scan after five years after the completion of therapy.

On the five year control CBCT the following measurements were collected. The distance between the outlining vestibular regenerated bone and the outer surface of the implant.

The distances were obtained from the outlining regenerated bone perpendicular to the main axis of the implant respectively at 1, 2, 3 and 4 mm from the neck of the implant (Fig. 16).

Results

The patient involved did not show any complication during the healing phase and in the last five years.

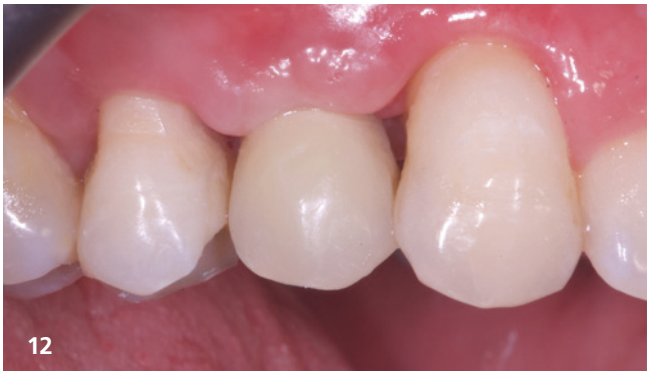
The patients had a vestibular dehiscence of 4 mm that was managed by means of DEPROTEINISED bovine bone and osseo-builder (one wall defect type).

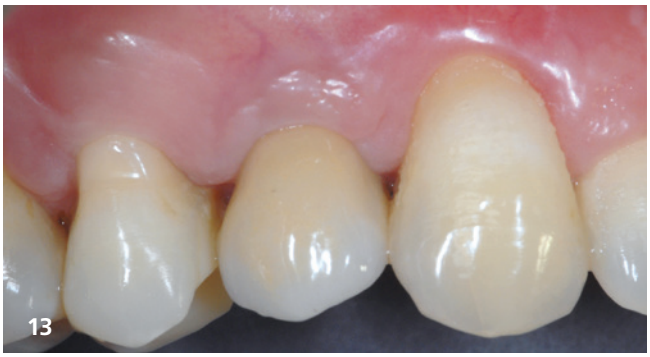
After five years the appearance of the tissues appeared stable with complete absence of inflammation and good integration with the prosthetic crown. An excellent increase in the volume of tissues in the treated area is observed. Measurements carried out on CBCT six years postsurgery showed an increase in hard tissue in the treated area with a mean horizontal volume increase of 1.6 mm. A greater volumetric increase was observed at the most apical part of the defect.

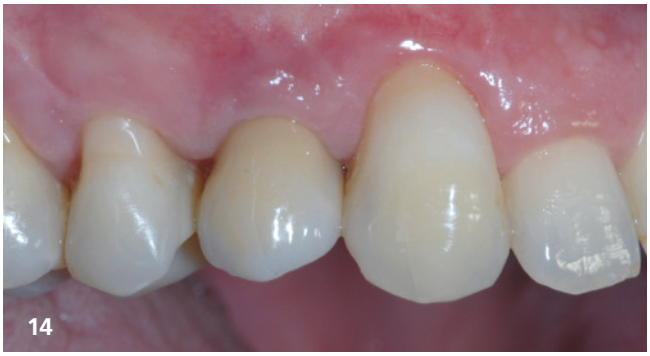
Discussion

Discussing the clinical case presented, it seems reasonable to state that the use of pre-formed titanium meshes, like other re-generative methods, is recommended above all in all those cases of aesthetic value in which there is a need for horizontal regeneration for a substantial increase in bone volumes capable of improving the emergence profiles of subsequent prosthetic crowns.

With reference to the technique presented in the article, it appears that the method of locking the grid to the head of the fixture is very simple if compared with the common fixing techniques of other types of non-absorbable barriers. In addition, the excellent rigidity of the mesh combined with the different designs provided by the manufacturer allows you to manage both horizontal defects and small vertical defects. As regards







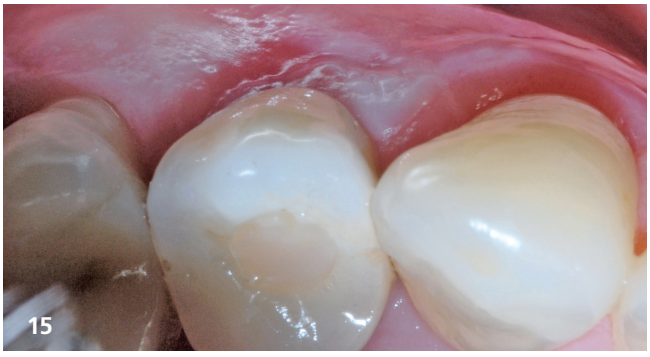
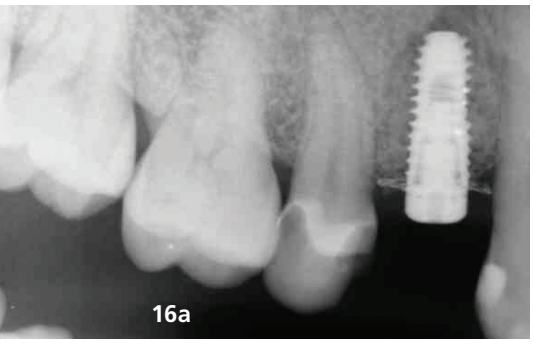


Fig. 12: Provisional restoration seated. **Fig. 13:** Definitive crown seated. **Fig. 14:** Follow-up after six years, vestibular aspect. **Fig. 15:** Follow-up after six years, occlusal aspect.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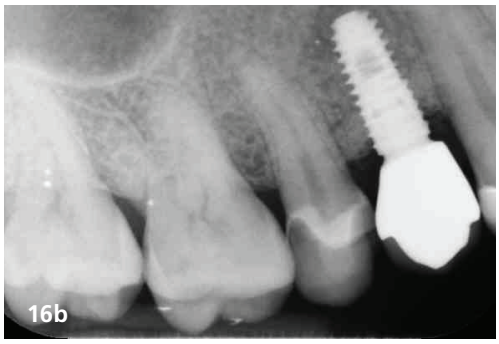
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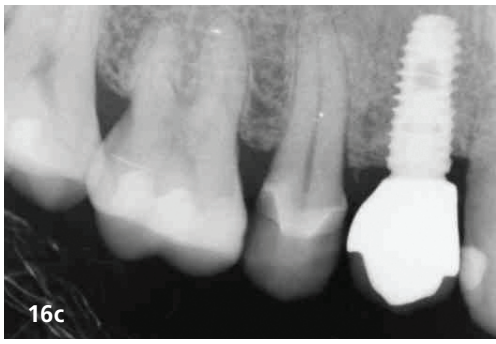
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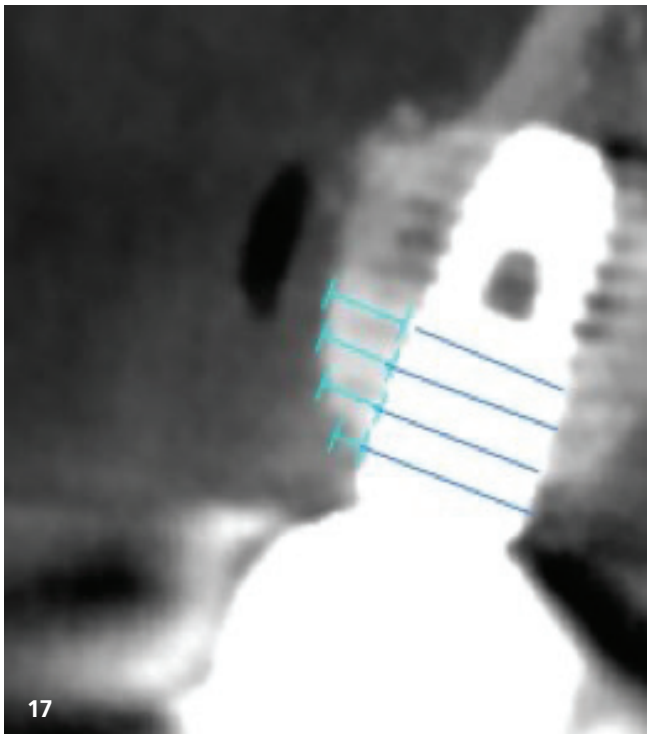
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Figs. 16a–c: Rx at surgery, at crown delivery and after five years in function.
Fig. 17: CBCT scan after six years. Reference lines used for measurements.

the long-term results of the case presented, it can be observed that a greater regenerative volume is obtained in the most apical portions of the dehiscence.

This result can be interpreted due to the shape of the grids which allows a greater volume of xenograft in the most apical portions compared to the coronal ones.

This requires extreme care in the careful compaction of the graft in order to properly replenish the space below the grid.

As regard the type of xenograft, deproteinised bovine bone seems to represent the good material for grafting under the mesh. Future follow-up can confirm the long-term results obtained in this case.

Author details

Literature

Contact address
Dr Leonardo Muzzi
+39 348 8324125
leo@leomuzzi.com
www.leomuzzi.com

About…

Dr Leonardo Muzzi

graduated with honours in dentistry and dental prosthodontics from the University of Siena in Italy and is an internal dentist in the periodontics department. He taught periodontics at the University of Florence in Italy from 1995 to 2002. Since 2019, he taught the master's programmes in implantology at the universities of Siena and Florence. Since 2020, he has been the course director of the Osstem Master Course in Rome. He is an active member of the Italian Academy of Osseointegration.