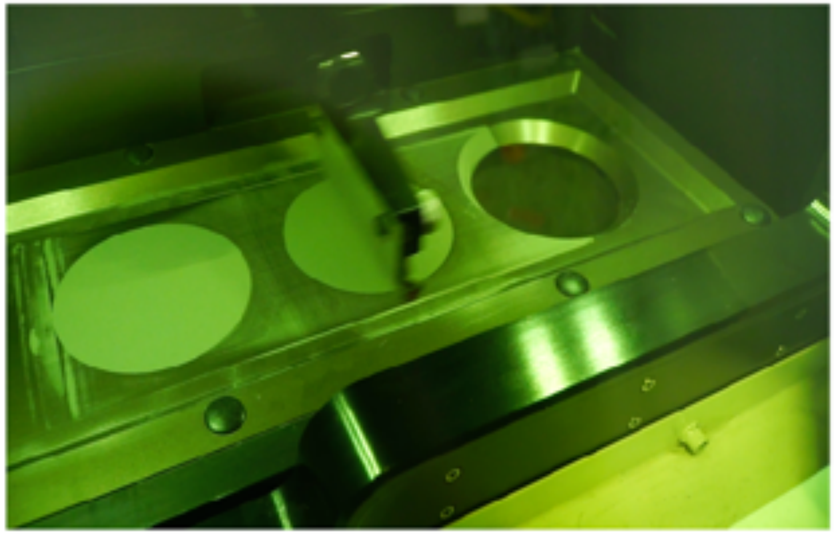
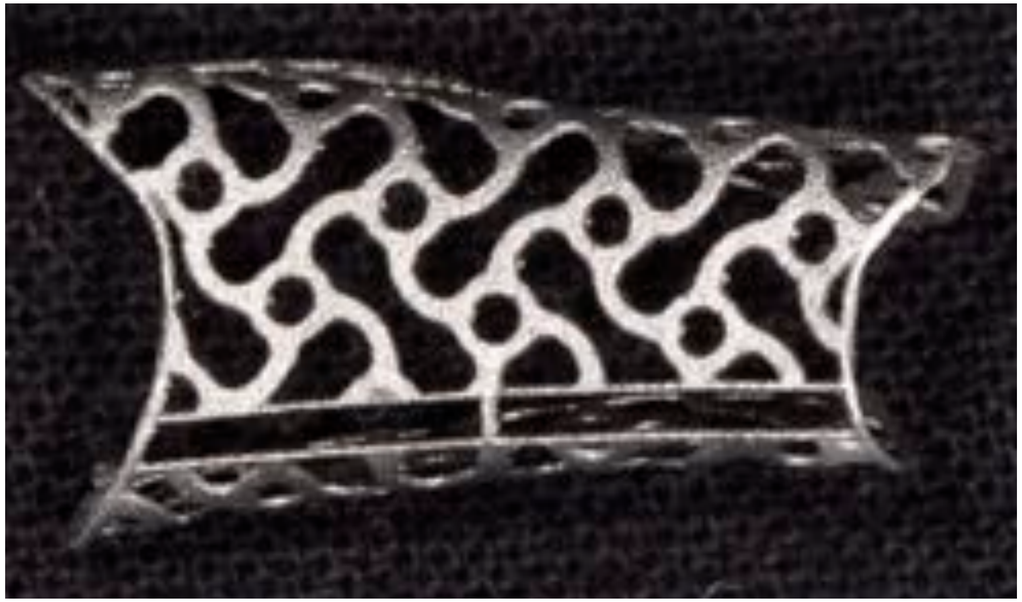
NEW SOLUTIONS WHICH MAY OFFER ADVANTAGES OF BOTH GBR AND BONE BLOCK RECONSTRUCTION

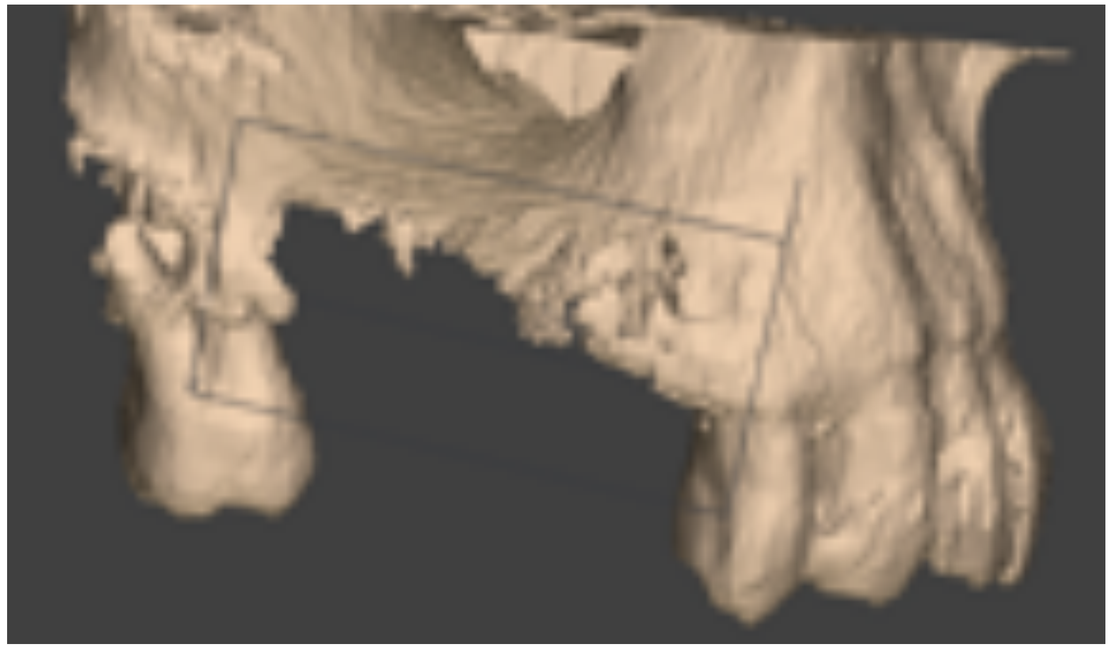
CAD/CAM CUSTOMIZED TITANIUM LATTICE STRUCTURES

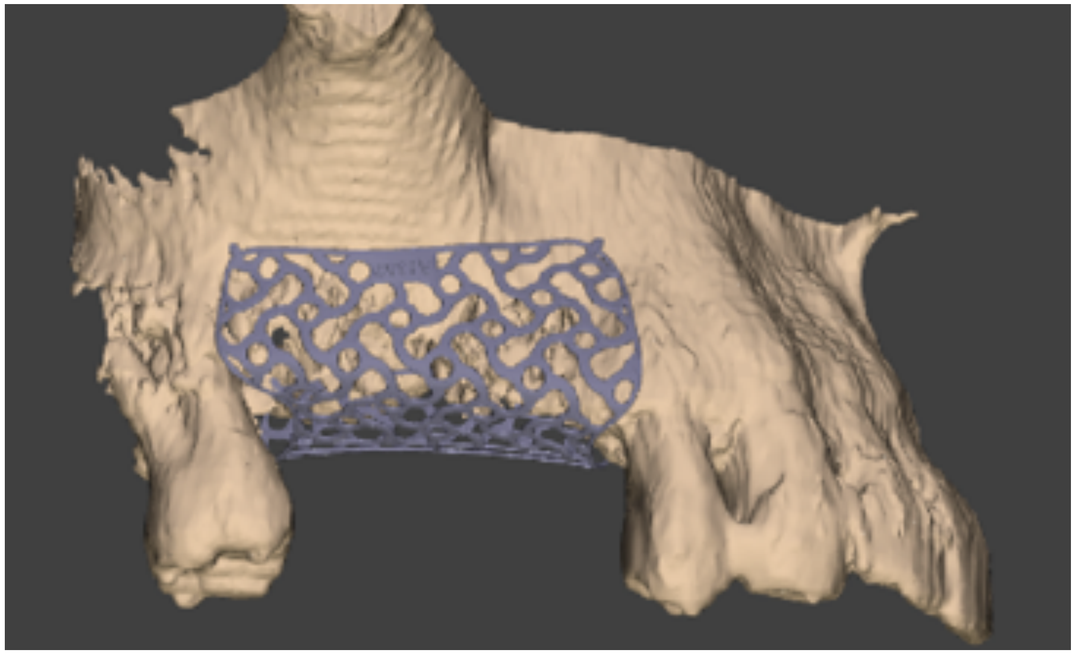
CAD/CAM patient specific lattice titanium structures



Selective Laser Sintering (SLS) technology







These meshes consist of commercial pure titanium grade 4 scaffold and it is individually made by a special manufacturing process. By using a specific reconstruction software, a 3D-projection of the atrophied segment can be obtained and a modern CAD/CAM customized scaffold can be designed.

The 3D model assists in accurate contouring of the meshes and/or planning of bone graft harvest geometry before surgery. These data (CT or CBCT) providing 3D information about the defect, allow to produce the tailored titanium mesh model, as a patient-specific scaffold.

Clinical Studies on Customized Titanium Meshes

- **Sagheb et al.** Clinical outcome of alveolar ridge augmentation with individualized CAD-CAM produced titanium mesh: Int J Impl Dent 2017; 3: 36-43

- **Seiler et al.** Customized Titanium Lattice Strucutre in three-dimensional defect: an initial case letter. J Oral Implantology 2018: 3; 219-224

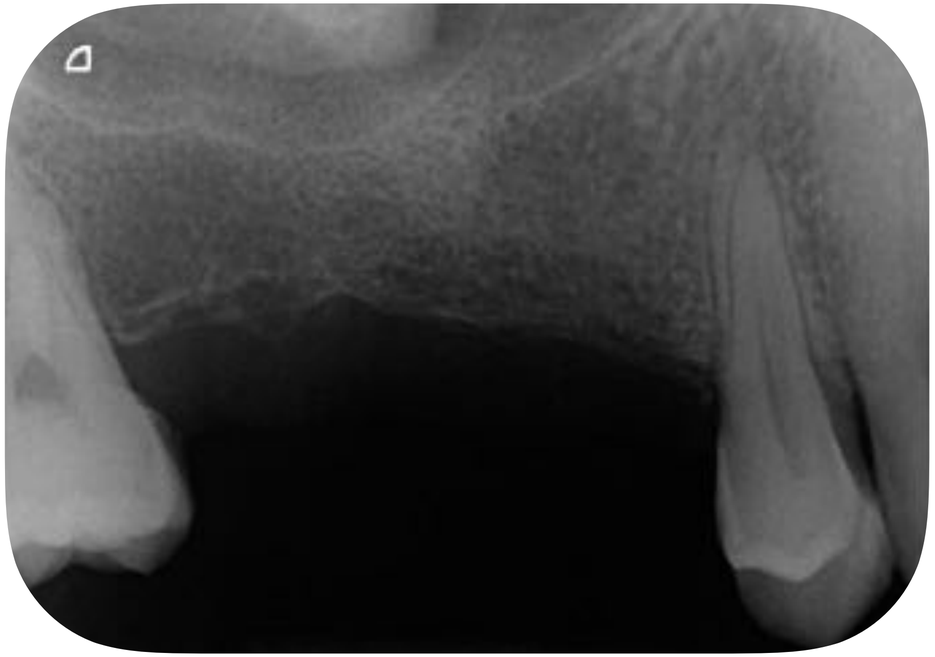
- **Chiapasco et al.** Customized CAD/CAM titanium lattice structures for guided bone regeneration of severe horizontal and vertical alveolar ridge defects: a prospective histomorphometric and clinical follow-up study in humans. (In Prep for COIR)

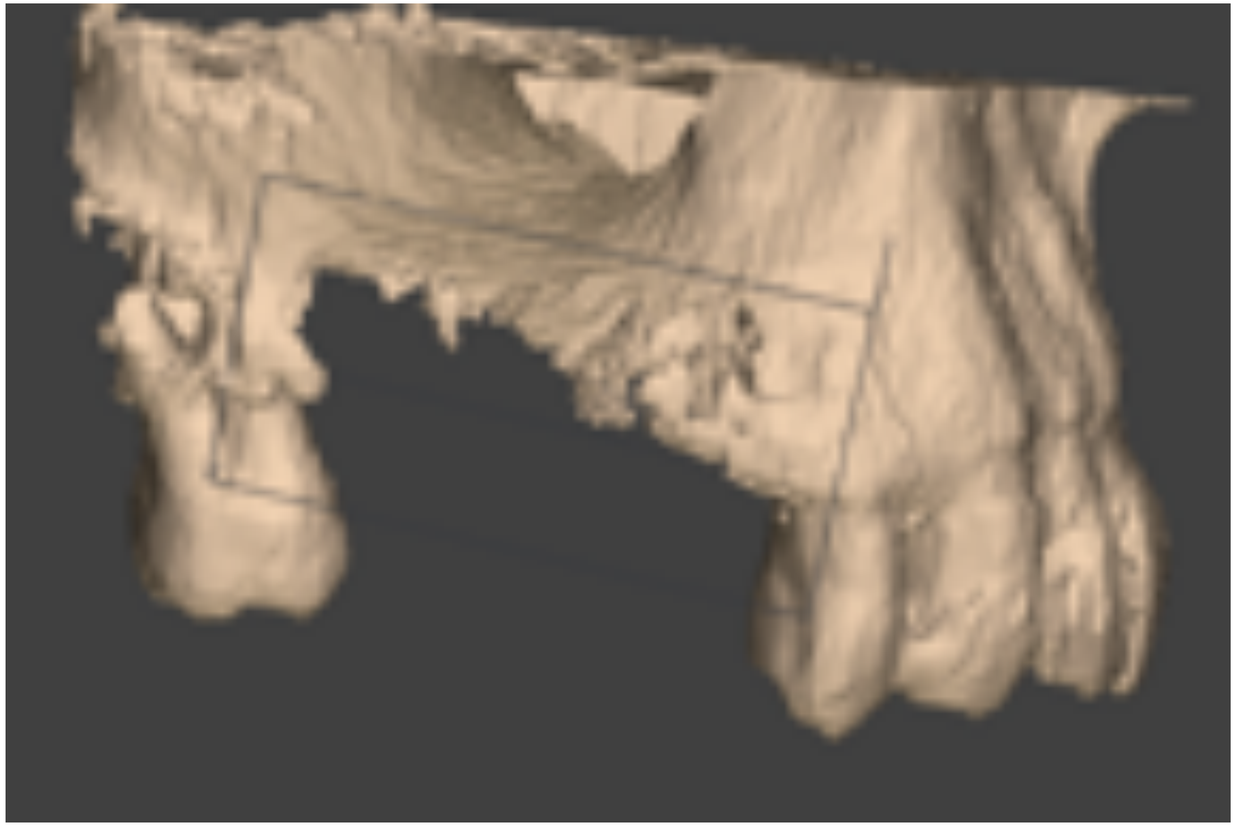
- **Sagheb et al.** Clinical outcome of alveolar ridge augmentation with individualized CAD-CAM produced titanium mesh: Int J Impl Dent 2017; 3: 36-43

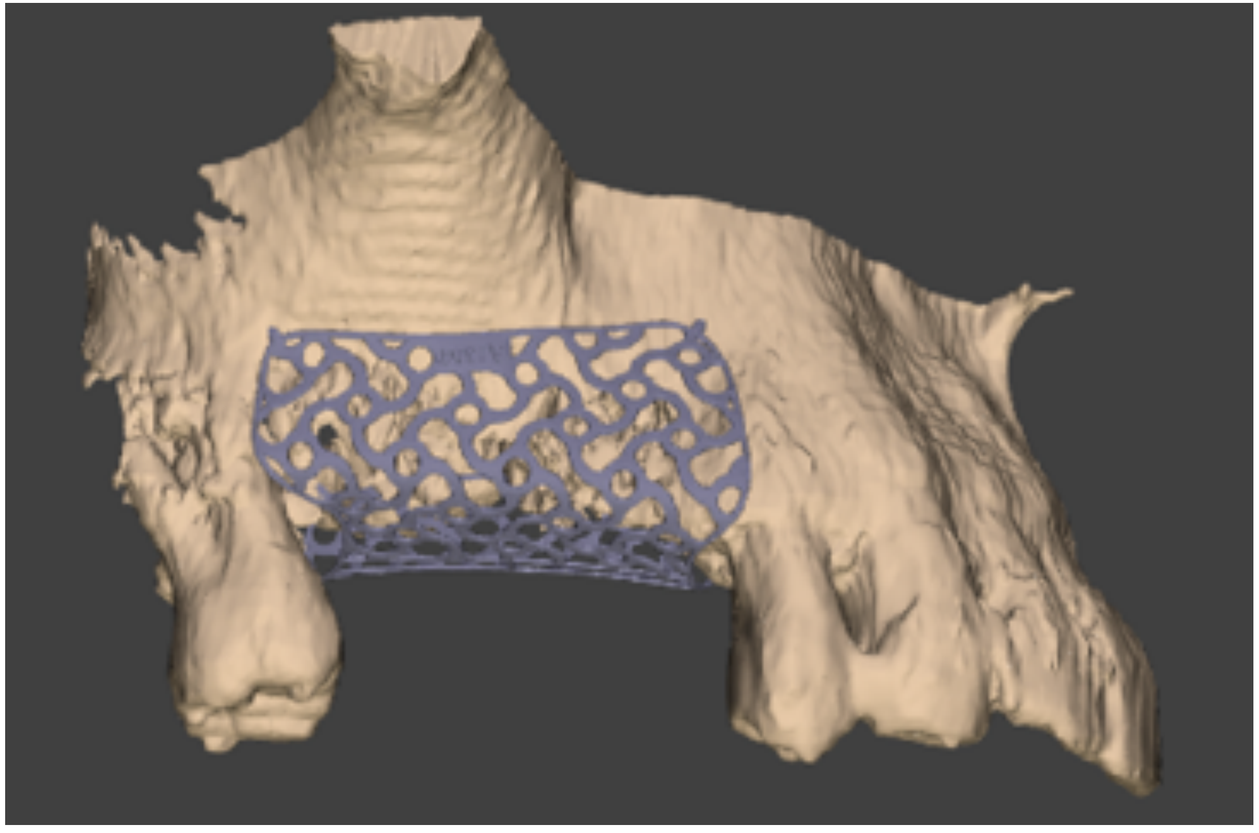
Methods: In 17 patients, 21 different regions were augmented with an individualized CAD-CAM-produced TM (Yxoss CBR®, Filderstadt, Germany). For the augmentation, a mixture of autologous bone and deproteinized bovine bone mineral (DBBM) or autologous bone alone was used. Reentry with explantation of the TM and simultaneous implantation of 44 implants were performed after 6 months. Preoperative and 6-month postoperative cone beam computed tomographies (CBCT) were performed to measure the gained bone height.

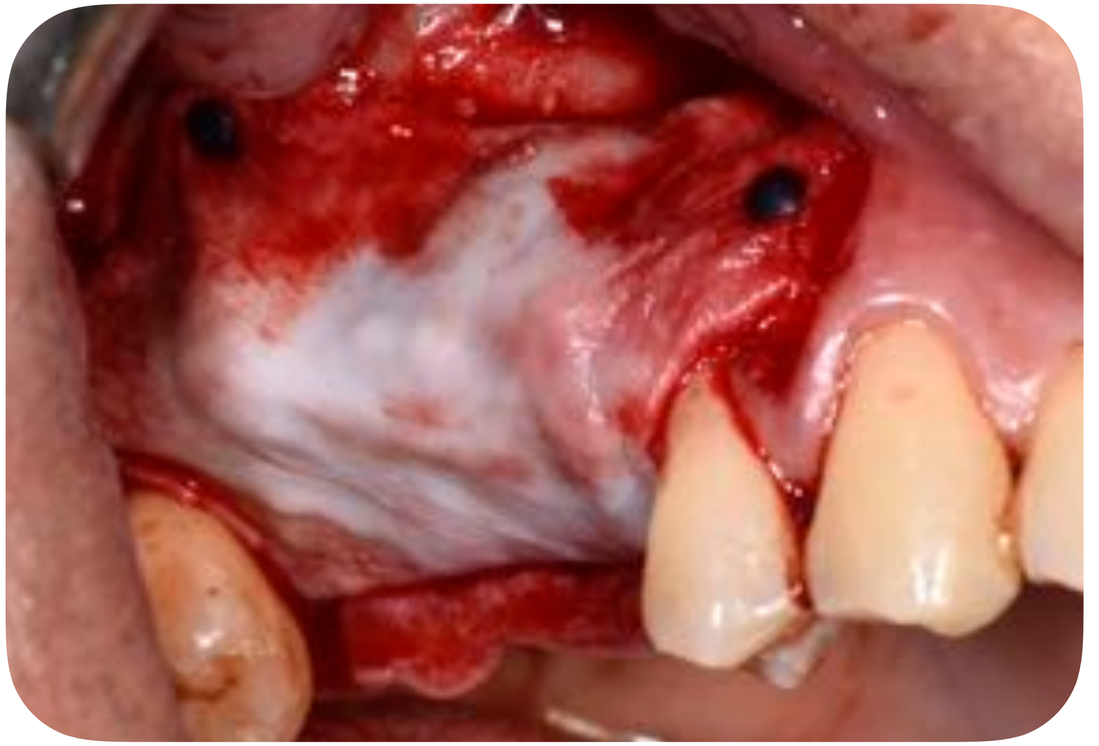
Results: The success rate for the bone grafting procedure was 100%. Thirty-three percent of cases presented an exposure of the TM during the healing period. However, premature removal of these exposed meshes was not necessary. Exposure rate in augmentations performed with mid-crestal incisions was higher than in augmentations performed with a modified poncho incision (45.5 vs. 20%, $p = 0.221$). In addition, exposure rates in the maxilla were significantly higher than in the mandible (66.7 vs. 8.3%, $p = 0.009$). Gender, smoking, periodontal disease, gingiva type, used augmentation material, and used membrane had no significant influence on the exposure rate ($p > 0.05$). The mean vertical augmentation was 6.5 ± 1.7 mm, and the mean horizontal augmentation was 5.5 ± 1.9 mm. Implant survival rate after a mean follow-up of 12 ± 6 months after reentry was 100%.

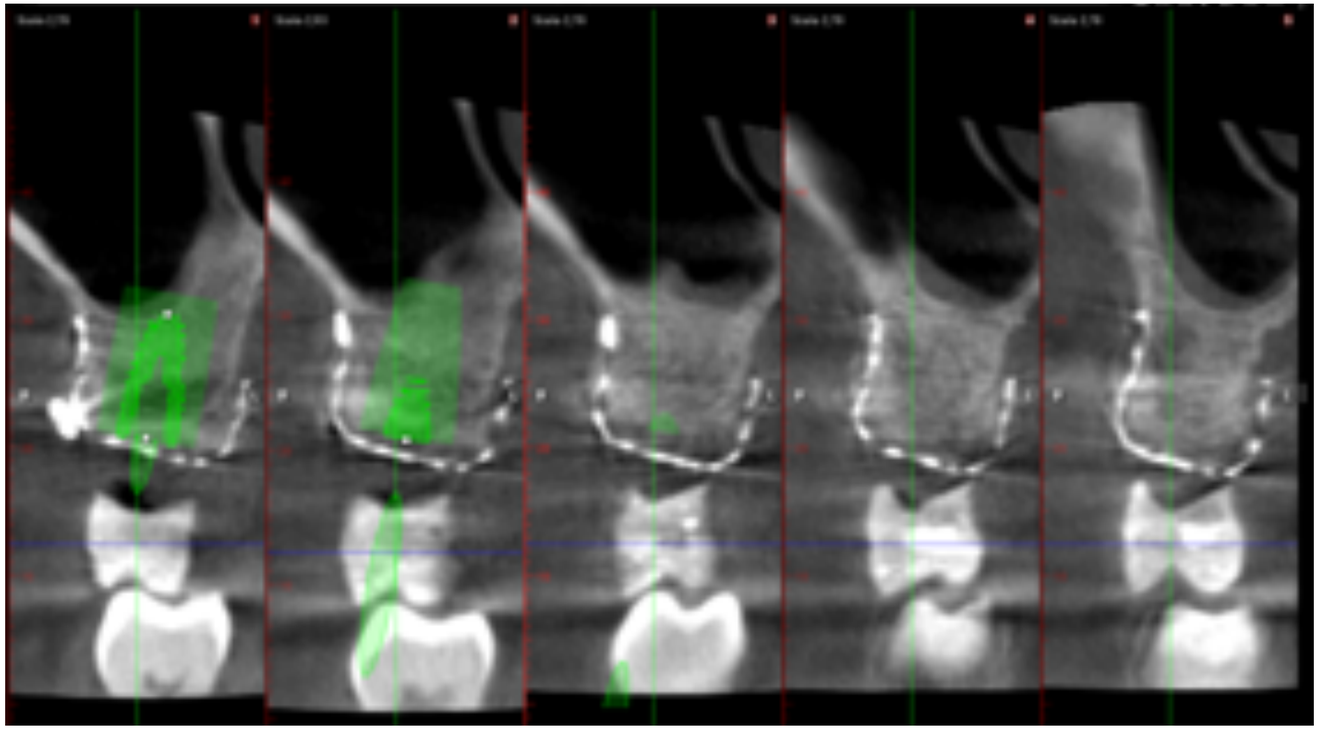
Conclusion: Within the limits of the retrospective character of this study, this study shows for the first time that individualized CAD-CAM TM provide a sufficient and safe augmentation technique, especially for vertical and combined defects. However, the soft tissue handling for sufficient mesh covering remains one of the most critical steps using this technique.

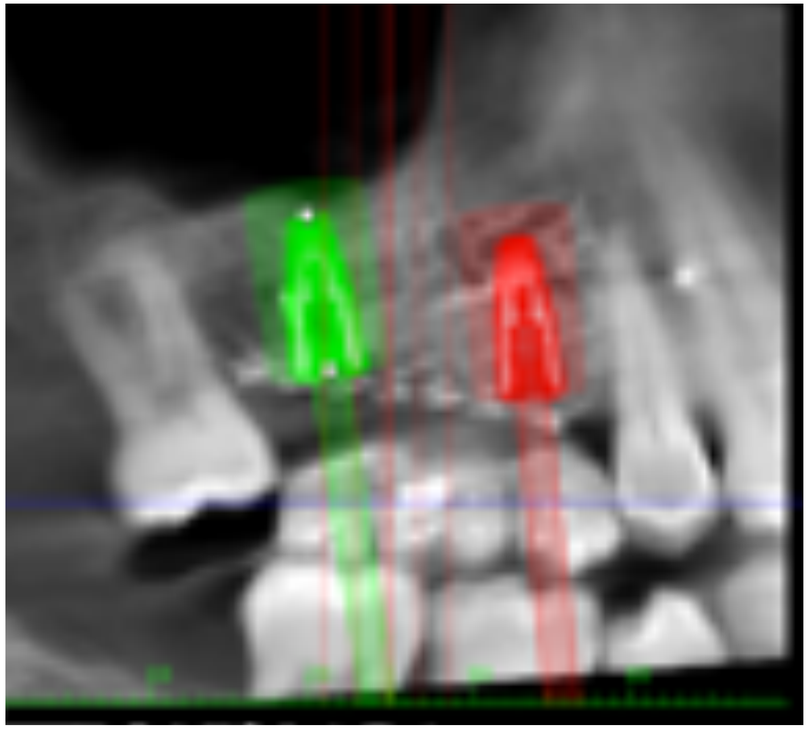


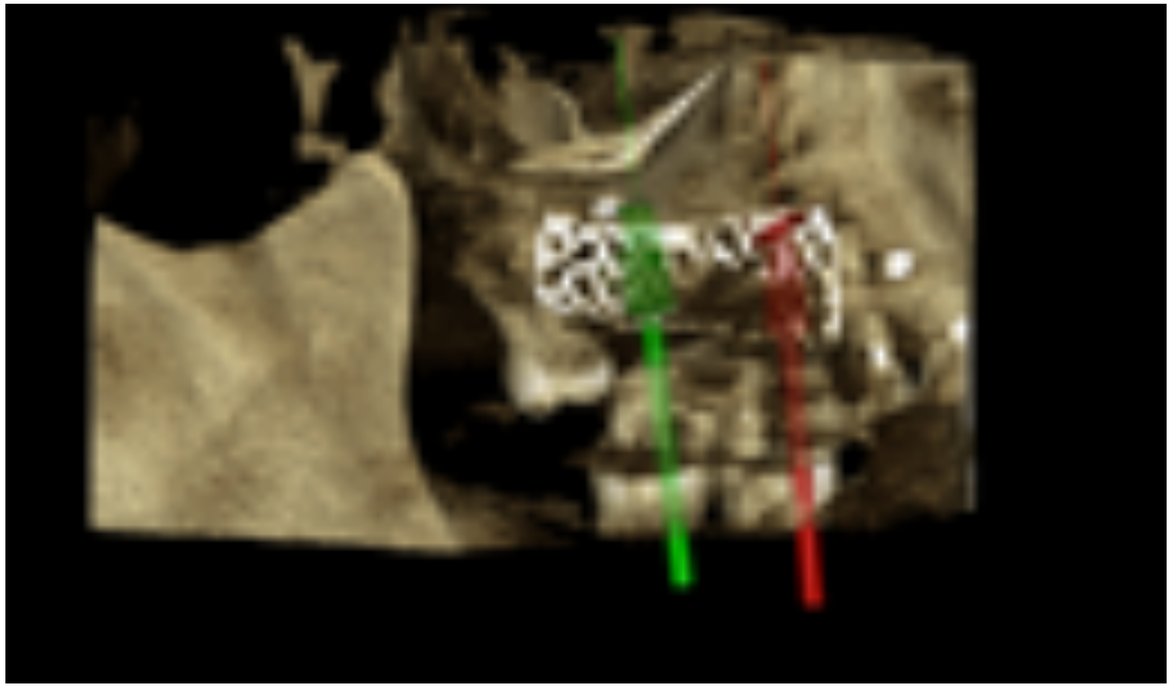


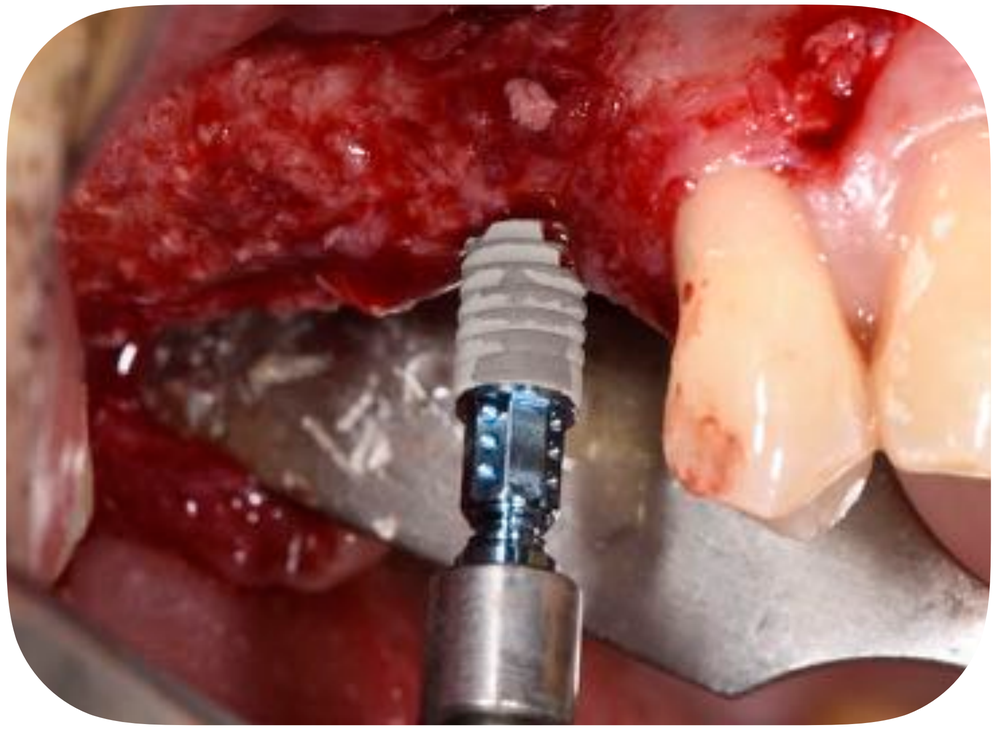


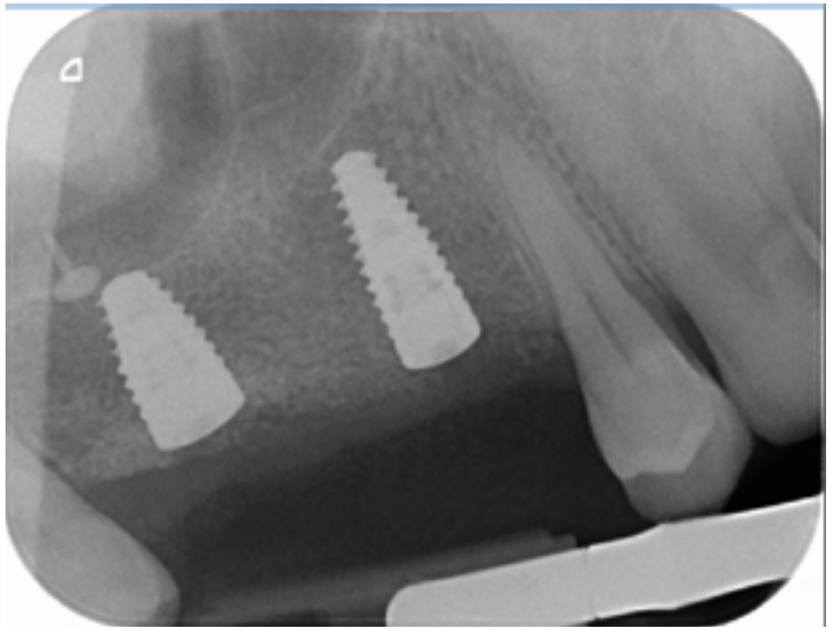












Conclusion (preliminary results)

- Pre-visualization of the final shape of the lattice titanium structure;
- Easier communication with patients;
- Precision of lattice titanium structures with easy adaptability and reduction of surgical times;

Conclusion (preliminary results)

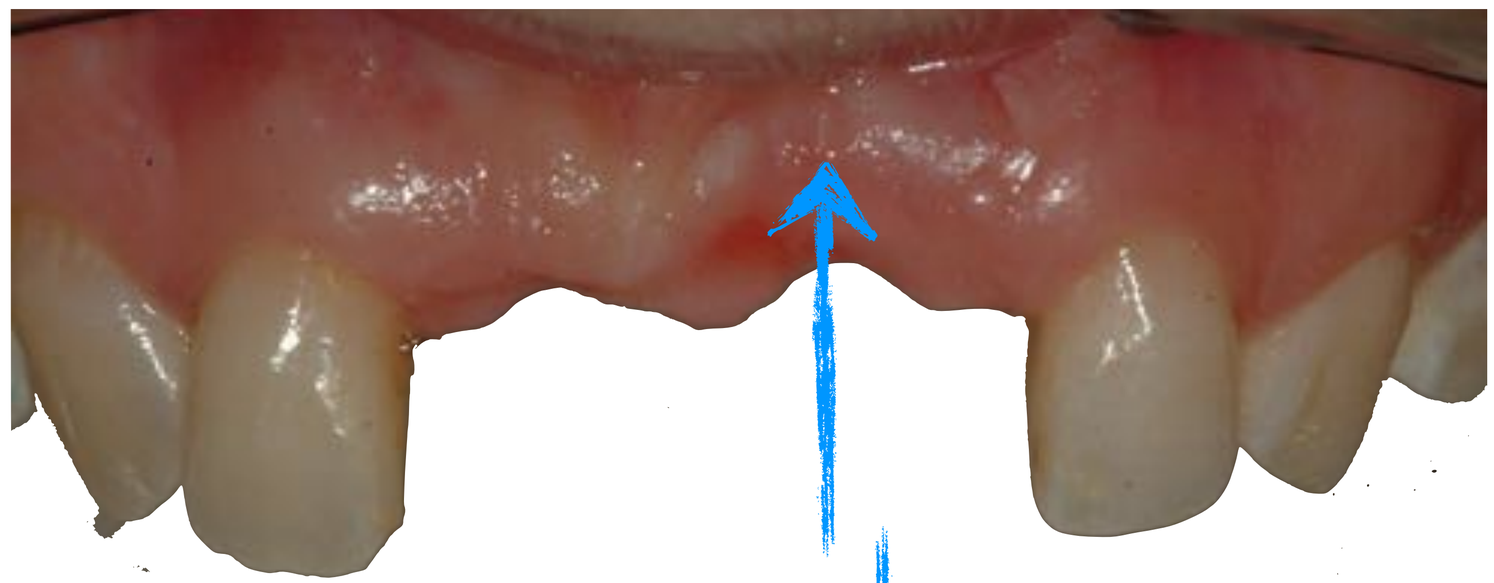
- Elimination of trimming and modelling of traditional Ti-meshes “in situ”;
- Rigidity of titanium mesh guarantees immobilization of graft, in particular in vertical and complex 3D defects, with no bone loss gain because of soft tissue tension;
- Easy management in case of exposure.

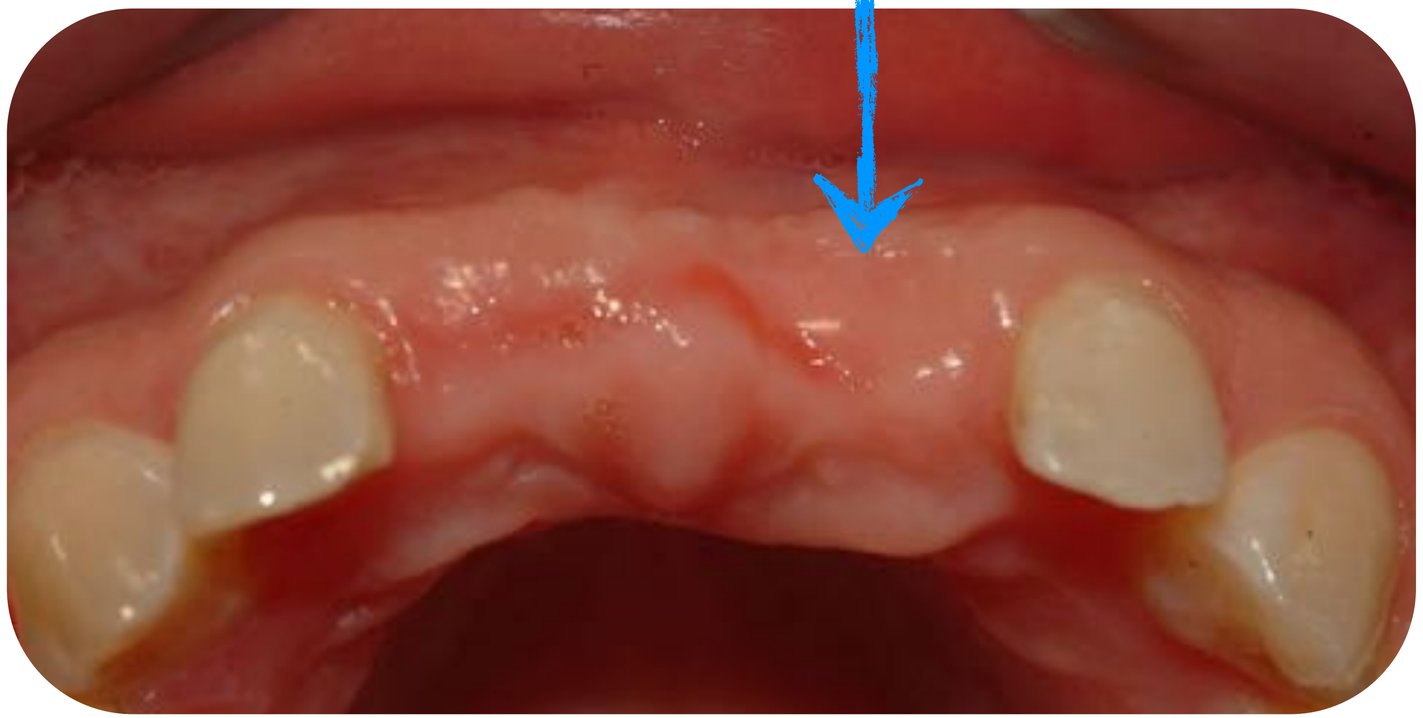
RELEVANT BONE / SOFT TISSUE DEFECTS

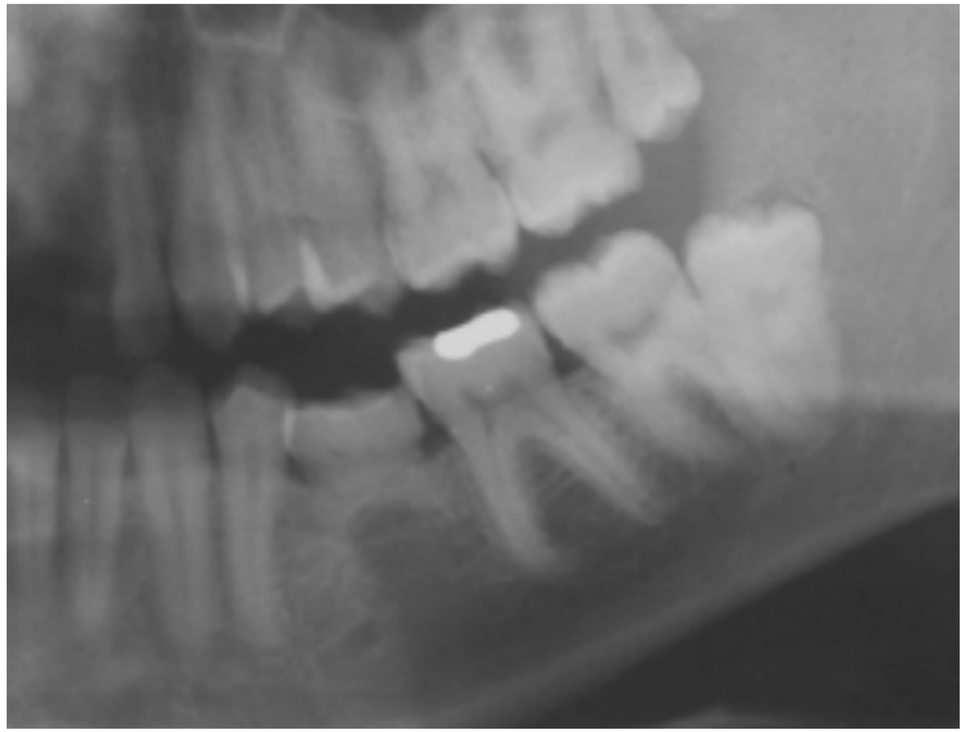
Prosthetically Guided Regeneration

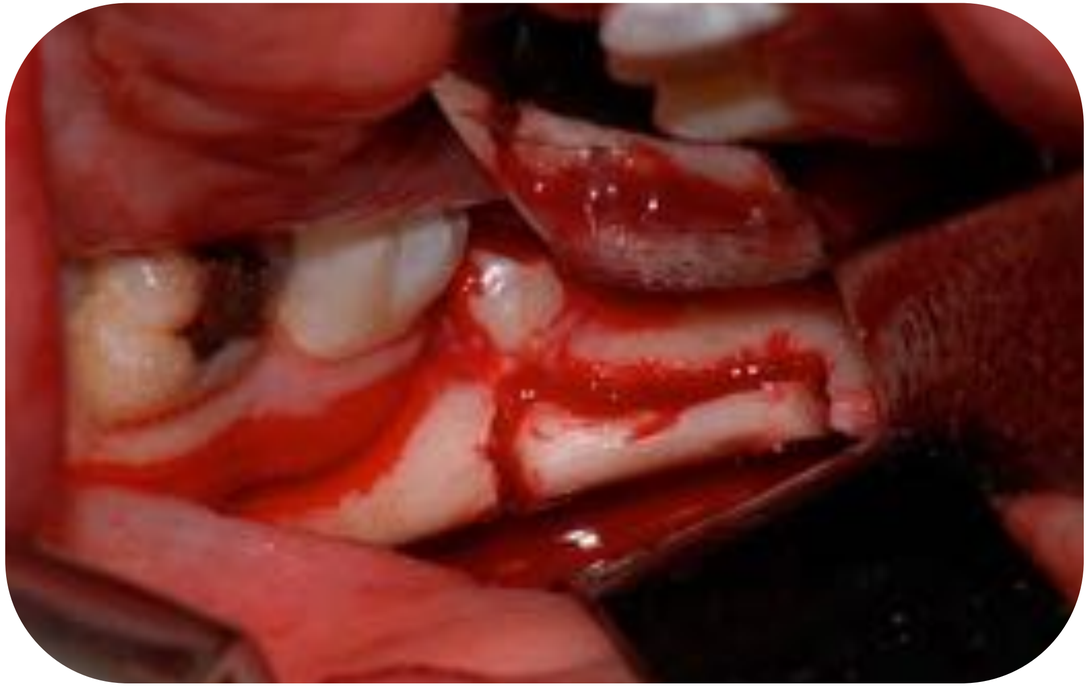
- Guided Bone Regeneration
- Bone blocks
- Soft tissue reconstruction

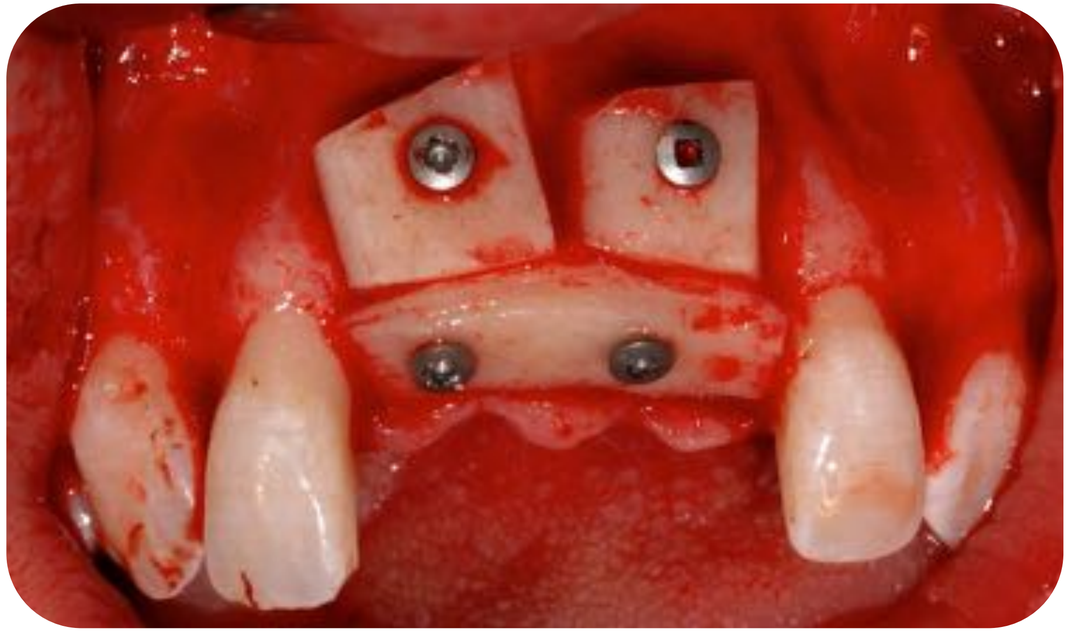
- Pt. # - Female, 34 years old
- Good general health, no perio problems
- Recent trauma with loss of upper central incisors
- Asking for a fixed solution without touching neighboring teeth



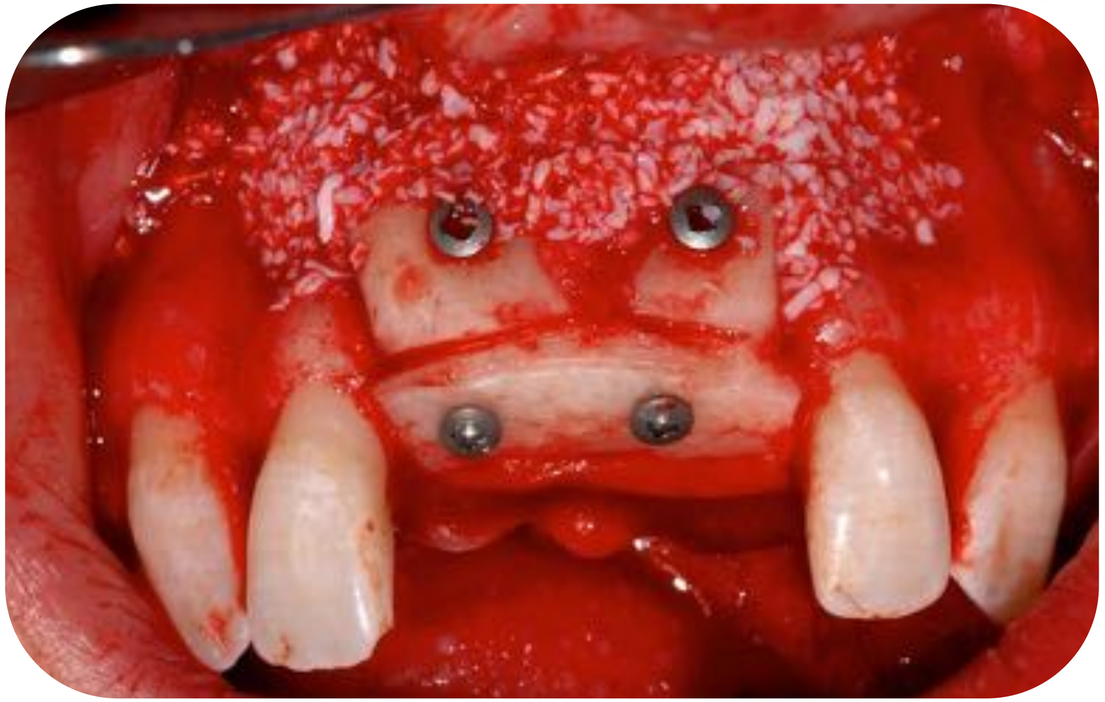








Prosthetically Guided Regeneration



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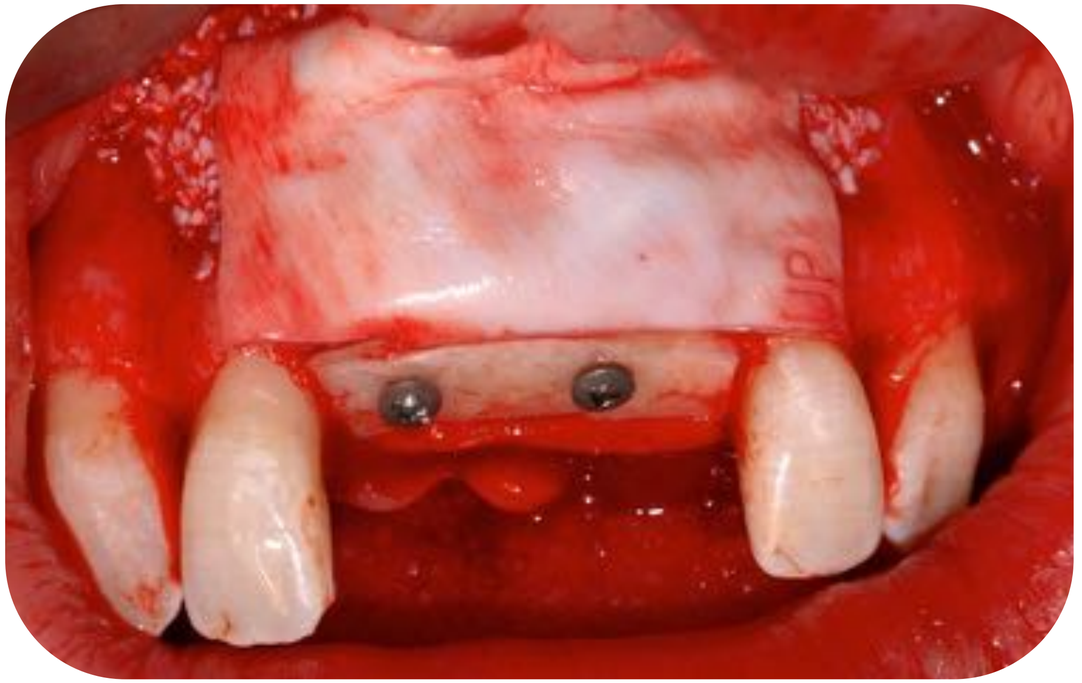
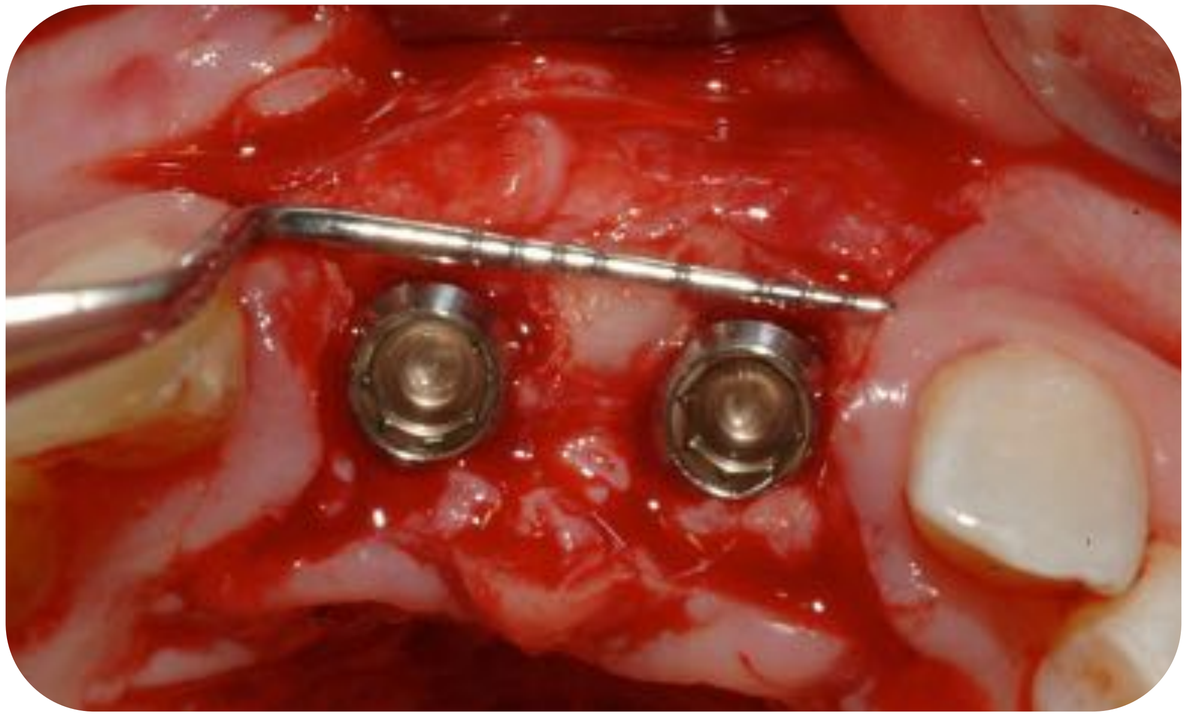
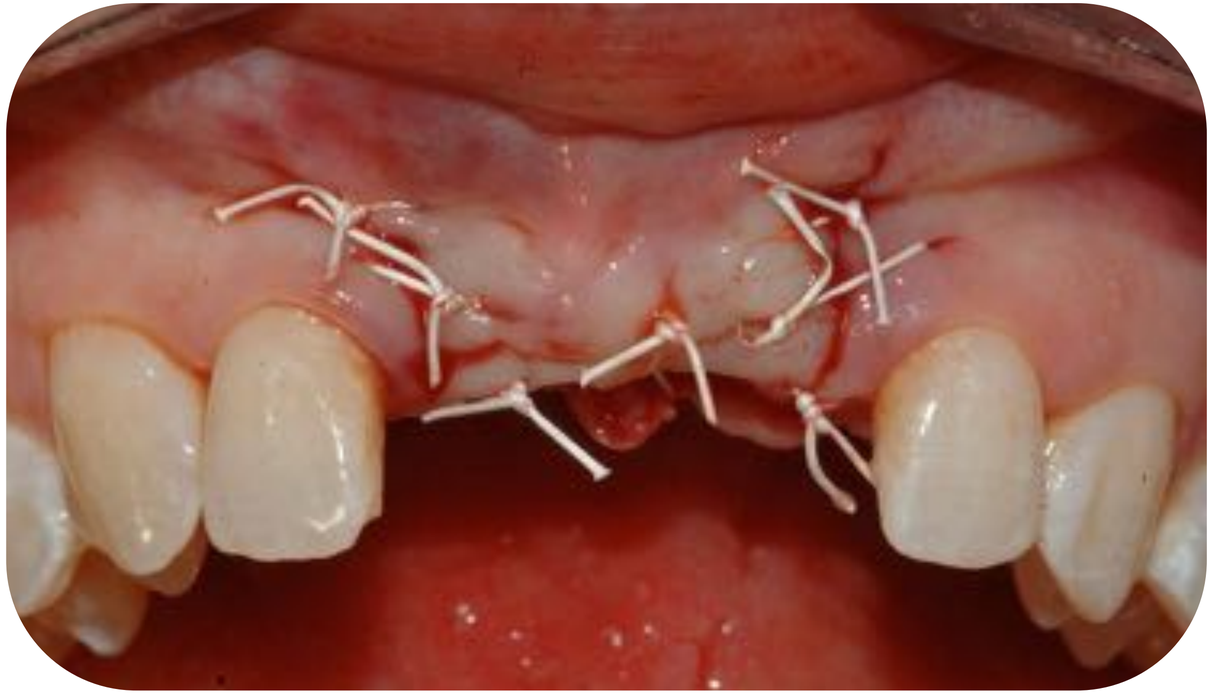


Before reconstruction

After reconstruction





Advantages of bone blocks

- They allow any type of reconstruction (3D reconstruction, severe atrophy of totally edentulous patients);
- Literature support is vast.

Limits of bone blocks

- Harvesting a block is demanding and increases morbidity, in particular when blocks are large or taken from extra-oral sites;
- Bone block modelling, adaptation, and fixation needs specific training and skills;
- In case of bone block exposure, there is a risk of failure.

ITI Consensus Conference, Stuttgart, August 25-30, 2008

M. Chiapasco, P. Casentini, M. Zaniboni

Int J Oral Maxillofac Impl 2009:24 (suppl);237-259

AUTOGENOUS BONE GRAFTS

- 26 articles selected (21 RS, 5 PS, 0 RCTs)
- 893 pts (593 maxillary defects, 179 mandibular defects, 149NS)
- 687 iliac grafts, 44 calvarial, 183 intraoral
- 4.7% failure rate of the reconstructive procedures
- 4390 implants placed (3351 machined, 288 rough, 751 NS)
- Follow-up: 1-12 years
- 94.2% survival rate for rough implants

I. Milinkovic, L. Cordaro: Are there specific indications for the different alveolar bone augmentation procedures for implant placement? A systematic review. Int. J. Oral Maxillofac. Surg. 2014; 43: 606–625.

- 53 articles selected for partial edentulism; 15 for edentulous pts
- GBR for horizontal defects MSR=100% - MCR=11.9%
- Bone grafts for horizontal defects MSR=98.4% -MCR=6.3%
- GBR for vertical defects MSR= 98.9% -MCR 13.1%
- Bone grafts for vertical defects MSR=96.3% -MCR=8.1%
- In edentulous pts only bone grafts are supported - MSR=87.7%

Amparo Aloy-Prósper et al.

The outcome of intraoral onlay block bone grafts on alveolar ridge augmentations: A systematic review. **Med Oral Patol Oral Cir Bucal. 2015 Mar 1;20 (2):e251-8.**

Conclusions: Survival and success rates of implants placed in horizontally and vertically resorbed edentulous ridges reconstructed with block bone grafts are similar to those of implants placed in native bone.

More surgical challenges and morbidity arise from vertical augmentations.

Markus Troeltzsch et al.

Clinical efficacy of grafting materials in alveolar ridge augmentation: A systematic review

Journal of Cranio-Maxillo-Facial Surgery xxx (2016) in press

Conclusion: Horizontal and vertical gain by 3.7 mm on average can be achieved using particulate materials. This can be increased by using titanium meshes. Substantial vertical gains beyond this dimension require the use of bone block grafts.

Personal references on autogenous bone grafts

Chiapasco et al. Tridimensional reconstruction of knife-edge edentulous maxillae by sinus lift, onlay grafts and sagittal osteotomy of the anterior maxilla: Preliminary surgical and prosthetic results. IJOMI 1998

Chiapasco et al. G. Clinical outcome of autogenous bone blocks or guided bone regeneration with e-PTFE membranes for the reconstruction of narrow edentulous ridges. COIR 1999

Chiapasco et al. Immediate loading of dental implants placed in severely resorbed edentulous mandibles reconstructed with autogenous calvarial grafts. COIR 2007

Chiapasco et al. Autogenous onlay bone grafts vs alveolar distraction osteogenesis for the correction of vetically deficient edentulous ridges: a 2-4 year prospective study on humans. COIR 2007

Chiapasco et al. The role of pericranium grafts in the reduction of post-operative dehiscences and bone resorption after reconstruction of severely deficient edentulous ridges with autogenous onlay bone grafts. COIR 2012

Chiapasco et al. Dental implants placed in severely atrophic jaws reconstructed with autogenous calvarium, BBM, and collagen membranes: A 3 -to-19 year retrospective follow-up study. COIR 2018

Chiapasco et al. Grafting of edentulous ridges with autogenous mandibular bone blocks covered by BBM and collagen membranes: a 3- to -15 years follow-up study on implants placed in the reconstructed bone. COIR (in press)

Clinical Outcome - Autogenous bone grafts anterior maxilla

	Number	Percentage
Patients treated (sites reconstructed)	77 (82)	
Success rate of reconstruction	74	96,1%
Dehiscence / partial resorption before implant placement	3	3,9%
Number of implants placed	180	
Follow-up after implant loading (months)	range: 42-200 months mean: 119 months	
Implants removed	3	1,7%
Implant success rate (resorption at end of observation < 3 mm)	159	88,3%
Impant survival rate (implants still in function with resorption > 3 mm)	range: 42-200 months mean: 119 months	98,3%

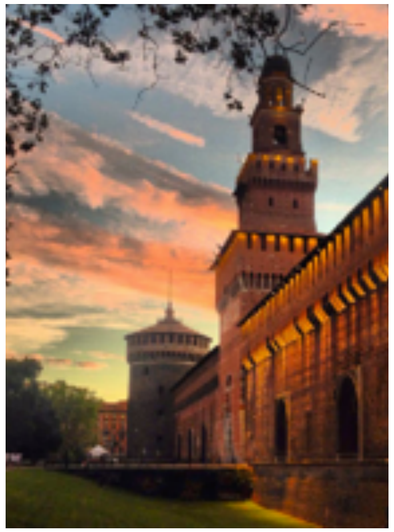
Table 2. Occurrence of pre-implant and post-implantation complications :the site reconstruction was the unit of analysis (n=82).

*Fisher exact test; O.R.=odds ratio, CI= confidence intervals

Interventions	N. grafting procedures (patients)	Pre-implant complications	Post-implantation complications		
		paresthesia	Bone resorption	Implant failure (patients)	Peri-implantitis (patients)
Vertical+horizontal defects	48 (44)	2	1	2 (2)	7 (6)
Only horizontal defects	20 (19)	1	1	0	3 (1)
Only vertical defects	14 (14)	0	1	0	0
p-value*		0.25	0.15	0.34	0.04

Table 3 - Peri-implant bone resorption at the end of the observation period (Values are in mm)

	Per patient (n=75)	Per implant (n=180)
mean value	1.06	1.11
Standard deviation	1.19	1.26
min value	0.00	0.00
1st quartile (25%)	0.00	0.00
2nd quartile (50%)	625	0.95
3rd quartile (75%)	1.45	1.51
max value	5.05	5.20
Frequency distribution of peri-implant bone resorption	**Number of patients (%)**	**Number of implants (%)**
< 1 mm	43 (57.3)	90 (49.5)
1 – 1.99 mm	21 (28.0)	59 (32.4)
2 – 2.99 mm	4 (5.3)	10 (5.5)
3 – 3.99 mm	3 (4.0)	7 (3.8)
≥ 4 mm	4 (5.3)	14 (7.7)
Implants removed	2 (2.7)	2 (1.1)



Thanks for

your kind attention

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