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1. Pre-clinical (*in vitro* & *in vivo*) studies

1. Bone Allograft Acid Lysates Change the Genetic Signature of Gingival Fibroblasts

Panahipour, L., Abbasabadi, A. O., Wagner, A., Kratochwill, K., Pichler, M., & Gruber, R. (2023). *International journal of molecular sciences*, 24(22), 16181. <https://doi.org/10.3390/ijms242216181>
<https://pubmed.ncbi.nlm.nih.gov/38003371/>

Bone allografts are widely used as osteoconductive support to guide bone regrowth. Bone allografts are more than a scaffold for the immigrating cells as they maintain some bioactivity of the original bone matrix. Yet, it remains unclear how immigrating cells respond to bone allografts. To this end, we have evaluated the response of mesenchymal cells exposed to acid lysates of bone allografts (ALBA). RNAseq revealed that ALBA has a strong impact on the genetic signature of gingival fibroblasts, indicated by the increased expression of IL11, AREG, C11orf96, STC1, and GK-as confirmed by RT-PCR, and for IL11 and STC1 by immunoassays. Considering that transforming growth factor- β (TGF- β) is stored in the bone matrix and may have caused the expression changes, we performed a proteomics analysis, TGF- β immunoassay, and smad2/3 nuclear translocation. ALBA neither showed detectable TGF- β nor was the lysate able to induce smad2/3 translocation. Nevertheless, the TGF- β receptor type I kinase inhibitor SB431542 significantly decreased the expression of IL11, AREG, and C11orf96, suggesting that other agonists than TGF- β are responsible for the robust cell response. The findings suggest that IL11, AREG, and C11orf96 expression in mesenchymal cells can serve as a bioassay reflecting the bioactivity of the bone allografts.

2. In vitro comparison of the osteogenic capability of human pulp stem cells on alloplastic, allogeneic, and xenogeneic bone scaffolds

Heitzer M, Modabber A, Zhang X, Winnand P, Zhao Q, Bläsius FM, Buhl EM, Wolf M, Neuss S, Hölzle F, Hildebrand F, Greven J. *BMC Oral Health*, 23(1), 1-13.
<https://pubmed.ncbi.nlm.nih.gov/36721114/>

Background: A rigorous search for alternatives to autogenous bone grafts to avoid invasiveness at the donor site in the treatment of maxillomandibular bone defects. Researchers have used alloplastic, allogeneic, and xenogeneic bone graft substitutes in clinical studies with varying degrees of success, although their *in vitro* effects on stem cells remain unclear. Dental pulp stem cells (DPSCs) can potentially enhance the bone regeneration of bone graft substitutes. The present *in vitro* study investigates the osteogenic capability of DPSCs on alloplastic (biphasic calcium phosphate [BCP]), allogeneic (freeze-dried bone allografts [FDBAs]), and xenogeneic (deproteinized bovine bone mineral [DBBM]) bone grafts.

Methods: Human DPSCs were seeded on 0.5 mg/ml, 1 mg/ml, and 2 mg/ml of BCP, FDBA, and DBBM to evaluate the optimal cell growth and cytotoxicity. Scaffolds and cell morphologies were analyzed by scanning electron microscopy (SEM). Calcein AM and cytoskeleton staining were performed to determine cell attachment and proliferation. Alkaline phosphatase (ALP) and osteogenesis-related genes expressions was used to investigate initial osteogenic differentiation.

Results: Cytotoxicity assays showed that most viable DPSCs were present at a scaffold concentration of 0.5 mg/ml. The DPSCs on the DBBM scaffold demonstrated a significantly higher proliferation rate of

214.25 ± 16.17 (p < 0.001) cells, enhancing ALP activity level and upregulating of osteogenesis-related genes compared with other two scaffolds.

Conclusion: DBBP scaffold led to extremely high cell viability, but also promoted proliferation, attachment, and enhanced the osteogenic differentiation capacity of DPSCs, which hold great potential for bone regeneration treatment; however, further studies are necessary.

3. Correlations between radiological and histological findings of bone remodelling and root resorption in a rodent cleft model

Möhlhenrich SC, Kniha K, Heitzer M, Magnuska Z, Hermanns-Sachweh B, Gremse F, Chhatwani S, Hölzle F, Modabber A, Danesh, G. *Head & Face Medicine*, 18(1), 33. DOI 10.1186/s13005-022-00338-x
<https://pubmed.ncbi.nlm.nih.gov/36357936/>

Background: The evaluation of bone remodelling and dental root resorption can be performed by histological techniques or micro-computed tomography (micro-CT). The present study aimed to evaluate the relationship between these two procedures in the context of cleft repair in a rat model.

Methods: The reconstructed maxillae and the orthodontically-moved first molar of 12 rats were analysed for correlations between the histological and radiological findings retrospectively. The alveolar cleft repairs were performed using bone autografts or (human) xenografts. Four weeks after the operation, the intervention of the first molar protraction was initiated and lasted for eight weeks. The newly formed bone and the root resorption lacunae were determined via histology. In the micro-CT analysis, the average change of bone mineral density (BMD), bone volume fraction (BV/TV), trabecular thickness and trabecular separation of the jaw, as well as the volume of the root resorptions were determined. The Pearson correlation coefficient was applied to study the associations between groups. Results: Positive correlations were found only between the newly formed bone (histology) and BMD changes (micro-CT) in the autograft group (r = 0.812, 95% CI: 0.001 to 0.979, p = 0.05). The relationship of newly formed bone and BV/TV was similar but not statistically significant (r = 0.691, 95% CI: -0.274 to 0.963, p = 0.013). Regarding root resorption, no significant correlations were found.

Conclusions: Due to the lack of correlation between histological and radiological findings of bone remodelling and the development of root resorptions, both methods should be combined in this cleft model in rats for a comprehensive analysis.

4. Lyophilized Human Bone Allograft as an Antibiotic Carrier: An In Vitro and In Vivo Study

Coraça-Huber DC, Steixner SJM, Najman S, Stojanovic S, Finze R, Rimashevskiy D, Saginova D, Barbeck M, Schnettler R. *Antibiotics*. 2022; 11(7):969. DOI 10.3390/antibiotics11070969
<https://pubmed.ncbi.nlm.nih.gov/35884224/>

Background: Antibiotics delivered from implanted bone substitute materials (BSM) can potentially be used to prevent acute infections and biofilm formation, providing high concentrations of antibiotics at the surgical site without systemic toxicity. In addition, BSM should allow osteoconductivity supporting bone healing without further surgery. Promising results have been achieved using lyophilized bone allografts mixed with antibiotics.

Methods: In this study specially prepared human bone allografts were evaluated as an antibiotic carrier in vitro and in vivo. The efficacy of different antibiotic-impregnated bone allografts was measured by

drug release tests in vitro and in vivo and bacterial susceptibility tests using four bacterial species usually responsible for implant associated infections.

Results: The loading procedures of allograft bone substitutes with antibiotics were successful. Some of the antibiotic concentrations exceeded the MIC90 for up to 7 days in vitro and for up to 72 h in vivo. The susceptibility tests showed that *S. epidermidis* ATCC 12228 was the most susceptible bacterial species in comparison to the other strains tested for all antibiotic substances. Vancomycin and rifampicin showed the best results against standard and patient-isolated strains in vitro. In vivo, new bone formation was comparable in all study groups including the control group without antibiotic loading. Conclusions: Human bone allografts showed the capacity to act as customized loaded antibiotic carriers to prevent acute infections and should be considered in the management of bone infections in combination with systemic antimicrobial therapy.

5. Evaluation of different grafting materials for alveolar cleft repair in the context of orthodontic tooth movement in rats

Möhlhenrich, S.C., Kniha, K., Magnuska, Z. et al. *Sci Rep* 2021 Jun 30;11(1):13586. doi: 10.1038/s41598-021-93033-x.

<https://pubmed.ncbi.nlm.nih.gov/34193933/>

To minimize the postoperative risks posed by grafting autologous transplants for cleft repair, efforts are being made to improve grafting materials for use as potential alternatives. The aim of this study was to compare the bone graft quality of different bone substitutes including the gold standard autografts during the healing processes after cleft repair in the context of orthodontic treatment. In 21 Wistar rats, a complete, continuity-interrupting cleft was created. After 4 weeks, cleft repair was performed using autografts from the hips' ischial tuberosity, human xenografts, or synthetic bone substitutes [beta-tricalcium phosphate (β -TCP)/hydroxyapatite (HA)]. After another 4 weeks, the first molar movement was initiated in the reconstructed jaw for 8 weeks. The bone remodeling was analyzed in vivo using micro-computed tomography (bone mineral density and bone volume fraction) and histology (new bone formation). All the grafting materials were statistically different in bone morphology, which changed during the treatment period. The β -TCP/HA substitute demonstrated less resorption compared to the autologous and xenogeneic/human bone, and the autografts led to a stronger reaction in the surrounding bone. Histologically, the highest level of new bone formation was found in the human xenografts, and the lowest was found in the β -TCP/HA substitute. The differences between the two bone groups and the synthetic materials were statistically significant. Autografts were confirmed to be the gold standard in cleft repair with regard to graft integration. However, parts of the human xenograft seemed comparable to the autografts. Thus, this substitute could perhaps be used as an alternative after additional tissue-engineered modification.

6. Does Platelet-Rich Fibrin Enhance the Early Angiogenic Potential of Different Bone Substitute Materials? An In Vitro and In Vivo Analysis.

Blatt, S.; Thiem, D.G.E.; Pabst, A.; Al-Nawas, B.; Kämmerer, P.W. *Biomedicines* 2021 Jan 10;9(1):61

<https://pubmed.ncbi.nlm.nih.gov/33435244/>

The impaired angiogenic potential of bone substitute materials (BSMs) may limit regenerative processes. Therefore, changes in the angiogenic properties of different BSMs in combination with platelet-rich fibrin (PRF) in comparison to PRF alone, as well as to native BSMs, were analyzed in vitro

and in vivo to evaluate possible clinical application. In vitro, four BSMs of different origins (allogeneic, alloplastic, and xenogeneic) were biofunctionalized with PRF and compared to PRF in terms of platelet interaction and growth factor release (vascular endothelial growth factor (VEGF), tissue growth factor β (TGF β) and platelet-derived growth factor (PDGF)) after 15 min. To visualize initial cell–cell interactions, SEM was performed. In vivo, all BSMs (_PRF) were analyzed after 24 h for new-formed vessels using a chorioallantoic membrane (CAM) assay. Especially for alloplastic BSMs, the addition of PRF led to a significant consumption of platelets ($p = 0.05$). PDGF expression significantly decreased in comparison to PRF alone (all BSMs: $p < 0.013$). SEM showed the close spatial relation of each BSM and PRF. In vivo, PRF had a significant positive pro-angiogenic influence in combination with alloplastic ($p = 0.007$) and xenogeneic materials ($p = 0.015$) in comparison to the native BSMs. For bio-activated xenogeneic BSMs, the branching points were also significantly increased ($p = 0.005$). Finally, vessel formation was increased for BSMs and PRF in comparison to the native control (allogeneic: $p = 0.046$; alloplastic: $p = 0.046$; and xenogeneic: $p = 0.050$). An early enhancement of angiogenetic properties was demonstrated when combining BSMs with PRF in vitro and led to upregulated vessel formation in vivo. Thus, the use of BSMs in combination with PRF may trigger bony regeneration in clinical approaches.

7. Influence of Different Rehydration Protocols on Biomechanical Properties of Allogeneic Cortical Bone Plates: A Combined in-vitro/in-vivo Study

Pabst, A., Ackermann, M., Thiem, D., & Kämmerer, P. (2021). *Journal of investigative surgery : the official journal of the Academy of Surgical Research*, 34(10), 1158–1164.
<https://doi.org/10.1080/08941939.2020.1767735>

<https://pubmed.ncbi.nlm.nih.gov/32441171/>

Introduction: Allogeneic cortical bone plates (CP) are used for alveolar ridge augmentation. Since CP are freeze-dried and dehydrated during processing, the breaking strength (BS) and the flexibility (FX) are reduced, resulting in a relevant risk for plate fractures during insertion. The aim of this study was to evaluate the influence of rehydration time on the biomechanical properties (BS & FX) of CP (maxgraft® cortico) in vitro and in vivo.

Material and Methods: 40 CP were randomly divided into four experimental groups. (A) untreated control (n=10), rehydration for 10 (B), 30 (C) and 60 (D) minutes in 0.9% saline solution (n=10 each). BS [Newton, N] and FX [mm] (force till fracture and distance of deflection to the breaking point) were analyzed. Besides, architectural features of all CP groups were visualized and examined by scanning electron microscopy (SEM). In addition, the frequency of CP fractures of rehydrated- vs. non-rehydrated CP was retrospectively analyzed in 6 patients.

Results: Compared to the control group, significantly increased BS and FX were demonstrated after 10, 30 and 60 minutes of rehydration (p each ≤ 0.035). After a rehydration time of 10 minutes, no additional increase of BS and FX was seen when compared to 30 and 60 minutes (p each = 1.0). SEM scans demonstrated that the CP fracture characteristics were influenced by the different rehydration protocols. The frequency of CP fractures was reduced in patients by CP rehydration.

Conclusion: The biomechanical properties of CP can be significantly improved by 10 min of rehydration, resulting in an increased BS and FX, that might be clinically relevant.

8. Combination of an allogenic and a xenogenic bone substitute material with injectable platelet-rich fibrin – A comparative in vitro study

Kyyak S, Blatt S, Pabst A, Thiem D, Al-Nawas B, Hölze F, Kämmerer PW. *J Biomater Appl.* 2020 Jul;35(1):83-96.

<https://pubmed.ncbi.nlm.nih.gov/32237950/>

Aim: The aim of this in vitro study was the comparison of allogeneic maxgraft® granules and xenogeneic BioOss® with and without injectable platelet-rich fibrin (i-PRF) on cell characteristics of human osteoblasts (HOB).

Material/ Methods: The bone grafting materials were incubated with HOB for 3, 7 and 10 days. HOB viability, migration, proliferation and differentiation (RT-PCR on alkaline phosphatase (AP), bone morphogenetic protein 2 (BMP-2) and osteonectin (OCN)) were measured and compared between the groups.

Results: An increased viability, migration and proliferation was seen for the combination of maxgraft® granules and i-PRF at the 3 day's time point. For viability and proliferation (days 7 and 10) and for migration (day 10), the combination of bone grafting materials with i-PRF showed higher values compared to the bone grafting materials alone with maximum values for maxgraft® granules + i-PRF and minimum values for BioOss®. Interestingly even maxgraft® alone induced a significantly faster proliferation and increased cell viability of osteoblasts compared to BioOss alone.

Conclusion: This in vitro study shows that maxgraft® granules with i-PRF demonstrate greater proliferation, differentiation, and cell-migration properties than Bio-Oss with i-PRF. Therefore, addition of i-PRF to allogeneic bone grafting material may influence osteoblast activity in vivo. Independently of iPRF, maxgraft® seems to have favorable effects on HOB compared to BioOss.

9. Balancing Purification and Ultrastructure of Naturally Derived Bone Blocks for Bone Regeneration: Report of the Purification Effort of Two Bone Blocks

Barbeck M, Jung O, Xiong X, Kraslev R, Korzinskas T, Najman S, Radenkovic M, Wegner N, Knyazeva M, Walther F. *Material*, 2019 Oct 2;12(19):3234.

<https://pubmed.ncbi.nlm.nih.gov/31581651/>

The present publication reports the purification effort of two natural bone blocks, that is, an allogeneic bone block (maxgraft®, botiss biomaterials GmbH, Zossen, Germany) and a xenogeneic block (SMARTBONE®, IBI S.A., Mezzovico-Vira, Switzerland) in addition to previously published results based on histology. Furthermore, specialized scanning electron microscopy (SEM) and in vitro analyses (XTT, BrdU, LDH) for testing of the cytocompatibility based on ISO 10993-5/-12 have been conducted. The microscopic analyses showed that both bone blocks possess a trabecular structure with a lamellar subarrangement. In the case of the xenogeneic bone block, only minor remnants of collagenous structures were found, while in contrast high amounts of collagen were found associated with the allogeneic bone matrix. Furthermore, only island-like remnants of the polymer coating in case of the xenogeneic bone substitute seemed to be detectable. Finally, no remaining cells or cellular remnants were found in both bone blocks. The in vitro analyses showed that both bone blocks are biocompatible. Altogether, the purification level of both bone blocks seems to be favorable for bone tissue regeneration without the risk for inflammatory responses or graft rejection. Moreover, the analysis of the maxgraft® bone block showed that the underlying purification process allows for preserving not only the calcified bone matrix but also high amounts of the intertrabecular collagen matrix.

10. Beneficial Effects of Vitamins K and D3 on Redox Balance of Human Osteoblasts Cultured with Hydroxyapatite-Based Biomaterials

Ambrożewicz E, Muszyńska M, Tokajuk G, Grynkiewicz G, Żarković N, Skrzydlewska E. *Cells*. 2019;8(4):325. doi:10.3390/cells8040325

<https://pubmed.ncbi.nlm.nih.gov/30965604/>

Hydroxyapatite-based biomaterials are commonly used in surgery to repair bone damage. However, the introduction of biomaterials into the body can cause metabolic alterations, including redox imbalance. Because vitamins D3 and K (K1, MK-4, MK-7) have pronounced osteoinductive, anti-inflammatory, and antioxidant properties, it is suggested that they may reduce the adverse effects of biomaterials. The aim of this study was to investigate the effects of vitamins D3 and K, used alone and in combination, on the redox metabolism of human osteoblasts (hFOB 1.19 cell line) cultured in the presence of hydroxyapatite-based biomaterials (maxgraft®, cerabone®, Apatos, and Gen-Os). Culturing of the osteoblasts in the presence of hydroxyapatite-based biomaterials resulted in oxidative stress manifested by increased production of reactive oxygen species and decrease of glutathione level and glutathione peroxidase activity. Such redox imbalance leads to lipid peroxidation manifested by an increase of 4-hydroxynonenal level, which is known to influence the growth of bone cells. Vitamins D3 and K were shown to help maintain redox balance and prevent lipid peroxidation in osteoblasts cultured with hydroxyapatite-based biomaterials. The strongest effect was observed for the combination of vitamin D3 and MK-7. Moreover, vitamins promoted growth of the osteoblasts, manifested by increased DNA biosynthesis. Therefore, it is suggested that the use of vitamins D3 and K may protect redox balance and support the growth of osteoblasts affected by hydroxyapatite-based biomaterials.

11. Comparison of autogenous and allograft bone rings in surgically created vertical bone defects around implants in a sheep model

Benlidayi ME, Tatli U, Salimov F, Tükel HC, Yüksel O. *Clin Oral Implants Res*. 2018 Nov;29(11):1155-1162.

<https://pubmed.ncbi.nlm.nih.gov/30281857/>

OBJECTIVES: The aim of this study was to compare autogenous and allograft bone rings (maxgraft® bonering) in surgically created vertical bone defects.

MATERIAL AND METHODS: Four male, 1-year-old sheep were used in this study. In each sheep, eight vertical bone defects 7 mm in diameter were created using trephine drill in the iliac wing. Autogenous and allograft bone rings 5 mm in height and 7 mm in diameter were used for vertical augmentation around implants. The study consisted of four groups according to the bone ring type and amount of vertical augmentation, autogenous 2 mm, allograft 2 mm, autogenous 4 mm, and allograft 4 mm. Two of the animals were sacrificed after 4 months, and the remaining two animals were sacrificed after 8 months. Undecalcified sections were prepared from harvested samples. Histological assessment and histomorphometric analysis were performed.

RESULTS: Autogenous 2 mm group showed higher values than allograft 2 mm group, and autogenous 4 mm group showed higher values than allograft 4 mm group in terms of bone area and bone-to-

implant contact (BIC) after 4 months. However, allograft 2 mm group showed higher bone area and BIC values than autogenous 2 mm group after 8 months. Also, autogenous 4 mm and allograft 4 mm groups showed comparable results after 8 months. Allograft 2 mm and allograft 4 mm groups showed higher bone area and BIC values at 8 months compared with 4 months.

CONCLUSIONS: Allograft bone ring looks promising in augmentation of surgically created vertical bone defects around implants after 8 months of healing.

12. Hydrophilicity, Viscoelastic, and Physicochemical Properties Variations in Dental Bone Grafting Substitutes

Trajkovski B, Jaunich M, Müller WD, Beuer F, Zafiropoulos GG, Houshmand A. *Materials* (Basel). 2018;11(2):215. Published 2018 Jan 30. doi:10.3390/ma11020215

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5848912/>

The indication-oriented Dental Bone Graft Substitutes (DBGS) selection, the correct bone defects classification, and appropriate treatment planning are very crucial for obtaining successful clinical results. However, hydrophilic, viscoelastic, and physicochemical properties' influence on the DBGS regenerative potential has poorly been studied. For that reason, we investigated the dimensional changes and molecular mobility by Dynamic Mechanical Analysis (DMA) of xenograft (cerabone®), synthetic (maxresorb®), and allograft (maxgraft®, Puros®) blocks in a wet and dry state. While no significant differences could be seen in dry state, cerabone® and maxresorb® blocks showed a slight height decrease in wet state, whereas both maxgraft® and Puros® had an almost identical height increase. In addition, cerabone® and maxresorb® blocks remained highly rigid and their damping behaviour was not influenced by the water. On the other hand, both maxgraft® and Puros® had a strong increase in their molecular mobility with different damping behaviour profiles during the wet state. A high-speed microscopical imaging system was used to analyze the hydrophilicity in several naturally derived (cerabone®, Bio-Oss®, NuOss®, SIC® nature graft) and synthetic DBGS granules (maxresorb®, BoneCeramic®, NanoBone®, Ceros®). The highest level of hydrophilicity was detected in cerabone® and maxresorb®, while Bio-Oss® and BoneCeramic® had the lowest level of hydrophilicity among both naturally derived and synthetic DBGS groups. Deviations among the DBGS were also addressed via physicochemical differences recorded by Micro Computed Tomography, Scanning Electron Microscopy, Fourier Transform Infrared Spectroscopy, X-ray powder Diffractometry, and Thermogravimetric Analysis. Such DBGS variations could influence the volume stability at the grafting site, handling as well as the speed of vascularization and bone regeneration. Therefore, this study initiates a new insight into the DBGS differences and their importance for successful clinical results.

13. Three-dimensional scanning electron microscopy of maxillofacial biomaterials

Pabst, A. M., Müller, W. E. G., & Ackermann, M. (2017). *The British journal of oral & maxillofacial surgery*, 55(7), 736–739. <https://doi.org/10.1016/j.bjoms.2017.05.010>

<https://pubmed.ncbi.nlm.nih.gov/28624164/>

Report on a method of 3-dimensional scanning electron microscopy (3D-SEM) to visualize maxillofacial biomaterials. 3D visualization of mucoderm®, Mucograft®, and maxgraft®.

2. Clinical studies and case series

I. maxgraft® granules

14. Alveolar Ridge Preservation Procedures Performed with a Freeze-Dried Bone Allograft: Clinical and Histologic Outcomes in a Case Series: Part II

Barone, A., Cinquini, C., Valente, N. A., Velasco-Ortega, E., Derchi, G., D'Amico, E., & Iezzi, G. (2024).

The International journal of periodontics & restorative dentistry, 0(0), 1–20.

<https://doi.org/10.11607/prd.6953>

<https://pubmed.ncbi.nlm.nih.gov/38175917/>

Introduction: Tooth extractions can result in alveolar bone dimensional changes, necessitating additional bone grafting for implant placement. Alveolar Ridge Preservation (ARP) aims to counteract post-extraction changes. This study evaluates the bone regenerative properties of a freeze-dried bone allograft (FDBA, maxgraft® granules) and the clinical outcomes of implants in grafted extraction sites.

Materials and methods: This case series enrolled 33 patients undergoing single/multiple tooth extractions followed by ARP. Biopsies were harvested during implant placement for histologic and histomorphometric analysis. Clinical outcomes included marginal bone loss and Pink Esthetic Score (PES).

Results: 25 patients completed the study. FDBA augmented sockets exhibited new bone formation adjacent to graft particles. Implants (n=25) showed 100% survival and success rates at 1 and 2 years. PES improved significantly over time ($p<.001$), while marginal bone loss did not significantly differ at 1 and 2 years ($p=.096$). Specimens showed trabecular bone, residual FDBA particles, and marrow spaces. High magnification revealed immature bone and woven bone bridges around graft particles. No inflammatory cells were observed.

Conclusions: The case series provides valuable insights into ARP performed with FDBA; implants were placed after 3 months of healing without any additional bone augmentation, the histologic outcomes were favorable, and implants were successful after a 2-year period of follow-up.

15. Evaluation of crestal sinus floor elevation in cases exhibiting an oblique sinus floor with a residual bone height of 4.0-7.0 mm using Densah burs with simultaneous implant placement: a prospective clinical study

Shalash, M., Mounir, M., & Elbanna, T. (2023). International journal of implant dentistry, 9(1), 41.

<https://doi.org/10.1186/s40729-023-00510-1>

<https://pubmed.ncbi.nlm.nih.gov/37917214/>

Purpose: To evaluate the effectiveness of using Densah burs for lifting the maxillary sinus membrane in cases with an oblique sinus floor with a residual bone height of 4-7 mm.

Methods: The study was conducted on 16 patients, comprising 9 males and 7 females, aged 25-60 years, split into two groups of 8 each: group I with a residual bone height of 4-5.5 mm below the sinus

floor and group II with a residual bone height of 5.5-7 mm. Exclusion criteria included smokers, presence of systemic or metabolic conditions that contraindicate implant placement and a local sinus pathology. The study involved the use of Densah burs, using the osseodensification concept to elevate the sinus floor, along with simultaneous dental implant placement. The integrity of the sinus membrane was verified via clinical examination and a confirmatory cone beam computed tomography scan.

Results: The study revealed that out of the 16 cases, one case had a sinus membrane perforation, confirmed clinically at the time of the operation. The study achieved a mean lift of 4.42 mm and a mean final seating torque of 35.5 N/cm. At the 1-year follow-up, all cases showed clinical success, with no signs of sinus pathology or complications.

Conclusions: In cases with oblique sinus floors and a residual bone height of 4-7 mm in moderately atrophic posterior maxilla, the osseodensification concept proved to be a safe and effective method for performing sinus lift procedures with simultaneous implantation.

16. Comparison between cortico-cancellous allograft and bovine xenograft for sinus augmentation: a radiographic, histologic and histomorphometric clinical study

Chávarri-Prado, D., Jones, A., Pérez-Pevida, E., Diéguez-Pereira, M., Estrada-Martínez, A., & Cabezón-Palacios, R. (2023). *The International journal of periodontics & restorative dentistry*, <https://doi.org/10.11607/prd.6900>

<https://pubmed.ncbi.nlm.nih.gov/37819845/>

Sinus floor augmentation is one of the most used approaches to obtain sufficient bone availability to place dental implants in cases with severe bone atrophy in the posterior maxilla. Several bone substitutes are indicated for sinus augmentation but they may obtain different clinical outcomes. This study aims to compare bovine bone mineral (BBM) with freeze dried bone allograft (FDBA, maxgraft® granules) in two-stage lateral window sinus grafting approach. 20 patients received a lateral window sinus lift with either FDBA or BBM. Post-operative graft height was measured with a cone-beam computerized tomography (CBCT). 6 months later implants were placed. Biopsies were taken for histological analysis and new CBCTs were performed to measure graft height at this point. 6 months after procedure, there was a height reduction of $20,27 \pm 4,94$ % for the FDBA sample and $5,36 \pm 2,41$ % for the BBM group. The histological analysis revealed a ratio of newly formed bone of $43,70 \pm 5,29$ % for the FDBA and $38,11 \pm 4,03$ % for the BBM group. The FDBA also showed a higher amount of residual biomaterial $17,25 \pm 10,10$ % and connective tissue $14,63 \pm 4,38$ % compared to the BBM $15,53 \pm 5,42$ % and $13,11 \pm 4,42$ %. The differences between groups were statistically significant for the height reduction and for the newly formed bone ($p \leq 0.05$) but not for the residual biomaterial amount and the non-mineralized connective tissue ($p \geq 0.05$). It could be concluded that the percentage of newly formed bone 6 months after performing a lateral window sinus lift using FDBA was significantly higher than when using BBM, although the graft height reduction was also significantly higher for the FDBA group.

17. Alveolar Ridge Preservation Procedures Performed with a Freeze-Dried Bone Allograft: Histologic Outcomes in a Cohort Study

Iezzi, G., Valente, N. A., Velasco-Ortega, E., Piattelli, A., Perez, A., D'amico, E., & Barone, A. (2023).

<https://pubmed.ncbi.nlm.nih.gov/37347612/>

The primary aim of this study was to assess the histomorphometric outcomes of extraction sockets grafted with freeze-dried bone allograft (FDBA) and sealed with a collagen membrane after 3 months of healing in specific region of interest (ROI) areas. The secondary aims were to analyze the biomaterial resorption rate, the bone-to-biomaterial contact (BBC), and the area and perimeter of grafted particles compared with commercially available FDBA particles. Fifteen patients underwent tooth extractions and ridge preservation procedures performed with FDBA and a collagen membrane. Bone biopsy samples were harvested after 3 months at the time of implant placement for histologic and histomorphometric analysis. Two areas of concern (ROI1 and ROI2) with different histologic features were identified within the biopsy samples; ROI1, ROI2, and commercially available particles were analyzed and compared. The following parameters were analyzed: newly formed bone, marrow space, residual graft particles, perimeter and area of FDBA particles, and BBC. The histomorphometric analysis showed $35.22\% \pm 10.79\%$ newly formed bone, $52.55\% \pm 16.06\%$ marrow spaces, and $12.41\% \pm 7.87\%$ residual graft particles. Moreover, the histologic data from ROI1 and ROI2 showed that (1) the mean percentage of BBC was $64.61\% \pm 27.14\%$; (2) the newly formed bone was significantly higher in ROI1 than in ROI2; (3) the marrow space was significantly lower in ROI1 than in ROI2; and (4) the FDBA particles in ROI1 sites showed significantly lower area and perimeter when compared to commercially available FDBA particles. This latter data led to the hypothesis that FDBA particles embedded in newly formed bone undergo a resorption/remodeling process.

18. Full mouth oral rehabilitation of a severely worn dentition based on a fully digital workflow

Lanis A, Gallucci G, Pedrinaci I. *J Esthet Restor Dent.* 2023;35(4):596-608. doi:10.1111/jerd.13020

<https://pubmed.ncbi.nlm.nih.gov/36715027/>

Objective: To demonstrate the use of a complete digital workflow for a full mouth rehabilitation in a severely worn dentition.

Clinical considerations: The present case report successfully rehabilitated a full-mouth case of a severely worn dentition based on the use of digital technologies, making the diagnosis and treatment process faster, accurate and less expensive. A long-lasting esthetic and functional result are showed after 30-months follow up.

Conclusions: An appropriate knowledge on dental erosion and oral rehabilitation, combined with a digital dentistry approach could lead the clinician to deliver a fast, accurate and predictable noninvasive restorative treatment in cases like the one described.

Clinical significance: Bruxism-based severely worn dentition is being found more often in population. In this situation, a detailed diagnosis and tailored treatment are mandatory to obtain a predictable treatment outcome. In this sense, the development of adhesive dentistry, new restorative materials and the incorporation of digital technologies can create a predictable synergy to rehabilitate these types of patients with a modern and less invasive approach.

19. First Clinical Case Report of a Xenograft-Allograft Combination for Alveolar Ridge Augmentation Using a Bovine Bone Substitute Material with Hyaluronate (Cerabone® Plus) Combined with Allogeneic Bone Granules (Maxgraft®)

Kloss, F. R., Kämmerer, P. W., & Kloss-Brandstätter, A. (2023). *Journal of clinical medicine*, 12(19), 6214. <https://doi.org/10.3390/jcm12196214>

<https://pubmed.ncbi.nlm.nih.gov/37834860/>

Background: A patient had lost the first left maxillary incisor in the esthetic zone.

Methods: The defect in the alveolar ridge was reconstructed for an implant-supported restoration using a new xenogeneic bone substitute containing hyaluronate, which was used in combination with allogeneic bone granules.

Results: After three years of follow-up, the dental implant was stable and showed no signs of infection.

Conclusions: This is the first case report with a long-term follow-up time of three years of a successful clinical application of a xenograft-allograft combination (cerabone® plus combined with maxgraft®) for alveolar ridge augmentation before dental implantation. Cerabone® plus offers volume stability, provides reliable and efficient structural support of the oral soft tissues in the augmented region (particularly crucial in the aesthetic zone), and preserves the alveolar ridge shape.

20. Resorbable magnesium metal membrane for sinus lift procedures: a case series

Elad, A., Pul, L., Rider, P., Rogge, S., Witte, F., Tadić, D., Mijiritsky, E., Kačarević, Ž. P., & Steigmann, L. (2023). *BMC oral health*, 23(1), 1006. <https://doi.org/10.1186/s12903-023-03695-4>

<https://pubmed.ncbi.nlm.nih.gov/38097992/>

Background: The purpose of this case series was to demonstrate the use of a magnesium membrane for repairing the perforated membrane in both direct and indirect approaches, as well as its application in instances where there has been a tear of the Schneiderian membrane.

Case presentation: The case series included four individual cases, each demonstrating the application of a magnesium membrane followed by bone augmentation using a mixture of xenograft (cerabone®) and allograft material (maxgraft® granules) in the sinus cavity. In the first three cases, rupture of Schneiderian membrane occurred as a result of tooth extraction, positioning of the dental implant, or as a complication during the procedure. In the fourth case, Schneiderian membrane was perforated as a result of the need to aspirate a polyp in the maxillary sinus. In case one, 10 mm of newly formed bone is visible four months after graft placement. Other cases showed between 15 and 20 mm of newly formed alveolar bone. No residual magnesium membrane was seen on clinical inspection. The vertical and horizontal augmentations proved stable and the dental implants were placed in the previously grafted sites.

Conclusion: Within the limitations of this case series, postoperative clinical examination, and panoramic and CBCT images demonstrated that resorbable magnesium membrane is a viable material for sinus lift and Schneiderian membrane repair. The case series showed successful healing and formation of new alveolar bone with separation of the oral cavity and maxillary sinus in four patients.

21. Retrospective analysis of dental implants immediately placed in extraction sockets with periapical pathology: immediate implant placement in infected areas

Çolak, S., & Demirsoy, M. S. (2023). *BMC oral health*, 23(1), 304. <https://doi.org/10.1186/s12903-023-02986-0>

<https://pubmed.ncbi.nlm.nih.gov/37208620/>

Background: The aim of this study is to examine the survival rates of immediate implants placed in extraction sockets with chronic periapical pathology.

Methods: 69 patients and 124 immediate implants were included in the study. The patients included in the study were examined in 3 groups. Group 1: Patients who underwent tooth extraction with periapical pathology and immediate implant placement. Group 2: patients who underwent tooth extraction with periapical pathology, immediate implant placement and guided bone regeneration. Group 3: Patients who underwent tooth extraction with periapical pathology, sinus lift procedure and immediate implant placement. In statistical analysis, t-test and Anova analysis were used in the evaluation of quantitative data, cross-tables and chi-square (χ^2) test were used in the evaluation of classified qualitative data. Statistical significance was determined as $p < 0.05$.

Results: It was observed that 116 (95.55%) of 124 implants were successful and 8 (4.45%) failed. The success rate was 97.2% in Group 1, 93.5% in Group 2 and 81.8% in Group 3. A significant correlation was found between the study groups and implant success in terms of χ^2 test ($p = 0.037$). A significant relationship was found between smoking and success in terms of the χ^2 test ($p = 0.015$).

Conclusions: High survival rates are observed for immediate implant placement in sockets with periapical pathology. The success rates observed in guided bone regenerations simultaneously with immediate implant placement are at satisfactory levels. In cases where simultaneous sinus lifting procedures are required, the success rates were observed to be significantly lower. In case of adequate curettage and debridement in sockets with periapical pathology, high implant survival rates are observed. As the complexity of the surgical procedure increases, treatment protocols may progress in safer ways.

22. Immediate implant placement vs. early implant treatment in the esthetic area. A 1-year randomized clinical trial

Puisys, A., Auzbikaviciute, V., Vindasiute-Narbute, E., Pranskunas, M., Razukevicius, D., & Linkevicius, T. (2022). *Clinical oral implants research*, 33(6), 634–655. <https://doi.org/10.1111/clr.13924>

<https://pubmed.ncbi.nlm.nih.gov/35318752/>

Objectives: To assess the impact of implant placement and temporization timing on esthetic outcomes of single maxillary anterior implants with intact bone walls and interproximal bone.

Materials and methods: Test group patients received an immediate implant with immediate provisional restoration and socket preservation, while patients in the control group received an early implant placement with guided bone regeneration and delayed loading. Patients were followed for 1 year after final prosthetic and pink esthetic score (PES), mid-buccal mucosal level (MBML), crestal bone changes (CBC), and peri-implant soft tissue parameters, and patient chair time was recorded.

Results: Fifty patients received the intended treatment (25 test and 25 control). No implants failed. PES after 1 year was 12.8 ± 1.19 for the test group and 12.5 ± 1.36 for the control group ($p = .362$). MBML difference between baseline (after final crown delivery) and the 1-year follow-up was gain of 0.2 ± 1.02 mm for the test group ($p = .047$) and no change in the control group. CBC after 1 year were $0.1 \text{ mm} \pm 0.21 \text{ mm}$ (mesial) and $0.2 \text{ mm} \pm 0.22 \text{ mm}$ (distal) for the test group and $0.2 \text{ mm} \pm 0.25 \text{ mm}$ (mesial) and $0.3 \text{ mm} \pm 0.19 \text{ mm}$ (distal) for the control group, $p = .540$ (mesial) and $p = .462$ (distal). Test group required half the chair time (127 ± 13 min) when compared to the control group (259 ± 15 min, $p < .001$).

Conclusions: Within the limits of this trial, both treatment protocols resulted in excellent esthetic outcomes with PES >12 after 1-year follow-up.

23. Histological and immunohistochemical comparison of two different allogeneic bone grafting materials for alveolar ridge reconstruction: A prospective randomized trial in humans

Solakoglu Ö, Götz W, Heydecke G, Schwarzenbach H. *Clin Implant Dent Relat Res.* 2019 Oct;21(5):1002-1016.

<https://pubmed.ncbi.nlm.nih.gov/31424173/>

Preclinical studies have hypothesized a possible immunological response to allogeneic materials due to detection of remnants of potential immunogenic molecules. However, their impact on integration, bone remodeling and immunological reaction after the augmentation procedure is largely unknown and a direct correlation of analytical data and evaluation of human biopsies is missing.

PURPOSE: The present study aimed to compare two commercially available allogeneic materials regarding their content of cellular remnants as well as the bone remodeling, and integration and potential immunologic reactions on a histological and immunohistochemical level, integrating also in vitro analytical evaluation of the specific batches that were used clinically.

MATERIAL / METHODS: Twenty patients were randomly assigned to treatment with maxgraft® or Puros for lateral ridge augmentation in a two-stage surgery. After a mean healing period of 5 months, implants were placed and biopsies were taken for histological, immunohistochemical, and histomorphometrical evaluation regarding bone remodeling and inflammation, protein concentrations in vitro and the presence of MHC molecules of the same batches used clinically.

RESULTS: No differences in clinical outcome, histological, immunohistochemical, and in vitro protein analysis between the two bone grafting materials were observed. Active bone remodeling, amount of newly formed bone, and residual grafting material was independent of the materials used but varied between subjects. MHC1 residues were not detected in any sample.

CONCLUSIONS: Within the limitations of this study, both tested materials yielded equivalent results in terms of clinical outcome, new bone formation, and lack of immunological potential on a histological and immunohistochemical level.

24. Four-year post-loading results of full-arch rehabilitation with immediate placement and immediate loading implants: A retrospective controlled study.

Simonpieri A, Gasparro R, Pantaleo G, Mignogna J, Riccitiello F, Sammartino G. *Quintessence Int.* 2017, 48(4):315-324.

<https://pubmed.ncbi.nlm.nih.gov/28294200/>

OBJECTIVES: The aim of this study was to evaluate implant survival rate and to measure peri-implant bone changes in full-arch rehabilitations with immediate placement and immediate loading implants with platform switching and Morse taper connection, in addition to platelet-rich fibrin (PRF) and buccal bone augmentation, after 4 years of follow-up.

Material/ Methods: In this retrospective controlled study, patients who had been fully rehabilitated with immediate placement and immediate loading implants were evaluated 4 years post-loading. Implants with platform switching and Morse taper connections were used (In-Kone Universal System, Global D) and PRF and buccal bone augmentation were applied. The radiographic bone loss was calculated by subtracting the bone level at baseline (BLT0) from that at the 4-year follow-up (BLT4) in

immediate and delayed implants. Measurements were made at the distal, mesial, vestibular, and oral sites of the implants and the deepest value was recorded. Implants placed in extraction sites and implants placed in healed sites were considered. A comparison between the groups was performed using the Mann-Whitney test. The implant survival rate was calculated using the Kaplan-Meier analysis.

RESULTS: In total, 42 patients (28 females and 14 males; average age 55.8 years old, age range 45 to 77) were recruited to this study. A total of 334 implants were put in place (226 in the maxilla, 108 in the mandible). The implant survival rate was 97.8% for the maxilla and 98.1% for the mandible, 98.3% for immediate implants and 96.9% for delayed implants. No statistically significant differences in the mean radiographic bone loss (mBL) were observed when comparing the immediate and delayed implants and the anterior and posterior implants. Statistically significant differences were found in the mBL between the mandibular and maxilla implants in the vestibular and mesial sites.

CONCLUSION: Within their limits, the present results suggest that rehabilitation with platform switching and taper connection implants, in addition to buccal bone augmentation and the use of PRF, can lead to predictable results.

25. A 3-year prospective randomized clinical trial of alveolar bone crest response and clinical parameters through 1, 2, and 3 years of clinical function of implants placed 4 months after alveolar ridge preservation using two different allogeneic bone-grafting materials

Solakoglu Ö, Ofluoğlu D, Schwarzenbach H, Heydecke G, Reißmann D, Ergun S, Götz W. *Int J Implant Dent* 8, 5 (2022). DOI: 10.1186/s40729-022-00402-w

<https://pubmed.ncbi.nlm.nih.gov/35102440/>

The aim of this study was to longitudinally evaluate changes in alveolar bone crest (ABC) levels and differences in resorption rates (RR) between the tested grafting materials following alveolar ridge preservation (ARP) after tooth extraction after 1, 2, and 3 years (T1–T8) of clinical function.

Methods: Patients were randomly assigned to two different bone allografts (group 1 maxgraft®, group 2 Puros®) for ARP. Non-restorable teeth were minimally traumatically extracted. Sockets were augmented with the tested materials and covered with a pericardium membrane. After 4 months of healing, 36 implants were placed and sites were clinically and radiographically monitored in the mesial (ABC-M), the distal (ABC-D, T1–T8), the bucco-lingual (ABC-BL), buccal (ABC-B) and oral (ABC-O) aspect (T1–T4).

Results: Changes in (ABC-M), (ABC-D), (ABC-BL), (ABC-B), and (ABC-O) levels showed statistically highly significant differences between T1 and T2 for both bone allografts ($p < 0.001$). Changes at the ABC-M and ABC-BL levels between T2 and T3 of group 1 showed a statistically significant difference ($p < 0.001$). Both groups achieved and maintained increased ABC levels without statistically significant differences throughout the monitoring periods of 1–3 years (T6–T8) of clinical function. No failures or adverse events were observed.

Conclusions: To the best of our knowledge, this study is within its limitations the first study to directly compare ABC-changes and differences in RR of two different allogeneic grafting materials for a period of 3 years after ARP. It was demonstrated to be, despite significant differences in RR, a successful method of preserving increased ABC levels through 1, 2, and 3 years of clinical function.

26. Connective tissue graft vs porcine collagen matrix after immediate implant placement in esthetic area: A randomized clinical trial

Puisys, A., Deikuvienė, J., Vindasiute-Narbutė, E., Razukevičius, D., Zvirblis, T., & Linkevicius, T. (2022). *Clinical implant dentistry and related research*, 24(2), 141–150. <https://doi.org/10.1111/cid.13058>

<https://pubmed.ncbi.nlm.nih.gov/35324053/>

Background: The use of connective tissue graft (CTG) with immediate implant placement and provisionalisation have shown promising results. It is not clear if the same outcome could be achieved using porcine-derived collagen matrix (PDCM) as grafting material.

Objectives: This study aimed to assess the esthetic and functional outcomes of immediate temporization of immediately placed fully tapered implants combined with bone and soft tissue augmentation, using either a CTG or a PDCM, in fresh extraction sockets of the anterior sites.

Materials and Methods: Patients with a failing anterior tooth were included in this study. After extraction, they received an immediate implant with simultaneous hard and soft tissue augmentation and immediate provisional restoration. Patients were randomly assigned to one of the group. Soft tissue augmentation in the control group (CTG) consisted of a CTG, whereas PDCM was used in the test group. After 4 months, definitive restorations were delivered, and pink esthetic score (PES) was evaluated at T1, prosthetic delivery, and at 12-month follow-up (T2). In addition, crestal bone change, probing depth, bleeding on probing, plaque index, bleeding on provisional removal, and implant stability quotient were also recorded.

Results: A total of 45 patients received the intended treatment (22 controls and 23 tests) 45 implants totally, with no implant failures at T2. PES mean \pm SD after 1 year was noted to be 12.9 ± 1.2 for the CTG group and 12.1 ± 1.3 for the PDCM group ($p = 0.507$).

Conclusion: Within the limits of this trial, both treatment protocols resulted in comparable esthetic outcomes, with results showing PES >12 and stable clinical parameters after 1 year of follow-up.

27. Decompression technique — A modified approach for lateral alveolar ridge augmentation: A case report

Puisys A, Auzbikaviciute V, Vindasiute-Narbutė E, Zukauskas S, Deikuvienė J, Razukevicius D. *Clin Case Rep*. 2021 Jan 3;9(3):1253-1260.

<https://pubmed.ncbi.nlm.nih.gov/33768821/>

A particular technique can increase the mucosal and peri-implant bone thickness, prevent compression around implant neck, and obtain proper space for the following prosthetic treatment with an adequate emergence profile.

28. Time analysis of alveolar ridge preservation using a combination of mineralized bone-plug and dense-polytetrafluoroethylene membrane: A histomorphometric study

Wen, S. C., Barootchi, S., Huang, W. X., & Wang, H. L. (2020). *Journal of periodontology*, 91(2), 215–222. <https://doi.org/10.1002/JPER.19-0142>

<https://pubmed.ncbi.nlm.nih.gov/31378923/>

The objective of this study was to histologically evaluate and compare vital bone formation, residual graft particles, and fraction of connective tissue (CT)/other tissues between three different time points at 2-month intervals after alveolar ridge preservation with a cancellous allograft and dense-polytetrafluoroethylene (d-PTFE) membrane.

Material/ Methods: Ridge preservation with a cancellous allograft (maxgraft®) and d-PTFE membrane was performed at 49 extraction sockets (one per patient). Volunteers were assigned to implant placement at three different time points of 2, 4, and 6 months, at which time core biopsies were obtained. Histomorphometric analysis was performed to determine the percentages of vital bone, residual graft particles, and connective tissue/other non-bone components, and subjected to statistical analyses.

Results: There was a statistically significant difference in the amount of vital bone at every time point from 28.31% to 40.87% to 64.11% (at 2-, 4-, and 6-month groups, respectively) ($P < 0.05$). The percentage of residual graft particles ranged from 44.57% to 36.16% to 14.86%, showing statistical significance from 4 to 6 months (21.29%, $P < 0.001$), and 2 to 6 months (29.71%, $P < 0.001$), while there were no significant differences for the amount of CT/other tissue among the different time points.

Conclusions: This study provided the first histologic comparison of alveolar ridge preservation using a cancellous allograft and d-PTFE membrane at three different time points. Extraction sockets that healed for 6 months produced the highest amount of vital bone in combination with the least percentage of residual graft particles, while similar results were observed for the fraction of CT/other tissues between the three time points.

29. Lateral bone augmentation in narrow posterior mandibles, description of a novel approach, and analysis of results.

Beitlitum I, Sebaoun A, Nemcovsky CE, Slutzkey S *Clin Implant Dent Relat Res.* 2018 Apr;20(2):96-101.

<https://pubmed.ncbi.nlm.nih.gov/29316182/>

PURPOSE: To evaluate a new simplified method for resorbable collagen membrane fixation in lateral bone augmentation procedures in narrow posterior mandibles.

Material / Methods: This retrospective study analyzed 16 procedures performed in 15 patients who followed lateral ridge augmentation procedures before implant placement in the posterior mandible. A particulate mineralized bone allograft (maxgraft® granules) was covered with a cross-linked resorbable collagen barrier membrane, which was fixated with a single, non-resorbable pin. Complications were registered and results analyzed on pre and post op measurements on computerized tomographic scans. Descriptive statistical analysis and ANOVA with repeated measures were performed.

RESULTS: No complications were recorded. Average bone gain was 3.3 mm at implant platform level and 4.29 mm at 3 mm apically, both, statistically significant. All sites had sufficient bone width allowing implant placement. Thirty-three implants placed in the augmented areas, integrated and survived for over a 2-year follow-up.

CONCLUSION: The simplified membrane fixation procedure enables large horizontal bone gain with minimal complications while allowing adequate implant placement.

30. The use of mineralized bone allograft as a single grafting material in maxillary sinus lifting with severely atrophied alveolar ridge (1-3 mm) and immediately inserted dental implants. A 3- up to 8-year retrospective study.

Tilaveridis I, Lazaridou M, Zouloumis L, Dimitrakopoulos I, Tilaveridis V, Tilaveridou S. *Oral Maxillofac Surg.* 2018 Sep;22(3):267-273.

<https://pubmed.ncbi.nlm.nih.gov/29858723/>

The primary aim of our study was to evaluate the efficacy of mineralized bone allograft alone in sinus floor augmentation with simultaneous implant placement in cases with severe atrophy of the residual maxillary bone (bone height < 4 mm).

Material/ Methods: Thirty-five dental implants were placed in 29 patients who underwent sinus augmentation via traditional lateral window technique from 2008 to 2013. Patients with residual alveolar height between 1 and 3 mm at the site of implantation were included in the study. The height of residual bone was initially estimated by plain panoramic X-ray and reevaluated intraoperatively by precise micrometric measurement at the site of implantation. Implants of 13 mm height and 3.5 or 4.3 mm in diameter were inserted simultaneously. Mineralized bone allograft was used alone to augment the sinus floor.

RESULTS: No wound dehiscence was recorded. In one case there was a postoperative site infection which subsided with antibiotics without implant failure. One implant migrated during the postoperative period to the maxillary sinus and was removed. One implant failed. The remaining 33 implants were successfully loaded. Follow-up ranged from 3 to 8 years.

CONCLUSIONS: Maxillary sinus lift in severely absorbed alveolar ridges with simultaneous implant placement could be safely performed using mineralized allograft alone, rendering the procedure less invasive and less time-consuming.

31. Bone augmentation and simultaneous soft tissue thickening with collagen tissue matrix derivate membrane in an aesthetic area. A case report

Puišys A, Žukauskas S, Kubilius R, Vindašiūtė E, Linkevičius T. *Stomatologija.* 2017;19(2):64-68.

<https://pubmed.ncbi.nlm.nih.gov/29243686/>

This case report describes a technique for aesthetic single implant placement with simultaneous bone grafting and soft tissue thickening. At the time of implant surgery, allogenic (maxgraft®, Botiss Biomaterials, Germany) and xenogenic bone substitute (cerabone®, Botiss Biomaterials, Germany) was used for bone grafting, soft tissues were augmented simultaneously with collagen tissue matrix derivate membrane (mucoderm®, Botiss Biomaterials, Germany). After 4 months during second stage surgery the implant was exposed. Subsequently healing abutment was replaced with provisional crown for gingival contouring. An individual zirconia abutment was made, and a cemented full-ceramic crown was placed for final restoration. The 12-month follow-up check-up revealed a pleasing aesthetic treatment outcome, as well as clinically healthy peri-implant soft tissues. Radiological examination showed a stable bone crest with minor bone remodelling around the implant platform. The use of a collagen tissue matrix derivate, simultaneously with GBR, in the aesthetic area can provide excellent results, by establishing and maintaining facial bone wall and thick soft tissue in aesthetic area.

*II. maxgraft® cortico***32. Comparison of morbidity-related parameters between autologous and allogeneic bone grafts for alveolar ridge augmentation from patients' perspective-A questionnaire-based cohort study**

Heimes, D., Pabst, A., Becker, P., Hartmann, A., Kloss, F., Tunkel, J., Smeets, R., & Kämmerer, P. W. (2024). *Clinical implant dentistry and related research*, 26(1), 170–182.
<https://doi.org/10.1111/cid.13242>

<https://pubmed.ncbi.nlm.nih.gov/37438839/>

Introduction: Alveolar ridge augmentation is often required before dental implant placement. In this context, autologous bone grafts are considered the biological gold standard. Still, bone block harvesting is accompanied by some serious potential disadvantages and possible complications, such as pain, bleeding, and nerve irritation. Several studies aimed to compare autologous to allogeneic bone grafts concerning bone quality and implant survival rates; this is the first prospective study analyzing and comparing morbidity-related parameters after alveolar ridge augmentation using autogenous and allogeneic bone blocks from patients' perspective.

Methods: Using a questionnaire, 36 patients were asked to evaluate the surgery as well as the post-operative period concerning pain, stress, sensibility deficits, satisfaction with, and consequences from the surgery as well as the preferred procedure for future alveolar ridge augmentations.

Results: No significant differences were shown regarding stress and pain during and after surgery, whereas the rate of nerve irritations was twice as high in the autologous group. The swelling was significantly higher in patients with autologous bone blocks ($p = 0.001$). Nevertheless, the overall satisfaction of patients of both groups was very high, with over 8/10 points.

Conclusions: The swelling was the main reason for patients' discomfort in both groups and was significantly higher after autologous bone augmentation. Since this side effect seems to be a highly relevant factor for patients' comfort and satisfaction, it needs to be discussed during preoperative consultation to allow shared decision-making considering the anticipated morbidity.

33. Allogeneic versus autogenous shell technique augmentation procedures: a prospective-observational clinical trial comparing surgical time and complication rates

Tunkel, J., Hoffmann, F., Schmelcher, Y., Kloss-Brandstätter, A., & Kämmerer, P. W. (2023). *International journal of implant dentistry*, 9(1), 52. <https://doi.org/10.1186/s40729-023-00505-y>

<https://pubmed.ncbi.nlm.nih.gov/38117445/>

Objectives: Autogenous and allogeneic blocks for shell augmentation of the jaw have shown comparable results. This observational clinical study aimed to compare both materials for shell augmentation concerning surgery time and intra- and postoperative complications.

Material and methods: Bone augmentation with the shell technique using autogenous or allogeneous bone (maxgraft® cortico) was performed in 117 patients with segmental jaw atrophy. The primary study parameter was the surgical time, comparing both materials. Subsequently, intra- and postoperative complications were recorded.

Results: Allogeneic (n = 60), autogenous (n = 52), or both materials (n = 5) were used. The use of allogeneic material led to a significantly shorter operation time ($p < 0.001$). A more experienced surgeon needed significantly less time than a less experienced surgeon ($p < 0.001$). An increasing number of bone shells ($p < 0.001$), an additional sinus floor elevation, and intraoperative complications also significantly increased the operation time ($p = 0.001$). Combining allogeneic and autogenous shells ($p = 0.02$) and simultaneous sinus floor elevation ($p = 0.043$) significantly impacted intraoperative complications. No correlations were found between the included variables for postoperative complications (all $p > 0.05$). In total, 229 implants were inserted after a healing time of 4-6 months, with a survival of 99.6% after a mean follow-up duration of 9 months.

Conclusions: Compared to the autogenous technique, allogeneic shell augmentation has a shorter surgical time and a similar rate of intra- and postoperative complications as autogenous bone. Together with its promising clinical results, this technique can be recommended.

34. Regeneration of Horizontal Bone Defect in Edentulous Maxilla Using the Allogenic Bone-Plate Shell Technique and a Composite Bone Graft-A Case Report

Kovac, Z., Cabov, T., Blaskovic, M., & Morelato, L. (2023). *Medicina (Kaunas, Lithuania)*, 59(3), 494. <https://doi.org/10.3390/medicina59030494>

<https://pubmed.ncbi.nlm.nih.gov/36984495/>

An insufficient volume of the alveolar bone may prevent implants from being placed in the prosthetically optimal position. Complex restoration of bony structures is required to achieve long-term peri-implant bone stability and represents an adequate prosthetic solution. Background and Objectives: The shell technique has become a widespread and important method for guided bone regeneration in dentistry. Allogeneic bone materials appear to be the most similar substitution for autogenous bone transplants. However, there are few studies using cortical bone allografts in combination with a mix of autogenous and xenograft materials for the augmentation of horizontal ridge defects. This combination offers the advantage of reduced patient morbidity while adding adequate volume and contour to the alveolar ridge. Case report: The present case study aimed to clinically and radiographically evaluate the efficacy of allogenic cortical bone lamina (maxgraft® cortico) combined with a composite bone graft in the augmentation of a horizontal bone defect in the edentulous maxilla during a 6-year follow-up period. Three CBCT scans taken before treatment, 6 months after the augmentation period/before implant placement, and after a 6-year follow-up period, were analyzed using stable referent points. After the 6-year follow-up period, the average resorption rate was 21.65% on the augmented buccal side, with no implant exposure being observed. Conclusions: The bone shell technique used in conjunction with allogenic bone plates combined with autogenous bone, xenografts, and collagen membranes is an effective technique to manage horizontal ridge defects.

35. The allogenic shell technique for alveolar ridge augmentation: a multicenter case series and experiences of more than 300 cases

Kämmerer PW, Tunkel J, Götz W, Würdinger R, Kloss F, Pabst A. *Int J Implant Dent* 8, 48 (2022). DOI 10.1186/s40729-022-00446-y

<https://pubmed.ncbi.nlm.nih.gov/36316597/>

Purpose: Allogeneic cortical bone plates (CP) might be used for alveolar ridge augmentation as an alternative to autogenous grafts (AG) and bone substitutes (BS). We report about a multicenter case series and our experiences of more than 300 cases using CP and the shell technique for reconstruction of the alveolar process to illustrate surgical key steps, variations, and complication management.

Methods: Different types of alveolar ridge defects were augmented using the shell technique via CP. The space between the CP and the alveolar bone was filled with either autogenous or allogeneic granules (AUG, ALG – maxgraft® cortico) or a mixture of both. Implants were placed after 4–6 months. Microscopic and histological assessments were performed. In addition, space filling using AUG, ALG and bovine BS was discussed.

Results: Scanning electron microscopy demonstrated the compact cortical structure of CP and the porous structure of ALG allowing micro-vessel ingrowth and bone remodeling. Histological assessment demonstrated sufficient bone remodeling and graft resorption after 4–6 months. In total, 372 CP cases and 656 implants were included to data analysis. The mean follow-up period was about 3.5 years. Four implants failed, while all implant failures were caused by peri-implantitis. Next, 30 CP complications were seen, while in 26 CP complications implant placement was possible. CP rehydration, stable positioning by adjusting screws, smoothing of sharp edges, and a tension-free wound closure were identified as relevant success factors. Space filling using ALG and a mixture of AUG/ALG resulted in sufficient bone remodeling, graft resorption and stability of the augmented bone.

Conclusions: CP and the shell technique is appropriate for alveolar ridge augmentation with adequate bone remodeling and low complication rates. Allografts can prevent donor site morbidity and therefore may decrease discomfort for the patient.

36. Comparison of Allogeneic Bone Plate and Guided Bone Regeneration Efficiency in Horizontally Deficient Maxillary Alveolar Ridges

Cinar IC, Gultekin BA, Saglanmak A, Akay AS, Zboun M, Mijiritsky E. *Applied Sciences*. 2022; 12(20):10518. DOI 10.3390/app122010518

<https://www.mdpi.com/1892410>

Background: Bone Lamina Technique and Guided Bone Regeneration (GBR) are commonly used for horizontally-deficient maxillary ridge reconstruction, although more detailed evaluation to assess the differences between such techniques is necessitated.

Methods: In this retrospective study, patients having a horizontal bone width of 4 mm in the maxilla, who were treated with Cortical Strut (CS), were collected to represent the “test group”, and those treated with GBR with no CS involvement represented the “control group”. A 1:1 mixture of autogenous bone (AB) and anorganic bovine bone (ABB) with resorbable collagen membrane was applied to both groups. Volumetric changes between groups were measured with cone-beam computed tomography (CBCT). The primary outcome represented volumetric graft resorption rate whilst the secondary outcomes represented any probable complications and implant insertion torque.

Results: A total of 36 patients were included in this study (36 grafted sites; 18 for CS group and 18 for GBR group). Mean bone graft volume reduction in the CS and GBR groups was 8.26 1.60% and 14.36 3.55%, respectively. The GBR group showed significantly more bone resorption than the CS group ($p < 0.001$). Complications and insertion torque were similar between the groups ($p > 0.05$).

Conclusions: Both CS and GBR techniques for hard-tissue augmentation provided sufficient bone graft mass volume for implant insertion, whereas CS demonstrated lower resorption rate at maxillary augmented sites, compared to GBR.

37. Allogeneic cortical struts and bone granules for challenging alveolar reconstructions: An innovative approach toward an established technique

Würdinger R and Donkiewicz P. *J Esthet Restor Dent.* 2020 Dec;32(8):747-756.

<https://pubmed.ncbi.nlm.nih.gov/32920939/>

Objective: The shell technique is a well-established procedure for GBR with which extensive osseous defects can be predictably restored by using cortical bone struts harvested from various intraoral aspects. Recent publications have demonstrated comparable results for autologous and allogeneic bone grafts, whereas the evidence on allogeneic cortical struts remains limited.

Clinical considerations: In this case series, we demonstrate the regeneration of five complex alveolar bone defects in four patients with subsequent insertion of fixed dental implants. In all cases, cortical struts (maxgraft® cortico) made from human donor bone were applied in combination with allogeneic bone granules (maxgraft®) and collagen membranes (Jason® membrane).

Conclusions: Similar to autologous cortical shells, the allogeneic struts functioned by creating an immobile container with which the osseous defects in all patients could be successfully restored, enabling placement of dental implants in accordance with the treatment plan. Even when the containers were solely filled with allogeneic granules, vascularized healthy tissue was present at re-entry, demonstrating the vast potential of these materials for applications in dentistry.

Clinical significance: Especially when it comes to regeneration of complex alveolar bone defects, autologous bone grafts are often outlined as the only treatment modality. Here we show that innovative biomaterials like allogeneic bone grafts hold the potential to mimic the functions of autologous bone transplants and provide excellent clinical results without the requirement of a second surgical side for bone harvesting and no risk of donor-site morbidity.

38. Alveolar ridge augmentation using the shell technique with allogeneic and autogenous bone plates in a split-mouth design—A retrospective case report from five patients

Tunkel J, de Stavola L, Kloss-Brandstätter A. *Clin Case Rep.* 2020 Dec 29;9(2):947-959.

<https://pubmed.ncbi.nlm.nih.gov/33598278/>

Atrophic alveolar ridges of five patients were augmented with allografts and autografts on opposite sites, followed by dental implantation. Both augmentation materials led to equivalent bone gains. Allografts did not compromise the clinical outcome.

*III. maxgraft® blocks***39. Clinical and Biological Validation of an Allogeneous Cancellous Bone Block for Alveolar Maxillary Ridge Reconstruction: A Case Series**

Perez, A., Pierantozzi, E., Di Felice, R., & Lombardi, T. (2024). *Dentistry journal*, 12(2), 42.
<https://doi.org/10.3390/dj12020042>

<https://pubmed.ncbi.nlm.nih.gov/38392246/>

This exploratory case series clinically and histologically investigated the performance of allogeneic cancellous freeze-dried bone allograft (FDBA) bone blocks (maxgraft®) for the lateral augmentation of local alveolar defects in the posterior maxilla as part of two-staged implant therapy. Five patients receiving eight implants 5 months after block augmentation with a follow-up period of up to 3 years were documented and analyzed. Horizontal alveolar dimensions before and 5 months after block augmentation were quantified using CBCT. Radiographic marginal bone level changes were quantified at implant placement, loading, and 1 year post-placement. Graft integration and resorption were histologically qualitatively evaluated from core biopsies retrieved at implant placement. Block augmentations resulted in a pronounced horizontal median bone gain of 7.0 (5.5 to 7.8) mm. Marginal implant bone levels in block-augmented bone remained constant over the 1 year follow-up period. Block grafts appeared histologically well integrated. Histologic analysis also revealed signs of progressive resorption and new bone formation at the lateral aspects of the grafts. The results of this case series support using maxgraft® cancellous FDBA blocks as suitable materials for the lateral augmentation of local alveolar defects.

40. Risk Factors for Complications Following Staged Alveolar Ridge Augmentation and Dental Implantation: A Retrospective Evaluation of 151 Cases with Allogeneic and 70 Cases with Autogenous Bone Blocks

Kloss, F. R., Kämmerer, P. W., & Kloss-Brandstätter, A. (2022). *Journal of clinical medicine*, 12(1), 6.
<https://doi.org/10.3390/jcm12010006>

<https://pubmed.ncbi.nlm.nih.gov/36614811/>

Purpose: the aim of this study was to identify potential risk factors favoring complications by assessing the number and types of complications associated with allogeneic or autogenous bone blocks applied as onlay grafts for alveolar ridge augmentation prior to implantation.

Methods: A retrospective chart review on the success of 151 allogeneic (maxgraft® blocks) and 70 autogenous bone blocks in a cohort of 164 consecutive patients, who were treated over a period of 6 years by the same surgeon, was conducted. Statistical conclusions were based on ROC curves and multiple logistic regression models.

Results: Complications were observed more frequently with autogenous bone blocks (14 out of 70 cases; 20%) compared to allogeneic bone blocks (12 out of 151 cases; 7.9%; $p = 0.013$). However, these complications were minor and did not impact the successful dental rehabilitation. In a multiple logistic regression model, the risk of a complication was increased by the use of an autogenous bone block (OR = 3.2; $p = 0.027$), smoking (OR = 4.8; $p = 0.007$), vertical augmentation above a threshold of 2.55 mm (OR = 5.0; $p = 0.002$), and over-contouring (OR = 15.3; $p < 0.001$).

Conclusions: Overall, the complication rate of ridge augmentations carried out with autogenous or allogeneic bone blocks was low. Despite previous recommendations, over-contouring and a vertical augmentation above a threshold of 2.55 mm should be avoided.

41. Comparison of allogeneic and autogenous bone grafts for augmentation of alveolar ridge defects – a 12-month retrospective radiographic evaluation

Kloss FR, Offermanns V, Kloss-Brandstätter A. *Clin Oral Implants Res.* 2018 Nov;29(11):1163-1175.

<https://pubmed.ncbi.nlm.nih.gov/30303581/>

The aim of this study was to compare three-dimensional alterations following the use of autogenous versus allogeneic onlay grafts for augmentation at single tooth defects.

Material / Methods: Alveolar bone width at specific implant sites were assessed using sagittal and cross-sectional CBCT images prior grafting and at three subsequent time points. 21 patients received autogenous bone blocks harvested from the retromolar region and another 21 patients received freeze-dried cancellous allogeneic bone blocks.

Results: The vertical and horizontal dimensions did not significantly differ between autogenous and allogeneic bone grafts at any time point. In addition, there were no statistically significant differences in graft remodeling rates between autogenous (mean shrinkage rate after 12 months: 12.5 ± 7.8 %) and allogeneic onlay grafts (mean shrinkage rate after 12 months: 14.4 ± 9.8 %).

Conclusions: Freeze-dried cancellous allogeneic bone blocks showed equivalent volumetric shrinkage rates as autogenous bone blocks when used for treating circumscribed bone defects classified as Type-II to Type-IV according to the ITI-treatment guide categories. Therefore, it is not necessary to over-contour the alveolar ridge when using allogeneic blocks for treating single tooth defects, but to apply the same procedure as when using autogenous blocks.

IV. *maxgraft® bonebuilder*

42. A Novel Approach to Assess and Measure Resorption of Allograft Cancellous Blocks. A Clinical Pilot Study

Patel, J., Srinivas, A., Patel, N., Bhakta, S., & Keeling, A. (2024). *Journal of Osseointegration*, 16(1), 48–52. <https://doi.org/10.23805/JO.2023.604>

<https://www.journalofosseointegration.eu/jo/article/view/604>

Aim: The aim of this pilot study was to evaluate the feasibility of a novel method in assessing the volumetric changes in block alveolar bone grafts following augmentation.

Methods: The study utilised information from pre-surgical cone beam CTs, post-surgical cone beam CTs, and milled allograft blocks (maxgraft® bonebuilder) to evaluate the volumetric differences in ridge volume, and thus the volumetric resorption of the augmentation block. This process involved reformatting DICOM data to obtain STL files, and 3-dimensional voxel analysis of the aligned STL files. In addition the study undertook surface mapping to obtain colorimetric maps depicting hotspots with increased resorption.

Results: Four cases were assessed in total (with six block grafts). Block volume sizes varied between 614mm³ and 1674mm³. The results obtained suggest a mean block resorption at 4-months post-augmentation of 19.5%. This is comparable to existing published literature which has involved calculation of block resorption using analog means. In addition, the method described was able to consistently show areas with increased resorption within the block volume at the 4-month timepoint.

Conclusion: This novel method may be beneficial to investigate the treatment outcomes from alveolar block grafting with greater accuracy than previous methods, whilst also providing new information on the patterns of resorption within blocks.

43. Efficacy and volume stability of a customized allogeneic bone block for the reconstruction of advanced alveolar ridge deficiencies at the anterior maxillary region: a retrospective radiographic evaluation

Blume, O., Back, M., Dinya, E., Palkovics, D., & Windisch, P. (2023). *Clinical oral investigations*, 27(7), 3927–3935. <https://doi.org/10.1007/s00784-023-05015-0>

<https://pubmed.ncbi.nlm.nih.gov/37055540/>

Objectives: The aim of this retrospective case series was to evaluate the efficacy and volume stability of a customized allogeneic bone block (CABB, maxgraft® bonebuilder) for the hard tissue reconstruction of severely atrophied anterior maxillary ridges.

Materials and methods: Hard tissue alterations between baseline (T1), 2-month follow-up (T2), and 6-month follow-up (T3) cone-beam computed tomography scans were evaluated with semi-automatic segmentation. Following automatic spatial alignment of the datasets, 3D subtraction analysis was performed. The volume stability of the inserted allogeneic bone block was determined on the basis of the ratio of the T3 and T2 hard tissue volumes.

Results: The newly formed hard tissue volume at T2 averaged at of $0.75 \text{ cm}^3 \pm 0.57 \text{ cm}^3$, whereas at T3, an average of $0.52 \text{ cm}^3 \pm 0.42 \text{ cm}^3$ volumetric hard tissue gain could be detected. The T3/T2 ratio was found to be $67.83\% \pm 18.72\%$ on average. The dice similarity coefficient between the T2 and T3 hard tissue models averaged at 0.73 ± 0.15 .

Conclusions: Cancellous CABBs are a reliable option for the reconstruction of severely atrophied alveolar ridges. The resorption rates of these grafts are similar to those found in the literature; however, with precise manufacturing and proper intraoperative flap management, the resorption rates may be reduced.

Clinical relevance: With precise knowledge of the resorption patterns, the shape of blocks can be altered in the future to compensate for the volumetric loss.

44. Volumetric Changes of a Customized Allogeneic Bone Block Measured by Two Image Matching Tools: Introduction of a Novel Assessment Technique for Graft Resorption.

Blume O, Donkiewicz P, Palkovics D, Götz W, Windisch P. *Acta Stomatol Croat.* 2021 Dec; 55(4): 406–417.

<https://pubmed.ncbi.nlm.nih.gov/35001936/>

Objective: The purpose of this case report was to present a method for the assessment of volumetric changes of bone blocks during healing and demonstrate its practicability by analysing the resorption of a pre-shaped allogeneic bone block used for the reconstruction of a complex maxillary defect.

Materials and methods: CBCT-scans of a 19-year-old male treated with an allogeneic bone block were recorded pre-OP, post-OP, and following six months of healing. Graft shrinkage was assessed via two image matching tools, namely coDiagnostiX® and Slicer. A biopsy specimen was harvested along the implant canal at the time of implantation.

Results: The osseous defect was successfully restored and advanced graft remodelling was found upon re-entry as confirmed by the histomorphometric and histologic analysis. The initial volumes of the graft determined via coDiagnostiX® and Slicer were 0.373 mL and 0.370 mL., respectively, while graft resorption after six months of healing was 0.011 mL (3.00%) and 0.016 mL (4.33%).

Conclusions: The avoidance of bone harvesting and reduction of invasiveness display an important issue in dentoalveolar restorations. However, before grafting materials can be considered a safe alternative, understanding their clinical performance, especially resorption stability, is pivotal. The present case report demonstrates a limited resorption of the allogeneic bone block and further emphasizes the practicability of determining bone resorption by the here introduced method. As our investigation comprises solely one subject, the results should be considered with care and substantiated by further studies

45. Ridge Augmentation Using Customized Allogeneic Bone Block: A 3-Year Follow-up of Two Case Reports

Landsberg C, Moses O. *Int J Periodontics Restorative Dent.* Nov/Dec 2020;40(6):881-889.

<https://pubmed.ncbi.nlm.nih.gov/33151194/>

A variety of surgical techniques and grafting materials for the purpose of ridge augmentation have been developed during the last three decades. Recently, the use of customized allogeneic bone blocks, prepared by CAD/CAM techniques, has been introduced. This new augmentation technology may significantly reduce surgical time and improve donor-recipient fit and adaptation. However, promising clinical and histologic results have been published in only a few short-term case reports. The 3-year follow-ups of these two case reports may provide more clinical data on the use of the customized bone blocks for horizontal and vertical ridge augmentation in the posterior mandible.

46. Customized allogeneic bone grafts for maxillary horizontal augmentation: A 5-year follow-up radiographic and histologic evaluation

Kloss FR, Offermanns V, Donkiewicz P, Kloss-Brandstätter A. *Clin Case Rep.* 2020 Mar 11;8(5):886-893.

<https://pubmed.ncbi.nlm.nih.gov/32477540/>

We report the histological evaluation of an individualized allogeneic bone block 5 years after alveolar ridge augmentation. The biopsy showed a well-vascularized lamellar bone with fatty incorporations without any avital allograft remnants. The presence of osteocytes, lining cells, macrophages, and blood vessels indicated a healthy and vital bone tissue.

47. Bilateral maxillary augmentation using CAD/CAM manufactured allogenic bone blocks for restoration of congenitally missing teeth: A case report.

Blume O, Donkiewicz P, Back M, Born T. *J Esthet Restor Dent.* 2019;31(3):171-178.

doi:10.1111/jerd.12454

<https://pubmed.ncbi.nlm.nih.gov/30756449/>

OBJECTIVE: Various biomaterials have been successfully applied in alveolar bone regeneration, however, the reconstruction of extensive osseous defects remains challenging and is often unfeasible with granular grafting materials. Several studies have outlined allogenic bone blocks as valid alternative to autologous block grafting.

CLINICAL CONSIDERATIONS: In this report, we demonstrate the regeneration of two large osseous defects in the maxilla with allogenic bone blocks made from human donor bone. The bone blocks were customized using the CAD/CAM technology in order to enable the insertion of four dental implants.

CONCLUSIONS: Both blocks perfectly matched the defect geometry, showed limited resorption, led to the formation of sufficient amounts of mineralized bone in both horizontal and vertical dimensions and enabled the installation of implants according to the treatment plan. The implementation of innovative technologies for individualization of allogenic bone blocks simplifies the restoration of complex and extensive osseous defects and poses great benefits for both practitioners and patients.

CLINICAL SIGNIFICANCE: The here presented procedure demonstrates the successful regeneration of two extensive osseous defects in a patient suffering from hypodontia using two CAD/CAM manufactured allogenic bone blocks, rendering the procedure far less invasive as compared to guided bone regeneration carried out with autologous transplants. Furthermore, to the best of our knowledge, this is the first case report that radiographically demonstrates the new formation of a cortical bone layer following block grafting with solely cancellous bone blocks.

48. Reconstruction of a Unilateral Alveolar Cleft Using a Customized Allogenic Bone Block and Subsequent Dental Implant Placement in an Adult Patient

Blume O, Back M, Born T, Donkiewicz P. *J Oral Maxillofac Surg.* 2019;77(10):2127.e1-2127.e11.
doi:10.1016/j.joms.2019.05.021

<https://pubmed.ncbi.nlm.nih.gov/31276656/>

Cleft lip and palate are the most common congenital deformity with severe effects on the quality of life of affected patients. The deformity often includes an alveolar cleft (AC). In most cases, osteoplasty will be performed using autogenous bone transplants harvested from the iliac crest. Thus, this treatment represents a highly invasive procedure. With freeze-dried bone allografts (FDBAs) becoming an increasingly accepted alternative to autogenous bone grafting for several indications, their application might also be suitable for AC reconstruction. We present the use of a customized allogenic bone block in a guided bone regeneration procedure for reconstruction of a unilateral AC and the successful insertion of dental implants after a healing period of 6 months. The use of FDA seems to represent a successful treatment option for AC reconstruction. The allogenic bone block demonstrated high volume stability with ideal integration and revascularization, resulting in functional bone tissue suitable for implantation and esthetic rehabilitation. Nevertheless, further investigations, especially concerning the long-term stability of the augmented bone and dental implants, are needed to draw definite conclusion regarding the performance of allogenic bone blocks in orofacial cleft osteoplasty.

49. Custom-milled individual allogeneic bone grafts for alveolar cleft osteoplasty—A technical note

Otto S, Kleye C, Burian E, Ehrenfeld M, Cornelius CP. *J Craniomaxillofac Surg.* 2017;45(12):1955-1961.
doi:10.1016/j.jcms.2017.09.011

<https://pubmed.ncbi.nlm.nih.gov/29066039/>

INTRODUCTION: Bone grafts from the iliac crest are most commonly used for osteoplasties of the cleft alveolus. To preclude undue donor site morbidity custom-milled allogeneic bone grafts might be an appropriate choice. **MATERIAL AND METHODS:** This technical note showcases the repair of an alveolar cleft using an individualized allogeneic bone graft in a 36-year old female patient. She was asking for an alternative to the iliac crest bone grafting. Her alveolus was successfully built up by a custom-milled cancellous bone block allograft (maxgraft® bonebuilder). **RESULTS:** Custom-milled cancellous bone block allografts can greatly facilitate alveolar cleft repair and may present an effective treatment option under the premise that resorption resistance corresponds to autografts. **CONCLUSION:** Further clinical studies are needed to explore the potential of bone block allografts for alveolar cleft osteoplasty.

V. *maxgraft® bonering***50. Vertical alveolar bone augmentation of atrophied posterior mandibular regions with simultaneous dental implant placement using allogeneic bone rings vs autogenous bone rings: a randomized controlled clinical trial**

Ragab Mahmoud AE, Mohammad Yassin S, Ali Hassan S, Sayed Abdelmoneim H. *Quintessence Int.* 2024;55(3):232-243. doi:10.3290/j.qi.b4867849

<https://pubmed.ncbi.nlm.nih.gov/38224105/>

Objective: Ideal implant placement in atrophied posterior mandibular regions is challenging due to surgical difficulties and anatomical limitations. This study aimed to evaluate the use of allogeneic bone rings for vertical augmentation of atrophied posterior mandibular regions with simultaneous implants compared to autogenous bone rings, while avoiding donor site morbidity.

Method and materials: A total of 24 vertically atrophied posterior mandibular segments (in 14 patients) were equally randomized into a study group in which mineralized freeze-dried allogeneic bone rings (maxgraft® bonering) were used, and a control group in which autogenous bone rings with prepared implant osteotomies were harvested from the chin and used. All augmentation sites were prepared before inserting the bone rings. Implants were simultaneously inserted, fixing the bone rings into the native bone. All patients were clinically assessed after 1 week, 2 weeks, and 1 month. Crestal bone level was radiographically assessed after 1 week, 6 months, and 3 months of prosthetic loading.

Results: None of the 24 bone rings showed signs of implant or graft failure. There was no significant difference in the crestal bone level between the groups.

Conclusion: Allogeneic bone rings can be a viable alternative to autogenous bone rings in augmenting the posterior aspect of the mandible, mitigating the concerns associated with donor site complications.

51. One Stage Vertical Ridge Augmentation and Dental Implantation with Allograft Bonerings: Results One Year after Surgery

Nord T, Yüksel O, Grimm WD, Giesenhagen B. *J Oral Implantol.* 2019;45(6):457-463

<https://pubmed.ncbi.nlm.nih.gov/31536460/>

The aim of this study was to analyze the success rate of dental implants and the graft shrinkage rate after vertical ridge augmentation and simultaneous implantation with an allograft bonering.

Materials / Methods: Fifty-one patients (81 augmentations and simultaneous implantations) were included. The bonering technique followed a standardized protocol. The alveolar ridge was prepared using a congruent trephine, and depending on the defect size, an allograft bonering with an outer diameter of 6-7 mm was placed. The height of the bonering was trimmed with a diamond disc to the required length. The average height of vertical augmentation was 5.5 mm. Implants were inserted through the bonering into the native bone of alveolar ridge.

Results: After 6 months, dental implants were exposed, and dental prosthetics were placed. Of 81 implants placed with the bonering technique, two failed during a 12-month follow-up, corresponding to a success rate of 97.5%. One year after surgery, the allograft bonering exhibited an average vertical graft shrinkage rate of 8.6%.

Conclusion: The allograft bonering technique was associated with a favorable outcome, and in cases with large vertical defects, both treatment time and donor site morbidity could be reduced.

52. Vertical bone augmentation in a single-tooth gap with an allogenic bone ring: Clinical considerations

Giesenhagen B, Martin N, Donkiewicz P, Perić Kačarević Ž, Smeets R, Jung O, Schnettler R, Barbeck M. *J Esthet Restor Dent*. 2018 Nov;30(6):480-483. doi: 10.1111/jerd.12392.

<https://pubmed.ncbi.nlm.nih.gov/30070751/>

OBJECTIVE: The main objective of this case report is to introduce a one-stage bone block augmentation with a cylindrical freeze-dried bone allograft (FDBA) and simultaneous implantation for the reconstruction of a single-tooth bone defect. **Clinical Considerations:** The report describes this method on the basis of radiographical and clinical images derived from a single patient. **CONCLUSIONS:** The report demonstrates the time-saving and successful application of this treatment concept, which has the potential to increase patient satisfaction and comfort. **CLINICAL SIGNIFICANCE:** The application of the presented technique enabled a prosthetic rehabilitation of the extracted tooth about 3 months earlier as compared to the conventional procedure, while demonstrating no compromises regarding clinical outcome, functionality and esthetics.