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

1. 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. 2023 Jan 31;23(1):56. doi: 10.1186/s12903-023-02726-4.

   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.

2. Cellular Behaviors of Periodontal Ligament Stem Cells in the Presence of Bone Grafting Biomaterials, In-Vitro Study.

   Esfahanian V, Ejeian F, Mohebinia H, Zojaji Nejad ZS, Yazdchi M, Ebrahimi Dastgerdi M, Ebrahimi Dastgerdi M, Nasr-Esfahani MH. Life (Basel). 2022 Dec 28;13(1):89. doi: 10.3390/life13010089.

   https://pubmed.ncbi.nlm.nih.gov/36676038/

Periodontal regeneration through the employment of bone substitutes has become a feasible strategy in animal and clinical studies. In this regard, we aimed to compare the periodontal ligament stem cell behavior in the vicinity of various bone grafting substitutes. Three types of popular bone substitutes, including allografts (Regen), xenografts (Cerabone), and alloplasts (Osteon) were studied in this experimental survey. The cellular attachment was assessed after four hours using the MTS assay and SEM imaging. In addition, cellular proliferation was investigated after 1, 3, 5, and 7 days through MTS assay. Osteogenesis was studied after 21 days of cell culture in a differentiation medium (DM+) and a normal medium (DM-), by employing real-time PCR and alizarin red staining. The highest cellular attachment was seen in the xenograft group with a significant difference in comparison to the other grafting materials. Despite the relatively low primary attachment of cells to allografts, the allograft group showed the highest total proliferation rate, while the lowest proliferation capacity was found in the alloplast group. Osteogenesis fount to be accelerated mostly by xenografts in both mediums (DM+ and DM-) after 3 weeks, while alloplasts showed the lowest osteogenesis. This study revealed that the type of bone substitutes used in regenerative treatments can affect cellular behavior and as a whole allografts and xenografts showed better results.

3. Influence of loading and grafting on hard- and soft-tissue healing at immediately placed implants: An experimental study in minipigs.

Parvini P, Buser D, Pippenger BE, Imber JC, Stavropoulos A, Bellón B, Jarry C, Schwarz F. J Clin Periodontol. 2023 Feb;50(2):232-241. doi: 10.1111/jcpe.13734.

https://pubmed.ncbi.nlm.nih.gov/36217692/

Aim: To histologically evaluate the influence of (1) loading and (2) grafting on osseointegration and peri-implant soft-tissue healing at immediately placed, self-cutting progressive tissue-level implants (TLX) in a minipig model. **Materials and methods:** TLX implants (n = 56) were immediately placed following the extraction of the mandibular first and second premolars, bilaterally, in a total of n = 14 minipigs. In each animal, the implant sites were allocated to the following four groups: (1) unloaded with simultaneous grafting using a bovine bone mineral; (2) unloaded without grafting; (3) loaded with simultaneous grafting; and (4) loaded without grafting. Histomorphometric assessments at 4 and 12 weeks (n = 7 animals each) included primary (i.e., bone-to-implant contact [BIC]) and secondary outcome measures (e.g., first BIC [fBIC], junctional epithelium length [JE], connective tissue contact length [CTC], biological width [BW = JE + CTC]). **Results:** At 4 weeks, mean BIC values ranged from 74.5 ± 11.6% in Group 2 to 83.8 ± 13.3% in Group 1, and, at 12 weeks, from 75.5% ± 7.9% in Group 2 to 79.9 ± 8.6% in Group 1. Multivariate linear mixed regression did not reveal any associations between BIC and implant loading or grafting at 4 and 12 weeks. At 12 weeks, significantly higher fBIC values were noted in Group 2 when compared with Group 1. All groups showed comparable JE, CTC, and BW values. **Conclusions:** Implant loading and grafting had no major effects on osseointegration and peri-implant soft tissue healing at TLX implants.

4. Different responses of heterogeneous graft presentations in bone reconstructions during sinus lift elevation surgery: an immunolabeling and histomorphometric study performed in rabbits.

   de Siqueira NB, Silva ACED, Pereira RDS, Hochuli-Vieira E, Lisboa-Filho PN, de Deus CBD, Okamoto R. Front Oral Maxillofac Med 2022;4:1. doi: 10.21037/fomm-21-45

   https://fomm.amegroups.com/article/view/60048/html

   Background: This study aims to analyze the process of bone formation, maturation and mineralization promoted by Cerabone® functionalization with raloxifene in rabbit sinus floor elevation, through immunohistochemical and histomorphometric analyses. **Methods:** Twenty-four male rabbits had their maxillary sinuses filled. To access the sinus cavity a circular window with a diameter of 5 mm was made bilaterally to the midline of the nasal dorsum, the sinus membrane was detached and elevated using special curettes. Autogenous bone (G1), Cerabone® (G2), Cerabone® submitted to ultrasonic processing (G3), Cerabone® associated to raloxifene submitted to ultrasonic processing (G4) were used to fill the maxillary sinus, 14 and 42 days postoperatively. Immunohistochemical and histomorphometric analyses were performed at 14 and 42 days postoperatively. **Results:** At 14 days postoperatively: the immunolabeling for vascular endothelial growth factor (VEGF) was moderate in groups G1, G3 and G4, while in group G2, the same protein was expressed in a mild way. The immunolabeling for alkaline phosphatase (ALP) was moderate in all experimental groups. Histomorphometric analysis showed a greater amount of newly formed bone in groups G1 (55.2%) and G4 (50.1%), which differed statistically from groups G2 (37.5%) and G3 (38.2%). At 42 days postoperatively: receptor activator of nuclear factor kappa-B ligand (RANKL) immunolabeling was slight in G1, intense in G2 and moderate in G3 and G4. The tartrate resistant acid phosphatase (TRAP) protein was slightly expressed in all experimental groups. The osteocalcin (OCN) protein was moderately expressed in the G1 group and intensely in the G2, G3 and G4 groups. As for the histomorphometric analysis, the greatest amount of neoformed bone was found in group G1 (83.5%), followed by group G4 (75.0%). Less neoformed bone was observed in G3 (56.7%), followed by G2 (64.2%). Statistical differences were observed between all experimental groups. **Conclusions:** Better performance was observed in the group in which Cerabone was used in association with raloxifene (G4), with better bone formation responses compared to the experimental groups.

5. LED photobiomodulation therapy combined with biomaterial as a scaffold promotes better bone quality in the dental alveolus in an experimental extraction model.

Dalapria V, Marcos RL, Bussadori SK, Anselmo G, Benetti C, da Silva Santana ACA, Marinho NSR, Pinto RS, de Sales RS, de França LS, Deana AM. Lasers Med Sci. 2022 Apr;37(3):1583-1592. doi: 10.1007/s10103-021-03407-w.

https://pubmed.ncbi.nlm.nih.gov/34767116/

A bone scaffold added to the dental alveolus immediately after an extraction avoids bone atrophy and deformity at the tooth loss site, enabling rehabilitation with implants. Photobiomodulation accelerates bone healing by stimulating blood flow, activating osteoblasts, diminishing osteoclastic activity, and improving the integration of the biomaterial with the bone tissue. The aim of the present study was to evaluate the effect of photobiomodulation with LED at a wavelength of 850 nm on bone quality in Wistar rats submitted to molar extraction with and without a bone graft using hydroxyapatite biomaterial (Straumann® Cerabone®). Forty-eight rats were distributed among five groups (n = 12): basal (no interventions); control (extraction) (basal and control were the same animal, but at different sides); LED (extraction + LED λ = 850 nm); biomaterial (extraction + biomaterial), and biomaterial + LED (extraction + biomaterial + LED λ = 850 nm). Euthanasia occurred at 15 and 30 days after the induction of the extraction. The ALP analysis revealed an improvement in bone formation in the control and biomaterial + LED groups at 15 days ($p = 0.0086$ and $p = 0.0379$, Bonferroni). Moreover, the LED group had better bone formation compared to the other groups at 30 days ($p = 0.0007$, Bonferroni). In the analysis of AcP, all groups had less resorption compared to the basal group. Bone volume increased in the biomaterial, biomaterial + LED, and basal groups in comparison to the control group at 15 days ($p < 0.05$, t-test). At 30 days, the basal group had greater volume compared to the control and LED groups ($p < 0.05$, t-test). LED combined with the biomaterial improved bone formation in the histological analysis and diminished bone degeneration (demonstrated by the reduction in AcP), promoting an increase in bone density and volume. LED may be an important therapy to combine with biomaterials to promote bone formation, along with the other known benefits of this therapy, such as the control of pain and the inflammatory process.

6. Histological and histomorphometrical evaluation of two types of bone substitutes in combination with i-PRF for bone regeneration in critical bone defects: An in vivo study

Ribeiro de Albuquerque Boia, J., Soares, L. F. F., Passos, G. P., dos Santos Neves, J., Mariano, R. C., & Vital Ribeiro Junior, N. (2022). Journal of Osseointegration, 14(4), 217–225.

https://doi.org/10.23805/JO.2022.14.33

Aim: This study aimed to evaluate the bone regeneration performance of two types of xenografts (Bio-Oss, Geistlich Pharma AG, Wolhusen, CH; Cerabone, Institut Straumann, Basel CH) isolated and associated with i-PRF, in critical bone defects in rat calvaria. **Materials and methods:** Surgical defects

were performed and filled with different materials, according to the referred groups: clot (CG), autogenous bone (AG), Bio-Oss® (BO), Cerabone (CB), i-PRF homogenous (i-PRF), Bio-Oss associated with i-PRF (BOPRF) and Cerabone associated with i-PRF (CBPRF). The animals were euthanized for histological and histomorphometric analysis after 4 and 8 weeks. Statistical analysis for bone neoformation assessment was performed by ANOVA and complemented by Tukey's test. **Results:** The AG group exhibited the highest mean values for bone neoformation (37.83 ± 7.96) in this study. Among the bone substitutes, CBPRF group (18.79 ± 5.98) exhibited highest means ($p<0.05$) compared to BO group (10.20 ± 2.82) and CG group (6.96 ± 3.29). i-PRF group (17.07 ± 4.95), BOPRF group (16.86 ± 6.14), BO group (10.20 ± 2.82), and CB group (16.15 ± 4.72) were not significant among them ($p>0.05$). **Conclusions**: According to the results obtained in this study, it was observed that Cerabone® and Bio-Oss®, associated with i-PRF, exhibited a satisfactory applicability to fill critical defects, favoring the bone regeneration process.

7. Hyaluronic Acid with Bone Substitutes Enhance Angiogenesis In Vivo.

Kyyak S, Blatt S, Wiesmann N, Smeets R, Kaemmerer PW. Materials (Basel). 2022 May 27;15(11):3839. doi: 10.3390/ma15113839.

https://botiss.com/product/hyaluronic-acid-with-bone-substitutes-enhance-angiogenesis-in-vivo/

Introduction: The effective induction of angiogenesis is directly related to the success of bone-substitute materials (BSM) for maxillofacial osseous regeneration. Therefore, the addition of pro-angiogenic properties to a commercially available bovine bone-substitute material in combination with hyaluronic acid (BSM+) was compared to the same bone-substitute material without hyaluronic acid (BSM) in an in-vivo model. **Materials and Methods:** BSM+ and BSM were incubated for six days on the chorioallantoic membrane (CAM) of fertilized chicken eggs. Microscopically, the number of vessels and branching points, the vessel area and vessel length were evaluated. Subsequently, the total vessel area and brightness integration were assessed after immunohistochemical staining (H&E, alphaSMA). **Results:** In the BSM+ group, a significantly higher number of vessels ($p < 0.001$), branching points ($p = 0.001$), total vessel area ($p < 0.001$) as well as vessel length ($p = 0.001$) were found in comparison to the BSM group without hyaluronic acid. Immunohistochemically, a significantly increased total vessel area ($p < 0.001$ for H&E, $p = 0.037$ for alphaSMA) and brightness integration ($p = 0.047$) for BSM+ in comparison to the native material were seen. **Conclusions:** The combination of a xenogenic bone-substitute material with hyaluronic acid significantly induced angiogenesis in vivo. This might lead to a faster integration and an improved healing in clinical situations.

8. A novel pilot animal model for bone augmentation using osseous shell technique for preclinical in vivo studies.

Kamal, M., Al-Obaidly, S., Lethaus, B., & Bartella, A. K. (2022). Clinical and Experimental Dental Research, 1–10.

https://doi.org/10.1002/cre2.644

Background: Bone grafting is commonly used for reconstructing skeletal defects in the craniofacial region. Several bone augmentation models were developed to optimize bone regeneration in both vertical and horizontal dimesions. **Aim:** The aim of this study was to develop a surgical animal model for establishing a three-dimensional (3D) grafting environment in the animal's mandibular ramus for horizontal and vertical bone regeneration using osseous shell technique, as in human patients. **Materials and methods:** Initial osteological and imaging survey were performed on a postmortem skull of a New Zealand White (NZW) rabbit skull, Oryctolagus cuniculus, for feasibility assessment for performing the surgical procedure. 3D osseus defect was created in the mandibular ramus through a submandibular incision and the osseous shell plates were stabilized with osteosynthesis fixation screws and defect filled with particular bone grafting material. The *in-vivo* surgical procedures were conducted in four 8-week-old NZW rabbits utilising two osseous shell materials: xenogenic human cortical plates, and autogenous rabbit cortical plates, and the created 3D defects were filled using xenograft and allograft bone grafting materials. The healed defects were evaluated for bone regeneration after 12 weeks using histological and Cone Beam Computed Tomography (CBCT) imaging analysis. **Results:** Clinical analysis at 12 weeks after surgery revealed the stability of the 3D grafted bone augmentation defects using the osseous shell technique. Imaging and histological analyses confirmed the effectiveness of this model in assessing bone regeneration. **Conclusion:** The rabbit model is an efficient and reliable biological method for creating a seizable three-dimensional horizontal and vertical bone regeneration model in the mandibular ramus using osseous shell technique for testing various bone-substitute materials testing without compromising the health of the animal. The filled defects could be analyzed for osteogenesis, quantification of bone formation, and healing potential, using histomorphometric analysis, in addition to 3D morphologic evaluation using radiation imaging.

9. Structural and chemical features of xenograft bone substitutes: A systematic review of *in vitro* studies

Amid R, Kheiri A, Kheiri L, Kadkhodazadeh M, Ekhlasmandkermani M. Biotechnol Appl Biochem. 2021 Dec;68(6):1432-1452. doi: 10.1002/bab.2065.

https://pubmed.ncbi.nlm.nih.gov/33135215/

Xenograft bone substitutes are obtained from different species and prepared by various procedures including heat treatment, hydrazine, and chemical and hydrothermal methods. These grafts are utilized widely because of similar structure and properties to human bone, proper bone formation, and biocompatibility. The aim of this systematic review was to evaluate different xenografts from structural and chemical aspects. *In vitro* studies published in English language, which assessed xenografts' features, met the inclusion criteria. Electronic search of four databases including PubMed,

Google Scholar, Scopus, and Web of Science and a hand search until September 2020 were performed. The irrelevant studies were the ones which focused on cell adhesion and effect of growth factors. Finally, 25 studies were included in the review. Nineteen studies used bovine xenografts, and 12 studies applied heat treatment as their preparation method. Particles showed various morphologies, and their largest size was observed at 5 mm. From 18 studies, it is found that the smallest pore size was 1.3 µm and the highest pore size was 1000 µm. There is large heterogeneity of porosity, crystallinity, Ca/P ratio, and osteogenesis based on the preparation method. Proper porosity and the connection between pores affect bone regeneration. Therefore, biomaterial selection and outcomes evaluation should be interpreted separately.

10. Scaffold-Type Structure Dental Ceramics with Different Compositions Evaluated through Physicochemical Characteristics and Biosecurity Profiles.

Fabricky MMC, Gabor AG, Milutinovici RA, Watz CG, Avram Ş, Drăghici G, Mihali CV, Moacă EA, Dehelean CA, Galuscan A, Buzatu R, Duma VF, Negrutiu ML, Sinescu C. Materials (Basel). 2021 Apr 27;14(9):2266. doi: 10.3390/ma14092266.

https://pubmed.ncbi.nlm.nih.gov/33925656/

The design and development of ceramic structures based on 3D scaffolding as dental bone substitutes has become a topic of great interest in the regenerative dentistry research area. In this regard, the present study focuses on the development of two scaffold-type structures obtained from different commercial dental ceramics by employing the foam replication method. At the same time, the study underlines the physicochemical features and the biological profiles of the newly developed scaffolds, compared to two traditional Cerabone® materials used for bone augmentation, by employing both the in vitro Alamar blue proliferation test at 24, 48 and 96 h poststimulation and the in ovo chick chorioallantoic membrane (CAM) assay. The data reveal that the newly developed scaffolds express comparable results with the traditional Cerabone® augmentation masses. In terms of network porosity, the scaffolds show higher pore interconnectivity compared to Cerabone® granules, whereas regarding the biosafety profile, all ceramic samples manifest good biocompatibility on primary human gingival fibroblasts (HGFs); however only the Cerabone® samples induced proliferation of HGF cells following exposure to concentrations of 5 and 10 µg/mL. Additionally, none of the test samples induce irritative activity on the vascular developing plexus. Thus, based on the current results, the preliminary biosecurity profile of ceramic scaffolds supports the usefulness for further testing of high relevance for their possible clinical dental applications.

11. Physicochemical Properties of Torus Mandibularis and Palatinus Indicate a Source of Autogenous Bone Graft

Martin Luis S. Redor, Rui Zhang, Natthamet Wongsirichat, Ratchapin Laovanitch Srisatjaluk, Teeranut Chaiyasamut, Dutmanee Seriwatanachai. Open Dentistry Journal. Vol.15, No.1 (2021), 357-365. DOI

10.2174/1874210602115010357

https://opendentistryjournal.com/VOLUME/15/PAGE/357/FULLTEXT/

Introduction: There has been extensive research on bone substitutes and autogenous bone; however, little is known about their physical and chemical characteristics of torus mandibularis and palatinus. In the present study, the physical and chemical properties of tori bone and bone graft substitutes were examined. Microbial contamination of torus bone collected during surgery was also investigated. **Objective:** To investigate the physical and chemical properties of torus mandibularis and torus palatinus, and the microbial contamination of tori bone collected during surgery. **Materials and Methods:** Torus mandibularis and palatinus were collected from healthy patients by regular surgical procedure via bone collector and a stringent aspiration protocol. Physicochemical properties such as surface structure, elemental components and the crystalline structure of tori and common bone grafting substitutes (OraGRAFT, BioOss, Cerabone) were examined via SEM-EDS, X-Ray Diffractometry analysis, and calcium dissolution assay. The bacterial morphology and gram staining from the torus samples after the surgery were analyzed. **Results:** The surface structure of tori bone differed greatly from that of bone graft substitutes. An irregular and rough surface structure was found for tori, while bone graft substitutes presented a smooth but dry pattern. Elements found within tori were similar to those within bone graft substitutes; in all cases, carbon, oxygen, sodium, magnesium, phosphate, and calcium were seen. All samples showed high crystallinity, with the highest value in Cerabone, followed by Bio-oss, torus mandibularis, torus palatinus, and Oragraft. Calcium dissolution was highest on the first day in tori samples, whereas it was constantly released until the seventh day in other bone grafts. The microbial contamination was found in all tori samples from the harvesting process, presumably due to saliva contamination. **Conclusion:** Tori bone was different from bone graft substitutes in terms of surface structure, crystallinity, and calcium release. However, tori bone and bone graft substitutes were similar in terms of elemental composition and crystal compounds, which may positively affect their clinical applications. Taken together, our findings suggest that with an effective decontamination, tori bone should be considered as a viable material for bone grafting, as it is not only practical but also cost-efficient for patients.

12. Sinus Mucosa Thinning and Perforations after Sinus Lifting Performed with Different Xenografts: A Histological Analysis in Rabbits

Favero R, Apaza Alccayhuaman KA, Botticelli D, Xavier SP, Ferreira Balan V, Macchi V, De Caro R. Dent J (Basel). 2021 Dec;10(1):2. doi: 10.3390/dj10010002.

https://pubmed.ncbi.nlm.nih.gov/35049600/

Background: Experimental studies have shown a progressive thinning and perforations of the sinus mucosa associated with sharpened edges and the cutting projections of graft particles used

simultaneously for maxillary sinus augmentation. Hence, the aim of the present study was to evaluate the damaging effects of two different bovine grafts on the sinus mucosa after sinus augmentation. **Methods:** Twenty New Zealand rabbits received a bilateral sinus lifting using, as fillers, two different types of deproteinized bovine bone in granules, one processed at low temperature (low-T group), and the other at high temperature (high-T group). Thinned mucosa sites (<40 µm) and perforations were evaluated in the sinus mucosa that were in contact with graft granules after 2 and 10 weeks, in ten animals per period. **Results:** After 2 weeks of healing, the number of thinned mucosa sites was 118 in the low-T group, and 149 in the high-T group (p = 0.191). At the 10-week assessment, the thinned sites increased to 237 and 195 sites, respectively. The numbers of sinus mucosa perforations after 2 weeks were eight and three in the low-T and high-T group, respectively. At the 10-week evaluation, the perforations increased to 19 in the low-T group, and to 14 in the high-T group. **Conclusions:** The contact with bovine xenografts yielded thinning and perforations of the sinus mucosa. Despite the differences in characteristics and dimensions, no differences were found between the two xenografts in the numbers of thinning mucosa sites and perforations. However, a trend of more events was found in the low-T compared to the high-T group.

13. Critical-size Defect Augmentation Using Sintered and Non-Sintered Bovine Bone Matrix - An Experimental Controlled Study in Minipigs

Schorn L, Fienitz T, De Donno F, Sterner-Kock A, Maul AC, Holtmann H, Lommen J, Rothamel D. J Oral Maxillofac Surg. 2021 Sep;79(9):1866-1873. doi: 10.1016/j.joms.2021.03.025.

https://pubmed.ncbi.nlm.nih.gov/34051155/

Purpose: Xenogeneic bone substitute materials are often used for augmentation of larger bone defects. Purification methods for these materials vary, mainly in terms of temperature. The aim of this study was to determine *in vivo* how sintering affects quantitative and qualitative bone regeneration of 2 bovine augmentation materials. **Methods:** A total of 56 critical size defects were set at the frontal bone of 14 domestic pigs (4 each) and filled randomly with either bovine, sintered hydroxyapatite (BO), bovine, non-sintered hydroxyapatite (BOS), local autologous bone (AB) or left empty. All defects were additionally covered with a collagen membrane. Specimens were harvested after 4 and 8 weeks and were evaluated histologically and histomorphometrically. **Results:** Histologically new bone could be seen in every group. Significantly highest new bone formation was found in AB. No significant difference could be detected between BO and BOS. **Conclusions:** According to the results of this study, sintered bone substitute material remains histologically distinguishable but does not affect quantitative and qualitative bone regeneration.

14. Cytocompatibility of Bone Substitute Materials and Membranes

Schafer S, Al-Qaddo H, Gosau M, Smeets R, Hartjen P, Friedrich RE, Nada OA, Vollkommer T, Rashad A. 2021 Jul-Aug;35(4):2035-2040. doi: 10.21873/invivo.12472.

https://pubmed.ncbi.nlm.nih.gov/34182478/

Background/aim: With the demographic change and associated chronic bone loss, the need for cytocompatible bone replacement materials arise in modern medicine. The aim of this *in vitro* study was to investigate the cytocompatibility of eleven different bone substitute materials and membranes. **Materials and methods:** Seven bone substitute materials and four membranes were assessed in vitro. The specimens were tested based on their interaction with MC3T3 pre-osteoblasts, through the utilization of viability, proliferation, and cytotoxicity assays. Cell vitality was evaluated using live-dead staining. **Results:** Although we found minor differences in cytocompatibility among the assessed materials, all tested materials can be considered as cytocompatible with a viability of more than 70% of the negative control, which indicates the non-toxic range as defined in current, international standards (DIN EN ISO 10993-5:2009, German Institute for Standardization, Berlin, Germany). Direct live-dead staining assays confirmed satisfactory cytocompatibility of all tested membranes. **Conclusion:** All examined bone substitute materials and membranes were found to be cytocompatible. In order to assess whether the observed minor differences can impact regenerative processes, further *in vivo* studies need to be conducted.

15. Osseointegration of different implant surfaces in areas grafted with deproteinized bovine bone associated or not with fresh bone marrow-Preclinical study in rabbits

Leocádio ACS, Silva M Jr, de Oliveira GJPL, Marcantonio É Jr. Clin Oral Implants Res. 2021 Jun;32(6):767-775. doi: 10.1111/clr.13746.

https://pubmed.ncbi.nlm.nih.gov/33749041/

Objectives: To assess the influence of two different implant surfaces on osseointegration in maxillary sinuses of rabbits previously grafted with deproteinized bovine bone (DBB) associated or not with fresh bone marrow (BM). **Material and methods:** Sixteen New Zealand albino rabbits (males, 3.5/4.5 kg and 9-12 months old) were randomly divided into two groups with 8 rabbits each, according to the type of association of biomaterials used to fill the animals' maxillary sinuses: DBB (Deproteinized Bovine Bone) and DBB/BM (Deproteinized bovine bone associated with fresh autologous bone marrow). Ninety (90) days following the grafting procedure, the animals received implants in the area with two different microstructures (SA-Sandblasting + acid attack and SA-H-Sandblasting + acid attack + immersion in 0.9% sodium chloride isotonic solution). All rabbits were euthanized 90 days after implant placement. The microtomographic analysis was performed to verify the number of mineralized tissues around the implants throughout their length (%BV/TV), while the histomorphometric analysis was performed to verify the percentage of bone-implant contact around the implants throughout their length (%BIC). **Results:** We observed no differences in the quantity for %BV/TV (DBB-SA:33.25 ± 19.67; DBB-SA-

H:35.15 ± 22.17; DBB/BM-SA:39.71 ± 24.21; DBB/BM-SA-H:36.40 ± 23.07) and %BIC (DBB-SA:58.94 ± 24.37; DBB-SA-H:52.52 ± 24.36; DBB/BM-SA: 61.66 ± 14.60; DBB/BM-SA-H: 64.06 ± 23.30) between the groups assessed. **Conclusions:** The addition of BM and the type of surface did not influence the osseointegration of implants installed in areas grafted with sintered deproteinized bovine bone at high temperatures in the late period assessed.

16. Effects of Different Bone Substitutes on Reactive Oxygen Species Release in Leukocytes *in Vitro*: A Pilot Study

Nomeika D, Jasiunas A, Janužis G, Skrodenienė E, Banienė R, Juodžbalys G. Int J Oral Maxillofac Implants. 2021 May-Jun;36(3):e42-e50. doi: 10.11607/jomi.8592.

https://pubmed.ncbi.nlm.nih.gov/34115064/

Purpose: To evaluate the formation of reactive oxygen species in human leukocytes promoted by bone substitutes that are different in origin and morphology used for jawbone tissue regeneration. **Materials and methods:** This preclinical prospective randomized crossover study involved 10 subjects, from whom venous blood samples were taken. Leukocytes were separated and standardized. Sixty experimental samples consisted of leukocytes incubated with allogeneic, xenogeneic, or alloplastic bone substitutes at different bone weights (12.5 and 25 mg). The control samples consisted only of incubated leukocytes. Reactive oxygen species were quantitatively determined with the fluorimetric method. Statistical analysis was carried out using SPSS 23 software. **Results:** The highest average reactive oxygen species values were obtained in the allogeneic bone substitute group ($P < .05$), while the xenogeneic bone substitute group and control group presented equal reactive oxygen species formation rates ($P > .05$). A proportional difference ($P < .05$) of reactive oxygen species emission was obtained between different masses of bone substitute in the samples. **Conclusion:** Allogeneic and alloplastic bone substitutes affect leukocytes and promote reactive oxygen species emission. Xenogeneic bone substitute presents no leukocyte stimulation and maintains anti-inflammatory conditions. Larger bone substitute mass provokes greater oxidative stress.

17. *In Vivo* Analysis of the Biocompatibility and Bone Healing Capacity of a Novel Bone Grafting Material Combined with Hyaluronic Acid

Pröhl A, Batinic M, Alkildani S, Hahn M, Radenkovic M, Najman S, Jung O, Barbeck M. Int J Mol Sci. 2021 May;22(9):4818. doi: 10.3390/ijms22094818.

https://pubmed.ncbi.nlm.nih.gov/34062885/

The present *in vivo* study analyses both the inflammatory tissue reactions and the bone healing capacity of a newly developed bone substitute material (BSM) based on xenogeneic bone substitute granules combined with hyaluronate (HY) as a water-binding molecule. The results of the hyaluronate containing

bone substitute material (BSM) were compared to a control xenogeneic BSM of the same chemical composition and a sham operation group up to 16 weeks post implantationem. A major focus of the study was to analyze the residual hyaluronate and its effects on the material-dependent healing behavior and the inflammatory tissue responses. The study included 63 male Wistar rats using the calvaria implantation model for 2, 8, and 16 weeks post implantationem. Established and Good Laboratory Practice (GLP)-conforming histological, histopathological, and histomorphometrical analysis methods were conducted. The results showed that the new hyaluronate containing BSM was gradually integrated within newly formed bone up to the end of the study that ended in a condition of complete bone defect healing. Thereby, no differences to the healing capacity of the control BSM were found. However, the bone formation in both groups was continuously significantly higher compared to the sham operation group. Additionally, no differences in the (inflammatory) tissue response that was analyzed via qualitative and (semi-) quantitative methods were found. Interestingly, no differences were found between the numbers of pro- and anti-inflammatory macrophages between the three study groups over the entire course of the study. No signs of the HY as a water-binding part of the BSM were histologically detectable at any of the study time points, altogether the results of the present study show that HY allows for an optimal material-associated bone tissue healing comparable to the control xenogeneic BSM. The added HY seems to be degraded within a very short time period of less than 2 weeks so that the remaining BSM granules allow for a gradual osteoconductive bone regeneration. Additionally, no differences between the inflammatory tissue reactions in both material groups and the sham operation group were found. Thus, the new hyaluronate containing xenogeneic BSM and also the control BSM have been shown to be fully biocompatible without any differences regarding bone regeneration.

18. The Influence of Hyaluronic Acid Biofunctionalization of a Bovine Bone Substitute on Osteoblast Activity *In Vitro*

Kyyak S, Pabst A, Heimes D, Kämmerer PW. Materials (Basel). 2021 May;14(11):2885. doi: 10.3390/ma14112885.

https://pubmed.ncbi.nlm.nih.gov/34072146/

Bovine bone substitute materials (BSMs) are used for oral bone regeneration. The objective was to analyze the influence of BSM biofunctionalization via hyaluronic acid (HA) on human osteoblasts (HOBs). BSMs with ± HA were incubated with HOBs including HOBs alone as a negative control. On days 3, 7 and 10, cell viability, migration and proliferation were analyzed by fluorescence staining, scratch wound assay and MTT assay. On days 3, 7 and 10, an increased cell viability was demonstrated for BSM+ compared with BSM- and the control (each $p \leq 0.05$). The cell migration was enhanced for BSM+ compared with BSM- and the control after day 3 and day 7 (each $p \leq 0.05$). At day 10, an accelerated wound closure was found for the control compared with BSM+/- (each $p < 0.05$). The highest proliferation rate was observed for BSM+ on day 3 ($p \leq 0.05$) followed by BSM- and the control (each p

≤ 0.05). At day 7, a non-significantly increased proliferation was shown for BSM+ while the control was higher than BSM- (each p < 0.05). The least proliferation activity was observed for BSM- (p < 0.05) at day 10. HA biofunctionalization of the BSMs caused an increased HOB activity and might represent a promising alternative to BSM- in oral bone regeneration.

19. Microtomographic reconstruction of mandibular defects treated with xenografts and collagen-based membranes: A pre-clinical minipig model

Gomez J, Bergamo ET, Tovar N, Talib HS, Pippenger BE, Herdia V, Cox M, Coelho PG, Witek L. Med Oral Patol Oral Cir Bucal. 2021 Nov;26(6):e825-e833. doi: 10.4317/medoral.24811.

https://pubmed.ncbi.nlm.nih.gov/34564687/

Background: The goal of this study was to evaluate hard tissue response following guided bone regeneration using commercially available bovine bone grafts and collagen membranes; bilayer collagen membrane and porcine pericardium-based membrane, by means of a non-destructive three-dimensional (3D) computerized volumetric analysis following microtomography reconstruction. **Material and methods:** Bone regenerative properties of various bovine bone graft materials were evaluated in the Göttingen minipig model. Two standardized intraosseous defects (15mm x 8mm x 8mm) were created bilaterally of the mandible of eighteen animals (n=72 defects). Groups were nested within the same subject and randomly distributed among the sites: (i) negative control (no graft and membrane), (ii) bovine bone graft/bilayer collagen membrane (BOB) (iii) Bio-Oss® bone graft/porcine pericardium-based membrane (BOJ) and (iv) cerabone® bone graft/porcine pericardium-based membrane (CJ). Samples were harvested at 4, 8, and 12-week time points (n=6 animal/time point). Segments were scanned using computerized microtomography (µCT) and three dimensionally reconstructed utilizing volumetric reconstruction software. Statistical analyses were performed using IBM SPSS with a significance level of 5%. **Results:** From a temporal perspective, tridimensional evaluation revealed gradual bone ingrowth with the presence of particulate bone grafts bridging the defect walls, and mandibular architecture preservation over time. Volumetric analysis demonstrated no significant difference between all groups at 4 weeks (p>0.127). At 8 and 12 weeks there was a higher percentage of new bone formation for control and CJ groups when compared to BOB and BOJ groups (p<0.039). The natural bovine bone graft group showed more potential for graft resorption over time relative to bovine bone graft, significantly different between 4 and 8 weeks (p<0.003). **Conclusions:** Volumetric analysis yielded a favorable mandible shape with respect to time through the beneficial balance between graft resorption/bone regenerative capacity for the natural bovine bone graft.

20. Evaluation of air polishing with a sterile powder and mechanical debridement during regenerative surgical periimplantitis treatment: a study in dogs

Solderer A, Pippenger BE, Donnet M, Wiedemeier D, Ramenzoni LL, Schmidlin PR. Clin Oral Investig. 2021 May;25(5):2609-2618. doi: 10.1007/s00784-020-03572-2.

https://pubmed.ncbi.nlm.nih.gov/32914269/

Objectives: To evaluate the effectiveness of mechanical debridement and/or air polishing on the healing of ligature-induced buccal periimplantitis dehiscence defects in dogs. **Material and methods:** Forty-eight implants were placed in the mandibles of twelve beagle dogs, and periimplantitis was induced for 2 months using ligatures. The resulting buccal dehiscence-type defects were surgically cleaned and augmented (xenogenic filler and resorbable membrane) according to one of the following treatments: (1) Cleaning with carbon curette (debridement - D) and guided bone regeneration (GBR/G): DG, (2) air polishing cleaning (A) and GBR: AG, (3) a combination of D/A/G: DAG, and (4) D/A without GBR: DA. After 2 months, histomorphometric and inflammatory evaluations were conducted. **Results:** The median bone gain after therapy ranged between 1.2 mm (DG) and 2.7 mm (AG). Relative bone gain was between 39% (DG) and 59% (AG). The lowest inflammation scores were obtained in DA without GBR (5.84), whereas significantly higher values between 8.2 and 9.4 were found in the groups with augmentation. At lingual sites without defects, scores ranged from 4.1 to 5.9. According to ISO, differences above 2.9 were considered representative for irritative properties. **Conclusions:** All treatments resulted in partial regeneration of the defects. No treatment group showed a significantly ($p < 0.05$) better outcome. However, pretreatment with air polishing showed a tendency for less inflammation. Noteworthy, inflammation assessment showed an overall irritative potential after GBR in the evaluated early healing phase. **Clinical relevance:** Periimplantitis treatment still represents a big issue in daily practice and requires additional preclinical research in order to improve treatment concepts.

21. Possible Implications for Improved Osteogenesis? The Combination of Platelet-Rich Fibrin With Different Bone Substitute Materials

Blatt S, Thiem DGE, Kyyak S, Pabst A, Al-Nawas B, Kämmerer PW. Front Bioeng Biotechnol. 2021 Mar;9:640053. doi: 10.3389/fbioe.2021.640053.

https://pubmed.ncbi.nlm.nih.gov/33816452/

Bone substitute materials (BSM) are widely used in oral regeneration, but sufficient angiogenesis is crucial for osteogenesis. The combination of BSM with autologous thrombocyte concentrations such as platelet-rich fibrin (PRF) may represent a clinical approach to overcome this limitation. This study analyzes the early influence on osteoblast (HOB) *in vitro*. Here, four different BSM (allogeneic, alloplastic, and two of xenogeneic origin) were combined with PRF. After the incubation with osteoblasts for 24 h, cell viability, migration, and proliferation were assessed. Next, marker of proliferation, migration, and differentiation were evaluated on gene and protein levels in comparison to the native BSM and osteoblast alone. Addition of PRF increased viability for both the xenogeneic BSM ($p = 0.0008$, $p = 0.032$, respectively) in comparison to HOB and vs. native BSM ($p = 0.008$), and led to a tendency for increased cell proliferation and migration for all BSM (each $p > 0.05$). On gene basis,

allogeneic and alloplastic BSM displayed a significantly increased RUNX2 expression (each p = 0.050). Expression of alkaline phosphatase for alloplastic (p = 0.050) and collagen-1 for xenogeneic BSM (p = 0.05) were significantly increased in combination with PRF. In addition, bone morphogenic protein was expressed significantly higher when xenogeneic material was combined with PRF in comparison to HOB alone (each p = 0.05). In summary, the combination of PRF with different BSM increases initial viability and may influence early proliferation and migration potential of osteoblast via RUNX2, alkaline phosphatase, collagen, and BMP2 especially in combination with alloplastic and xenogeneic BSM. Biofunctionalization of BSM using PRF might improve osteogenesis and extend the range of indications.

22. Activation of Human Osteoblasts via Different Bovine Bone Substitute Materials With and Without Injectable Platelet Rich Fibrin in vitro

Kyyak S, Blatt S, Schiegnitz E, Heimes D, Staedt H, Thiem DGE, Sagheb K, Al-Nawas B, Kämmerer PW. Front Bioeng Biotechnol. 2021 Feb;9:599224. doi: 10.3389/fbioe.2021.599224.

https://pubmed.ncbi.nlm.nih.gov/33681155/

Introduction: The aim of the in vitro study was to compare the effect of four bovine bone substitute materials (XBSM) with and without injectable platelet-reach fibrin for viability and metabolic activity of human osteoblasts (HOB) as well as expression of alkaline phosphatase (ALP), bone morphogenetic protein 2 (BMP-2), and osteonectin (OCN). **Materials and methods:** Cerabone® (CB), Bio-Oss® (BO), Creos Xenogain® (CX) and MinerOss® X (MO) ± i-PRF were incubated with HOB. At day 3, 7, and 10, cell viability and metabolic activity as well as expression of ALP, OCN, and BMP-2, was examined. **Results:** For non-i-PRF groups, the highest values concerning viability were seen for CB at all time points. Pre-treatment with i-PRF increased viability in all groups with the highest values for CB-i-PRF after 3 and 7 and for CX-i-PRF after 10 days. For metabolic activity, the highest rate among non-i-PRF groups was seen for MO at day 3 and for CB at day 7 and 10. Here, i-PRF groups showed higher values than non-i-PRF groups (highest values: CB + i-PRF) at all time points. There was no difference in ALP-expression between groups. For OCN expression in non-i-PRF groups, CB showed the highest values after day 3, CX after day 7 and 10. Among i-PRF-groups, the highest values were seen for CX + i-PRF. At day 3, the highest BMP-2 expression was observed for CX. Here, for i-PRF groups, the highest increase was seen for CX + i-PRF at day 3. At day 7 and 10, there was no significant difference among groups. **Conclusion**: XBSM sintered under high temperature showed increased HOB viability and metabolic activity through the whole period when compared to XBSM manufactured at lower temperatures. Overall, the combination of XBSM with i-PRF improved all cellular parameters, ALP and BMP-2 expression at earlier stages as well as OCN expression at later stages.

23. A Novel Xenograft Bone Substitute Supports Stable Bone Formation in Circumferential Defects Around Dental Implants in Minipigs

Catros S, Sandgren R, Pippenger BE, Fricain JC, Herber V, El Chaar E. Int J Oral Maxillofac Implants. 2020 Nov/Dec;35(6):1122-1131. doi: 10.11607/jomi.8265. PMID: 33270052.

https://pubmed.ncbi.nlm.nih.gov/33270052/

Purpose: The aim of this study was to evaluate and compare bone growth and implant integration in circumferential defects with two commercially available bone substitutes (demineralized bovine bone mineral [DBBM]). **Materials and methods:** Circumferential defects were created in the mandibles of minipigs (n = 10), and Bone Level Tapered implants (Straumann Roxolid with SLActive surface) were placed. The defects (4-mm-deep circumferential defect, 2 mm around each implant) were augmented with either sintered bovine bone mineral (test, cerabone) or natural bovine bone mineral (control, Bio-Oss). Bone formation and tissue composition in augmented sites were histomorphometrically assessed after 8 and 12 weeks of healing time (n = 5 each), respectively, in terms of the percentage of area of newly formed bone to total area, bone-to-implant contact (BIC), and crestal bone height relative to the implant shoulder (first bone-to-implant contact [fBIC]). **Results:** Bone formation in all defect sites was adequate and equivalent for both groups at individual healing time points. The amount of residual graft material was comparable in both groups after 8 and 12 weeks, with no significant resorption in either group. The mean newly formed bone area in the test group amounted to 46.7% ± 5.1% and 48.7% ± 4.0% after 8 and 12 weeks vs 47.0% ± 4.8% and 47.8% ± 7.3% in the control group, respectively. BIC and fBIC as individually assessed for the lingual and buccal aspects were comparable at both healing time points without any statistically significant differences between the groups. A slightly greater variability of fBIC was observed within the test group. **Conclusion:** The results of this study indicate that test and control materials both represent viable bovine bone graft material that equivalently support the formation of new and stable bone volume specifically when used for simultaneous augmentation around implants.

24. The Impact of Compaction Force on Graft Consolidation in a Guided Bone Regeneration Model

Viteri-Agustín I, Brizuela-Velasco A, Lou-Bonafonte JM, Jiménez-Garrudo A, Chávarri-Prado D, Pérez-Pevida E, Benito-Garzón L, Gruber R. Int J Oral Maxillofac Implants. 2020 Sep/Oct;35(5):917-923. doi: 10.11607/jomi.8082.

https://botiss.com/product/the-impact-of-compaction-force-on-graft-consolidation-in-a-guided-bone-regeneration-model/

Purpose: Compaction of particulated grafts is done manually; thus, the effect of compression force on bone regeneration remains unclear. The aim of this study was to evaluate the impact of two different compression forces on the consolidation of particulated bovine hydroxyapatite. **Materials and methods:** Two titanium cylinders were fixed on the calvarium of eight New Zealand rabbits. Both

defects were filled with particulated bovine hydroxyapatite subjected to a compression force of 0.7 kg/cm2 or 1.6 kg/cm2 before being covered with a resorbable collagen membrane. A handheld device that uses a spring to control the compression force applied by the plugger was used. At 6 weeks, histomorphometry of the area immediately adjacent to the calvaria bone and to the collagen membrane was performed. **Results:** It was shown that next to the calvaria, the bone volume per tissue volume (BV/TV) was 29.0% ± 8.8% and 27.6% ± 8.2% at low and high compression force, respectively; the bone-to-biomaterial contact (BBC) was 58.2% ± 25.0% and 69.3% ± 22.9%, respectively (P > .05). In the corresponding area next to the collagen membrane, BV/TV was 4.9% ± 5.1% and 5.7% ± 4.7%, and the BBC was 18.3% ± 20.8% and 20.1% ± 15.9%, respectively (P > .05). In addition, the number and area of blood vessels were not significantly affected by compression force. **Conclusion:** Both compression forces applied resulted in similar consolidation of bovine hydroxyapatite expressed by new bone formation and vascularization based on a rabbit calvaria augmentation model.

25. Albumin-impregnated bone granules modulate the interactions between mesenchymal stem cells and monocytes under in vitro inflammatory conditions

Mijiritsky E, Gardin C, Ferroni L, Lacza Z, Zavan B. Mater Sci Eng C Mater Biol Appl. 2020 May;110:110678. doi: 10.1016/j.msec.2020.110678.

https://pubmed.ncbi.nlm.nih.gov/32204105/

Bone regeneration around newly implanted biomaterials is a complex process, which in its early phases involves the interactions between Mesenchymal Stem Cells (MSCs) and immune cells. The response of these cells to the biomaterial depends both on the local microenvironment and on the characteristics of the inserted bone substitute. In this work, bone allografts impregnated with albumin are loaded with a co-culture of human MSCs and monocytes; bone granules without albumin are used for comparison. Co-cultures are contextually treated with pro-inflammatory cytokines to simulate the inflammatory milieu naturally present during the bone regeneration process. As revealed by microscopic images, albumin-impregnated bone granules promote adhesion and interactions between cells populations. Compared to control granules, albumin coating diminishes reactive species production by cells. This reduced oxidative stress may be attributable to antioxidant properties of albumin, and it is also reflected in the mitigated gene expression of mitochondrial electron transport chain complexes, where most intracellular reactive molecules are generated. MSCs-monocytes co-cultured onto albumin-impregnated bone granules additionally release higher amounts of immunomodulatory cytokines and growth factors. In summary, this work demonstrates that impregnation of bone granules with albumin positively modulates the interactions between MSCs and immune cells, consequently influencing their mutual activities and immunomodulatory functions.

26. Bone regeneration in rabbit calvarial defects using PRGF and adipose-derived stem cells: histomorphometrical analysis

Stumbras A, Kuliesius P, Darinskas A, Kubilius R, Zigmantaite V and Juodzbalys G. Regen Med. 2020 Apr; 15(4):1535-1549. doi: 10.2217/rme-2019-0123.

https://pubmed.ncbi.nlm.nih.gov/32452715/

The aim of the study was to evaluate the osteogenic potential of adipose-derived stem cells (ADSCs) and to assess the influence of plasma rich in growth factors (PRGF) on bone regeneration using ADSCs. **Materials/ Methods**: Bone defects were randomly allocated to the five treatment modalities: spontaneous healing, natural bovine bone mineral (BBM- cerabone®), BBM loaded with PRGF, BBM loaded with ADSCs and BBM loaded with a combination of ADSCs and PRGF. **Results:** The PRGF significantly enhanced the biomaterial-to-bone contact. Defects treated with ADSCs and PRGF or a combination of both showed the greatest bone regeneration. **Conclusion:** Combining PRGF and ADSCs boosts the bone graft regenerative potential at the earliest period of healing.

27. The Influence of Local Pamidronate Application on Alveolar Dimensional Preservation after Tooth Extraction—An Animal Experimental Study*

Kauffmann F, Höhne C, Assaf AT, Vollkommer T, Semmusch J, Reitmeier A, Stein JM, Heiland M, Smeets R, Rutkowski R. Int J Mol Sci. 2020 May;21(10):3616. doi: 10.3390/ijms21103616.

https://www.mdpi.com/1422-0067/21/10/3616

The aim of this randomized, controlled animal exploratory trial was to investigate the influence of local application of aminobisphosphonate pamidronate during the socket preservation procedure. Mandibular premolars were extracted in five Göttingen minipigs. Two animals underwent socket preservation using BEGO OSS (n = 8 sockets) and three animals using BEGO OSS + Pamifos (15 mg) (n = 12 sockets). After jaw impression, cast models (baseline, eight weeks postoperative) were digitized using an inLab X5 scanner (Dentsply Sirona) and the generated STL data were superimposed and analyzed with GOM Inspect 2018 (GOM, Braunschweig). After 16 weeks, the lower jaws were prepared and examined using standard histological methods. In the test group (BEGO OSS + pamidronate), buccooral dimensional loss was significantly lower, both vestibulary (0.80 ± 0.57 mm vs. 1.92 ± 0.63 mm; p = 0.00298) and lingually (1.36 ± 0.58 mm vs. 2.56 ± 0.65 mm; p = 0.00104) compared with the control group (BEGO OSS). The test group showed a significant difference between vestibular and lingual dimensional loss (p = 0.04036). Histology showed cortical and cancellous bone in the alveolar sockets without signs of local inflammation. Adjuvant application of pamidronate during socket preservation reduces alveolar dimensional loss significantly. Further investigations with regard to dose-response relationships, volume effects, side effects, and a verification of the suitability in combination with other bone substitute materials (BSMs) are necessary.

*Study refers to BEGO OSS, which was a private label of cerabone®.

28. Evaluation of efficacy of platelet-rich fibrin membrane and bone graft in coverage of immediate dental implant in esthetic zone: An in vivo study

Soni R, Priya A, Agrawal R, Bhatnagar A, Kumar L. Natl J Maxillofac Surg. 2020 Jan-Jun;11(1):67-75. doi: 10.4103/njms.NJMS_26_19.

https://pubmed.ncbi.nlm.nih.gov/33041580/

Objective: This study compared and evaluated the clinical and radiographic results of guided bone regeneration using platelet-rich fibrin (PRF) and collagen membrane as barrier membrane in immediately placed implants with severe buccal bone defect (with respect to marginal bone level, implant stability quotient [ISQ]), and histological analysis of new bone formation. **Materials and methods:** Sixteen implants were placed in patients requiring immediate implant placement and having a buccal wall defect and randomly divided into two groups one receiving PRF membranes and other collagen membrane. The sites were grafted with bone-substitute material in both the groups. After 4 months, at the time of second-stage surgery, implant stability is measured by Osstell Mentor, crestal bone level on mesial and distal sides of implant by digital intraoral periapical, buccal defect clinically by probe and histological analysis of biopsied bone. **Results:** The results were insignificant and comparable in both the groups when comparison was made between the groups. The mean buccal defect, mean values of average ISQ, crestal bone level in both the groups at baseline and after 4 months were compared. No significant difference between both the groups was found after 4 months. Bone quality seemed to be equal in both groups after histological analysis. Within the limits of the study, both the groups had shown similar results in all criteria.

29. CSBD Healing in Rats after Application of Bovine Xenogeneic Biomaterial Enriched with Magnesium Alloy

Jerbić Radetić AT, Zoričić Cvek S, Tomas M, Erjavec I, Oguić M, Perić Kačarević Ž, Cvijanović Peloza O. Int J Mol Sci. 2021 Aug;22(16):9089. doi: 10.3390/ijms22169089.

https://pubmed.ncbi.nlm.nih.gov/34445794/

Xenogeneic biomaterials Cerbone® and OsteoBiol® are widely used in oral implantology. In dental practice, xenogeneic biomaterial is usually combined with autologous bone to provide bone volume stability needed for long-term dental implants. Magnesium alloy implants dissolve and form mineral corrosion layer that is directly in contact with bone tissue, allowing deposition of the newly formed bone. CSBD heals by intramembranous ossification and therefore is a convenient model for analyses of ostoconductive and osteoinductive properties of different type of biomaterials. Magnesium alloy-enriched biomaterials have not yet been applied in oral implantology. Therefore, the aim of the current study was to investigate biological properties of potentially new bovine xenogeneic biomaterial

enriched with magnesium alloy in a 5 mm CSBD model. Osteoconductive properties of Cerabone®, Cerabone® + Al. bone, and OsteoBiol® were also analyzed. Dynamics of bone healing was followed up on the days 3, 7, 15, 21, and 30. Calvary bone samples were analyzed by micro-CT, and values of the bone morphometric parameters were assessed. Bone samples were further processed for histological and immunohistochemical analyses. Histological observation revealed CSBD closure at day 30 of the given xenogeneic biomaterial groups, with the exception of the control group. TNF-α showed high intensity of expression at the sites of MSC clusters that underwent ossification. Osx was expressed in pre-osteoblasts, which were differentiated into mature osteoblasts and osteocytes. Results of the micro-CT analyses showed linear increase in bone volume of all xenogeneic biomaterial groups and also in the control. The highest average values of bone volume were found for the Cerabone® + Mg group. In addition, less residual biomaterial was estimated in the Cerabone® + Mg group than in the Cerabone® group, indicating its better biodegradation during CSBD healing. Overall, the magnesium alloy xenogeneic biomaterial demonstrated key properties of osteoinduction and biodegradidibility during CSBD healing, which is the reason why it should be recommended for application in clinical practice of oral implantology.

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

Blatt S, Thiem DGE, Pabst A, Al-Nawas B, Kämmerer PW. Biomedicines. 2021 Jan;9(1):61. doi: 10.3390/biomedicines9010061.

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

The impaired angiogenic potential of bone substitute materials (BSMs) may limit regenerative processes. Therefore, changes in the angiogenetic 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 ß (TGFß) 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.

31. Enamel matrix derivative in liquid form as adjunct to natural bovine bone grafting at buccal bone dehiscence defects at implant sites: An experimental study in beagle dogs

Ikawa T, Akizuki T, Shujaa Addin A, Fukuba S, Stavropoulos A, Izumi Y. Clin Oral Implants Res. 2019 Oct;30(10):989-996. doi: 10.1111/clr.13512.

https://pubmed.ncbi.nlm.nih.gov/31319440/

Aim: Evaluation of the effect of enamel matrix derivative in liquid form (EMD-liquid) as adjunct to grafting with natural bovine bone (NBB- cerabone®), on new bone formation and osseointegration in buccal dehiscence defects at dental implants. **Material and methods:** In six beagles, 3 months after extraction of the mandibular premolars and first molars. Three titanium implants (3.3 Ø × 8.0 mm) were inserted, and dehiscence-type defects (mesiodistal width 3 mm × 5 mm depth) were created on their buccal aspect. The defects were randomly assigned to one of the following three treatment groups: Group 1: NBB-cerabone®, Group 2: NBB-cerabone®/EMD-L, Group 3: Control. All sites were covered with a collagen membrane (collprotect® membrane). Histomorphometric measurements were performed after 3 months of healing. **Results:** New bone area, bone-to-implant contact (BIC), and first BIC (fBIC) in the NBB-cerabone® and NBB-cerabone®/EMD-L groups were significantly greater than in the control group ($p < .05$). Further, f-BIC was at a significantly more coronal position in the NBB + EMD-liquid group (0.4 ± 0.1 mm) compared with the NBB group (1.2 ± 0.2 mm). **Conclusions:** cerabone® enhances bone regeneration and osseointegration at implants with buccal bone dehiscences compared with no grafting, and adjunct use of EMD-liquid appears to further enhance bone formation and osseointegration.

32. Raman Spectroscopy: Application in Periodontal and Oral Regenerative Surgery for Bone Evaluation

E. Gatin, P. Nagy, I. Paun, O. Dubok, V. Bucur, P. Windisch. IRBM, Volume 40, Issue 5, 2019, Pages 279-285, ISSN 1959-0318.

https://doi.org/10.1016/j.irbm.2019.05.002

Objectives: The aim of this study is to evidence the importance of the phase changes for calcified tissues evolution to the stage of “mature bone” and to define a precise meaning of bone regeneration process using Raman spectroscopy. **Materials and Methods:** Reference calcium phosphates compounds and harvested bone samples from selected patients were used. Investigation method was mainly based on

Raman spectroscopy. **Results:** The specific peaks for the Raman shift were traced for reference calcium phosphates compounds and bone samples, as follows: 430 – 450 cm-1 (v2, PO43-), 955 – 960 cm-1 (immature bone, amorphous bone), 960 – 965 cm-1 (mature bone, mineral bone) and 1023 cm-1 (P2O, PPi - inorganic pyrophosphate). Depending on CO quantity, its florescence peak is more or less stronger. The Raman shift corresponding to collagen proteins belongs to 800 – 900 cm−1 interval and it is the most relevant sector for spectra curvature. **Conclusions:** The spectra intensity variation related to the specific bone constituents' concentrations, before and after healing, is reflecting the rate of the healing process mostly by the changes that occurred for the calcified tissues. Moreover, the bone sample fluorescence is related to the collagen content, enabling the quantification of healing process. **Clinical relevance:** Therefore, since a complete evaluation of the processed spectra offers quantitative information for bone samples, Raman spectroscopy can be considered a viable investigation method (even forensics) for periodontal disease and bone quality assessment.

33. Osseointegration of Superhydrophilic Implants Placed in Defect Grafted Bones.

El Chaar E, Zhang L, Zhou Y, Sandgren R, Fricain JC, Dard M, Pippenger B, Catros S. Int J Oral Maxillofac Implants. 2019 March/April;34(2):443–450. doi: 10.11607/jomi.7172.

https://pubmed.ncbi.nlm.nih.gov/30703182/

The goal of this study was the analysis and comparison of bone formation around implants with a superhydrophilic modSLA (SLActive) or hydrophobic SLA (SLA) surface. **Methods:** Straumann® Roxolid, Ø 3.3 mm, length 8 mm, either SLA or SLActive, were implanted in circumferential defects in minipig mandibles. Following implant placement, the 2-mm circumferential defects around the implants were filled with maxgraft® or cerabone®. Distance from implant shoulder to first bone-to-implant contact (f-BIC), percentage of bone-to-implant contact (BIC), and bone aggregate percentage (amount of new bone and remaining graft) within the defect area were evaluated after 8 weeks of healing. **Results:** In the cerabone® group, lingual fBIC and buccal BIC were significantly lower for SLA (mean -0.404 ± 0.579 mm for modSLA versus -1.191 ± 0.814 mm for SLA, P = .021 and mean 62.61% ± 9.49% for modSLA versus 34.67% ± 24.41% for SLA, P = .047,respectively). Bone aggregate percentage was significantly higher for modSLA versus SLA implants in cerabone® (77.84% ± 6.93% versus 64.49% ± 13.12%; P = .045). The differences between implant surfaces in maxgraft® showed a similar trend but were less pronounced than in the cerabone® group and did not reach a statistically significant level**. Conclusions:** The authors concluded that the results suggest that implants with a superhydrophilic modSLA surface are more conducive to faster osseointegration even in conjunction with simultaneous bone grafting procedures.

34. Comparison of the effect of hemihydrate calcium sulfate granules and Cerabone on dental socket preservation: An animal experiment.

Sargolzaie N, Rafiee M, Salari Sedigh H, Zare Mahmoudabadi R, Keshavarz H. J Dent Res Dent Clin Dent Prospects. 2018 Fall;12(4):238-244. doi: 10.15171/joddd.2018.037.

https://pubmed.ncbi.nlm.nih.gov/30774788/

The goal of this study was to compare the effects of cerabone® and a synthetic bone graft (hemihydrate calcium sulfate) on socket preservation histologically using a dog model. **Methods:** The premolars on both sides of the lower jaw were extracted (dogs n = 6), and the sockets were grafted either with cerabone® or the synthetic bone graft. Four and eight weeks following the surgery, bone cores were harvested and a histological evaluation was performed to determine the amount of newly formed bone and connective tissue. In addition, the presence of inflammatory cells was determined.

Results:

- Mean values of bone proportion were 11% and 8% for cerabone® and calcium sulfate, respectively (P=0.58)
- Mean values for connective tissue proportion were 29% and 33% for cerabone® and calcium sulfate, respectively (P=0.72)
- No inflammatory cells were observed in the cerabone® group, while 50% of the samples in the calcium sulfate group showed inflammation (P=0.50)

Conclusions: The authors concluded that the effects of cerabone® and calcium sulfate on socket preservation in the used dog model were comparable. The found differences concerning bone formation, fibrous connective tissue amounts and inflammation levels were not significantly different at four and eight-week post-operative intervals.

35. 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 Jan 30;11(2):215. doi: 10.3390/ma11020215.

https://pubmed.ncbi.nlm.nih.gov/29385747/

Investigation of 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 result

36. Comparison of three different types of scaffolds preseeded with human bone marrow mononuclear cells on the bone healing in a femoral critical size defect model of the athymic rat.

Janko M, Sahm J, Schaible A, Brune JC, Bellen M, Schroder K, Seebach C, Marzi I, Henrich D. J Tissue Eng Regen Med. 2018 Mar;12(3):653-666. doi: 10.1002/term.2484.

https://pubmed.ncbi.nlm.nih.gov/28548246/

Comparison of three different scaffolds serving as carrier for BMC in a rat femoral critical size defect with regard to the osteogenic activity in the defect zone. Human demineralized bone matrix (DBM), bovine cancellous bone hydroxyapatite ceramic (BS), or β-TCP were seeded with human BMC and hereafter implanted into critically sized bone defects of male athymic nude rats. Autologous bone served as control. Gene activity was measured after one week, bone formation was analysed histologically and radiologically after 8 weeks. Generally, regenerative gene expression (BMP2, RUNX2, VEGF, SDF-1, RANKL) as well as bony bridging and callus formation was observed to be most pronounced in defects filled with autologous bone, followed in descending order by DBM, β-TCP and BS. Although DBM was superior in most aspects of bone regeneration analysed in comparison to β-TCP and BS, the level of autologous bone could not be attained.

37. High-temperature sintering of xenogeneic bone substitutes leads to increased multinucleated giant cell formation: In vivo and preliminary clinical results.*

Barbeck M, Udeabor S, Lorenz J, Schlee M, Holthaus MG, Raetscho N, Choukroun J, Sader R, Kirkpatrick CJ, Ghanaati S. J Oral Implantol. 2015 Oct;41(5):e212-22. doi: 10.1563/aaid-joi-D-14-00168.

https://pubmed.ncbi.nlm.nih.gov/25105868/

The present preclinical and clinical study assessed the inflammatory response to a high temperature-treated xenogeneic material (Bego-Oss®) and the effects of this material on the occurrence of multinucleated giant cells, implantation bed vascularization and regenerative potential. After evaluation of the material characteristics via scanning electron microscopy, subcutaneous implantation in CD-1 mice was used to assess the inflammatory response to the material for up to 60 days. The

clinical aspects of this study involved the use of human bone specimens six months after sinus augmentation. Established histological and histomorphometric analysis methods were applied. After implantation, the material was well integrated into both species without any adverse reactions. Multinucleated giant cells were observed in both species and were associated with enhanced vascularization. These results revealed that the high heat treatment led to an increase in the inflammatory tissue response to the biomaterial and a combined increase in multinucleated giant cell formation. Further clarification of the differentiation of the multinucleated giant cells toward so-called osteoclast-like cells or foreign body giant cells is needed to relate these cells to the physicochemical composition of the material.

*Study refers to BEGO OSS, which was a private label of cerabone®.

38. Bone substitute material composition and morphology differentially modulate calcium and phosphate release through osteoclast-like cells.

Konermann A, Staubwasser M, Dirk C, Keilig L, Bourauel C, Götz W, Jäger A, Reichert C. Int J Oral Maxillofac Surg. 2014 Apr;43(4):514-21. doi: 10.1016/j.ijom.2013.10.017.

https://pubmed.ncbi.nlm.nih.gov/24268900/

The aim of this study was to determine the material composition and cell-mediated remodelling of different calcium phosphate-based bone substitutes**.** Osteoclasts were cultivated on bone substitutes (cerabone®, maxresorb®, and NanoBone) for up to 5 days. Bafilomycin A1 addition served as the control. To determine cellular activity, the supernatant content of calcium and phosphate was measured by inductively coupled plasma optical emission spectrometry. Cells were visualized on the materials by scanning electron microscopy. Material composition and surface characteristics were assessed by energy-dispersive X-ray spectroscopy. Osteoclast-induced calcium and phosphate release was material-specific. maxresorb® exhibited the highest ion release to the medium (P = 0.034; calcium 40.25mg/l day 5, phosphate 102.08 mg/l day 5) and NanoBone the lowest (P = 0.021; calcium 8.43 mg/l day 5, phosphate 15.15 mg/l day 5); cerabone® was intermediate (P = 0.034; calcium 16.34 mg/l day 5, phosphate 30.6 mg/l day 5). All investigated materials showed unique resorption behaviours. The presented methodology provides a new perspective on the investigation of bone substitute biodegradation, maintaining the material-specific micro- and macrostructure.

39. Biocompatibility and biodegradation of a native porcine pericardium membrane: results of in vitro and *in vivo* examinations.

Rothamel D, Schwarz F, Fienitz T, Smeets R, Dreiseidler T, Ritter L, Happe A, Zöller J. Int J Oral Maxillofac Implants. 2012 Jan-Feb;27(1):146-54.

https://pubmed.ncbi.nlm.nih.gov/22299091/

The objective of this pilot study was to examine, in vitro and in vivo, a novel native collagen membrane extracted from porcine pericardium. **Materials and Methods:** The morphologic structure of two different native collagen membranes (Remotis, Thommen Medical; Bio-Gide, Geistlich Biomaterials) was examined using a scanning electron microscope. For biocompatibility testing, membranes were incubated with SaOs-2 osteoblastlike cells. After 2 hours, 3 days, and 7 days, proliferation of the cells on the membranes was determined. Evaluation of the biodegradation pattern was performed in a dog model with simultaneous bone augmentation with Bio-Oss (Geistlich Biomaterials) or cerabone® (Botiss Biomaterials) in the lateral anterior maxilla in eight animals with histologic examination after 4, 8, 12, and 24 weeks. **Results:** An interconnective pore system was identifiable for Remotis, while Bio-Gide displayed a more fibrous structure. In vitro, Remotis showed considerable cell proliferation, which was significantly superior to that observed with Bio-Gide, especially after 7 days (2,910 ± 1,273 and 707 ± 706, respectively). *In vivo*, both membranes integrated into the surrounding tissue without any inflammatory reaction. Both membranes allowed early vascularization. However, considerable biodegradation was noted within 4 to 8 weeks with Bio-Gide, while Remotis resorbed generally within the first 8 to 12 week. Both membranes supported underlying bone formation. **Conclusion:** Both examined membranes indicate a high level of biocompatibility. Both are resorbed without inflammation within 8 weeks (Bio-Gide) or 12 weeks (Remotis). The compact interconnective pericardium collagen of Remotis may have stabilized the resorption process.

40. Effect of Guided Tissue Regeneration on Newly Formed Bone and Cementum in Periapical Tissue Healing after Endodontic Surgery: An In Vivo Study in the Cat.

Artzi Z, Wasersprung N, Weinreb M, Steigmann M, Prasad HS, Tsesis I. J Endod. 2012 Feb;38(2):163-9. doi: 10.1016/j.joen.2011.10.002.

https://pubmed.ncbi.nlm.nih.gov/22244630/

The purpose of this study was to evaluate the influence of anorganic bovine bone as a grafted biomaterial on newly formed bone and cementum in periapical regions after surgical endodontic treatment in cats. **Methods:** After inducing apical periodontitis in 9 cats, root canal and surgical endodontic treatment were performed on 72 roots of first and second maxillary premolars. Bone defects were treated with biomaterial particles + a membrane, biomaterial only, a membrane only, or left unfilled (control). Histomorphometry on nondecalcified sections were performed at 3 and 6 months after surgery. Analysis of variance with repeated measures was used within 2 and 3 subject factors to analyze newly formed bone, cementum, biomaterial conduction, and resorption. **Results:** At each time period, bone formation was greater at the grafted membrane-protected sites than in the grafted unprotected sites. At 6 months, the bone area fraction at membrane nongrafted sites was greater than in the grafted-protected sites. The new cementum was significantly greater at 6 months than at 3 months and greater at the grafted membrane-protected sites over the unprotected ones at 6 months. Statistically, the grafted biomaterial, the membrane, and the time contributed significantly to the amount of new bone ($P < .05$) with no significant interaction. Biomaterial osteoconduction was

significantly affected by the time. All 3 variables showed a significant interaction on new cementum. **Conclusions:** There was significantly more bone formation after surgical endodontic treatment when membrane and bone grafts were used as compared with bone grafts only or unfilled control sites. However, it appears that the key factor to the enhanced tissue regeneration is the membrane and not the grafted biomaterial.

41. Impact of Citric Acid Etching on Biocompatibility and Osseous Organisation of a Natural Bovine Bone Mineral: Preliminary Results of an In-Vitro/In-Vivo Study.
Rothamel D, Schwarz F, Herten M, Berndsen K, Fienitz T, Ritter L, Dreiseidler T and Zöller J in Magjarevic R, Dössel O and Schlegel WC (Eds.), IFMBE Proceedings 2009; 25(11): 259–262.

http://link.springer.com/chapter/10.1007/978-3-642-03891-4_69

The aim of the present study was to evaluate the influence of superficial etching of a xenogenous bone mineral on cell proliferation and bone regeneration. A granular bone substitute material [BSM] (cerabone® [CB], botiss medical, Berlin, Germany) was superficially etched using citric acid (Acid [CBA]). CB and CBA were allocated into 96 non-binding well plates and incubated with 1×104 human osteoblast-like cells (SaOs-2) per well under standardized conditions. After 2 hours, 3 and 7 days a LDH-Assay was used for photometric evaluation of cell proliferation (n=8). LDH values were transferred into cell amounts using a standard curve and analyzed for statistical difference. Additionally, cell morphology was investigated using scanning electron microscopy (SEM) (n=3). In the in-vivo part, CB and CBA granules were used for lateral augmentation of the maxillae of four beagle dogs and covered with a collagen membrane (Jason® Membrane, botiss medical). Healing periods were set at 3 and 8 weeks (n=2, respectively). In-vitro evaluation revealed statistically significant higher cell proliferation after 3 and 7 days on CBA compared to CB ($p<0.05$, Wilcoxon test). SEM observation presented flat and star-shaped SaOs-2- osteoblasts displaying high numbers of lamellopodia on both CB and CBA surfaces. In vivo, both BSM showed osteoconductive properties and osseous organisation after 8 weeks. However, the number of the in-vivo applications did not allow further statistical analysis. Within the limits of the present study it was concluded that superficial etching of natural bone minerals using citric acid may support osteoblast-like cell proliferation. Further studies are necessary to specify the impact on bone regeneration.

42. Comparison of different methods for the preparation of porous bone substitution materials and structural investigations by synchrotron µ-computer tomography.
Tadic D, Beckmann F, Donath T and Epple M. Materialwissenschaft und Werkstofftechnik 2004; 35(4): 240–244.

http://onlinelibrary.wiley.com/doi/10.1002/mawe.200400730/abstract

The preparation of porous biomaterials for bone substitution is an important clinical issue in current biomedical technology because the ingrowth of bone can only occur if a suitable number of sufficiently large pores is available. Different procedures are compared here: The combined chemical-thermal treatment of bovine and human cancellous bone, the calcination of bovine cancellous bone, mechanical hole-drilling, and the extraction of porogens (in this case: salt crystals). The inner structure and the porosity of all samples were studied using high-resolution synchrotron µ-computer tomography.

43. A thorough physicochemical characterisation of 14 calcium phosphate-based bone substitution materials in comparison to natural bone.

Tadic D, Epple M. Biomaterials. 2004 Mar;25(6):987-94. doi: 10.1016/s0142-9612(03)00621-5.

https://pubmed.ncbi.nlm.nih.gov/14615163/

Fourteen different synthetic or biological bone substitution materials were characterised by high-resolution X-ray diffractometry, infrared spectroscopy, thermogravimetry, and scanning electron microscopy. Thus, the main parameters chemical composition, crystallinity, and morphology were determined. The results are compared with natural bone samples. The materials fall into different classes: Chemically treated bone, calcined bovine bone, algae-derived hydroxyapatite, synthetic hydroxyapatite, peptide-loaded hydroxyapatite, and synthetic beta-TCP ceramics.

44. Bone ingrowth in bFGF-coated hydroxyapatite ceramic implants.

Schnettler R, Alt V, Dingeldein E, Pfefferle HJ, Kilian O, Meyer C, Heiss C, Wenisch S. Biomaterials. 2003 Nov;24(25):4603-8. doi: 10.1016/s0142-9612(03)00354-5.

https://pubmed.ncbi.nlm.nih.gov/12951003/

This experimental study was performed to evaluate angiogenesis, bone formation, and bone ingrowth in response to osteoinductive implants of bovine-derived hydroxyapatite (HA) ceramics either uncoated or coated with basic fibroblast growth factor (bFGF) in miniature pigs. A cylindrical bone defect was created in both femur condyles of 24 miniature pigs using a saline coated trephine. Sixteen of the 48 defects were filled with HA cylinders coated with 50 microg rhbFG, uncoated HA cylinders, and with autogenous transplants, respectively. Fluorochrome labelled histological analysis, histomorphometry, and scanning electron microscopy were performed to study angiogenesis, bone formation and bone ingrowth. Complete bone ingrowth into bFGF-coated HA implants and autografts was seen after 34 days compared to 80 days in the uncoated HA group. Active ring-shaped areas of fluorochrome labelled bone deposition with dynamic bone remodelling were found in all cylinders. New vessels could be found in all cylinders. Histomorphometric analysis showed no difference in bone ingrowth over time between autogenous transplants and bFGF-coated HA implants. The current

experimental study revealed comparable results of bFGF-coated HA implants and autogenous grafts regarding angiogenesis, bone synthesis and bone ingrowth.

2. Clinical studies and case series

45. Reconstructive Peri-Implantitis Therapy by Using Bovine Bone Substitute with or without Hyaluronic Acid: A Randomized Clinical Controlled Pilot Study

Rakašević D, Šćepanović M, Mijailović I, Mišić T, Janjić B, Soldatović I, Marković A. J Funct Biomater. 2023 Mar 8;14(3):149. doi: 10.3390/jfb14030149.

https://botiss.com/product/reconstructive-peri-implantitis-therapy-by-using-bovine-bone-substitute-with-or-without-hyaluronic-acid-a-randomized-clinical-controlled-pilot-study/

Background: The present pilot study aimed to assess clinical and radiographic efficiencies of bovine bone substitute (BBS) merged with hyaluronic acid (HA) in peri-implantits reconstructive surgery. **Methods:** Peri-implantitis (diagnosed 6.03 ± 1.61 years of implant loading) bone defects were randomly treated either with BBS plus HA (test group) or BBS alone (control group). Clinical parameters including peri-implant probing depth (PPD), bleeding on probing (BOP), implant stability (ISQ), and radiographic changes in vertical and horizontal marginal bone (MB) levels were assessed at six months postoperatively. New temporary and permanent screw-retained crowns were made at two weeks and three months postoperatively. Data were analyzed using parametric and non-parametric tests. **Results:** In both groups, 75% of patients and 83% of implants achieved treatment success after six months (no BOP, PPD <5 mm, and no further MB loss). Clinical outcomes improved over time within groups; however, without significant difference between them. ISQ value obtained significant increases in the test compared to the control group at six months postoperatively ($p < 0.05$). The vertical MB gain was significantly greater in the test group compared to the control ($p < 0.05$). **Conclusions:** Short-term outcomes suggested that BBS merged with HA could improve clinical and radiographic outcomes in peri-implantitis reconstructive therapy.

46. Nasal Floor Elevation—An Option of Premaxilla Augmentation: A Case Report

Jordan A, Vuletić M, Sušić M, Stojić L, Gabrić D. Surgeries. 2022; 3(4):306-313.

https://botiss.com/product/nasal-floor-elevation-an-option-of-premaxilla-augmentation-a-case-report/

The atrophic edentulous maxilla is demanding for dental implant placement because of extensive resorption of the alveolar ridge after teeth loss and, consequently, the proximity of the anatomical structures, nasal cavity, and maxillary sinus. Treatment options are short implants, guided bone regeneration, onlay grafts, Le Fort I osteotomy with interpositional bone grafting, distraction osteogenesis, or nasal floor elevation. Nasal floor elevation is a method of augmentation of premaxilla

by raising the base of the nose. The aim of this case report is to evaluate the success of implants placed after nasal floor elevation. A 75-year-old female patient came to the Clinical Department of Oral Surgery, University Hospital Centre Zagreb, unsatisfied with her complete removable denture. Clinical and radiological examination revealed severe maxillary alveolar ridge atrophy. Nasal floor elevation was made under local anesthesia through aperture piriformis and lateral window in the distal part. After eight months, four implants were placed and, after period of osseointegration, a bar-retained implant overdenture was made. This case report shows that nasal floor augmentation can be considered among the surgical techniques to allow implant-supported rehabilitation of the atrophic anterior maxilla.

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

Cinar, I.C.; Gultekin, B.A.; Saglanmak, A.; Akay, A.S.; Zboun, M.; Mijiritsky, E. Appl. Sci. 2022, 12, 10518.

https://doi.org/10.3390/app122010518

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.

48. Dental Implant Placement in Focal Osteoporotic Bone Marrow Defect: a Case Report and Treatment Recommendations.

Juodzbalys G. J Oral Maxillofac Res 2022;13(3):e5. doi: 10.5037/jomr.2022.13305

http://www.ejomr.org/JOMR/archives/2022/3/e5/v13n3e5.pdf

Background: Focal osteoporotic bone marrow defect is asymptomatic radiolucent area usually discovered incidentally during radiographic examination of the jaws. This bone condition can lead to clinical complications during dental implant placement or during osseointegration process. **Methods:** A 54-year-old woman was referred to private dental implant centre for a dental implant rehabilitation treatment in May 17, 2016. Oral examination revealed a healthy mucosa with no visible pathology. Adentia of tooth #46 and moderate atrophy of the edentulous alveolar process were found. Panoramic radiography of the jaws showed 2 cm x 2 cm radiolucency with irregular borders located in tooth #46 region. The margins of the bone defect were uneven, single trabeculae were visible, and the cortical layer was not deformed. In the absence of signs of pathology, it was decided to perform a dental implant surgery in the edentulous jaw segment #46. **Results:** The osteoporotic focus was filled with natural bovine bone substitute Cerabone®. The granules were gently condensed to the sides - to the buccal and lingual walls until they filled the entire cavity. A 10 mm long, 4.1 mm diameter Straumann® Tissue Level implant was surgically placed with the shoulder of the implant resting on the margins of the osteotomy. It was proposed six steps protocol for surgical dental implant installation in focal osteoporotic bone marrow defect in mandible. **Conclusions:** A six-step protocol for surgical placement of dental implants in focal osteoporotic bone marrow defects may be a useful tool for clinicians in implant dentistry.

49. Clinical and Radiologic Evaluation of a Fully Tapered Implant with Immediate Placement in the Esthetic Zone: A Prospective Case Series Study.

Cardaropoli D, Tamagnone L, Roffredo A, De Maria A. Int J Periodontics Restorative Dent. 2022 Sep-Oct;42(5):631-637. doi: 10.11607/prd.5682.

https://pubmed.ncbi.nlm.nih.gov/36044694/

A fully tapered implant was recently introduced to increase primary stability and to be used in challenging situations. Twenty single implants were inserted in maxillary postextraction sockets, from premolar to premolar, and immediately restored. Marginal bone level (MBL) and probing depth (PD) were evaluated over a 12-month follow-up period. All implants osseointegrated, achieving a success rate of 100%. The difference in MBL between implant placement and 1 year later was 0.20 ± 0.04 mm, while PD was 2.82 ± 0.51 mm at 1 year. The data reported here support the use of a fully tapered implant for immediate placement and immediate provisionalization for single-tooth replacements in the esthetic area.

50. Immediate Functional Loading with Full-Arch Fixed Implant-Retained Rehabilitation in Periodontal Patients: Clinical Study

Velasco-Ortega E, Cracel-Lopes JL, Matos-Garrido N, Jiménez-Guerra A, Ortiz-Garcia I, Moreno-Muñoz J, Núñez-Márquez E, Rondón-Romero JL, López-López J, Monsalve-Guil L. Int J Environ Res Public Health. 2022 Oct 13;19(20):13162. doi: 10.3390/ijerph192013162.

https://pubmed.ncbi.nlm.nih.gov/36293738/

(1) Background. The immediate functional loading of implants is a clinical procedure used for treating periodontal edentulous patients. This clinical study aimed to evaluate the clinical outcomes of the immediate functional loading of implants with fully fixed rehabilitations in compromised periodontal patients. **(2) Methods.** Three hundred and five implants IPX screw implants were placed in 27 periodontal patients using an immediate functional loading protocol with fixed rehabilitations. All patients had a previous history of periodontitis, four patients (14.8%) were smokers and seven patients (25.9%) suffered from chronic medical conditions. **(3) Results.** Implant and prosthetic clinical findings were evaluated during a mean period of 41.3 ± 19.6 months. No implants were lost during the clinical follow-up. The cumulative survival rate for all implants was 100%. Regarding the prostheses designed, a total of 54 fixed prostheses were placed in the 27 patients immediately after the surgery. Forty-four hybrid fixed prostheses (81.5%) and 10 fixed rehabilitations (18.5%) were placed in the patients. The mean marginal bone loss was 1.51 ± 1.16 mm, ranging from 0 to 3.5 mm during the follow-up evaluation. Thirty-one implants (10.2%) in 10 patients (37%) were associated with peri-implantitis. Five patients (18.5%) showed some kind of technical complications (loss/fracture of the prosthetic screw, acrylic resin fracture, ceramic chipping). **(4) Conclusions.** The clinical outcomes of this study demonstrate that fixed rehabilitation by immediate functional loading of implants is considered a predictable procedure.

51. Alveolar ridge and keratinized gingiva preservation using collagen matrix and inorganic bone substitute in flapless extractions: A case series of exposed biomaterials

Souza, Mariana & Martinez, Jesus & Carvalho, Valessa & Novaes, Arthur & Taba Jr, Mario. (2022). Journal of the International Academy of Periodontology (2022) 24/4: 367-77

https://www.perioiap.org/publications/62-october-2022/293-alveolar-ridge-and-keratinized-gingiva-preservation-using-collagen-matrix-and-inorganic-bone-substitute-in-flapless-extractions-a-case-series-of-exposed-biomaterials

Aim: To evaluate the dimensional changes after alveolar ridge preservation (ARP) with flapless and flapped techniques, using demineralized bovine bone mineral (DBBM) and a collagen matrix (CM) intentionally left exposed. **Materials and methods:** In this case series, randomly selected patients were divided into one of two surgical approaches, Group 1 (G1): ARP flapless and Group 2 (G2): ARP flapped.

Clinical and cone beam computed tomography assessments were performed at 1 week, 4 and 24 months after ARP. Evaluations of postoperative discomfort with visual analogue scale (VAS) were also performed. **Results:** Surgical procedures run uneventfully with no healing complications of the treated sockets. There were reductions in the horizontal and vertical dimensions of the socket and in the width of the keratinized gingiva, but they were smaller for G1. The thickness of the keratinized gingiva increased in G1 and reduced in G2. Only the VAS had a statistically significant difference between the groups (P=0.03). **Conclusions:** The ARP limited vertical and horizontal socket changes, regardless of the surgical technique used when the biomaterials where left exposed. The flapless approach seems to provide better results regarding dimensional changes and significantly less discomfort.

52. Reconstruction of vertical alveolar ridge deficiencies utilizing a high-density polytetrafluoroethylene membrane /clinical impact of flap dehiscence on treatment outcomes: case series/

Palkovics D, Bolya-Orosz F, Pinter C, Molnar B, Windisch P. BMC Oral Health. 2022 Nov 15;22(1):490. doi: 10.1186/s12903-022-02513-7.

https://botiss.com/product/reconstruction-of-vertical-alveolar-ridge-deficiencies-utilizing-a-high-density-polytetrafluoroethylene-membrane-clinical-impact-of-flap-dehiscence-on-treatment-outcomes-case-series/

Objectives: The aim of this study was to evaluate the effects of membrane exposure during vertical ridge augmentation (VRA) utilizing guided bone regeneration with a dense polytetrafluoroethylene (d-PTFE) membrane and a tent-pole space maintaining approach by registering radiographic volumetric, linear and morphological changes. **Methods:** In 8 cases alveolar ridge defects were accessed utilizing a split-thickness flap design. Following flap elevation VRA was performed with tent-pole space maintaining approach utilizing the combination of a non-reinforced d-PTFE membrane and a composite graft (1:1 ratio of autogenous bone chips and bovine derived xenografts). Three-dimensional radiographic evaluation of hard tissue changes was carried out with the sequence of cone-beam computed tomography (CBCT) image segmentation, spatial registration and 3D subtraction analysis. **Results:** Class I or class II membrane exposure was observed in four cases. Average hard tissue gain was found to be 0.70 cm3 ± 0.31 cm3 and 0.82 cm3 ± 0.40 cm3 with and without membrane exposure resulting in a 17% difference. Vertical hard tissue gain averaged 4.06 mm ± 0.56 mm and 3.55 mm ± 0.43 mm in case of submerged and open healing, respectively. Difference in this regard was 14% between the two groups. Horizontal ridge width at 9-month follow-up was 5.89 mm ± 0.51 mm and 5.61 mm ± 1.21 mm with and without a membrane exposure respectively, resulting in a 5% difference. **Conclusions:** With the help of the currently reported 3D radiographic evaluation method, it can be concluded that exposure of the new-generation d-PTFE membrane had less negative impact on clinical results compared to literature data reporting on expanded polytetrafluoroethylene membranes.

53. The allogeneic 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. 2022 Nov 1;8(1):48. doi: 10.1186/s40729-022-00446-y.

https://botiss.com/product/multicenter-case-series-maxgraft-cortico-for-alveolar-ridge-augmentation/

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) 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.

54. A Novel Muco-Gingival Approach for Immediate Implant Placement to Obtain Soft- and Hard-Tissue Augmentation

Stefanini, M.; Sangiorgi, M.; Bianchelli, D.; Bellone, P.; Gelpi, F.; De Santis, D.; Zucchelli, G. J. Clin. Med. 2022, 11,4985.

https://doi.org/10.3390/jcm11174985

The aim of this article is to describe a novel approach combining muco-gingival, regenerative and prosthetics concepts for immediate implant insertion that overcomes the limits traditionally considered as contraindications for Type 1 flapless implant positioning, simultaneously obtaining soft- and hard-tissue augmentation. After pre-surgical CBCT evaluation, the surgical technique consisted in the execution of a lateral-approach coronally advanced envelope flap, with oblique submarginal interproximal incisions directed towards the flap's center of rotation (the tooth to be extracted); after buccal-flap elevation, the atraumatic extraction of the tooth was performed. Following guided implant insertion, a mixture of biomaterial and autologous bone was placed, stabilized by a pericardium membrane and a connective-tissue graft sutured in the inner aspect of the buccal flap. The peri-implant soft tissues were conditioned with a provisional crown until the shape and position for the mucosal scallop to resemble the gingival margin of the adjacent corresponding tooth were obtained; then, the definitive screw-retained restoration was placed. Within the limitations of this case report, the proposed immediate implant placement approach combining CTG application and buccal bone regeneration showed the possibility of obtaining 1-year-follow-up implant success, stable bone level, good esthetic results and high patient satisfaction.

55. Matrix Metalloproteinase 9 (MMP-9) and Interleukin-8 (IL-8) in Gingival Crevicular Fluid after Regenerative Therapy in Periodontal Intrabony Defects with and without Systemic Antibiotics-Randomized Clinical Trial.

Dolińska E, Pietruska M, Dymicka-Piekarska V, Milewski R, Sculean A. Pathogens. 2022 Oct 14;11(10):1184. doi: 10.3390/pathogens11101184.

https://pubmed.ncbi.nlm.nih.gov/36297241/

The aim of our study was to assess changes in the levels of IL-8 and MMP-9 in gingival crevicular fluid (GCF) collected from the periodontal pocket before and after regenerative surgery with deproteinized bovine bone mineral (DBBM) and collagen membrane (GTR) either independently (DBBM/GTR) or with the postoperative administration of antibiotic (DBBM/GTR+AB). The study involved 41 patients, each with one intrabony defect. IL-8 and MMP-9 were determined before therapy and after 2 weeks, 4 weeks and 6 months following the surgical procedure by means of dedicated ELISA kits. No statistical differences were observed in the levels of IL-8 and MMP-9 after 2 weeks, 4 weeks and 6 months between the groups. The changes in the level of MMP-9 over time were not statistically significant in any group. The changes in the level of IL-8 were significant for the group given antibiotic but not in the nonantibiotic group in the follow-up period. IL-8 and MMP-9 were found to correlate positively but not after 4 weeks in the test group. Current assessment of IL-8 and MMP-9 obtained from GCF samples provides evidence that collagen matrix turnover occurs actively during the early healing phase in the periodontium after regenerative procedures. We observed positive correlations of MMP-9 and IL-8

throughout the study. However, we failed to reveal any differences regard parameters studied between the two groups.

56. Apical approach in periodontal reconstructive surgery with enamel matrix derivate and enamel matrix derivate plus bone substitutes: a randomized, controlled clinical trial

Moreno Rodríguez JA, Ortiz Ruiz AJ. Clin Oral Investig. 2022 Mar;26(3):2793-2805. doi: 10.1007/s00784-021-04256-1.

https://pubmed.ncbi.nlm.nih.gov/34791548/

Objectives: This parallel, randomized controlled clinical trial evaluated the influence of bone substitutes (BS) on the efficacy of the non-incised papillae surgical approach (NIPSA) with enamel matrix derivate (EMD) in resolving deep, isolated, combined non-contained intrabony and supra-alveolar periodontal defects, preserving the soft tissue. **Material and methods:** Twenty-four patients were randomized to treatment with NIPSA and EMD or NIPSA plus EMD and BS. Bleeding on probing (BoP), interproximal clinical attachment level (CAL), interproximal probing depth (PD), recession (REC), location of the tip of the papilla (TP), and width of the keratinized tissue (KT) were evaluated before surgery and at 1 year post-surgery (primary outcomes). Wound closure was assessed at 1 week post-surgery, and supra-alveolar attachment gain (SUPRA-AG) was recorded at 1 year post-surgery. **Results:** At 1 week, 87.5% of cases registered complete wound closure and there were no cases of necrosis, without differences between groups ($p > .05$). At 1 year, all cases showed negative BoP. A significant PD reduction (NIPSA + EMD 8.25 ± 2.70 mm vs. NIPSA + EMD + BS 6.83 ± 0.81 mm) and CAL gain (NIPSA + EMD 8.33 ± 2.74 mm vs. NIPSA + EMD + BS 7.08 ± 2.68 mm) were observed ($p < .001$) in both groups, without significant between-group differences ($p > .05$). The residual PD was < 5 mm in all defects (NIPSA + EMD 2.50 ± 0.67 mm vs. NIPSA + EMD + BS 2.67 ± 0.78 mm). Soft tissues were preserved without significant between-group differences (REC: NIPSA + EMD 0.25 ± 0.45 mm vs. NIPSA + EMD + BS 0.17 ± 0.58 mm, $p > .05$; KT: 0.00 ± 0.43 mm vs. 0.08 ± 0.67 mm, $p > .05$). There were improvements in the papilla in both groups (TP: NIPSA + EMD 0.33 ± 0.49 mm vs. NIPSA + EMD + BS 0.45 ± 0.52 mm, $p > .05$), which was only significant in the NIPSA EMD + BS group (0.45 ± 0.52 mm; $p < .05$). In both groups, CAL gain was recorded in the supra-alveolar component, showing full resolution of the intrabony component of the defect in all cases (SUPRA-AG: NIPSA + EMD 1.83 ± 1.11 mm vs. NIPSA + EMD + BS 2.00 ± 1.76 mm, $p > .05$). **Conclusions:** NIPSA and EMD with or without BS seem to be a valid surgical approach in the treatment of isolated, deep non-contained periodontal defects. In our study, both treatments resulted in significant PD reduction and CAL gain, that extended in the supra-alveolar component, without differences with the use of BS. Both treatments resulted in soft tissue preservation. However, the addition of BS may improve interdental papillary tissue.

57. Surgical reconstructive treatment for infraosseous peri-implantitis defects with a submerged healing approach: A prospective controlled study

Wen SC, Barootchi S, Huang WX, Wang HL. J Periodontol. 2022 Feb;93(2):195-207. doi: 10.1002/JPER.21-0161.

https://botiss.com/product/surgical-reconstructive-treatment-for-infraosseous-peri-implantitis-defects-with-a-submerged-healing-approach-a-prospective-controlled-study-2/

Background: The aim of this study was to assess the reconstructive potential of a submerged healing approach for the treatment of infraosseous peri-implantitis defects. **Methods:** Patients with a diagnosis of peri-implantitis were recruited. Implant suprastructures were removed before the surgical treatment, which included implant surface and defect detoxification using implantoplasty, air-power driven devices, and locally delivered antibiotics. The augmentation procedure included a composite bone graft and a non-resorbable membrane followed by primary wound coverage and a submerged healing of 8 months, at which point membranes were removed, and peri-implant defect measurements were obtained as the primary outcome. Secondary endpoints included assessment of cone-beam computed tomography (CBCT) and probing depth (PD) reductions. **Results:** Thirty implants in 22 patients were treated. A significant clinical bone gain of 3.22 ± 0.41 mm was observed at 8 months. Radiographic analysis also showed an average gain of 3.47 ± 0.41 mm. Three months after installment of new crowns, final PD measures showed a significant reduction compared to initial examinations and a significant reduction in bleeding on probing compared to examinations at the pre-surgical visit. **Conclusions:** Reconstruction of infraosseous peri-implantitis defects is feasible with thorough detoxification of implant sites, and a submerged regenerative healing approach.

58. Digital vs. conventional workflow for one-abutment one-time immediate restoration in the esthetic zone: a randomized controlled trial

Hanozin B, Li Manni L, Lecloux G, Bacevic M, Lambert F. Int J Implant Dent. 2022 Feb;8(1):7. doi: 10.1186/s40729-022-00406-6.

https://pubmed.ncbi.nlm.nih.gov/35129763/

Objectives: To compare short-term outcomes after immediate restoration of a single implant in the esthetic zone with one-abutment one-time technique comparing a conventional (control) vs. a fully digital workflow (test). **Materials and methods**: Eighteen subjects were randomly assigned to the two groups, and a digital implant planning was performed for all. In the test group, a custom-made zirconia abutment and a CAD-CAM provisional crown were prepared prior to surgery; implants were placed using a s-CAIS guide allowing immediate restoration after surgery. In the control group, the implant was placed free-handed using a conventional surgical guide, and a custom-made zirconia abutment to

support a stratified provisional crown was placed 10 days thereafter, based on a conventional impression. Implant accuracy (relative to the planning), the provisional restoration outcomes, as well as PROMs were assessed. **Results:** The implant positioning showed higher accuracy with the s-CAIS surgical guide compared to free-handed surgery (angular deviation (AD): 2.41 ± 1.27° vs. 6.26 ± 3.98°, $p < 0.014$; entry point deviation (CGD): 0.65 ± 0.37 mm vs. 1.27 ± 0.83 mm, $p < 0.059$; apical deviation (GAD): 1.36 ± 0.53 mm vs. 2.42 ± 1.02 mm, $p < 0.014$). The occlusion and interproximal contacts showed similar results for the two workflows ($p = 0.7$ and $p = 0.69$, respectively). The PROMs results were similar in both groups except for impression taking with intra-oral scanning preferred over conventional impressions ($p = 0.014$). **Conclusions:** Both workflows allowed implant placement and immediate/early restoration and displayed similar clinical and esthetic outcomes. The fully digital workflow was associated with a more accurate implant position relative to planning.

59. Osseointegration at Implants Installed in Composite Bone: A Randomized Clinical Trial on Sinus Floor Elevation

Kotsu M, Apaza Alccayhuaman KA, Ferri M, Iezzi G, Piattelli A, Fortich Mesa N, Botticelli D. J Funct Biomater. 2022 Feb;13(1):22. doi: 10.3390/jfb13010022.

https://pubmed.ncbi.nlm.nih.gov/35323222/

Osseointegration of implants installed in conjunction with sinus floor elevation might be affected by the presence of residual graft. The implant surface characteristics and the protection of the access window using a collagen membrane might influence the osseointegration. To evaluate these factors, sinus floor elevation was performed in patients using a natural bovine bone grafting material. The access windows were either covered with a collagen membrane made of porcine corium (Mb group) or left uncovered (No-Mb group) and, after six months, two mini-implants with either a moderate rough or turned surfaces were installed. After 3 months, biopsies containing the mini-implants were retrieved, processed histologically, and analyzed. Twenty patients, ten in each group, were included in the study. The two mini-implants were retrieved from fourteen patients, six belonging to the Mb group, and eight to the No-Mb group. No statistically significant differences were found in osseointegration between groups. However, statistically significant differences were found between the two surfaces. It was concluded that implants with a moderately rough surface installed in a composite bone presented much higher osseointegration compared to those with a turned surface. The present study failed to show an effect of the use of a collagen membrane on the access window.

60. Comparison of Injectable Biphasic Calcium Phosphate and a Bovine Xenograft in Socket Preservation: Qualitative and Quantitative Histologic Study in Humans

Čandrlić M, Tomas M, Karl M, Malešić L, Včev A, Perić Kačarević Ž, Matijević M. Int J Mol Sci. 2022 Feb;23(5):2539. doi: 10.3390/ijms23052539.

https://pubmed.ncbi.nlm.nih.gov/35269686/

This study is the first histologic evaluation of an injectable biphasic calcium phosphate (IBCP) in humans six months after socket preservation according to the principles of guided bone regeneration. After tooth extraction, the alveolar ridge of 21 patients was augmented with IBCP (maxresorb® inject) in the test group, while 20 patients in the control group received a bovine xenograft (BX) (cerabone®). Six months after augmentation, a reentry procedure was performed to collect biopsies of regenerated bone for qualitative and quantitative histologic analysis. A total of 20 biopsies were taken for analysis. Qualitative histologic analysis showed complete integration of the biomaterial and no inflammatory tissue reaction, indicating the biocompatibility of the bone grafts and the surrounding tissue in both groups. Histomorphometric analysis showed comparable results in terms of newly formed bone (IBCP: 26.47 ± 14.71%, BX: 30.47 ± 16.39%) and residual biomaterial (IBCP: 13.1 ± 14.07%, BX: 17.89 ± 11.81%), with no significant difference found across groups (p > 0.05, Mann-Whitney U test). Statistical significance between groups was found in the result of soft tissue percentage (IBCP: 60.43 ± 12.73%, BX: 51.64 ± 14.63%, p = 0.046, Mann-Whitney U test). To conclude, IBCP and BX showed good osteoconductivity and biocompatibility with comparable new bone formation six months after alveolar ridge preservation.

61. Immediate implant placement combining socket seal abutment and peri-implant socket filling: A prospective case series

Lilet R, Desiron M, Finelle G, Lecloux G, Seidel L, Lambert F. Clin Oral Implants Res. 2022 Jan;33(1):33-44. doi: 10.1111/clr.13852.

https://pubmed.ncbi.nlm.nih.gov/34551159/

Objectives: The aim of this prospective case series was to assess the implant outcomes as well as hard and soft tissue dimensional changes of immediate implant placement in posterior sites using a custom-made sealing socket abutment (SSA) combined to peri-implant socket filling (PISF). **Material and methods:** Twenty patients were considered for single extraction and immediate implant in upper or lower posterior regions. The remaining peri-implant sockets were filled with Deproteinized Bovine Bone Mineral. Based on intra-oral scans (IOS), custom-made SSAs were placed the same day. Implant survival rate, peri-implant bone changes, peri-implant health and pink esthetic score (PES) were recorded up to 1 year post-implant placement. Moreover, CBCT and IOS were performed to monitor hard and soft tissue dimensional changes. **Results:** One implant failed to osseointegrate leading to an implant survival rate of 95% after 1 year. Peri-implant bone changes yielded 0.19 ± 0.31 mm and 84.2% of the implants displayed no or mild bleeding on probing. Horizontal bone remodeling was not significant from baseline to 1 year at any levels. Finally, soft tissue profile was stable in the most cervical area while minor changes occurred during the first 6 months below the gingival margin. The absence

of mid-buccal recession (0.07 mm) and good PES were found after 1 year. **Conclusion:** Despite its limitations, this study showed that immediate implants in the posterior region using the SSA + PISF protocol resulted in promising implant outcomes with limited hard and soft tissue dimensional changes while decreasing the overall treatment time.

62. Accuracy of half-guided implant placement with machine-driven or manual insertion: a prospective, randomized clinical study

Orban K, Varga E Jr, Windisch P, Braunitzer G, Molnar B. Clin Oral Investig. 2022 Jan;26(1):1035-1043. doi: 10.1007/s00784-021-04087-0.

https://pubmed.ncbi.nlm.nih.gov/34401946/

Objectives: To compare the accuracy of implant placement performed with either a surgical motor or a torque wrench as part of a half-guided surgical protocol. **Materials and methods:** Implant insertion with half-guided surgical protocol was utilized by surgical motor (machine-driven group) or torque wrench (manual group) in the posterior maxilla. After the healing period, accuracy comparison between planned and actual implant positions was performed based on preoperative cone beam computed tomography and postoperative digital intraoral scans. Coronal, apical, and angular deviations, insertion time, and insertion torque were evaluated. **Results:** Forty patients were treated with 1 implant each; 20 implants were inserted with a surgical motor and 20 implants with a torque wrench. Global coronal and apical deviations were 1.20 ± 0.46 mm and 1.45 ± 0.79 mm in the machine-driven group, and 1.13 ± 0.38 mm and 1.18 ± 0.28 mm in the manual group (respectively). The mean angular deviation was 4.82 ± 2.07° in the machine-driven group and 4.11 ± 1.63° in the manual group. Mean insertion torque was 21.75 ± 9.75 Ncm in the machine-driven group, compared to 18.75 ± 7.05 Ncm in the manual group. Implant placement duration was 9.25 ± 1.86 s in the machine-driven group at a speed of 50 rpm, and 36.40 ± 8.15 s in the manual group. **Conclusion:** No significant difference was found between the two groups in terms of accuracy and mean insertion torque, while machine-driven implant placement was significantly less time-consuming.

63. Bone Dimensional Change Following Immediate Implant Placement in Posterior Teeth with CBCT: A 6-Month Prospective Clinical Study

Bungthong W, Amornsettachai P, Luangchana P, Chuenjitkuntaworn B, Suphangul S. Molecules. 2022 Jan;27(3):608. doi: 10.3390/molecules27030608.

https://pubmed.ncbi.nlm.nih.gov/35163869/

This prospective clinical study aimed to evaluate the peri-implant hard tissue dimensional change at 6 months of immediate implant placement with bone graft materials in the posterior area using cone-

beam computed tomography (CBCT). Twelve dental implants were placed concurrently following tooth extraction in the posterior area and filled with xenograft particles. The CBCT images were taken immediately after surgical procedures and then at 6 months follow-up. To evaluate the hard tissue changes, the vertical and horizontal bone thickness were analyzed and measured using ImageJ software. Paired t-test or Wilcoxon match-pair signed-rank test was done to analyze the changes of hard tissue values at the same level between immediately and 6 months following immediate implant placement. Independent t-test or Mann-Whitney U test was used to analyze the dimensional change in the vertical and horizontal direction in buccal and lingual aspects. The level of significance was set at p value = 0.05. All implants were successfully osseointegrated. At 6 months follow-up, the vertical bone change at the buccal aspect was -0.69 mm and at the lingual aspect -0.39 mm. For horizontal bone thickness, the bone dimensional changes at 0, 1, 5, and 9 mm levels from the implant platform were -0.62 mm, -0.70 mm, -0.24 mm, and -0.22 mm, respectively. A significant bone reduction was observed in all measurement levels during the 6 months after implant placement (p value < 0.05). It was noted that even with bone grafting, a decrease in bone thickness was seen following the immediate implant placement. Therefore, this technique can be an alternative method to place the implant in the posterior area.

64. Preliminary Study with the Use of a Titanium Mesh as Space Maker and Implant Primary Stabilization for One-Stage Sinus Lift in Cases with Less Than 1.5 mm Residual Bone

Filipov I, Bolognesi F, Chirila L, Cristache CM, Corinaldesi G, Park KB. J Clin Med. 2021 Oct;10(21):4853. doi: 10.3390/jcm10214853.

https://pubmed.ncbi.nlm.nih.gov/34768375/

Background: In the lateral area of the maxilla, the alveolar bone can lose significant volume due to maxillary sinus pneumatization following teeth extractions. This preliminary study evaluated the effectiveness of a novel technique for one-stage sinus lifting and simultaneous implant placement in cases with less than 1.5 mm residual alveolar bone. The subsequent survival rate at 1-year post-occlusal loading was assessed. **Methods:** 15 patients were selected, the main inclusion criteria were the partially edentulous area in the posterior maxilla with alveolar bone height of less than 1.5 mm below the sinus. All of the patients underwent one-stage sinus lifting, along with simultaneous implant placement using a "butterfly" anchorage device to optimize the primary stability and xenograft bone as graft material. At 6 to 9 months after surgery, the anchorage device was removed and implants were loaded. Panoramic x-ray images were used to assess the new bone formation, while the biological stability was measured using resonance frequency analysis. **Results:** 15 implants were inserted. The mean implant stability quotient (ISQ) value was 71.3 (SD = ±2.51) and the mean healing period was 7.3 (SD = ±1.23) months. The mean bone height after the healing period was 14.4 (SD = ±2.05). A statistically significant

correlation was found between the healing period and the ISQ value (Spearman rho = 0.684, sig. = 0.005). No statistically significant correlation was found between the ISQ value and the new regenerated bone height (Person r = 0.389, sig. = 0.152). Smoking was identified as a risk factor involved in postoperative complications. **Conclusions:** The results of the present preliminary study demonstrated that the proposed "butterfly" technique was effective when performing one-stage sinus lifting and simultaneous implant placement in cases with less than 1.5 mm of residual alveolar bone. The survival rate was 100% at 1-year post occlusal loading.

65. Sinus Mucosa Thickness Changes and Ostium Involvement after Maxillary Sinus Floor Elevation in Sinus with Septa. A Cone Beam Computed Tomography Study

Kato S, Omori Y, Kanayama M, Hirota A, Ferri M, Apaza Alccayhuaman KA, Botticelli D. Dent J (Basel). 2021 Jul;9(8):82. doi: 10.3390/dj9080082.

https://pubmed.ncbi.nlm.nih.gov/34435994/

Background: A thickening of the sinus mucosa is observed after sinus floor augmentation. The objective of this retrospective study was to evaluate the influence of the presence of septa in the dimensional variation and ostium involvement over time of the Schneiderian mucosa after sinus floor augmentation. **Materials and methods:** Fifteen sinuses with septa (septa group) and 15 without (control group) were selected. CBCTs taken before surgery, and were analyzed after 1 week and after 9 months. Schneiderian membrane thickness changes over time and involvement of the ostium were evaluated. **Results:** Four perforations occurred in the septa group and none in the control group. After 1 week of healing, the sinus mucosa thickness increased in height by 5.7 mm and 7.1 mm in the septa and control groups, respectively. In this period, the patency of the ostium decreased in both groups, and three infundibula were obstructed in the septa group, and five in the control group. The mucosa was thicker and the edema was closer to the ostium in the control compared to in the septa group. After 9 months of healing, the dimensions regressed to normal pattern and no obstruction of the infundibula were observed. No statistically significant differences were found between septa and control groups. **Conclusions:** after one week of healing, the sinus mucosa increased in dimensions in both septa and control groups. However, the sinus mucosa presented a tendency of being thicker and closer to the ostium, resulting in a higher number of infundibula obstructions, in the control group compared to in the septa group. After 9 months, the sinus mucosa regressed to normal dimensions and no obstructions of the infundibula were observed in any group.

66. PRF versus xenograft in sinus augmentation in case of HA-coating implant placement: A 36-month retrospective study

Dominiak S, Karuga-Kuźniewska E, Popecki P, Kubasiewicz-Ross P. Adv Clin Exp Med. 2021 Jun;30(6):633-640. doi: 10.17219/acem/134202.

https://pubmed.ncbi.nlm.nih.gov/33984195/

Background: Sinus lift with a simultaneous implant placement in the residual maxilla is a common technique used worldwide. Nevertheless, choosing an ideal grafting material remains an object of dispute. The use of an autologous blood-derived graft, known as platelet-rich fibrin (PRF), has not yet been recognized to be as good as xenografts and alloplastic materials. However, initial results have been promising. **Objectives:** To conduct a clinical and radiological comparison of implantation with a simultaneous sinus lift using xenograft or PRF clots. **Material and methods:** Thirty sinus lifts with simultaneous implantation were conducted using a lateral window approach and the tent pole technique, with xenograft (group 1 (G1)) or PRF (group 2 (G2)) as a filling material. To be included in the study, patients must have had an alveolar ridge height of 4-5 mm, no signs of inflammatory processes, good oral hygiene, and no other grafting procedures performed in region of implant insertion. In each case, the measurements taken were probing pocket depth (PPD), height of keratinized tissue (HKT), clinical attachment level (CAL), recession depth/width (RD/RW), and, on panoramic X-rays, marginal bone loss (MBL), grafted sinus high (GSH), and bone gain (BG). Preand post-operative treatment was applied to reduce the chance of infection. **Results:** During the study, 30 implants (hydroxyapatite-coated implants manufactured by SGS - 10 mm in length and 4.2 mm in diameter) were placed. The survival rate of implants in both groups was 100% with no implant mobility, pain, paresthesia, or inflammatory processes in the direct vicinity of the implants observed, except in 1 patient. After 36 months of follow-up, the radiological assessments for G1 were: GSH 4.5 mm, MBL 0.46 mm and BG 4.53 mm; and for G2: 3.4 mm, 0.6 mm and 3.4 mm, respectively. Results of the clinical measurements were for G1: HKT after 36 months (HKT36) 2.46 mm, CAL 0.47 mm and PPD 2 mm; and for G2: HKT36 3.13 mm, CAL 0.6 mm and PPD 2.07 mm. **Conclusions:** After 3 years of follow-up, the results of sinus lifting solely using PRF with simultaneous implantation were promising, especially in terms of soft tissue management. Therefore, PRF can be regarded as an alternative to previously used materials.

67. Effect of systemic antibiotics on the outcomes of regenerative periodontal surgery in intrabony defects: a randomized, controlled, clinical study

Pietruska M, Dolińska E, Milewski R, Sculean A. Clin Oral Investig. 2021 May;25(5):2959-2968. doi: 10.1007/s00784-020-03616-7.

https://pubmed.ncbi.nlm.nih.gov/33048260/

Objectives: To assess the potential influence of systemic antibiotic administration on the healing of periodontal intrabony defects treated with deproteinized bovine bone mineral (DBBM) and collagen membrane. **Materials and methods:** Forty-one intrabony defects were treated by means of DBBM and collagen membrane (GTR). Postoperatively, the patients received either systemic antibiotics (i.e., 1 g of

amoxicillin, twice daily for 7 days) (test) or no antibiotics (control). Clinical attachment level (CAL), probing depth (PD), and gingival recession (GR) were measured at baseline and at 1 year following regenerative surgery. The depth of the intrabony component (INTRA DD) and its width (INTRA DW) were measured during surgery and after 1 year at reentry. The depth (RxD) and width (RxW) of the intrabony defects were evaluated radiographically at baseline and at 1 year. **Results:** No adverse events were observed in any of the two groups throughout the entire study period. In the test group, mean CAL changed from 8.7 ± 1.4 mm at baseline to 5.0 ± 1.7 mm at 1 year ($p < 0.0001$), while PD decreased from 7.8 ± 1.5 mm at baseline to 4.0 ± 0.9 mm at 1 year ($p < 0.0001$). In the control group, mean CAL changed from 8.6 ± 1.9 mm to 5.9 ± 1.6 mm ($p < 0.001$) and mean PD improved from 7.4 ± 1.3 mm to 4.1 ± 1.3 mm ($p < 0.001$). Mean CAL gain measured 3.6 ± 1.6 mm in the test and 2.7 ± 1.6 mm in the control group, respectively. Defect fill (i.e., INTRA DD gain) at re-entry measured 3.7 ± 1.8 mm in the test and 2.7 ± 2.1 mm in the control group. A CAL gain of ≥ 3 mm was measured in 76% of the defects in the test group and in 40% of the defects in the control group, respectively. In both groups, all evaluated clinical and radiographic parameters improved statistically significantly compared with baseline, but no statistically significant differences were found between the two groups. **Conclusions:** Within their limits, the present study has failed to show any substantial added clinical benefits following the postoperative administration of amoxicillin in conjunction with regenerative periodontal surgery using DBBM and GTR.

68. Two-Year Follow-Up of 4-mm-Long Implants Used as Distal Support of Full-Arch FDPs Compared to 10-mm Implants Installed after Sinus Floor Elevation. A Randomized Clinical Trial

Rossi F, Tuci L, Ferraioli L, Ricci E, Suerica A, Botticelli D, Pellegrino G, Felice P. Int J Environ Res Public Health. 2021 Apr;18(7):3846. doi: 10.3390/ijerph18073846.

https://pubmed.ncbi.nlm.nih.gov/33917587/

Background: In edentulous patients, bone resorption cannot allow the installation of standard implants and it is demanded to use short implants in the residual alveolar bone or longer implants in grafted bone. **Aim:** To compare the survival and bone level changes of standard plus short 4-mm implants used as distal support of a maxillary full-arch fixed dental prostheses (FDPs) with standard (10-mm) implants placed in association with a bilateral sinus floor augmentation procedure. **Material and methods:** Full-arch FDPs supported by six implants were randomly placed in both groups. In the control group, all implants were 10 mm long and 4.1 mm in diameter. The distal implant in both sides of the maxilla was installed after 4 months from bilaterally sinus floor elevation. In the test group (short group), the distal implant in both sides of the maxilla was 4 mm long and 4.1 mm in diameter. No sinus floor elevations were performed in the test group. Clinical assessments and X-rays were taken at prosthesis delivering and after 6, 12, 18, and 24 months. Patient-reported outcome measures (PROMs) were also evaluated

before surgery and after 6, 12, and 24 months. **Results:** The changes over time of the bone level for the short implants were -0.01 ± 0.11 mm, -0.04 ± 0.13 mm, -0.17 ± 0.29 mm, and -0.28 ± 0.37 mm after 6, 12, 18, and 24 months from prosthesis delivering, respectively. For the standard implants, bone changes were -0.21 ± 0.33 mm (p = 0.103), -0.30 ± 0.32 mm (p = 0.023), -0.40 ± 0.37 mm (p = 0.144), and -0.54 ± 0.49 mm (p = 0.128), respectively. A statistically relevant difference was found only at 12 months after loading between the two groups. **Conclusions:** Similar results on implant survival rate and marginal bone loss were observed for the short and standard implants, placed in association with a bilateral sinus floor augmentation procedure, used as distal support of a maxillary full-arch FDP. A statistically relevant difference was found only at 12 months after loading between the two groups (p = 0.023).

69. Reconstructive surgical treatment of isolated deep intrabony defects with guided tissue regeneration using entire papilla preservation technique: A prospective case series

Aslan S, Buduneli N, Cortellini P. J Periodontol. 2021 Apr;92(4):488-495. doi: 10.1002/JPER.20-0288.

https://botiss.com/product/reconstructive-surgical-treatment-of-isolated-deep-intrabony-defects-with-guided-tissue-regeneration-using-entire-papilla-preservation-technique-a-prospective-case-series/

Background: The aim of this prospective study is to evaluate the clinical applicability of the entire papilla preservation (EPP) technique in the regenerative treatment of isolated deep intrabony defects using native collagen membrane and bone grafting materials. **Methods:** Fifteen healthy and non-smoker patients (nine males and six females; mean age: 47.73 ± 12.18; range 21 to 63 years) with one isolated deep intrabony defect each (baseline probing depth (PD): 9.03 ± 1.62 mm; clinical attachment level (CAL): 11.16 ± 1.81 mm) were treated with guided tissue regeneration. Surgical access to the defect was provided by a single buccal vertical incision with an interdental tunneling flap. Following the granulation tissue removal, intrabony defect was filled with bone substitutes. A collagen barrier was trimmed and placed under the intact defect-associated papilla with palatal positioning suture. Microsurgical sutures were used for primary closure. **Results:** At 1 week, healing of the 15 sites was uneventful. During the study, all sites showed 100% primary closure rate. At 1-year follow-up, an average CAL gain of 5.86 ± 1.28 mm (P < 0.0001), PD reduction of 6.1 ± 1.47 mm (P < 0.0001), and minimal increase in gingival recession of 0.23 ± 0.62 mm (P = 0.168) were observed. **Conclusion:** This novel surgical technique, that keeps the interdental papilla intact, seems promising to provide optimal biomaterial protection and healing conditions, even when a collagen barrier and bone substitutes are applied.

70. Tomographic Assessment on the Influence of the Use of a Collagen Membrane on Dimensional Variations to Protect the Antrostomy After Maxillary Sinus Floor Augmentation: A Randomized Clinical Trial

Imai H, Lang NP, Ferri M, Hirota A, Apaza Alccayhuaman KA, Botticelli D. Int J Oral Maxillofac Implants. 2020 Mar/Apr;35(2):350-356. doi: 10.11607/jomi.7843.

https://pubmed.ncbi.nlm.nih.gov/32142572/

Purpose: To evaluate the dimensional variations after elevation of the maxillary sinus floor and the healing of the antrostomy left unprotected or protected by a collagen membrane. **Materials and methods:** Twenty patients were included in the study. After the elevation of the sinus mucosa, natural bovine bone was grafted into the elevated space. In 10 randomly selected patients, a native collagen membrane made of porcine corium was placed on the antrostomy (membrane group). In the other 10 patients, the antrostomy was left uncovered (no-membrane group). Cone beam computed tomography (CBCT) images were taken for all patients before surgery (T0), 1 week after sinus floor augmentation (T1), and after 9 months of healing (T2), and evaluations of dimensional variations over time of soft and hard tissues were performed. **Results:** At T1, the elevation of the sinus floor in the middle aspect was 12.5 ± 3.8 mm and 11.9 ± 3.6 mm in the membrane and no-membrane groups, respectively. At T2, the reduction in height of the elevated space was 0.6 ± 0.9 mm and 0.8 ± 0.8 mm in the membrane and no-membrane groups, respectively. The elevated area decreased between ~10% and 11% in the membrane group and between ~15% to 20% in the no-membrane group. However, no statistically significant differences were found. **Conclusion:** The use of a collagen membrane to cover the antrostomy after sinus floor elevation did not produce significant clinical effects on dimensional variations over time.

71. Clinical comparison of different flap advancement techniques to periosteal releasing incision in guided bone regeneration: A randomized controlled trial

Zazou N, Diab N, Bahaa S, El Arab AE, Aziz OA, El Nahass H. Clin Implant Dent Relat Res. 2021 Feb;23(1):107-116. doi: 10.1111/cid.12960.

https://pubmed.ncbi.nlm.nih.gov/33155422/

Objectives: To compare Double Flap Incision (DF), Coronally Advanced Lingual Flap (CALF), and Modified Periosteal Releasing Incision (MPRI) to Periosteal Releasing Incision (PRI) in flap advancement, postoperative complications in augmentation using titanium mesh. **Material and methods**: Forty patients with partially edentulous posterior mandibles were randomly assigned to the four groups. We evaluated: (a) Flap advancement in mm (Primary outcome). (b) Pain using the Numerical Rating scale (NRS). (c) Swelling using the Visual Analogue Scale (VAS). (d) Exposure in mm and exposure percentage

at 1 week to 6 months. **Results:** The CALF showed the highest mean flap advancement of 19.9 (±5.0) mm while the PRI showed the lowest; 10.2 (±1.7) mm. The difference between groups was statistically significant (P value <.0001). MPRI showed the highest pain score of 5.3 (±1.3) while the DF showed the lowest; 2.39 (±1.7). Swelling did not show a significant difference between groups. MPRI showed the highest exposure mean; 18.6 mm (±26.3) while CALF showed the lowest; 2.5 mm (±4.0). PRI showed the highest exposure percentage; 7.4% (±9.3) while CALF showed the lowest; 0.4% (±0.7). The difference between groups was insignificant. **Conclusions:** CALF reported highest advancement, least complications while PRI reported the highest complications.

72. Alveolar ridge preservation in defect sockets in the maxillary aesthetic zone followed by single-tooth bone level tapered implants with immediate provisionalization: a 1-year prospective case series

Meijndert CM, Raghoebar GM, Vissink A, Meijer HJA. Int J Implant Dent. 2021 Feb;7(1):18. doi: 10.1186/s40729-021-00292-4.

https://pubmed.ncbi.nlm.nih.gov/33604747/

Background: Clinical studies of single-tooth replacement in compromised bone using bone level tapered implants in the aesthetic zone are scarce. **Aim:** To assess clinically, radiographically and aesthetically over 1 year the performance of a bone level tapered implant in the maxillary aesthetic zone in sites after alveolar ridge preservation. **Material and methods:** Thirty patients (16 male, 14 female) with a failing tooth and large bone defect after removal received alveolar ridge preservation. After 3 months, implants were placed with immediate provisionalization. Definitive restorations were placed after 3 months. The treatment was evaluated 1 year following the definitive restoration. Results: All the patients attended the 1-year follow-up. One implant was lost (96.7% implant survival rate). The mean implant stability quotient value was 68.9 ± 8.74 at implant placement. The mean marginal bone level change was minor (- 0.07 ± 0.12 mm). The mean mid-buccal mucosa changed with + 0.01 ± 0.45 mm. The median Pink Esthetic Score and White Esthetic Score after 1 year were 6 [4; 7] and 8 [7; 9], respectively. The patients' mean overall satisfaction (0-100 VAS scale) was 86.6 ± 10.3. **Conclusion:** Bone level tapered implants with immediate provisionalization perform well after alveolar ridge preservation in the maxillary aesthetic zone, according to implant stability, clinical, radiographic, aesthetic and patient-centred outcomes.

73. Dimensional Change of Peri implant Soft Tissue Following Immediate Implant Placement and Customized Healing Abutment in Posterior Teeth

Choorak N, Amornsettachai P, Chuenjitkuntaworn B, Suphangul S. J Int Dent Med Res. 2021 Jan;14(1), 273-279.

https://www.semanticscholar.org/paper/Dimensional-Change-of-Peri-implant-Soft-Tissue-and-Choorak-Amornsettachai/852cfa9736e7db552afdefcd8c1db32892822ee9

The present study aimed to evaluate the change of soft tissue with 6-month follow-up after immediate implant placement (IIP) with customized healing abutment (CHA) in posterior teeth. Patients were received IIP with bone graft and connected of CHA. Silicone impression were taken at pre-extraction, immediate post-extraction, 1, 3, and 6 months after extraction. Scanned models were superimposed and measured. Data were analyzed by Friedman test for comparing between time interval of the same region and Wilcoxon signed rank test for analyzing the comparison between regions. The results showed that soft tissue had most rate of changes during the first month. After that, the dimensional of tissue was almost constant (±0.01 mm per month) except on the buccal side. At 3-month follow-up, there was a significant difference of buccolingual width (P = .019). The median change of buccolingual width was -0.73 mm. but no significant difference change of gingival margins and heights throughout 6-months follow-up except on the lingual height that show difference (P = .001). In conclusion, IIP with CHA could maintain the architecture and horizontal dimension of “transmucosal tissue” but could not maintain the vertical dimension of lingual height and buccolingual width during the 6-month follow-up.

74. 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. doi: 10.1002/ccr3.3626.

https://botiss.com/product/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/

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.

75. Tomographic Assessment on the Influence of the Use of a Collagen Membrane on Dimensional Variations to Protect the Antrostomy After Maxillary Sinus Floor Augmentation: A Randomized Clinical Trial

Imai H, Lang NP, Ferri M, Hirota A, Apaza Alccayhuaman KA, Botticelli D. Int J Oral Maxillofac Implants. 2020 Mar/Apr;35(2):350-356. doi: 10.11607/jomi.7843.

https://pubmed.ncbi.nlm.nih.gov/32142572/

Purpose: To evaluate the dimensional variations after elevation of the maxillary sinus floor and the healing of the antrostomy left unprotected or protected by a collagen membrane. **Materials and methods:** Twenty patients were included in the study. After the elevation of the sinus mucosa, natural bovine bone was grafted into the elevated space. In 10 randomly selected patients, a native collagen membrane made of porcine corium was placed on the antrostomy (membrane group). In the other 10 patients, the antrostomy was left uncovered (no-membrane group). Cone beam computed tomography (CBCT) images were taken for all patients before surgery (T0), 1 week after sinus floor augmentation (T1), and after 9 months of healing (T2), and evaluations of dimensional variations over time of soft and hard tissues were performed. **Results:** At T1, the elevation of the sinus floor in the middle aspect was 12.5 ± 3.8 mm and 11.9 ± 3.6 mm in the membrane and no-membrane groups, respectively. At T2, the reduction in height of the elevated space was 0.6 ± 0.9 mm and 0.8 ± 0.8 mm in the membrane and no-membrane groups, respectively. The elevated area decreased between ~10% and 11% in the membrane group and between ~15% to 20% in the no-membrane group. However, no statistically significant differences were found. **Conclusion:** The use of a collagen membrane to cover the antrostomy after sinus floor elevation did not produce significant clinical effects on dimensional variations over time.

76. Comparison of Regenerative Potential of Platelet-rich Fibrin Alone and in Combination with Bovine Bone Graft in Intraosseous Defect by Single Flap Approach: A Clinical and Radiographic Study

Thakkar B, Chandran S, Vishnoi S, Nadig P, Raval R, Doshi P. J Int Soc Prev Community Dent. 2020 Nov 24;10(6):743-751. doi: 10.4103/jispcd.JISPCD_200_19.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7791578/

Aim: To compare the regenerative potential of platelet-rich fibrin alone and in combination with bovine bone graft in intraosseous defect by the single flap approach. **Materials and Methods:** A total of 32 sites of intrabony defects were selected and were treated with platelet-rich fibrin (PRF) alone or in combination with bovine bone graft. Clinical parameters [Gingival index (GI), probing depth (PD), clinical attachment level (CAL), Gingival recession, and radiographic parameters (defect fill, alveolar crest level, and defect depth)] were recorded at baseline, 3 months, and 6 months. **Results:** Statistical analysis was done by independent and paired t-test. There were statistically significant changes in GI, PD reduction, CAL gain, defect fill, alveolar crest level changes, and defect depth resolution from baseline, 3 months, and 6 months in both the groups ($P < 0.001$). On intergroup comparison, Group II showed statistically significant changes in a reduction in pocket depth and defect depth resolution at $P < 0.001$. **Conclusion:** PRF in combination with bovine bone graft was more effective in the treatment of intrabony defects.

77. Effect of Simvastatin on Bone Regeneration: A Histologic and Histomorphometric Analysis*

Yaghobee S, Panjnoush M, Chokami Rafiei S, Amini Shakib P, Mahmoodi S, Rasouli-Ghahroudi AAR, Poursafar F. J Oral Maxillofac Surg. 2020 Jun;78(6):927-934. doi: 10.1016/j.joms.2020.01.016.

https://pubmed.ncbi.nlm.nih.gov/32084353/

Purpose: The purpose of the present study was to evaluate the efficacy of simvastatin administration as an osteoinductive agent combined with bovine bone material (BBM) for augmentation of human maxillary sinuses. **Materials and methods:** In the present randomized clinical trial with a split-mouth design, 24 maxillary sinuses in 12 patients were augmented using BBM alone or BBM combined with simvastatin. Biopsy samples were taken 9 months after maxillary sinus floor augmentation for histologic and histomorphometric analyses. A total of 44 implants were placed in the augmented bone. **Results:** The results of the microscopic assessment of most samples revealed no inflammation or only mild chronic inflammation. Lamellation was detectable in old bone trabeculae under polarized light microscopy but was not observed in newly formed bone. Osteocytes were found with a lower frequency in the lacunae of newly formed bone compared with normal bone. No significant differences were found in the amount of newly formed bone and the amount of residual particles between the 2 groups. **Conclusions:** Despite the greater mean percentage of newly formed bone in the test group, the histomorphometric analysis results did not show a significant positive effect for the use of simvastatin in maxillary sinus augmentation.

*Study refers to CompactBone B., which was a private label of cerabone®.

78. Histological evaluation of two different anorganic bovine bone matrixes in lateral wall sinus elevation procedure: A retrospective study

Mahesh L, Mascarenhas G, Bhasin MT, Guirado C, Juneja S. Natl J Maxillofac Surg. 2020 Jul-Dec;11(2):258-262. doi: 10.4103/njms.NJMS_81_19.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8051657/

Introduction: Grafting in oral implantology involves bone augmentation procedures with various bone graft materials. Success of such procedures is evaluated through the amount of bone volume and bone formed at the grafted site. The primary aim of this prospective study was to histomorphometrically evaluate and compare the new bone formation with Bio Oss or Cerabone in the lateral approach sinus augmentation procedure. **Materials and Methods:** The research targeted 22 patients who were either partially or completely edentulous posterior maxilla with residual alveolar height 3 mm at the site of

implantation and underwent a two staged surgical protocol, with a lateral approach sinus grafting with either Bio Oss or Cerabone. Bone trephine biopsies for histological analysis were harvested 6 months after augmentation while preparing the osteotomies for implant placement trephine. The histologic evaluation was performed comparing the newly formed bone, marrow spaces, biomaterial particles remnants, and presence of osteocytes embedded in both trabecular bone and bone tissue near the anorganic bovine bone. **Results:** The present study showed that neither of the graft material showed any active osteoclasts and host inflammatory reaction. From sites grafted with Cerabone, an ample amount of mature lamellated bone formation was seen, also host inflammatory response was indicative of minimal reactive inflammatory response suggestive of good acceptability of the graft material by the host. No significant differences between the groups could be detected with regard to new bone formation and residual bone substitute. Conclusion: The results of the study illustrates that both the bone substitute materials allow predictable new bone formation in sinus augmentation procedures.

79. Impact of fully or partially guided surgery on the position of single implants immediately placed in maxillary incisor sockets: A randomized controlled clinical trial

Kraft B, Frizzera F, de Freitas RM, de Oliveira GJLP, Marcantonio Junior E. Clin Implant Dent Relat Res. 2020 Oct;22(5):631-637. doi: 10.1111/cid.12941.

https://pubmed.ncbi.nlm.nih.gov/32875722/

Purpose: The aim of this study was to compare the deviation of the implant position after placement in single maxillary incisor post-extraction sockets between fully and partially guided surgery. **Materials and methods:** Twenty-four patients with a failing maxillary incisor were randomly allocated into two groups: the partially guided surgery (PGS, n = 12) group or fully guided surgery (FGS, n = 12) group. Clinical analyses, intra-oral scans, and computed tomography scans (CT) were initially performed to define the virtual positioning of the implants and fabrication of the 3D printed surgical guides. A narrow, 3.5 × 16 mm implant was placed in each socket. In this moment, the insertion torque (IT) was assessed and resonance frequency analysis (RFA) was performed. All patients received an immediate provisional without occlusal contacts. Another CT scan was performed after the procedures to compare the implant position with the virtually planned position. **Results:** Significant deviations occurred at the implant apex, according to the global and facial-palatal analyses, in comparison to its cervical position. The PGS group also presented a larger deviation in the MD position. No statistical differences between the groups were detected, however, there was a tendency of lower angular deviation in the PGS group. **Conclusions:** While there was a slight deviation from the virtually planned position of the implant to the actual position and a tendency of lower angular deviation in the PGS group, there was no difference among groups regarding its position and primary stability.

80. Influence of the type of bone substitute materials on the rates of bone regeneration in sinus lift grafting with lateral approach and delayed implant placement

Papanchev G, Peev S, Georgiev T. Clin. Oral Implants Res. 2020 Oct;31, 251-251.

https://onlinelibrary.wiley.com/doi/full/10.1111/clr.189_13644

Background: Dental implantology is the most dynamic area of the dental medicine and today it is an integral part of the daily practice. Often the placement of dental implants must be combined with various augmentation procedures. Such a case is the maxillary sinus floor augmentation, which has been used for occlusal rehabilitation in the posterior maxilla. Different kinds of bone substitute materials have been used to solve the problems with the shortage and quality of the remaining bone in this region. **Aim/Hypothesis:** The aim of this research is to follow the rates of bone regeneration in sinus lift grafting with synthetic biphasic calcium phosphate-BoneCeramic, xenogeneic bovine hydroxyapatite-Cerabone and biphasic calcium phosphate paste-Maxresorb inj. using instrumental, histomorphometric and imaging methods. **Materials and Methods:** Thirty patients were divided into three equal groups, as each was divided into two subgroups of five people. Each patient underwent a sinus lift with lateral access, and depending on which of the three main groups he fell in, different bone substitute material was used: synthetic biphasic calcium phosphate, xenogeneic bovine hydroxyapatite and biphasic calcium phosphate paste. On the 6th or 9th postoperative month, depending on the subgroup in which each patient falls, a CBCT was performed and the height of the augmented subantral bone was measured. A biopsy was taken using a 4.3 mm trephine bur. The resulting cylINDIAr was fixed in neutral formalin for 24 hours. The sample was stained with a Goldner's Masson trichrome stain, imaged under a scanning microscope and digitized. Staining makes it possible to differentiate mineralized bone by staining it green with NO-mineralized bone, which is stained red. A histomorphometric analysis was performed with the PS CS5 Extended program. **Results:** The obtained results were distributed in tables and statistically processed using descriptive analysis, regression analysis, ANOVA analysis of variance and Student's t-test. They showed that the largest total volume of bone tissue (mineralized and NO-mineralized) in the biopsy sample without residual bone was obtained using xenogeneic bovine hydroxyapatite - 15.7%, followed by biphasic calcium phosphate paste - 14.2% and synthetic biphasic calcium phosphate - 8.2%. The highest values of mineralized bone were obtained with xenogeneic bovine hydroxyapatite, while the NO-mineralized bone was the highest with biphasic calcium phosphate paste. From the analysis of the obtained results it is clear that the sex (P = 0.879) and age (P = 0.143) of the patient do not affect the quantity and quality of the newly formed bone. We did not find a relationship between the volume of bone tissue in the biopsy sample and the time elapsed from sinus lift grafting (P = 0.406). **Conclusions and Clinical Implications:** In conclusion, we can say that sinus lift grafting with lateral approach can be used with equal success in different age groups

and always leads to predictable and stable results over time. Xenogeneic bovine hydroxyapatite is a favourite when choosing a bone substitute material. The lack of a statistically significant difference in the volume of the newly formed bone between the 6th and 9th month gives grounds for earlier placement of dental implants reducing treatment time.

81. Radiological changes in maxillary sinus morphology after lateral sinus floor augmentation

Shpachynskyi O, Didkovskij V, Kopchak A. Otolaryngol Pol. 2020 Jun 3;74(5):1-5. doi: 10.5604/01.3001.0014.1679.

https://pubmed.ncbi.nlm.nih.gov/32831187/

Background: Restoration of the masticatory function in patients with edentulous posterior maxilla is often challenging due to the severe atrophy of the alveolar ridges and proximity of the maxillary sinus, resulting in insufficient bone quantity for implant-supported dentures. **Aim:** The purpose of this study was to analyze the changes in Schneiderian membrane thickness after lateral sinus floor augmentation (LSFA) using cone beam computed tomography (CBCT). **Material and methods:** WLSFA procedures using different bone grafting materials were performed in 87 patients, operated on in two clinical institutions from 2016 to 2018. CBCT examination was performed in all patients before the LSFA procedure, at 1 month after surgery, and after 6 months, before implant placement or loading**. Results:** Minor r adiological changes in mucous membrane morphology were observed preoperatively in 17.1% of patients. Postoperative CBCT in the early postsurgical period demonstrated that the number of intact non-specific sinuses decreased significantly, i.e. from 86.7% to 26.7%. The number of cases with local hypertrophia of the mucous membrane increased from 20.3% to 26.7%. Mucosal thickening was observed in 41.7% vs 7.5%. The number of intact sinuses increased to 57.8%. The number of cases with local membrane hypertrophia also increased - to 37.4%. The number of cases with mucosal thickening or fluid accumulation decreased significantly to 11.8 and 5.3% respectively. In 2 cases the development of chronic sinusitis required secondary surgeries. **Conclusion:** The present retrospective study revealed that minor radiological changes in the morphology of the maxillary sinus mucosa were observed preoperatively in 17.1% of patients who underwent LSFA procedures. In the early and late postoperative period their frequency increased to 68.5% and 47.1%, respectively. However, the clinical signs of sinusitis developed only in 19.26% of patients. No significant correlations were found between the frequency and severity of postoperative radiological changes and residual bone height, sinus anatomy, initial state of the mucous membrane and type of the grafting material.

82. Extramaxillary Zygomatic Implants: An Alternative Approach for the Reconstruction of the Atrophic Maxilla

Blanc O, Shilo D, Weitman E, Capucha T, Rachmiel A. Ann Maxillofac Surg. 2020 Jan-Jun;10(1):127-132. doi: 10.4103/ams.ams_157_19.

https://pubmed.ncbi.nlm.nih.gov/32855928/

Background: Limited bone quality in the posterior maxilla results in low success rates for dental implants. Various bone augmentation methods have been described, yet most require two-step surgical procedures with relatively high rates of resorption and failure. An alternative for these patients is zygomatic implants. Zygomatic implants utilize the basal craniofacial bone. **Materials and methods:** A retrospective study was conducted on 25 patients exhibiting ridges classified as V-VI according to the Cawood and Howell classification. Seventy-six extramaxillary zygomatic implants were placed. Immediate rehabilitation was performed with a mean follow-up of 18.6 months. **Results:** Three implants failed, and two were replaced successfully. No significant bone loss was observed in the rest of the implants. Soft tissue around the implant heads healed properly. All implants were prosthetically rehabilitated successfully. **Conclusions:** Zygomatic implants allow for immediate loading of an atrophic maxilla. The emergence of the implant is prosthetically correct compared to the intrasinus approach, leading to better dental hygiene and decreased mechanical resistance. 96.1% of the implants survived, with good anchorage and proper soft tissue healing and rehabilitation. We suggest using extramaxillary zygomatic fixture as the first line of treatment in severe atrophic maxilla.

83. Open-Healing Socket Preservation with a Novel Dense Polytetrafluoroethylene (dPTFE) Membrane: A Retrospective Clinical Study

Zafiropoulos GG, Kačarević ZP, Qasim SSB, Trajkovski B. 2020. Medicina (Kaunas). 2020 Apr;56(5):216. doi: 10.3390/medicina56050216.

https://botiss.com/product/open-healing-socket-preservation-with-a-novel-dense-polytetrafluoroethylene-dptfe-membrane-a-retrospective-clinical-study/

Background and objectives: Non-resorbable dense polytetrafluoroethylene (dPTFE) membranes are widely used for regeneration procedures, alone or in combination with particulate materials. The aim of this work was to examine the efficacy of a newly developed dPTFE membrane in the management of extraction socket healing. **Materials and Methods:** The extraction premolar sockets of 44 patients (20 men and 24 women) were preserved. One group received prosthetic rehabilitation with a fixed partial denture (FPD) (PROS group, N = 19) and a second group received immediate implant placement (IMPL group, N = 25). The PROS group sockets were augmented with a bovine derived xenograft and covered with a newly developed dPTFE membrane prior to FPD rehabilitation. **Results:** In the IMPL group, socket preservation was combined with immediate implant placement. Before (T0) and 6 months after surgery (T1), horizontal and vertical dimensions were measured with customized stents. No significant differences in alveolar bone loss from T0 to T1 were observed between the PROS and

IMPL groups in the horizontal dimension for any tooth type. There was a significant difference in alveolar bone loss from T0 to T1 between the two groups for only single-rooted maxillary premolars in the vertical dimension. **Conclusions:** The use of the examined new dPTFE membrane consistently led to the preservation of hard tissue in the extraction sites.

84. Clinical outcomes of the entire papilla preservation technique with and without biomaterials in the treatment of isolated intrabony defects: A randomized controlled clinical trial

Aslan S, Buduneli N, Cortellini P. J Clin Periodontol. 2020 Apr;47(4):470-478. doi: 10.1111/jcpe.13255.

https://pubmed.ncbi.nlm.nih.gov/31925811/

Aim: This study compared the clinical efficacy of the entire papilla preservation technique (EPP) alone and in combination with enamel matrix proteins plus bovine-derived bone substitutes (EPP EMD + BS) in the treatment of isolated inter-dental intrabony defects. **Material and methods:** Thirty patients, each with one isolated intrabony defect, were randomly assigned to EPP EMD + BS or EPP alone. Clinical outcomes were assessed 1-year post-surgery. **Results:** Early healing phase was uneventful in all cases, and 100% primary wound closure was maintained throughout the study period. Intragroup differences between baseline and 1-year were statistically significant in both groups in terms of clinical attachment level (CAL) gain and probing depth (PD) reduction ($p \leq .001$). No statistically significant differences were detected in gingival recession (REC) ($p > .05$). No statistically significant differences were detected in terms of CAL gain (6.3 ± 2.5 mm vs. 5.83 ± 1.12 mm), PD reduction (6.5 ± 2.65 mm vs. 6.2 ± 1.33 mm) or increase in gingival recession (0.2 ± 0.25 mm vs. 0.36 ± 0.54 mm) between the groups treated with EPP EMD + BS or EPP alone. **Conclusions:** Application of EPP with and without regenerative biomaterials resulted in significant amounts of CAL gain and PD reduction, with negligible increase in gingival recession. Within the limits of the present study, it can be concluded that the addition of regenerative biomaterials does not improve the clinical outcomes of EPP alone.

85. Horizontal ridge augmentation using native collagen membrane vs titanium mesh in atrophic maxillary ridges: Randomized clinical trial

Atef M, Tarek A, Shaheen M, Alarawi RM, Askar N. Clin Implant Dent Relat Res. 2020 Apr;22(2):156-166. doi: 10.1111/cid.12892.

https://botiss.com/product/horizontal-ridge-augmentation-using-native-collagen-membrane-vs-titanium-mesh-in-atrophic-maxillary-ridges-randomized-clinical-trial/

Background: Several techniques have been proposed to reconstruct deficient alveolar ridges including bone blocks, ridge splitting and guided bone regeneration (GBR). GBR has been successfully established

in restoring horizontal bone deficiency. However, yet still there is a debate regarding the ideal barrier for GBR. **Purpose**: To evaluate the quantity and the quality of the bone gained using collagen membrane with 1:1 mixture of autogenous and anoraganic bovine bone mineral compared to titanium mesh with the same mixture of bone for GBR of horizontally deficient maxillary ridges. **Materials and methods:** Two different grafting techniques were evaluated, 10 patients receiving GBR using native collagen membrane using 1:1 autogenous and anorganic bovine bone mineral (ABBM) bone mixture, and 10 patients receiving GBR using titanium mesh with same mixture of bone. **Results:** Statistical analysis showed a significant increase in alveolar bone width in both techniques with a mean bone gain of 4.0 mm for Collagen group and 3.7 mm for titanium mesh group. Bone area percent was almost 28% for both groups. For Ti-mesh group, six sites soft tissue healing was uneventfully with no signs of wound dehiscence. However, four cases showed mesh exposure first 3 patients showed this exposure 3 weeks postoperatively while the fourth patient showed exposure 4 months postoperatively. The mean graft resorption in the Collagen and mesh group 6 months postoperative was considered nonsignificant. **Conclusions:** GBR with both collagen membrane and titanium mesh using a 1:1 mixture of autogenous and ABBM is a viable technique for horizontal augmentation of deficient maxillary alveolar ridges. Titanium mesh is a more technique sensitive compared to collagen membrane. Soft tissue dehiscence and difficulty during second stage removal should limit its use in augmentation of horizontally deficient maxillary ridges.

86. Esthetic outcome of immediately placed and nonfunctionally loaded implants in the anterior maxilla utilizing a definitive abutment: A pilot clinical trial

AlTarawneh S, Hamdan AAS, Alhadidi A, Hattar S, Al-Rabab'ah M, Baqain Z. Dent Res J (Isfahan). 2020 Mar;17(2):92-99.

https://pubmed.ncbi.nlm.nih.gov/32435430/

Background: Immediate dental implants placement and loading utilizing definitive abutments might save time and cost when an esthetic final result is anticipated. The objective of this prospective clinical trial was to evaluate the esthetic outcome of immediate implantation and immediate nonfunctional loading utilizing definitive abutments, with and without bony substitutes filling the peri-implant gap. **Materials and methods:** In this clinical trial study a total of 11 implants were placed utilizing a flapless immediate post extraction approach in the maxilla (second premolar to second premolar). Atraumatic extraction was performed and implants were immediately placed. The gap was either left without grafting or filled with particulate bone material. Immediate nonfunctional loading was performed utilizing a definitive abutment. The pink esthetic scores (PESs) were assessed preoperatively, at 1- and 2-year follow-up periods. Dental casts were obtained at respective time intervals; scanned, registered, and closest point distances were measured. For all statistical tests, value of P = 0.05 was set as a statistical significance level. **Results:** The mean of PES at baseline was 9.4 ± 1.69, at 1 year was 9.5 ± 2.07, at 2 years was 10.2 ± 2.75, for the graft group 10.3 ± 2.8, and for nongrafting group was 10.2 ±

2.59. There were no statistically significant differences in PESs at baseline when compared to 1- and 2-year intervals, and for grafting group versus nongrafting group (P = 0.24). Distances between the two time points for all cases were <1 mm in all reference planes. **Conclusion:** Immediate placement and nonfunctional loading utilizing a definitive abutment appear to result in a stable result as far as esthetic outcome and alveolar process sufficiency are concerned.

87. Implant stability in patients treated with platelet-rich fibrin and bovine bone substitute for alveolar ridge preservation is associated with peripheral blood cells and coagulation factors

Brouwers JEIG, van der Vorm LN, Buis S, Haumann R, Karanzai A, Konings J, de Groot PG, de Laat B, Remijn JA. Clin Exp Dent Res. 2020 Apr;6(2):236-243. doi: 10.1002/cre2.263.

https://pubmed.ncbi.nlm.nih.gov/32250570/

Aims: The aim of the present study was to assess the association between dental implant stability and peripheral blood cell composition and levels of coagulation factors in patients treated with alveolar ridge preservation with platelet-rich fibrin (PRF) and bovine bone substitute. **Materials and methods:** Fifty patients were included between 2015 and 2017. PRF was prepared from autologous blood, in which blood cells and coagulation factor levels were measured. PRF and bovine bone were placed in the socket, followed by closure with PRF membrane. Implants were placed 14 (±2.5) weeks postextraction. The implant stability quotient was measured at t = 0, t = 10 days, t = 7 weeks, and t = 17 weeks by resonance frequency analysis. **Results:** Erythrocyte count was inversely associated with PRF membrane length, but not with implant stability. Conversely, platelet count did not correlate with membrane size but inversely correlated with implant stability at 7 and 17 weeks. In addition, implant stability was directly correlated with levels FXIII (t = 0, p < .01), active von Willebrand factor (VWF; t = 0 and 7 weeks, p < .05), and total VWF (t = 7 weeks, p = .012). **Conclusion:** Implant stability following alveolar ridge preservation with PRF and bovine bone substitute is associated with circulating blood cells and coagulation factors. In particular, fibrin structure, VWF, and FXIII may be important modulators of implant stability.

88. Three-dimensional analysis of dimensional changes after alveolar ridge preservation with bone substitutes or plasma rich in growth factors: Randomized and controlled clinical trial

Stumbras A, Galindo-Moreno P, Januzis G, Juodzbalys G. Clin Implant Dent Relat Res. 2021 Feb;23(1):96-106. doi: 10.1111/cid.12950.

https://pubmed.ncbi.nlm.nih.gov/33084205/

Objectives: To evaluate alveolar ridge dimensional changes of different alveolar ridge preservation techniques after 3 months of tooth extraction and to compare the efficacy of autologous plasma rich in growth factor (PRGF) to the bone substitutes in alveolar ridge preservation and sites left to heal spontaneously. **Materials and methods:** Forty patients requiring tooth extraction in the anterior maxilla were randomly allocated to the four following treatment modalities: spontaneous healing (control), natural bovine bone mineral covered with resorbable native collagen membrane (BBM/CM), freeze-dried bone allograft covered with resorbable native collagen membrane (FDBA/CM) and PRGF alone. Cone beam computed tomography (CBCT) scans were taken after surgery and 3 months later. The measurements of height and width (at 1, 3, and 5 mm below the crest) were performed after superimposing the 2 consecutive CBCT scans. **Results:** The greatest horizontal alveolar bone resorption at 1 mm below bone crest was observed in the control group (-1.61 ± 1.76 mm, P = .037), whereas the least reduction in width was found in the BBM/CM group (-0.68 ± 0.67 mm, P = .037). The most pronounced alveolar height reduction was observed in the control group (-0.86 ± 0.43 mm), whereas alveolar ridge preservation with BBMC/CM (-0.26 ± 0.91 mm) and PRGF (-0.54 ± 0.86 mm) successfully reduced the alveolar height reduction as compared to the control group. **Conclusions:** Alveolar ridge preservation technique in the esthetic zone using BBM/CM or using PRGF is beneficial to reduce horizontal and vertical bone changes.

89. Evaluation Of Anterior Maxillary Horizontal Ridge Augmentation With Simultaneous Implant Placement Using Cerabone® Versus Cerabone® Combined With Platelet Rich Plasma – RCT

Ibrahim AM, Khalil MM, El Halawani GN. Alexandria Dental Journal. 2020. DOI: 10.21608/adjalexu.2020.88461

https://adjalexu.journals.ekb.eg/article_88461.html

Aim: To evaluate horizontal augmentation of narrow anterior maxillary alveolar ridge with simultaneous implant placement using cerabone® with and without platelet rich plasma (PRP). **Materials/Methods:** In this study, 14 implants were placed in patients with insufficient alveolar ridge width in the maxillary lateral incisor region. Patients were divided into two groups; In Group 1: cerabone® only while in Group 2 a mixture of cerabone® and PRP was used. A collagen membrane was used to cover the grafting material. Postoperative pain was assessed using visual analogue scale. Healing and postoperative edema were evaluated. Cone Beam Computed Tomography (CBCT) was obtained before surgery, immediately postoperatively and after 6 months so that the labial bone width and bone density were evaluated. Osstell was used to evaluate implant stability quotient (ISQ) during surgery and after 6 months. **Results:** All implants in both groups were successfully osseointegrated and functionally stable. No significant difference in postoperative pain, edema or wound healing was detected between the two groups. The mean percentage of change in ISQ was

superior in Group 2 when compared to Group 1 but statistically there was no significant difference (P=0.898). The labial bone width in Group 2 was significantly higher than that of Group 1. The mean percentage of change in labial bone density was 57.95% in Group 1 and 112.52% in Group 2. **Conclusion:** cerabone® can be used effectively for guided bone regeneration around dental implant in narrow maxillary anterior alveolar ridges. Moreover, the addition of PRP has a positive effect on bone regeneration around implants.

90. Stability of Tissue Augmented with Deproteinized Bovine Bone Mineral Particles Associated with Implant Placement in Anterior Maxilla.

Kamadjaja DB, Mira Sumarta NP, and Rizqiawan A. 2019. Case Rep Dent.; 27;2019:5431752.

https://www.hindawi.com/journals/crid/2019/5431752/

AIM: This study is evaluating the stability of tissue augmented with DBBM (cerabone®) particle associated with implant placement in the anterior maxilla. **MATERIALS and METHODS:** The inclusive criteria consist of patients being treated with guided bone regeneration (GBR) incorporating the use of DBBM particles with either a simultaneous or staged approach. The parameters analyzed include the implant survival rate, post-GBR clinical stability based on tissue resorption level, and the tissue stability between simultaneous and staged approaches. **RESULTS:** Seventeen patients with 23 implant placements satisfy the criteria for this study. Simultaneous approach is adopted in 18 (78.3%) implants and a staged approach in 5 (21.7%) implants. The implant survival rate is 100%. The evaluation of horizontal tissue stability reveals a low resorption level in 19 (82.6%) implants, while moderate and high resorption levels are found only in 3 (13.0%) and 1 (4.3%) implants, respectively. The statistical analysis shows that the simultaneous approach produces significantly lower resorption level compared to the staged approach. **CONCLUSION:** Horizontal ridge augmentation using cerabone® particles associated with implant placement in the anterior maxilla produces good clinical stability. The stability appears to be higher in the simultaneous approach compared to the staged approach.

91. Regeneration of Peri-implantitis Infrabony Defects: Report on Three Cases.

Wen SC, Huang WX, Wang HL. Int J Periodontics Restorative Dent. 2019 Sep/Oct;39(5):615-621. doi: 10.11607/prd.4275. PMID: 31449569.

https://pubmed.ncbi.nlm.nih.gov/31449569/

This paper presents a surgical treatment protocol known as EP-DDS (etiology identification, primary wound closure, debridement, decontamination, and stability of wound). The treatment protocol can be achieved in five steps. First, identify etiologic factors associated with peri-implantitis to determine whether or not the defects can be treated with this protocol. Second, in order to achieve primary

wound coverage, ensure there is undisturbed wound healing, which may involve using procedures such as removing an existing prosthesis and performing tension-releasing flap design. Third, perform proper debridement of the inflamed granulomatous tissues to ensure the wound is free of any inflamed remnants. Fourth, conduct implant-surface decontamination by using a titanium brush or lasers. And finally, place appropriate space fillers (bone grafts and membrane) for wound stability. The three cases that have been successfully treated with the EP-DDS surgical protocol suggest it is a feasible surgical approach to obtain good infrabony defect bone fill (5.5-mm average) around the defects (buccal, mesial, lingual, and distal). Nonetheless, future randomized clinical trials with larger sample sizes and longer follow-ups are needed to further validate this treatment protocol.

92. Digitalized CAD/CAM protocol for the fabrication of customized sealing socket healing abutments in immediate implants in molar sites.*

Finelle G, Sanz-Martín I, Knafo B, Figué M, Popelut A. Int J Comput Dent. 2019; 22(2):187-204.

https://pubmed.ncbi.nlm.nih.gov/31134225/

This case series aimed to evaluate the performance and efficacy of a digitally fabricated sealing socket abutment in implant immediacy. **Methods:** Molars in the mandible or maxilla were extracted atraumatically (patients n=29) and implants (n=30) were placed in the irrigated and cleaned sockets. Small cerabone® granules were placed around the implants to augment the gaps. A digital impression was taken and based on that a customized healing abutment was milled chairside. Then, the abutment was placed onto the implants. After three to four months, the abutment was removed and a digital impression was taken for preparation of the final prosthesis. The clinical outcomes were evaluated at one and two years post-surgery.

Results:

- Uneventful healing for all patients one week after abutment placement
- Maintenance of the buccal contours over the 2-year follow up period
- All implants remained successfully in situ over the 2-year follow up period

Conclusion: The authors summarized that the use of a CAD/CAM-fabricated healing abutment in immediate implant placement is a viable treatment option for the management of molar extraction sites.

*Publication in English and German.

93. Buccal fat pad-derived stem cells with anorganic bovine bone mineral scaffold for augmentation of atrophic posterior mandible: An exploratory prospective clinical study.

Khojasteh A, Hosseinpour S, Rezai Rad M, Alikhasi M, Zadeh HH. Clin Implant Dent Relat Res. 2019 Apr;21(2):292-300. doi: 10.1111/cid.12729.

https://pubmed.ncbi.nlm.nih.gov/30821120/

This study aims to evaluate the efficacy of buccal fat pad-derived stem cells (BFPSCs) mixed with cerabone® in comparison to autologous bone for vertical and horizontal augmentation of the posterior mandible. **Methods:** 14 patients with horizontal and vertical alveolar ridge deficiencies of less than 4 and 8 mm respectively were treated with cerabone® either preloaded with BFPSCs (group 1) or mixed with autologous bone chips (group 2). A titanium mesh was used to cover the grafts and to stabilize the augmented sites. The surface areas of newly formed bone were determined by quantitative CBCT analysis. Images were taken pre-operative and six months post-surgery.

Results:

- Total areas of newly formed bone were 169.5 ± 5.90 (group 1) and 166.75 ± 10.05 mm^2 (group 2)
- Areas of new bone formation for vertical defects were 164.91 ± 3.74 (group 1) and 169.36 ± 12.09 mm^2 (group 1)
- The area of new bone formation for horizontal deficiencies were 170.51 ± 4.54 mm^2 (group 1) and 166.98 ± 9.36 mm^2 (group 2)
- Differences between the two groups were not statistically significant

Conclusion: The authors concluded that BFPSCs may be an alternative to autologous bone in alveolar ridge reconstruction as no differences in bone volume formation between the groups were found.

94. Can placement of an immediate bone level tapered implant and subperiosteal xenograft help maintain bone architecture in esthetic areas?

Caiazzo A, Brugnami F, Mehra P. Journal of Oral Biology and Craniofacial Research 2019; 9: 186-189.

https://www.sciencedirect.com/science/article/pii/S221242681830304X

The goal of the study was to evaluate if the buccal plate preservation (BBP) technique in implant immediacy in conjunction with cerabone® prevents alveolar ridge resorption. **Methods:** 20 patients were subjected to single tooth extraction in the aesthetic zone. In four-wall intact sockets implants were placed immediately following curettage. Spaces between the buccal plate and implant were augmented with cerabone® according to the BBP technique. Sites were stabilized by sutures, but no primary wound closure was achieved. CBCTs were taken immediately after implant placement (T1) and six months post-surgery (T2) to evaluate buccal plate resorption. Measurements were performed at two sites of the socket, at 1mm and at 4mm below the cementoenamel junction of the adjacent teeth.

Results:

- Mean bone thickness was 2.86mm (range 1.4–5.3) at T1 at the 1mm point, and 3.09mm (range 1.8–5.3) at the 4mm point
- At T2, the thicknesses were 2.49mm (range 1.2–4.9) at M1, and 2.83mm (range 1.5–5) at M2

- The mean of the difference between T1 and T2 was −0.19±0.85mm at the 1mm point and −0.05±0.99mm at the 4mm point
- The difference between the means at T1 and T2 was not statistically significant
- No implants were lost, all remained successfully in function over the whole observation period

Conclusion: The results showed excellent stability of the buccal plate contour six months post-operative. The authors concluded that the BBP technique can be successfully used in combination with immediate implant placement.

95. Bone Graft Displacement After Maxillary Sinus Floor Augmentation With or Without Covering Barrier Membrane: A Retrospective Computed Tomographic Image Evaluation.

Ohayon L, Taschieri S, Friedmann A, Del Fabbro M. Int J Oral Maxillofac Implants. 2019; 34(3):681–691.

https://www.ncbi.nlm.nih.gov/pubmed/30521657

The goal of this retrospective study was to evaluate, if a collagen barrier membrane placed over the lateral bone window affects the stability of the bone graft and the displacement of bone graft particles following sinus floor augmentation. **Methods:** 41 patients did underwent lateral sinus floor augmentation using cerabone®. The bone windows were either covered with collprotect® membrane (control group, n=17) or left uncovered (test group, n=24). All sites were closed by the flap. CBCTs were taken immediately after the surgery, and seven days as well as six months post-operative in order to evaluate bone graft stability and bone graft particle displacement. Post-surgical morbidity was analyzed using a visual analog scale (VAS) seven days after the surgical intervention. **Results:** The mean displacement of the bone graft particles six months post-operative was significantly greater in the test group (3.8±3.1 mm) than in the control group (0.5±0.4 mm). The post-operative morbidity was significantly more pronounced in the test group (pain 3.3±1.4/swelling 4.3±4.5) than in the control group (2.1±0.9/2.7±0.9). **Conclusion:** The authors concluded that a barrier membrane placed over the lateral bone window helped preventing bone graft particles displacement thus reducing post-operative morbidity.

96. Nonincised Papillae Surgical Approach (NIPSA) in Periodontal Regeneration: Preliminary Results of a Case Series.

Moreno Rodriguez JA, Caffesse RG. Int J Periodontics Restorative Dent. 2018; 38(Suppl.):s105-s111.

https://www.ncbi.nlm.nih.gov/pubmed/30118534

This case series aims to clinically evaluate a new surgical approach to treat periodontal intrabony defects in conjunction with cerabone® and Emdogain®. Surgically, the defects are accessed via the

alveolar mucosa preserving the interdental tissues (Nonincised Papillae Surgical Approach, NIPSA). **Methods:** Ten patients diagnosed with periodontal intrabony defects with a mean probing pocket depth (PPD) of 9.6 ± 2.3 mm were treated with NIPSA in conjunction with cerabone® and Emdogain®. PPD reduction, clinical attachment level gain (CAL), keratinized tissue width and recessions were recorded six to 18 months post-surgery. **Results:** Healing was uneventful in all cases. PPD decreased to 2.3 ± 0.5 mm and a CAL gain of 7.3 ± 2.4 mm was found. Gingival papilla height, keratinized tissue width and buccal gingival margin remained stable over time. All defects presented negative bleeding on probing. **Conclusions:** Deep isolated intrabony defects can be successfully treated using the Nonincised Surgical Approach in conjunction with cerabone® and Emdogain®. It preserves the interdental papillae and marginal keratinized tissues avoiding post-operative soft tissue shrinkage.

97. Dimensional changes in the sinus membrane following maxillary sinus augmentation.

Mayer Y, Ben-Dor A, Zigdon-Giladi H, Gutmacher Z. Quintessence Int. 2018; 49(10):841-847.

https://www.ncbi.nlm.nih.gov/pubmed/30264057

This retrospective clinical study aims to evaluate the dimensional changes of the Schneiderian membrane following maxillary sinus augmentation and to analyze the impact of the height of the bone grafting material. **Methods:** 50 patients (66 sites) underwent lateral wall maxillary sinus augmentation using cerabone® and a collagen membrane. Sinus membrane thickness was measured prior to and 9 to 11 months post sinus augmentation using CBCT scans.

Results:

- Following sinus augmentation, thin Schneiderian membranes (< 1.56 mm) thickened to a mean value of 2.89±2.33 mm (+ 482.55%), while thick membranes (> 1.56 mm) lost in thickness to a mean value of 3.10±4.45 mm (-29.84%)
- The postoperative thickness of thin and thick membranes leveled off (2.89±2.3 and 3.10±4.4 mm, respectively)
- No correlation was found between the graft height and changes in the sinus membrane thickness

Conclusions: Maxillary sinus floor augmentation is a safe procedure in terms of sinus membrane thickness. It seems that the membranes thickness at baseline affects the subsequent dimensional changes. The amount of bone grafting material used may not affect the thickness of the membrane.

98. Buccal fat pad-derived stem cells in three-dimensional rehabilitation of large alveolar defects: A report of two cases.

Khojasteh A, Hosseinpour S, Rezai Rad M, Alikhasi M. J Oral Implantol. 2019; 45(1):45-54.

https://www.ncbi.nlm.nih.gov/pubmed/30280966

This report of two cases describes the treatment of large alveolar bone defects using orally-derived stem cells in combination with autografts and cerabone®. **Methods:** Several impacted, non-erupted teeth in the maxilla and mandible of two patients were extracted and the bone defects were augmented with autologous cortical plates and adipose- derived stem cells-loaded cerabone® particles. **Results:** Six months after bone augmentation up to seven implants each site were successfully placed. At 48 months post-operative, radiographies showed 100% survival of all placed implants. **Conclusions:** The presented approach demonstrates a considerable amount of three dimensional bone formation in both cases. The application of adipose- derived stem cells isolated from buccal fat pad in combination with cerabone® can be considered as an efficient treatment for bone regeneration in large alveolar bone defects.

99. Sinus Floor Elevation Using the Lateral Approach and Window Repositioning and a Xenogeneic Bone Substitute as a Grafting Material: A Histologic, Histomorphometric, and Radiographic Analysis.

Tawil G, Barbeck M, Unger R, Tawil P, Witte F. Int J Oral Maxillofac Implants. 2018; 33(5):1089–1096.

https://www.ncbi.nlm.nih.gov/pubmed/29894551

The aim of this histologic and histomorphometric study was to determine the fate of the bone window, its contributing role in the healing process, and the osseoconductivity and resorption potential of the high-temperature sintered bovine bone (cerabone®) used, as well as to correlate the histomorphometric results with sinus depth and lateral wall thickness as determined on CBCT. **Materials and methods:** 30 biopsy specimens were harvested from the lateral side of the maxilla of patients operated on for sinus floor elevation and implant placement at two postoperative periods: early, group 1 (mean: 5.73 ± 0.44 months); and late, group 2 (mean: 8.68 ± 1.76 months). Sinus depth and lateral wall thickness were determined on CBCT and correlated to graft maturation. **Results:** The repositioned bone window was microscopically detectable in both study groups and looked well integrated. Bone was found growing out of the repositioned window toward the center of the graft, most often forming a trabecular network independently from the bone matrix, which is in favor of osteogenic potential of the window. Also, newly built bone was found directly attached to the surfaces of the window, indicating bone growth via osseoconduction. Repositioned window sides showed signs of low-grade inflammation. Active osteoclasts were only found to be associated with the newly built bone matrix, hinting at an active bone remodeling process. No signs of biodegradation or remodeling of the window were detected using the tartrate-resistant acid phosphatase (TRAP) technique. The histomorphometric analysis of the tissue distribution showed similar values of newly formed bone in group 1 (22.77% ± 5.89%) and in group 2 (26.15% ± 11.18%) and connective tissue values in both study groups (42.29% ± 8.98% for group 1 vs 46.03% ± 5.84% for group 2). No significant differences were found between group 1 (34.94% ± 7.10%) and group 2 (27.82% ± 11.97%) for xenogeneic bone

substitute values. Statistically significant differences were only found between connective tissue values and newly built bone values (P < .01 and P < .001, respectively). Furthermore, a significant difference was found between connective tissue values and that of bone substitute up to 12 months (P < .01). No significant correlation was found between sinus depth and lateral window thickness and histomorphometric results. **Conclusions:** The repositioned window technique appears to be a good osteoconductive barrier for bone formation. Its osteogenic potential needs to be confirmed immunochemically. The authors also concluded that cerabone® proved to be an effective slowly resorbing osseoconductive material.

100. Periosteal Envelope Flap as a Technique for Horizontal Bone Augmentation: A Case Series Study.

Arab S, Reza Arab H, Aghaloo M, Shiezadeh F, Tajik S, Moeintaghavi A. The Open Dentistry Journal 2018; 12. 995-1003.

https://benthamopen.com/FULLTEXT/TODENTJ-12-995

The goal of this clinical study was to evaluate the effect of the periosteal pocket flap in horizontal GBR. **Methods:** 22 patients with a mean ridge width of 2.94 mm were treated by GBR using a periosteal envelope flap. Following detachment of the periosteum from the bone, a pocket was created to accommodate the bone grafting material (cerabone®) and barrier membrane (Jason® membrane). The periosteum was sutured to the membrane and the flap was closed tension-free. Ridge width was measured prior augmentation and 4 to 6 months post-surgery using CBCT. **Results:** Healing was uneventful for all treated patients. A statistically significant mean gain in ridge width of 2.53 mm was achieved 4 to 6 months post-operative allowing for the placement of dental implants. **Conclusions:** The authors concluded that the periosteal pocket flap in conjunction with GBR is a suitable technique to increase the width of the alveolar ridge.

101. Effectiveness of naturally derived bovine hydroxyapatite (Cerabone™) combined with platelet-rich fibrin matrix in socket preservation: A randomized controlled clinical trial.

Kollati P, Koneru S, Dwarakanath CD, Gottumukkala SN. Journal of Indian Society of Periodontology 2018. DOI: 10.4103/jisp.jisp_400_18.

http://www.jisponline.com/preprintarticle.asp?id=247348;type=0

This controlled clinical trial aims to evaluate prevention of alveolar ridge resorption by socket grafting using cerabone® in conjunction with PRF. **Methods:** 23 patients were treated in a split-mouth design with one extraction site augmented with cerabone® and PRF (test), while the contralateral site was

subjected to atraumatic extraction alone (control). The test site was sealed with a collagen sponge. Alterations of ridge width and -height were evaluated clinically and radiographically at baseline and six months post-extraction. **Results:** Mean ridge width loss was 2.75 ± 1.49 mm at untreated sites and 1.47 ± 1.44 mm at the sites that did underwent a socket preservation procedure. The mean reduction in buccal height was 0.96 mm at the test sites and 2.26 mm at control sites, mean reduction in lingual height were 1.04 mm and 2.17 mm respectively. 2.31 mm more bone fill was observed at the test sites, which was statistically significant. **Conclusion:** The authors concluded that the described socket preservation procedure is a reliable method that minimizes alveolar bone loss.

102. The influence of initial alveolar ridge defect morphology on the outcome of implants in augmented atrophic posterior mandible: an exploratory retrospective study.

Khojasteh A, Motamedian SR, Sharifzadeh N, Zadeh HH, Clin Oral Implants Res. 2017; 28(10):e208-e217.

https://www.ncbi.nlm.nih.gov/pubmed/27804178

The purpose of this retrospective study was to examine the influence of initial atrophic posterior mandible morphology on the outcome of implants placed following augmentation. **Materials and methods:** A total of 52 patients contributed 71 edentulous sites, and 185 implants were placed with mean follow-up of 37.97 months. The initial defect morphology was classified according to ABC classification (Journal of Oral Implantology, 37, 2013a and 361). Ridge augmentation was performed by "cortical autogenous tenting" (CAT) followed by either simultaneous or delayed implant placement after 4-6 months of healing. The European Academy of Osseointegration success criteria were used to evaluate implant outcomes. **Results:** The overall survival and success rates of dental implants were 98.91% and 80%, respectively. Cumulative success and survival rates in CAT group were 95% and 100% after 2 years of follow-up. The highest marginal bone loss (MBL) was observed (1.26 mm ± 0.99) around implants placed in augmented edentulous sites with initially narrow and flat alveolar crest (defect class CII). Conversely, least MBL (0.48 mm ± 0.78) was detected around implants placed into edentulous sites with two sloped boney walls (defect class AII). Differences between MBL observed around implants placed into initial defect class C, initial defect type and class A (I, II), as well as class BII, were statistically significant ($P < 0.05$). Among all implants, 148 were considered as successful, 26 exhibited satisfactory survival, nine with compromised survival, and two implants failed. **Conclusion:** The present data confirmed the effect of initial ridge morphology on the outcome of implants placed into augmented bone. Specifically, class A and class B atrophic ridge defects, with one and two vertical boney walls, respectively, may be considered as more favorable recipient sites than class C defects with flat morphology. This conclusion is based on least MBL around implants placed into initial defect class A

and class B augmented sites, and higher MBL in implants placed into class C recipient sites. A randomized controlled trial is warranted to examine these exploratory observations.

103. Cortical lamina technique: A therapeutic approach for lateral ridge augmentation using guided bone regeneration.

Deepika-Penmetsa SL, Thomas R, Baron TK, Shah R, Mehta DS5. J Clin Exp Dent. 2017; 9(1):e21-e26.

https://www.ncbi.nlm.nih.gov/pubmed/28149458

The present study aimed at evaluating the efficacy of a novel technique, the bone lamina technique, in horizontal ridge augmentation clinically & radiographically using a combination of allogenic cortical shell, particulate xenograft and resorbable collagen membrane. **Material and methods:** Localized horizontal ridge defects, in ten patients (6 male, 4 female), with bucco-palatal ridge width less than 5 mm were included in this study. Localised ridge augmentation was performed using bone lamina technique with mineralised allogenic shell of 1 mm thickness trimmed to the appropriate size using stereo-lithographic models and fixed to the recipient site with stainless steel micro-screws of 1 mm diameter. The space between the shell & host bone was filled with particulate xenograft followed by placement of collagen membrane and primary closure of the site. Clinical parameters including ridge width before & after flap reflection & radiographic (CBCT) ridge width measurements were recorded pre-operatively, and six months after the augmentation procedure. Results obtained were analyzed statistically. **Results:** The mean clinical ridge width before flap reflection (BFR), after flap reflection (AFR) & radiographically was 3.7 ± 0.74 mm, 2 ± 0.70 mm & 1.77 ± 0.71 mm respectively at baseline which increased to 6.8 ± 0.95 mm, 5.15 ± 0.98 mm & 4.90 ± 0.90 mm with a mean gain in ridge width of 3.1 ± 0.63 mm ($p< 0.005$), 3.15 ± 0.63 mm ($p<0.005$) & 3.13 ± 0.70 mm ($p< 0.005$) respectively. **Conclusions:** The present study demonstrates that bone lamina technique can be effective means of horizontal ridge augmentation and the use of mineralized allograft in combination with xenograft and collagen membrane leads to good amount of bone regeneration for subsequent implant placement.

104. Presurgical Cone Beam Computed Tomography Bone Quality Evaluation for Predictable Immediate Implant Placement and Restoration in Esthetic Zone.

Cristache CM. Case Rep Dent. 2017; 2017:1096365.

https://www.ncbi.nlm.nih.gov/pubmed/28321342

Despite numerous advantages over multislice computed tomography (MSCT), including a lower radiation dose to the patient, shorter acquisition times, affordable cost, and sometimes greater detail with isotropic voxels used in reconstruction, allowing precise measurements, cone beam computed tomography (CBCT) is still controversial regarding bone quality evaluation. This paper presents a brief

review of the literature on accuracy and reliability of bone quality assessment with CBCT and a case report with step-by-step predictable treatment planning in esthetic zone, based on CBCT scans which enabled the clinician to evaluate, depending on bone volume and quality, whether immediate restoration with CAD-CAM manufactured temporary crown and flapless surgery may be a treatment option.

105. Histological and radiological evaluation of sintered and non-sintered deproteinized bovine bone substitute materials in sinus augmentation procedures. A prospective, randomized-controlled, clinical multicenter study.*

Fienitz T, Moses O, Klemm C, Happe A, Ferrari D, Kreppel M, Ormianer Z, Gal M, Rothamel D. Clinical Oral Investigations 2017; 21(3):787-794. [Epub 2016].

https://www.ncbi.nlm.nih.gov/pubmed/27129584

The objective of this study is to histologically and radiologically compare a sintered and a non-sintered bovine bone substitute material in sinus augmentation procedures. **Materials and methods:** Thirty-three patients were included in the clinically controlled randomized multicentre study resulting in a total of 44 treated sinuses. After lateral approach, sinuses were filled with either a sintered (SBM, Alpha Bio's Graft®) or a non-sintered (NSBM, BioOss®) deproteinized bovine bone substitute material. The augmentation sites were radiologically assessed before and immediately after the augmentation procedure as well as prior to implant placement. Bone trephine biopsies for histological analysis were harvested 6 months after augmentation whilst preparing the osteotomies for implant placement. **Results:** Healing was uneventful in all patients. After 6 months, radiological evaluation of 43 sinuses revealed a residual augmentation height of 94.65 % (±2.74) for SBM and 95.76 % (±2.15) for NSBM. One patient left the study for personal reasons. Histological analysis revealed a percentage of new bone of 29.71 % (±13.67) for SBM and 30.57 % (±16.07) for NSBM. Residual bone substitute material averaged at 40.68 % (±16.32) for SBM compared to 43.43 % (±19.07) for NSBM. All differences between the groups were not statistically significant ($p > 0.05$, Student's t test). **Conclusion:** Both xenogeneic bone substitute materials showed comparable results regarding new bone formation and radiological height changes in external sinus grafting procedures. **Clinical relevance:** Both bone substitute materials allow for a predictable new bone formation following sinus augmentation procedures.

*Study refers to Alpha Bio's Graft®, which was a private label of cerabone®.

106. Sinus Floor Elevation Using the Lateral Approach and Bone Window Repositioning I: Clinical and Radiographic Results in 102 Consecutively Treated Patients Followed from 1 to 5 Years.

Tawil, G., Tawil, P. and Khairallah, A. Int J Oral Maxillofac Implants. 2016; 31(4):827-34.

https://www.ncbi.nlm.nih.gov/pubmed/27447149

Determination of potential complications and clinical outcomes using the lateral sinus elevation technique with window repositioning. **Materials and Methods:** One hundred nine sinus elevations were performed on 102 consecutively treated patients. Following lateral window outward fracturing, sinus mucosa was elevated, and the sinus was grafted with anorganic bovine bone. Two hundred five implants were placed: 160 concomitantly with grafting, and 45 six months after grafting. Seventeen implants replaced single missing molars. One hundred eighty-eight implants replaced multiple missing posterior teeth. The bone window was repositioned over the osteotomy site and the flap sutured. Implants were connected at 6 months and followed up from 12 to 60 months (mean: 29.8 months). In 30 cases, biopsy specimens were harvested from the lateral wall of the sinus for histomorphometric analysis. The Fisher exact test and Kruskal-Wallis test followed by the Mann-Whitney test were used for statistical analysis. **Results:** No clinically significant complications were encountered in using this technique (mucosa tear, intraoperative bleeding, window sequestration). In three cases, the window was separated in two before outfracturing. In 20 cases, it was stabilized with a collagen fleece. Limited sinus mucosa tears occurred in 14 cases during elevation. They were patched with a collagen membrane, and 18 implants were placed in these cases. All of the latter cases osseointegrated at abutment connection with no statistically significant difference in the outcome compared with implants placed with no tear of the membrane ($P < .05$). The reconstruction of the lateral wall was confirmed in all cases. No significant differences in outcomes were found between the immediately and delayed placed implants ($P < .05$). One implant failed in the immediately placed group due to a sinus infection. All other implants were loaded and remained in function during the observation period. **Conclusion:** Lateral sinus elevation with window repositioning is safe and effective with minimal risks, such as mucosal tear, intraoperative bleeding, or window sequestration. The repositioned window can serve as an alternative for collagen membrane in containing the graft. Graft maturation, percent of vital bone formation, and the potential of the window to serve as a source of osteogenic cells need to be confirmed histomorphometrically. This will be reported in a subsequent article.

107. Tuberosity-alveolar block as a donor site for localised augmentation of the maxilla: a retrospective clinical study.

Khojasteh A, Nazeman P, Tolstunov L. Br J Oral Maxillofac Surg. 2016; 54(8):950-955.

https://www.ncbi.nlm.nih.gov/pubmed/27453038

Retrospective assessment of the efficacy of tuberosity-alveolar block bone (posterior maxillary alveolar ridge) in the augmentation of adjacent defects in the maxilla using data from 14 patients (10 men and four women, mean (range) age 55 (38-69) years) who had had 20 bony augmentations with block bone

from the alveolar tuberosity during 2014. Patients were divided into three groups according to the technique by which the bone was collected. The first group had a graft from the alveolar tuberosity covered with titanium mesh (titanium mesh group); the second group had the block bone covered by platelet rich fibrin and collagen membrane (platelet rich fibrin group), and in the third group the graft was covered only with periosteum (periosteum group). The primary width of the bone was recorded at the time of placement of the graft and changes were evaluated 4-6 months later when the implant was inserted. The changes in the width of the bone were 4.1, 3.3, and 2.5 in the platelet rich fibrin, titanium mesh, and periosteum groups, respectively. The difference in bony change among groups was not significant except between the platelet rich fibrin and and periosteum groups (p = 0.005). Tuberosity-alveolar block bone graft may be a good source of bone for augmentation of deficient ridges, and more favourable results can be expected by the addition of resorbable membranes and growth factors.

108. Management of acute maxillary sinusitis after sinus bone grafting procedures with simultaneous dental implants placement - a retrospective study.

Chirilă L, Rotaru C, Filipov I, Săndulescu M. BMC Infect Dis. 2016; 16(1):94.

https://www.ncbi.nlm.nih.gov/pubmed/27169511

The sinus lift was first described in 1974 and it has proven to be a predictable procedure ever since. We aimed to evaluate the rate of acute maxillary sinusitis after sinus lift procedures and the appropriate management strategies. **Methods:** Between 2013 and 2015, 245 dental implants were placed in 116 patients (76 males and 40 females) with concomitant bone augmentation of the maxillary sinus floor. The sinus lifting procedure was bilateral in 35 patients and unilateral in 81 patients (a total of 151 sinuses). **Results:** Maxillary sinusitis occurred in 5 patients (4.3 %). The clinical signs of infection were: headache, locoregional pain, cacosmia, inflammation of the oral buccal mucosa and rhinorrhea or unilateral nasal discharge. A mucosal fistula was observed during inspection in one patient. The management included only the removal of the grafting material in 3 patients, in 1 patient the grafting material was removed together with all the implants, and in 1 patient only 2 implants and the grafting material were removed, 1 implant being left in place. The sinus cavity was irrigated with metronidazole solution and antibiotic therapy with clindamycin and metronidazole was prescribed for 10 days. Subsequently, all signs of infection disappeared within 5 to 7 days and normal sinus function and drainage were restored**. Conclusions:** Although sinus lift is regarded as a safe and reliable procedure, acute sinusitis is a possible complication which has to be managed immediately in order to reduce the risk of further complications like pansinusitis, osteomyelitis of the maxillary bone, and spreading of the infection in the infratemporal space or orbital cavity. To minimize risk, caution must be taken with all the steps of the procedure, in order not to obliterate the ostium, impairing maxillary sinus clearance.

109. Histological and histomorphometric study using an ultrasonic crestal sinus grafting procedure. A multicenter case study.*

Wainwright M, Torres-Lagares, D, Pérez-Dorao B, Serrera-Figallo M.A, Gutierrez-Perez J.L, Troedhan, A, Kurrek, A. Med Oral Patol Oral Cir Bucal. 2016; 21(3):e367-73.

https://www.ncbi.nlm.nih.gov/pubmed/26946203

The aim of this study was to evaluate the efficacy of a hydrodynamic ultrasonic driven transcrestal sinus grafting procedure (Intralift®, Acteon Company, Bordeaux, France) and the use of a bovine high temperature sintered grafting material in sinus sites with less than 5 mm remaining bone height with no additional autogenous bone in order to create a sufficient recipient site for implants. **Material and Methods:** 12 patients (16 sinus) in this multicenter case study were included. Using a crestal approach, bone under the sinus was prepared with ultrasonic tips until the Schneiderian membrane was reached. With a trumpet shaped instrument, the Schneiderian membrane was elevated. In the new created subantral space a high temperature sintered bovine grafting material was introduced (Bego Oss, BEGO Implant Systems GmbH & Co. KG, Bremen, Germany). After 6 months biopsies were taken with a trephine bur and histologies were generated following histomorphometric analysis. Results: The results showed new vital bone in average of 33.4% ± 17.05%, and 43.6% ± 16.70 of bone substitute material. No signs of abnormal inflammation were observed. **Conclusions:** This procedure (Intralift®) allows, using a bovine material with no additional autogenous bone, new bone formation in the sinus in order to allow place implant subantraly.

*Study refers to BEGO OSS, which was a private label of cerabone®.

110. Comparison of two different xenografts in bilateral sinus augmentation: Radiographic and histologic findings.

Panagiotou D, Özkan Karaca E, Dirikan İpçi Ş, Çakar G, Olgaç V and Yılmaz S. Quintessence Int. 2015; 46(7):611-9.

http://www.ncbi.nlm.nih.gov/pubmed/25699296

The aim of this study was to evaluate the radiographic and histomorphometric results of two different xenografts in bilateral sinus augmentation in patients with posterior maxillary atrophy**. Method and Materials:** Eight patients with less than 5 mm residual alveolar bone height were included in this study. One side was augmented with bovine bone graft-1 and the other side with bovine bone graft-2. Radiographic analyses were performed before and after augmentation, and before the implant placement. After 8 months of healing period, bone biopsies were obtained during implant placement. **Results:** No statistically significant difference was found between the groups, based on post-augmentation and pre-implantation graft heights (P>.05). Histomorphometric evaluation demonstrated 24.63% and 29.13% newly formed bone in the graft-1 and graft-2 groups, respectively. Intergroup differences were not significant for the mean percentage of new bone formation (P > .05).

Conclusion: Within the limitations of this study, it can be concluded that xenograft materials resulted in satisfactory bone height and trabecular new bone formation, and they could be used for the rehabilitation of atrophic maxillae.

111. Influence of Material Properties on Rate of Resorption of Two Bone Graft Materials after Sinus Lift Using Radiographic Assessment.

Riachi F, Naaman N, Tabarani C, Aboelsaad N, Aboushelib MN, Berberi A and Salameh Z. Int J Dent. 2012:737262.

https://www.ncbi.nlm.nih.gov/pubmed/22899930

The aim of this study was to investigate the influence of chemical and physical properties of two graft materials on the rate of resorption. **Materials and Methods:** Direct sinus graft procedure was performed on 22 patients intended for implant placement. Two types of graft materials were used (Bio-Oss and cerabone®) and after 8 months healing time the implants were inserted. Radiographic assessment was performed over the period of four years. Particle size, rate of calcium release, and size and type of crystal structure of each graft were evaluated. **Results**: The average particle size of Bio-Oss (1 mm) was much smaller compared to cerabone® (2.7 mm). The amount of calcium release due to dissolution of material in water was much higher for Bio-oss compared to cerabone®. X-ray image analysis revealed that Bio-Oss demonstrated significantly higher volumetric loss (33.4 ± 3.1%) of initial graft size compared to cerabone® (23.4 ± 3.6%). The greatest amount of vertical loss of graft material volume was observed after one year of surgery.

112. Sinus floor elevation using a sintered, natural bone mineral - A histological case report study.*#

Rothamel, D, Smeets, R, Happe, A, Fienitz, T, Mazor, Z, Schwarz, F, Zöller, J. Zeitschrift für zahnärztliche Implantologie 2011; 27(1): 60-70.

http://www.online-jdi.com/media/article/2011/1/00365097-4D06-438D-A1E8-AA217B7773F8/003650974D06438DA1E8AA217B7773F8_oa_rothamel_engl_1_original.pdf

The aim of the present study was the histological and clinical evaluation of the xenogeneic bone substitute material (BEGO OSS, Bego Implant Systems, Bremen) for the indications one-stage and two-stage sinus floor elevation. **Materials and method:** Twelve patients were included in the study, undergoing 15 simultaneous or staged sinuslift operations. Data were evaluated clinically and, for two-stage approach, histologically and histomorphometrically after trephine harvesting during implant bed preparation. **Results:** Healing was uneventful in all cases. All patients showed good hard tissue regeneration of the lateral window of the sinus. Neither resorption nor dislocation of the granular bone

substitute material was observed. Radiologically, good volume stability of the graft was observed. Histologically, bone substitute particles displayed complete osseous integration in newly formed bone matrix. The proportion of newly formed bone within the graft was 25.8-49.6 %, whereas the proportion of remaining bone substitute material varied from 28.6-38.5 %. **Conclusion:** It was concluded that BEGO OSS acts as an osteoconductive material to support hard tissue regeneration after sinus floor elevation. Showing excellent volume stability, it is integrated into newly formed bone matrix within a six-month healing period.

*Study refers to BEGO OSS, which was a private label of cerabone®.
[#] Publication in English and German.

06/2023