1. Pre-clinical (*in vitro* & *in vivo*) studies (p. 2 – p. 18)
2. Clinical studies and case series (p. 19 – p. 46)

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

9. *In Vitro* Direct and Indirect Cytotoxicity Comparative Analysis of One Pre-Hydrated versus One Dried Acellular Porcine Dermal Matrix
    Guarnieri R, Reda R, Di Nardo D, Miccoli G, Zanza A, Testarelli L. Materials (Basel). 2022 Mar;15(5):1937. doi: 10.3390/ma15051937.

    https://pubmed.ncbi.nlm.nih.gov/35269168/

    Aim: The aim of the present study was to compare the direct and indirect cytotoxicity of a porcine dried acellular dermal matrix (PDADM) versus a porcine hydrated acellular dermal matrix (PHADM) *in vitro*. Both are used for periodontal and peri-implant soft tissue regeneration. **Materials and methods:** Two standard direct cytotoxicity tests-namely, the Trypan exclusion method (TEM) and the reagent WST-1 test (4-3-[4-iodophenyl]-2-[4-nitrophenyl]-2H-[5-tetrazolio]-1,3-benzol-desulphonated)-were performed using human primary mesenchymal stem cells (HPMSCs) seeded directly onto a PDADM and PHADM after seven days. Two standard indirect cytotoxicity tests-namely, lactate dehydrogenase (LTT) and MTT (3-[4,5-dimethyl-2-thiazolyl]-2,5-diphenyl-2H-tetrazoliumbromide)-were performed using HPMSCs cultivated in eluates from the matrices incubated for 0.16 h (10 min), 1 h, and 24 h in a serum-free cell culture medium. **Results:** The WST and the TEM tests revealed significantly lower direct cytotoxicity values of HPMSCs on the PHADM compared with the PDADM. The indirect cytotoxicity levels were low for both the PHADM and PDADM, peaking in short-term eluates and decreasing with longer incubation times. However, they were lower for the PHADM with a statistically significant difference ($p < 0.005$). **Conclusions:** The results of the current study demonstrated a different biologic behavior between the PHADM and the PDADM, with the hydrated form showing a lower direct and indirect cytotoxicity.

10. The effects of gamma and microwave sterilization on periodontological grafts
    Bargh S, Silindir-Gunay M, Ozer AY, Colak S, Kutlu B, Nohutcu R. Chem Phys. 2021 Dec; 3:100046. doi: 10.1016/j.chphi.2021.100046.

    https://www.sciencedirect.com/science/article/pii/S2667022421000359

    Guided tissue regeneration (GTR) and guided bone regeneration (GBR) biomaterials play an important role in periodontal procedures in recent years. A guided tissue-regeneration membrane performances as a block stopping fast-growing soft tissue from raiding space required to be filled with new bone, so, it permit osseous regeneration prior to soft tissue migration into the area of interest. Degradable polymeric sterilization of grafts as regenerative biomaterials is an essential topic in medicine due to their direct contact with human blood. As a result, the sterilization method applied to these materials has to be reliable beside being cost-effective and cause a minor change in the grafts' structure and effectiveness. In this study, gamma irradiation as an accepted sterilization method and microwave as a new sterilization industry approach were evaluated. In this evaluation, widely used dental collagen-based biomaterials from human and animal sources were exposed to different gamma radiation level used in the experiments (2, 4, 5, 10, 25, and 50 kGy). Also, microwave sterilized grafts as a novel

sterilization method were evaluated at 1,2,3,and 4 min of irradiation. Although free radicals are not expected after microwave irradiation, grafts were evaluated by ESR after irradiation by microwave to consider this radiation as a sterilization method. Microwave irradiation did not cause major differences in the samples' ESR spectra. This situation continue even up to 8 min of irradiation. The radiolytic intermediates formed in the samples due to gamma and microwave irradiation were considered by Electron Spin Resonance (ESR) spectroscopy. The characteristic features of the free radicals induced by gamma and microwave radiation in biomaterials were detected. Also, the radical stability biomaterials were studied for a long time interval. Based on results, HL1 is considered an excellent radiosensitive material, and PDG3 is regarded as a good ratio resistive material among the other examined samples. It was also concluded that ESR spectroscopy is a suitable technique in providing indispensable detailed spectroscopic findings for GTR/GBR biomaterials exposed to microwave and gamma radiation sterilization at different doses.

11. 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.

12. *In Vitro* Biodegradation Pattern of Collagen Matrices for Soft Tissue Augmentation

Vallecillo C, Toledano-Osorio M, Vallecillo-Rivas M, Toledano M, Osorio R. Polym (Basel). 2021 Aug;13(16):2633. doi: 10.3390/polym13162633.

https://pubmed.ncbi.nlm.nih.gov/34451173/

Collagen matrices have become a great alternative to the use of connective tissue grafts for soft tissue augmentation procedures. One of the main problems with these matrices is their volume instability and rapid degradation. This study has been designed with the objective of examining the degradation of three matrices over time. For this purpose, pieces of 10 × 10 mm2 of Fibro-Gide, Mucograft and Mucoderm were submitted to three different degradation tests-(1) hydrolytic degradation in phosphate buffer solution (PBS); (2) enzyme resistance, using a 0.25% porcine trypsin solution; and (3) bacterial collagenase resistance (Clostridium histolyticum)-over different immersion periods of up to 50 days. Weight measurements were performed with an analytic microbalance. Thickness was measured with a digital caliper. A stereomicroscope was used to obtain the matrices' images. ANOVA and Student-Newman-Keuls tests were used for mean comparisons (p < 0.05), except when analyzing differences between time-points within the same matrix and solution, where pair-wise comparisons were applied (p < 0.001). Fibro-Gide attained the highest resistance to all degradation challenges. The bacterial collagenase solution was shown to constitute the most aggressive test as all matrices presented 100% degradation before 14 days of storage.

13. Mesenchymal Stromal Cells Enhance Vascularization and Epithelialization within 7 Days after Gingival Augmentation with Collagen Matrices in Rabbits

Kulakov A, Kogan E, Brailovskaya T, Vedyaeva A, Zharkov N, Krasilnikova O, Krasheninnikov M, Baranovskii D, Rasulov T, Klabukov I. Dentistry Journal. 2021 Jul; 9(9):101. doi: 10.3390/dj9090101.

https://www.mdpi.com/2304-6767/9/9/101

Soft gingival tissue deficiency remains a severe problem leading to postoperative recession, peri-implantitis, and bone resorption. The use of collagen matrices does not always lead to complete rebuilding of the gingiva volume. The application of mesenchymal stromal cells (MSCs) simultaneously with collagen materials represents a promising approach for the restoration of soft gingival tissues. However, short-term effects of MSCs-enriched collagen grafts after gingival augmentation have not yet been studied properly. Mucograft and Mucoderm matrices were implanted in rabbits (n = 12) simultaneously with the intraoperative injection of rabbit bone marrow-derived mesenchymal stromal cells (BM-MSCs) or without cells. Collagen matrices were implanted under the flap or by the surface technique without intentional primary closure. The samples were harvested seven days after implantation, histological staining with hematoxylin and eosin, and immunohistochemical staining for VEGF, IGF1, and TGF were performed. The use of Mucoderm led to better augmentation outcomes on day 7 compared with Mucograft (p < 0.0001). Gingival augmentation in combination with the local administration of BM-MSCs led to better regeneration of the soft gingival tissues independently of the type of implanted collagen matrices (p < 0.0001). Furthermore, injection of BM-MSCs significantly

enhanced gingival vascularization and epithelization with a clear positive correlation between vascular growth and epithelial response. Administration of BM-MSCs in combination with various collagen materials may potentially improve gingiva regeneration.

14. Positive Effects of Three-Dimensional Collagen-Based Matrices on the Behavior of Osteoprogenitors

Lin Z, Nica C, Sculean A, Asparuhova MB. Front Bioeng Biotechnol. 2021 Jul;9:708830. doi: 10.3389/fbioe.2021.708830.

https://pubmed.ncbi.nlm.nih.gov/34368101/

Recent research has demonstrated that reinforced three-dimensional (3D) collagen matrices can provide a stable scaffold for restoring the lost volume of a deficient alveolar bone. In the present study, we aimed to comparatively investigate the migratory, adhesive, proliferative, and differentiation potential of mesenchymal stromal ST2 and pre-osteoblastic MC3T3-E1 cells in response to four 3D collagen-based matrices. Dried acellular dermal matrix (DADM), hydrated acellular dermal matrix (HADM), non-crosslinked collagen matrix (NCM), and crosslinked collagen matrix (CCM) did all enhance the motility of the osteoprogenitor cells. Compared to DADM and NCM, HADM and CCM triggered stronger migratory response. While cells grown on DADM and NCM demonstrated proliferative rates comparable to control cells grown in the absence of a biomaterial, cells grown on HADM and CCM proliferated significantly faster. The pro-proliferative effects of the two matrices were supported by upregulated expression of genes regulating cell division. Increased expression of genes encoding the adhesive molecules fibronectin, vinculin, CD44 antigen, and the intracellular adhesive molecule-1 was detected in cells grown on each of the scaffolds, suggesting excellent adhesive properties of the investigated biomaterials. In contrast to genes encoding the bone matrix proteins collagen type I (Col1a1) and osteopontin (Spp1) induced by all matrices, the expression of the osteogenic differentiation markers Runx2, Alpl, Dlx5, Ibsp, Bglap2, and Phex was significantly increased in cells grown on HADM and CCM only. Short/clinically relevant pre-coating of the 3D biomaterials with enamel matrix derivative (EMD) or recombinant bone morphogenetic protein-2 (rBMP-2) significantly boosted the osteogenic differentiation of both osteoprogenitor lines on all matrices, including DADM and NCM, indicating that EMD and BMP-2 retained their biological activity after being released from the matrices. Whereas EMD triggered the expression of all osteogenesis-related genes, rBMP-2 upregulated early, intermediate, and late osteogenic differentiation markers except for Col1a1 and Spp1. Altogether, our results support favorable influence of HADM and CCM on the recruitment, growth, and osteogenic differentiation of the osteoprogenitor cell types. Furthermore, our data strongly support the biofunctionalization of the collagen-based matrices with EMD or rBMP-2 as a potential treatment modality for bone defects in the clinical practice.

15. Viability, Distribution and Penetration of Human Gingival Fibroblasts into Three Types of Acellular Dermal Matrix Membranes

Esmaeilnejad A, Kadkhodazadeh M, Mohammadi S, Yadegari Z, Amid R. J. Oral Maxillofac. Surg. 2021 May; 1-12. doi: 10.1007/s12663-021-01584-3.

https://link.springer.com/article/10.1007/s12663-021-01584-3#citeas

Objective: This study aimed to assess the viability, distribution and penetration of human gingival fibroblasts (HGFs) into three types of acellular dermal matrix (ADM) membranes. **Materials and Methods:** HGFs (HGF1-PT1 cell line) were seeded and cultured onto three types of ADM membranes, namely medium-thickness and thick Regen, SureDerm and one collagen matrix (Mucoderm). Viability and proliferation of HGFs on membranes were assessed at 24, 48 and 72 h and seven days using the methyl thiazolyl tetrazolium assay. Distribution and morphology of cells were assessed qualitatively at 24 h and seven days using a scanning electron microscope (SEM). Penetration of HGFs on day seven was assessed using a transmission electron microscope (TEM). Data were analyzed using two-way ANOVA. **Results:** Viability of HGFs was not significantly different on the four types of membranes at 24 or 48 h (P > 0.05). At seven days, viability on SureDerm was higher than that in other groups and cell viability on thick Regen was less than that in other groups (P < 0.05). Qualitative analysis by SEM showed that HGFs on SureDerm had a more natural morphology and they were spindle-shaped, uniformly distributed and dense while on day seven, no cell was noted on thick Regen. TEM showed that at seven days, maximum penetration was noted into SureDerm while no cell penetration was noted into thick Regen. **Conclusion:** Viability, distribution and penetration of HGFs into SureDerm and Mucoderm were more favorable than into thick Regen.

16. Histomorphometric Comparison between Two Types of Acellular Dermal Matrix Grafts: A Mini Pig Animal Model Study

Aragoneses J, Suárez A, Rodríguez C, Aragoneses JM. Int J Environ Res Public Health. 2021 Apr;18(8):3881. doi: 10.3390/ijerph18083881.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8067850/

Acellular dermal matrix grafts (ADMG) have been used as soft tissue graft substitutes for autografts in periodontal plastic surgical procedures. They have benefits like avoiding a second surgical site and patient morbidity that have been associated with autografts, but there is limited evidence available on their tissue response and wound healing process. This histomorphometric animal model study was carried out in mini pigs and it aimed to compare the two types of ADMG materials of porcine derivative with a control group through observation of parameters like epithelial and Keratinized layer thickness, angiogenesis, cellularity, matrix resorption, and inflammatory infiltrate. The surgical technique involved punctures on the edentulous areas stripping the epithelial tissue and exposing the underlying connective tissue, placement of the ADMGs in the appropriate control and test sites. Following this, gingival biopsies were procured at three different time intervals of 15, 45, and 90 days. There were significant differences in epithelial and Keratinized layer thickness among the three groups. This study concluded that there was no clear consensus on which graft material was superior but it gave an insight into the tissue response and wound healing process associated with the graft materials.

17. Engaging a polylactide copolymer in oral tissue regeneration: first validation of Suprathel® for guided epithelial and osseous healing

Vacaras S, Baciut G, Gheban D, Bran S, Colosi H, Toader S, Opris D, Kretschmer W, Manea A, Armencea G, Baciut M, Opris H, Mitre I, Hedesiu M, Dinu C. J Med Life. 2021 Mar-Apr;14(2):181-197. doi: 10.25122/jml-2021-0083.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8169152/

The present study investigated the capacity of Suprathel® (a copolymer membrane, so far validated for skin regeneration) to also regenerate oral tissue – mucosa and bone, by comparing this biomaterial, in a split-mouth rabbit model, to Mucoderm®, a xenogeneic collagen matrix certified for keratinized oral mucosa healing. The clinical reason behind this experimental animal model was to determine whether the benefits of this advanced skin regeneration product (Suprathel®) could be conveyed for future evaluation in clinical trials of oral tissue regeneration in humans. The outcomes of this study validated the use of Suprathel®, a terpolymer of polylactide with trimethylene carbonate and ε-caprolactone, for stimulation of oral epithelium and alveolar bone regeneration in rabbits. Both Suprathel® and Mucoderm® exhibited comparable results and the null hypothesis stating a comparable regenerating effect of these two materials could not be rejected.

18. Enhanced Wound Healing Potential of Primary Human Oral Fibroblasts and Periodontal Ligament Cells Cultured on Four Different Porcine-Derived Collagen Matrices

Lin Z, Nica C, Sculean A, Asparuhova MB. Materials (Basel). 2020 Aug;13(17):3819. doi: 10.3390/ma13173819.

https://pubmed.ncbi.nlm.nih.gov/32872458/

Xenogenic collagen-based matrices represent an alternative to subepithelial palatal connective tissue autografts in periodontal and peri-implant soft tissue reconstructions. In the present study, we aimed to investigate the migratory, adhesive, proliferative, and wound-healing potential of primary human oral fibroblasts (hOF) and periodontal ligament cells (hPDL) in response to four commercially available collagen matrices. Non-crosslinked collagen matrix (NCM), crosslinked collagen matrix (CCM), dried acellular dermal matrix (DADM), and hydrated acellular dermal matrix (HADM) were all able to significantly enhance the ability of hPDL and hOF cells to directionally migrate toward the matrices as well as to efficiently repopulate an artificially generated wound gap covered by the matrices. Compared to NCM and DADM, CCM and HADM triggered stronger migratory response. Cells grown on CCM and HADM demonstrated significantly higher proliferative rates compared to cells grown on cell culture plastic, NCM, or DADM. The pro-proliferative effect of the matrices was supported by expression analysis of proliferative markers regulating cell cycle progression. Upregulated expression of genes encoding the adhesive molecules fibronectin, vinculin, CD44 antigen, and the intracellular adhesive molecule-1 was detected in hPDL and hOF cells cultured on each of the four matrices. This may be considered as a prerequisite for good adhesive properties of the four scaffolds ensuring proper cell-matrix and cell-cell interactions. Upregulated expression of genes encoding TGF-β1 and EGF growth factors as well as MMPs in cells grown on each of the four matrices provided support for their pro-proliferative and pro-migratory abilities. The expression of genes encoding the angiogenic factors FGF-2 and VEGF-A was dramatically increased in cells grown on DADM and HADM only, suggesting a good basis for accelerated vascularization of the latter. Altogether, our results support favorable influence of the investigated collagen matrices on the recruitment, attachment, and growth of cell types implicated in oral soft tissue regeneration. Among the four matrices, HADM has consistently exhibited

stronger positive effects on the oral cellular behavior. Our data provide solid basis for future investigations on the clinical application of the collagen-based matrices in surgical periodontal therapy.

19. The Biomaterial-Induced Cellular Reaction Allows a Novel Classification System Regardless of the Biomaterials Origin

Al-Maawi S, Rutkowski JL, Sader R, Kirkpatrick CJ, Ghanaati S. J Oral Implantol. 2020 Jun;46(3):190-207. doi: 10.1563/aaid-joi-D-19-00201.

https://pubmed.ncbi.nlm.nih.gov/32068853/

Several different biomaterials are being introduced for clinical applications. However, no current material-specific systematic studies define parameters for evaluating these materials. The aim of this retrospective animal study is to classify biomaterials according to the *in vivo* induced cellular reaction and outline the clinical consequence of the biomaterial-specific cellular reaction for the regeneration process. A retrospective histologic analysis was performed for 13 polymeric biomaterials and 19 bone substitute materials (BSMs) (of various compositions and origins) that were previously implanted in a standardized subcutaneous model. Semiquantitative analyses were performed at days 3, 15, and 30 after implantation according to a standardized score for the induction of multinucleated giant cells (MNGCs) and vascularization rate. The induced cellular reaction in response to different polymeric materials allowed their classification according to the MNGC score in the following groups: class I induced no MNGCs at any time point, class II induced and maintained a constant number of MNGCs over 30 days, and class III induced MNGCs and provided an increasing number over 30 days. All BSMs induced MNGCs to varying extents. Therefore, the resultant BSM classifications are as follows: class I induced MNGCs with a decreasing number, class II induced and maintained constant MNGCs over 30 days, and class III induced MNGCs with increasing number over 30 days. These observations were mostly related to the biomaterial physicochemical properties and were independent of the biomaterial origin. Consequently, the induction of MNGCs and their increase over 30 days resulted in disintegration of the biomaterial. By contrast, the absence of MNGCs resulted in an integration of the biomaterial within the host tissue. This novel classification provides clinicians a tool to assess the capacity and suitability of biomaterials in the intended clinical indication for bone and soft tissue implantations.

20. Adsorption and Release of Growth Factors from Four Different Porcine-Derived Collagen Matrices

Nica C, Lin Z, Sculean A, Asparuhova MB. Materials (Basel). 2020 Jun;13(11):2635. doi: 10.3390/ma13112635.

https://pubmed.ncbi.nlm.nih.gov/32526991/

Xenogeneic acellular collagen matrices represent a safe alternative to autologous soft tissue transplants in periodontology and implant dentistry. Here, we aimed to investigate the adsorption and release of growth factors from four porcine-derived collagen matrices using enzyme-linked

immunosorbent assay. Non-crosslinked collagen matrix (NCM), crosslinked collagen matrix (CCM), dried acellular dermal matrix (DADM), and hydrated acellular dermal matrix (HADM) adsorbed each of the following growth factors, TGF-β1, FGF-2, PDGF-BB, GDF-5 and BMP-2, with an efficiency close to 100%. Growth factor release for a 13-day period was in the range of 10-50% of the adsorbed protein, except for the BMP-2 release that was in the range of 5-7%. Generally, protein release occurred in two phases. Phase I was arbitrary defined by the highest release from the matrices, usually within 24 h. Phase II, spanning the period immediately after the peak release until day 13, corresponded to the delayed release of the growth factors from the deeper layers of the matrices. HADM showed significantly (P < 0.001) higher TGF-β1, FGF-2, and PDGF-BB release in phase II, compared to the rest of the matrices. NCM exhibited significantly (P < 0.001) higher FGF-2 release in phase II, compared to CCM and DADM as well as a characteristic second peak in PDGF-BB release towards the middle of the tested period. In contrast to NCM and HADM, CCM and DADM showed a gradual and significantly higher release of GDF-5 in the second phase. Several burst releases of BMP-2 were characteristic for all matrices. The efficient adsorption and sustained protein release in the first 13 days, and the kinetics seen for HADM, with a burst release within hours and high amount of released growth factor within a secondary phase, may be beneficial for the long-term tissue regeneration following reconstructive periodontal surgery.

21. Biofunctionalization of porcine-derived collagen matrices with platelet rich fibrin: influence on angiogenesis *in vitro* and *in vivo*.

Blatt S, Burkhardt V, Kämmerer PW, Pabst AM, Sagheb K, Heller M, Al-Nawas B, Schiegnitz E. 2020. Clin Oral Investig. 2020. [Epub ahead of print]

https://www.ncbi.nlm.nih.gov/pubmed/32030513

Aim: Analysis of the influence of platelet-rich fibrin (PRF) on the angiogenesis of different collagen matrices *in vitro* and *in vivo*. **MATERIALS AND METHODS:** Three different collagen matrices (mucoderm®, Jason® membrane, collprotect®) were combined with PRF in a plotting process. Growth factor release (VEGF, TGF-β) was measured *in vitro* via ELISA quantification after 1, 4 and 7 days in comparison to PRF alone. In ovo yolk sac (YSM) and chorion allantois membrane (CAM) model, angiogenic potential were analyzed *in vivo* with light- and intravital fluorescence microscopy after 24 h, then verified with immunohistochemical staining for CD105 and αSMA. **RESULTS:** Highest growth factor release was seen after 24 h for all three activated membranes in comparison to the native CM and the PRF (no significant difference). All activated membranes revealed a significantly increased angiogenic potential *in vivo* after 24 h and with immunohistochemical staining for CD105 and αSMA. **CONCLUSIONS:** PRF improved the angiogenesis of CM *in vitro* and i*n vivo*. CLINICAL **RELEVANCE:** Bio-functionalization of CM with PRF could easily implemented in the clinical pathway and may lead to advanced soft tissue healing.

22. Biofunctionalization of porcine-derived collagen matrix using enamel matrix derivative and platelet-rich fibrin: influence on mature endothelial cell characteristics *in vitro*.
Park JS, Pabst AM, Ackermann M, Moergel M, Jung J, Kasaj A. 2018. Clin Oral Investig.; 22(2):909-917. [Epub 2017].

https://www.ncbi.nlm.nih.gov/pubmed/28695450

Aim: Evaluation of the effect of enamel matrix derivative (EMD) and platelet-rich fibrin (PRF)-modified porcine-derived collagen matrix (PDCM) on human umbilical vein endothelial cells (HUVEC) *in vitro*.
MATERIALS AND METHODS: PDCM (mucoderm®) was prepared to 6 mm (±0.1 mm) diameter discs. PDCM samples were incubated with either EMD, PRF, or control solutions for 100 min at 4 °C before the experiments. Cell-inducing properties of test materials on HUVEC cells were tested with cell proliferation assays (MTT, PrestoBlue®), a cytotoxicity assay (ToxiLight®), a Boyden chamber migration assay, and a cell attachment assay. Scanning electron microscopy (SEM) imaging was performed to determine the surface and the architecture of the modified matrices.

RESULTS: Cell proliferation was elevated in the EMD and PRF groups compared with control. PRF modification increased HUVEC migration ability by 8-fold compared with both control and EMD groups. Both treatments significantly promoted the cell attachment of HUVEC to PDCM, as assessed by direct cell counts on the matrices.

CONCLUSIONS: HUVEC cell characteristics were overall improved by EMD- and PRF- modified PDCM. Adsorbed bioactive molecules to the PDCM surface may have contributed to a more preferable environment to surrounding cells.

23. Treatment of dehiscence-type defects with collagen matrix and/or enamel matrix derivative: Histomorphometric study in minipigs.
França-Grohmann IL, Sangiorgio JPM, Bueno MR, Casarin RCV, Silvério Ruiz KG, Nociti FH Jr, Casati MZ, Sallum EA. 2019. J Periodontol. 2019 [Epub ahead of print].
https://www.ncbi.nlm.nih.gov/pubmed/31833570
Aim: Histomorphometrical evaluation of the use of collagen matrix (mucoderm®) and/or enamel matrix derivative (EMD) for the treatment of dehiscence-type recession defects in minipigs.
METHODS: Eight healthy minipigs, with no periodontal disease were treated. Bilateral dehiscence-type defects were surgically created on the buccal of the mandibular premolars (PI and PII). After 30 days, the defects were randomly assigned to four groups: coronally advanced flap (CAF); CAF + CM; CAF + EMD; and CAF + CM + EMD (split-mouth design). Evaluated parameters (mm): total defect length; new cementum (NC); new bone (NB); gingival margin position; total epithelium length; epithelium on the root; connective tissue adaptation; and soft tissue thickness (STT). **RESULTS:** The EMD-treated groups showed a superior length of NC in (CAF + EMD) followed by (CAF + CM + EMD)

and (CAF + CM); NB superior in (CAF + CM + EMD), (CAF + EMD)followed by (CAF + CM). The CAF and CAF + CM groups showed a superior epithelial length when compared to EMD-treated groups after 3 months. A superior STT was observed for CAF + CM + EMD group when compared with the other groups (CAF + EMD) and (CAF + CM). **CONCLUSION(S):** The results of the present study indicate that EMD application, irrespective of the combination with CM, may improve the periodontal regeneration of dehiscence-type defects in this animal model.

Gingiva thickening with a porcine collagen matrix in a preclinical dog model: Histological outcomes.

Schmitt CM, Schlegel KA, Gammel L, Moest T. 2019. J Clin Periodontol.;46(12):1273-1281.

https://www.ncbi.nlm.nih.gov/pubmed/31517397

AIM: Comparison of 10-month histological and immunohistological outcomes after soft tissue thickening around teeth with a porcine collagen matrix (mucoderm®) versus a subepithelial connective tissue graft (SCTG). **MATERIAL AND METHODS:** In eight beagle dogs, soft tissue thickening of the buccal gingiva of upper canines was performed with the SCTG or mucoderm. Connective tissue thickness (CTT) was histomorphometrically measured in the augmented regions. The augmented connective tissues were also histologically characterized and the collagen I and vascular endothelial growth factor (VEGF) expressions immunohistologically quantified. **RESULTS:** CTT significantly differed between groups (SCTG and mucoderm®. Descriptive histological analyses revealed mature connective tissue that did not differ between groups. Immunohistological quantification of collagen I and VEGF expressions in the connective tissue also revealed no significant inter-group differences. **CONCLUSION:** SCTG is superior to mucoderm® with regard to CTT in this experimental model. The mucoderm and the SCTG lead to comparable connective tissue quality ten months after connective tissue thickening.

24. Three-dimensional scanning electron microscopy of maxillofacial biomaterials.

   Pabst AM, Müller WEG, Ackermann M. 2017. Br J Oral Maxillofac Surg.; 55(7):736-739.

   https://www.ncbi.nlm.nih.gov/pubmed/28624164

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

25. Comparison of Two Porcine Collagen Membranes Combined with rhBMP-2 and rhBMP-9 on Osteoblast Behavior *in vitro*.

   Fujioka-Kobayashi M, Schaler B, Shirakata Y, Nakamura T, Noguchi K, Zhang Y, Miron RJ. 2017. Int J Oral Maxillofac Implants.; 32(4):e221-e230.

   https://www.ncbi.nlm.nih.gov/pubmed/28708926

Investigation of bone-inducing properties of two types of collagen membranes in combination with recombinant human bone morphogenetic protein (rhBMP)-2 and rhBMP-9 on osteoblast behavior.

MATERIALS AND METHODS: Porcine pericardium collagen membranes (PPCM) and porcine dermis-derived collagen membranes (PDCM) were coated with either rhBMP-2 or rhBMP-9. The adsorption and release abilities were first investigated via enzyme-linked immunosorbent assay up to 10 days. Moreover, murine bone stromal ST2 cell adhesion, proliferation, and osteoblast differentiation were assessed by MTS assay; real-time polymerase chain reaction for genes encoding runt-related transcription factor 2 (Runx2); alkaline phosphatase (ALP); and osteocalcin, ALP assay, and alizarin red staining. **RESULTS:** Both rhBMP-2 and rhBMP-9 adsorbed to collagen membranes and were gradually released over time up to 10 days. PPCM showed significantly less cell attachment, whereas PDCM demonstrated comparable cell attachment with the control tissue culture plastic at 8 hours. While both rhBMPs were shown not to affect cell proliferation, collagen membranes combined with rhBMP-9 significantly increased ALP activity at 7 days and ALP mRNA levels at either 3 or 14 days compared with the control tissue culture plastic. Furthermore, rhBMP-9 increased osteocalcin mRNA levels and alizarin red staining at 14 days compared with the control tissue culture plastic. **CONCLUSION:** The results from this study suggest that both porcine-derived collagen membranes combined with rhBMP-9 accelerated the osteopromotive potential of ST2 cells. Interestingly, rhBMP-9 demonstrated additional osteogenic differentiation compared with rhBMP-2 and may serve as a suitable growth factor for future clinical use.

26. Healing of localized gingival recessions treated with a coronally advanced flap alone or combined with an enamel matrix derivative and a porcine acellular dermal matrix: a preclinical study.

Shirakata Y, Sculean A, Shinohara Y, Sena K, Takeuchi N, Bosshardt DD, Noguchi K. 2016. Clin Oral Investig. 20(7):1791-800. [Epub 2015].

http://www.ncbi.nlm.nih.gov/pubmed/26612398

This study aimed to evaluate the effects of a porcine acellular dermal matrix (PADM) with or without an enamel matrix derivative (EMD) on gingival recession defects treated with a coronally advanced flap (CAF) in dogs. **MATERIALS AND METHODS**: Miller class II gingival recession defects (5 mm wide and 7 mm deep) were surgically created on the labial side of bilateral maxillary canines in 12 dogs. After 8 weeks of plaque accumulation, the 24 chronic defects were randomly assigned to one of the following 4 treatments: CAF, CAF with PADM (CAF/PADM), CAF with EMD (CAF/EMD), and CAF with EMD and PADM (CAF/EMD/PADM). The animals were sacrificed 10 weeks after surgery for histologic evaluation. **RESULTS:** In all groups, root coverage was obtained to a varying degree. PADM was well incorporated in gingival connective tissue in the CAF/PADM and in the CAF/EMD/PADM groups. The height of newly formed bone was significantly greater in the CAF/EMD/PADM group than in the CAF and CAF/PADM groups. New cementum with periodontal ligament-like tissue was predominantly found in the CAF/EMD and CAF/EMD/PADM groups. The CAF/EMD/PADM group showed the greatest amount of new cementum among the groups examined, although the difference was not statistically

significant. CONCLUSION: Within the limitations of the present study, it can be concluded that CAF/EMD/PADM treatment may promote periodontal regeneration in gingival recession defects. **CLINICAL RELEVANCE:** The present results suggest that the combination of EMD and PADM in conjunction with CAF may represent a promising approach for treating single Miller class II gingival recessions.

27. The influence of various rehydration protocols on biomechanical properties of different acellular tissue matrices.

Kasaj A, Levin L, Stratul SL, Götz H, Schlee M, Rütters CB, Konerding MA, Ackermann M, Willershausen B, Pabst AM. 2016. Clin Oral Invest.; 20(6):1303-15. [Epub 2015].

http://www.ncbi.nlm.nih.gov/pubmed/26434650

This study evaluated the influence of different rehydration media and time-periods on biomechanical and structural properties of different acellular collagen matrices (ACMs). **MATERIAL AND METHODS:** Specimens of three ACMs (mucoderm®, Mucograft®, Dynamatrix®) were rehydrated in saline solution (SS) or human blood for different time-periods (5 - 60 min). ACMs under dry condition served as controls. Biomechanical properties of the ACMs before and after different rehydration periods were determined by means of tensile testing. ACMs properties were further characterized using Fourier transform-infrared-spectroscopy (FTIR) and different scanning calorimetry. **RESULTS:** At dry conditions, mucoderm® presented the highest tensile strength (TS), whereas Dynamatrix® showed the maximum elastic modulus (EM, p each ≤ 0.036). Rehydration in SS and blood resulted in significant TS changes of mucoderm® (p each ≤ 0.05). Concerning EM, mucograft® showed significantly decreased values after rehydration in SS compared to Dynamatrix® and mucoderm® after 10 min (p each ≤ 0.024). mucoderm® hydrated for 5 min in blood displayed nearly double TS and a significantly increased EM after 60 min (p = 0.043) compared to rehydration in SS. TS and EM values of Dynamatrix® and Mucograft® were not altered following rehydration in blood versus saline solution (p each ≥ 0.053). FTIR analysis confirmed the recovery of the graft protein backbone with increased rehydration in all samples. DSC measurements revealed that tissue hydration decreased thermal stability of the investigated ACMs. **CONCLUSION:** Our findings demonstrated that the rehydration protocol affects the biomechanical properties of ACMs. **CLINICAL RELEVANCE:** Clinicians should be aware of altered handling and mechanical properties of ACMs following different rehydration protocols.

28. Collagen Membranes Adsorb the Transforming Growth Factor-β Receptor I Kinase-dependent Activity of Enamel Matrix Derivative.

Stähli A, Miron RJ, Bosshardt DD, Sculean A, Gruber R. J. 2016. Periodontol.; 87(5):583-90.

http://www.ncbi.nlm.nih.gov/pubmed/26777762

Here, we studied the ability of two collagen membranes and a collagen matrix to adsorb the activity intrinsic to enamel matrix derivative that provokes transforming growth factor-beta (TGF-β) signaling in oral fibroblasts. **MATERIAL AND METHODS:** Three commercially available collagen products were exposed to enamel matrix derivative or recombinant TGF-β1, followed by vigorous washing. Oral fibroblasts were then either seeded directly onto the collagen products or were incubated with the respective supernatant. The expression of the TGF-β target genes interleukin 11 and proteoglycan 4 was evaluated by real time PCR. To study the fraction of enamel matrix derivative proteins binding to collagen, we used proteomic analysis. **RESULTS:** Enamel matrix derivative or TGF-β1 provoked a significant increase of interleukin 11 and proteoglycan 4 expression of oral fibroblasts when seeded onto the collagen products and when incubated with the respective supernatant. Gene expression was blocked by the TGF-β receptor I kinase inhibitor SB431542. Amelogenin bound most abundantly to gelatin coated culture dishes. Incubation of palatal fibroblasts with recombinant amelogenin, however, did not alter expression of interleukin 11 and proteoglycan 4. **CONCLUSIONS:** These *in vitro* findings suggest that collagen products adsorb a TGF-β receptor I kinase-dependent activity of enamel matrix derivative and make it available for potential target cells.

29. Soft tissue volume alterations after connective tissue grafting at teeth: the subepithelial autologous connective tissue graft versus a porcine collagen matrix - a pre-clinical volumetric analysis.

Schmitt CM, Matta RE, Moest T, Humann J, Gammel L, Neukam FW, Schlegel KA. J. 2016. Clin Periodontol.; 43(7):609-17.

https://www.ncbi.nlm.nih.gov/pubmed/26990041

Evaluation of a porcine collagen matrix (CM) for soft tissue thickening in comparison to the subepithelial connective tissue graft (SCTG). **MATERIAL AND METHODS:** In eight beagle dogs, soft tissue thickening was performed at the buccal aspects of the upper canines (SCTG and CM). Impressions were taken before augmentation (i1), after surgery (i2), after one (i3), three (i4) and ten month (i5). Casts were optically scanned with a 3D scanner. Each augmented region (unit of analysis) evaluated (primary outcome variable: volume increase in mm (3); secondary outcome variables: volume increase in percent, mean and maximum thickness increases in mm). **RESULTS:** 3D tissue measurements after surgery revealed a significant higher volume increase in the mucoderm than in the SCTG group. After 10 months, volume increase was non-significant between groups SCTG and mucoderm. Maximum soft tissue thickness increase was 0.66 mm ± 0.29 mm (SCTG) and 0.79 mm ± 0.37 mm (mucoderm) with no significant difference. **CONCLUSIONS:** Ten months after soft tissue thickening, the CM is statistically non-inferior to the SCTG in terms of soft tissue volume and thickness increase. Further 3D studies are needed to confirm the data.

30. Influence of porcine-derived collagen matrix on endothelial progenitor cells: an *in vitro* study.

Pabst AM, Lehmann KM, Walter C, Krüger M, Stratul SI, Kasaj A. Odontology. 2016; 104(1):19-26. [Epub 2014].

http://www.ncbi.nlm.nih.gov/pubmed/25487653

The aim of this study was to analyze the influence of a novel PDCM on endothelial progenitor cells (EPC) *in vitro*. EPC were isolated from human peripheral blood, cultured and transferred on the PDCM (mucoderm®). Tissue culture polystyrene surface (TCPS) served as control. Cell viability of EPC on PDCM was measured by a MTT and PrestoBlue® assay. Migration ability was tested using a Boyden migration assay. A ToxiLight® assay was performed to analyze the influence of PDCM on adenylate kinase (ADK) release and apoptosis rate of EPC. Using the MTT assay, EPC cultured on PDCM demonstrated a significantly increased cell viability compared to the control group at days 3, 6 and 12. According to the PrestoBlue® assay, EPC showed a significant increase of cell viability compared to the control group at 48, 72, and 96h. In the Boyden migration assay, a significantly increased EPC migration ability could be observed after 3-12 days. No significantly increased apoptosis rate of EPC on PDCM could be observed with exception after 96h. Overall, our results suggest a good biocompatibility of PDCM without any cytotoxic effects on EPC, which might support a rapid revascularization and therefore a sufficient ingrowth of the PDCM.

31. Synchrotron-based X-ray tomographic microscopy for visualization of three-dimensional collagen matrices.

Pabst AM, Wagner W, Kasaj A, Gebhardt S, Ackermann M, Astolfo A, Marone F, Haberthür D, Enzmann F, Konerding MA. 2015. Clin Oral Investig, 19(2):561-4; [Epub 2014].

http://www.ncbi.nlm.nih.gov/pubmed/25209594

Report on synchrotron-based X-ray tomographic microscopy (SRXTM) to image 3D-CMsin native tissue probes. **MATERIAL AND METHODS:** SRXTM of 3D-CMs (mucoderm®, Mucograft®) was performed at the TOMCAT beamline of the Swiss Light Source (SLS) at the Paul Scherrer Institute (Villigen, Switzerland). **RESULTS:** SRXTM combines the advantages of high-resolution scanning electron microscopy (SEM) imaging with the low resolution reconstructions of micro-CT (µCT) imaging. It may be used to non-destructively visualize and analyze structures within the 3D-CMs without the need of serial sectioning and reconstruction. **CONCLUSION:** High-resolution SRXTM is a useful tool in analyzing the topology and morphometry of structures in 3D-CMs. The outcome justifies the efforts in sophisticated data processing.

32. Porcine dermis-derived collagen membranes induce implantation bed vascularization via multinucleated giant cells: a physiological reaction.

Barbeck M, Lorenz J, Kubesch A, Booms P, Boehm N, Choukroun J, Sader R, Kirkpatrick CJ, Ghanaati SJ. 2015. Oral Implantol.; 41(6):e238-51.

https://www.ncbi.nlm.nih.gov/pubmed/25546240

In this study, the tissue reactions to two new porcine dermis-derived collagen membranes of different thickness were analyzed. The thicker material (mucoderm®) contained sporadically pre-existing vessel skeletons and fatty islands. The thinner membrane (collprotect®) had a bilayered structure (porous and occlusive side) without any pre-existing structures. These materials were implanted subcutaneously in mice to analyze the tissue reactions and potential transmembranous vascularization. Histological and histomorphometrical methodologies were performed at four time points (3, 10, 15 and 30 days).Both materials permitted stepwise connective tissue ingrowth into their central regions. In the mucoderm® matrix, newly built microvessels were found within the pre-existing vessel and fatty island skeletons after 30 days. This vascularization was independent of the inflammation-related vascularization on both material surfaces. The collprotect® membrane underwent material disintegration by connective tissue strands in combination with vessels and multinucleated giant cells. The histomorphometric analyses revealed that the thickness of mucoderm® did not decrease significantly, while an initial significant decrease of membrane thickness in case of collprotect® was found at day 15.The present results demonstrate that the two analyzed collagen membranes underwent a multinucleated giant cell-associated vascularization. Neither of the materials underwent transmembraneous vascularization. The micro-vessels were found within the pre-existing vessel and fatty island skeletons. Additional long-term studies and clinical studies are necessary to determine how the observed foreign body giant cells affect tissue regeneration.

33. Biodegradation pattern and tissue integration of native and cross-linked porcine collagen soft tissue augmentation matrices – an experimental study in the rat.

Rothamel D, Benner M, Fienitz T, Happe A, Kreppel M, Nickenig JH and Zöller JE. 2014. Head and Face 2014, 10:10.

http://www.ncbi.nlm.nih.gov/pubmed/24670219

The aim of the present study was to compare the biodegradation and tissue integration of native, differently processed and cross-linked collagen scaffolds in rats. **METHODS:** Four experimental porcine collagen matrices of 1.0 mm thickness, developed for soft tissue augmentation procedures, were tested. Based on the same native dermal Type I and III collagen, native (ND, mucoderm® prototype), specifically defatted (DD), ethylene dioxide cross-linked (ECL) and dehydrothermally cross-linked (DCL) dermis collagen (AAP/Botiss Biomaterials, Berlin, Germany) were evaluated. Two specimens of 1 × 1

cm were fixed around a non-absorbable spacer using non-absorbable sutures. After rehydration, specimens (N = 8) were randomly allocated in unconnected subcutaneous pouches on the back of 40 Wistar rats. Rats were divided into five groups (1, 2, 4, 8 and 12 weeks), including eight animals each. After each period, eight rats were sacrificed and explanted specimens were prepared for histological analysis. The following parameters were evaluated: membrane thickness as a sign of biodegradation and volume stability, cell ingrowth, vascularization, tissue integration and foreign body reaction. **RESULTS:** Biodegradation pattern of the non-cross-linked collagen scaffolds differed only slightly in terms of presence of inflammatory cells and cell invasion into the matrix. In terms of biodegradation, ECL displayed a considerable slower resorption than ND, DCL and DD. Chemical cross-linking using ethylene dioxide showed a significant higher invasion of inflammatory cells. **CONCLUSION:** Within the limits of the present study it was concluded that the processing techniques influenced the collagen properties in a different intensity. Dehydrothermal cross-linking and special defatting did not notably change the biodegradation pattern, whereas cross-linking using ethylene dioxide led to significant higher volume stability of the matrix. However, ECL showed an increased inflammatory response and compromised tissue integration. Therefore, ethylene dioxide seems to be not suitable for stabilization of collagen matrices for soft tissue augmentation procedures.

34. *In vitro* and *in vivo* characterization of porcine acellular dermal matrix for gingival augmentation procedures

Pabst AM, Happe A, Callaway A, Ziebart T, Stratul SI, Ackermann M, Konerding MA, Willershausen B, Kasaj A. 2014. J Periodont Res; 49(3):371-81. [Epub 2013].

http://www.ncbi.nlm.nih.gov/pubmed/23815471

The aim of the present study was to investigate the *in vitro* responses of four different oral cell lines cultured on a novel PADM. Furthermore, tissue reaction to PADM was evaluated histologically after subcutaneous implantation in mice. **MATERIAL AND METHODS:** Human gingival fibroblasts (HGF), human osteoblast-like cells, human umbilical vein endothelial cells and human oral keratinocytes (HOK) were cultured and transferred on to the PADM. A tissue culture polystyrene surface served as the control. The viability of all tested cell lines on PADM was measured by using the 3-(4, 5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide colorimetric assay and PrestoBlue® reagent. The ToxiLight® assay was performed to analyze the effect of PADM on adenylate kinase release. PADM was implanted into nude mice subcutaneously and subjected to histological analysis after 21d. **RESULTS:** Using 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide colorimetric assays, all tested cell lines cultured on PADM demonstrated a significant increase of viability compared to the control group (each $p < 0.001$) with the exception of HGF and HOK after 3 d (each $p > 0.05$). According to the PrestoBlue® analysis, all cell lines demonstrated a significant increase of viability compared to the control group at the particular points of measurement after 18 h (HGF $p < 0.01$; human osteoblast-like cells, human umbilical vein endothelial cells, HOK each $p < 0.001$). No significant cytotoxic effects of PADM on the tested cell lines could be observed, as assessed by changes in adenylate kinase release. Subcutaneous implantation of PADM into nude mice demonstrated good integration with surrounding tissues and

significant revascularization of its collagen structure. **CONCLUSION:** Overall, the results suggest that PADM is a promising substitute for autogenous soft tissue grafts in periodontal surgery.

Clinical studies and case series

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

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

Background: The use of connective tissue graft (CTG) with immediate implant placement and provisionalisation have shown promising results. It is not clear if the same outcome could be achieved using porcine-derived collagen matrix (PDCM) as grafting material. **Objectives:** This study aimed to assess the esthetic and functional outcomes of immediate temporization of immediately placed fully tapered implants combined with bone and soft tissue augmentation, using either a CTG or a PDCM, in fresh extraction sockets of the anterior sites. **Materials and methods:** Patients with a failing anterior tooth were included in this study. After extraction, they received an immediate implant with simultaneous hard and soft tissue augmentation and immediate provisional restoration. Patients were randomly assigned to one of the group. Soft tissue augmentation in the control group (CTG) consisted of a CTG, whereas PDCM was used in the test group. After 4 months, definitive restorations were delivered, and pink esthetic score (PES) was evaluated at T1, prosthetic delivery, and at 12-month follow-up (T2). In addition, crestal bone change, probing depth, bleeding on probing, plaque index, bleeding on provisional removal, and implant stability quotient were also recorded. **Results**: A total of 45 patients received the intended treatment (22 controls and 23 tests) 45 implants totally, with no implant failures at T2. PES mean ± SD after 1 year was noted to be 12.9 ± 1.2 for the CTG group and 12.1 ± 1.3 for the PDCM group (p = 0.507). **Conclusion:** Within the limits of this trial, both treatment protocols resulted in comparable esthetic outcomes, with results showing PES >12 and stable clinical parameters after 1 year of follow-up.

36. Peri-implant soft-tissue esthetic outcome after immediate implant placement in conjunction with xenogeneic acellular dermal matrix or connective tissue graft: A randomized controlled clinical study

https://pubmed.ncbi.nlm.nih.gov/35043553/

Objectives: This randomized comparative study evaluated the clinical esthetic outcome of the peri-implant mucosa following extraction and immediate implant placement in conjunction with anorganic bovine bone mineral (ABBM) and the use of a porcine acellular dermal matrix (pADM) versus an autogenous connective tissue graft (CTG) in the anterior maxilla. **Materials and methods:** Twenty patients (11 men, 9 women) with a mean age of 48,9 years (range 21-72) were included in the study

and randomly assigned to either the test (pADM) or control group (CTG). They underwent extraction and immediate implant placement together with ABBM for socket grafting and either pADM or CTG for soft tissue augmentation. Twelve months after implant placement color measurements of the peri-implant mucosa and a reference tooth were performed using a spectophotometer and the color difference (ΔE) was calculated. The overall esthetic appearance of the peri-implant soft tissue was evaluated using the Pink Esthetic Score (PES). Statistical analysis was performed using Student's T-Test, the alpha was set to 0.05. **Results:** All implants received osseointegration and were restored. The mean color difference of the peri-implant mucosa 1 year after surgery amounted ΔE 4.06 ± 1.6 for the test group (pADM) and ΔE 3.58 ± 1.36 mm for the control group (CTG), showing no statistically significant difference (p = 0.47). The mean PES of the pADM group was 11.4 ± 1.4 and for the CTG group 10.7 ± 1.5, showing no statistically significant difference (p = 0.29). **Conclusion:** Twelve months after surgery, a porcine acellular dermal matrix for soft tissue augmentation in conjunction with immediate implant placement showed no difference in the overall esthetic appearance regarding color match and Pink Esthetic Score in comparison to autogenous soft tissue graft.

37. Linear and profilometric changes of the mucosa following soft tissue augmentation in the zone of aesthetic priority: A systematic review and meta-analysis

Raghoebar GM, Korfage A, Meijer HJA, Gareb B, Vissink A, Delli K. Clin Oral Implants Res. 2021 Oct;32 Suppl 21:138-156. doi: 10.1111/clr.13759.

https://pubmed.ncbi.nlm.nih.gov/34642988/

Objectives: To assess the outcomes of soft tissue augmentation, in terms of change in level and thickness of mid-buccal mucosa, at implants sites in the zone of the aesthetic priority. **Material and methods:** MEDLINE, EMBASE and Cochrane Central Register of Controlled Trials databases were searched (last search on 1 June 2020). Inclusion criteria were studies reporting outcomes of different materials and timing of grafting in patients undergoing soft tissue augmentation at implant sites in the aesthetic zone with a follow-up of ≥1 year after implant placement. Outcome measures assessed included changes in level and thickness of mid-buccal mucosa, implant survival, peri-implant health and patients' satisfaction. **Results:** Eighteen out of 2,185 articles fulfilled the inclusion criteria. Meta-analysis revealed a significant difference in vertical mid-buccal soft tissue change (0.34 mm, 95% CI: 0.13-0.56, p = .002) and mid-buccal mucosa thickness (0.66 mm, 95% CI: 0.35-0.97, p < .001) following immediate implant placement in favour of the use of a graft versus no graft. Mean difference in mid-buccal mucosa level following delayed implant placement (0.17 mm, 95% CI: 0.01-0.34, p = .042) was also in favour of the use of a graft versus no graft. With regard to mucosa thickness, the use of a graft was not in favour compared with no graft following delayed implant placement (0.22 mm, 95% CI: -0.04-0.47, p = .095). Observed changes remained stable in the medium term. **Conclusion:** Soft tissue augmentation in the zone of the aesthetic priority results in less recession and a thicker mid-buccal mucosa following immediate implant placement and less recession in mid-buccal mucosa following delayed implant placement compared with no graft.

38. Root coverage of multiple gingival recessions treated with coronally advanced flap associated with xenogeneic acellular dermal matrix or connective tissue graft: a 6-month split-mouth controlled and randomized clinical trial

Maluta R, Monteiro MF, Peruzzo DC, Joly JC. Clin Oral Investig. 2021 Oct;25(10):5765-5773. doi: 10.1007/s00784-021-03879-8.

https://pubmed.ncbi.nlm.nih.gov/33723662/

Objectives: This study aimed to compare xenogeneic dermal matrix (XDM) to connective tissue graft (CTG) associated with coronally advanced flap (CAF) in treating Miller's class I and II (RT1) multiple gingival recession in a split-mouth randomized clinical trial. **Materials and methods:** Fifteen patients with bilateral Miller's class I and II multiple recessions were selected. The patient's side receiving each treatment was randomly allocated to receive XDM or CTG. The clinical parameters were measured at baseline and 6 months of follow-up. Results: At 6 months, no significant difference in the root coverage (RC) (95.28 ± 6.89% for CTG and 92.68 ± 7.35% for XDM) and the keratinized tissue (KT) gain (0.91 ± 0.46 mm for CTG and 0.74 ± 0.39 mm for XDM) was observed between groups (p > 0.05). The CTG group presented higher complete root coverage (CRC) than XDM (60% and 33%, respectively) (p = 0.045). Multiple logistic regression indicated that the XDM (p = 0.01) and the XDM and KT interaction (p = 0.02) negatively interfered in the CRC. A 1-mm increase in the baseline KT when using XDM increases almost 6 times the chance of achieving CRC, and XDM reached a similar CRC probability to CTG when the receptor area presented at least 2 mm of KT. Conclusions: Both treatments were effective for treating multiple gingival recession; similar KT gain, GR reduction, and RC were obtained for CTG and XDM, while CTG promoted higher CRC than XDM. Moreover, the amount of KT at baseline was determinant for CRC when treating multiple gingival recession with XDM.

39. Porcine Acellular Dermal Matrix: An Alternative to Connective Tissue Graft-A Narrative Review

Dadlani S. Int J Dent. 2021 Sep;2021:1652032. doi: 10.1155/2021/1652032.

https://pubmed.ncbi.nlm.nih.gov/34527053/

Porcine acellular dermal matrix has recently been introduced in dentistry as an alternative to the gold standard connective tissue graft especially for the use in gingival recession treatments and soft tissue augmentation in implant surgery. Connective tissue grafts are inconvenient and require a second surgical site leading to greater morbidity, longer surgical procedures, and a more painful postoperative phase for the patient. Other options such as allografts have ethical concerns and are less available in Europe. Thus, dental professionals have sought other techniques and materials. Porcine acellular dermal matrix results in periodontal recession treatment with a gain in recession coverage as well as increased keratinized tissue and soft tissue augmentation. This leads to more keratinized mucosa and greater tissue thickness. Many studies have been published using collagen matrices, but a few strictly use porcine acellular dermal matrix, which have been studied in prospective randomized clinical trials

with a large number of patients and longer follow-up periods (more than 5 years). Nevertheless, more data are needed to confirm that the porcine acellular dermal matrix is a suitable alternative although its favourable results to date suggest a positive future.

40. Peri-Implant Mucosa Augmentation with an Acellular Collagen Matrix

Zafiropoulos GG, Al-Asfour AA, Abuzayeda M, Kačarević ZP, Murray CA, Trajkovski B. Membranes (Basel). 2021 Sep;11(9):698. doi: 10.3390/membranes11090698.

https://pubmed.ncbi.nlm.nih.gov/34564515/

Peri-implant keratinized mucosa (PI-KM) may support implant survival. Acellular collagen matrices (aCMs) have been widely used to facilitate soft tissue regeneration. The aim of this study was to investigate clinical outcomes obtained with the use of an aCM (mucoderm®) to enhance PI-KM. In this retrospective non-randomized case series, 27 restored implants in 14 patients (eight males and six females, mean age = 56 years) with a PI-KM width ≤ 1 mm were followed for 6 months. It was demonstrated that aCM grafts augmented PI-KM effectively (mean increase of 5.4 mm; >533%) without a significant change in bleeding on probing (BOP) from baseline. The mean aCM shrinkage was 3.9 mm (42%). Gender, area, arch, and BOP did not influence PI-KM augmentation or aCM shrinkage significantly. The present results demonstrated that the examined aCM was effective and predictable for attaining a band of keratinized tissue, while avoiding graft donor site harversting.

41. Clinical and volumetric analysis of peri-implant soft tissue augmentation using an acellular dermal matrix: A prospective cohort study

Papi P, Penna D, Di Murro B, Pompa G. J Periodontol. 2021 Jun;92(6):803-813. doi: 10.1002/JPER.20-0219.

https://pubmed.ncbi.nlm.nih.gov/33000864/

Background: The role of keratinized mucosa in promoting peri-implant health is controversial, however recent evidence support the use of soft tissue augmentation procedures around dental implants. Soft tissue substitutes have been proposed to replace autogenous connective tissue grafts, therefore the aims of this study are to report clinical and volumetric three-dimensional changes in mucosal thickness (MT) 1 year after treatment with an acellular dermal matrix (ADM). **Methods:** Soft tissue augmentation was performed at second-stage surgery in the premolar maxillary area with an ADM. MT was assessed prior to implant placement and 1, 6, and 12 months after treatment. Digital linear and volumetric measurements were recorded at baseline and after 1 and 12 months. Furthermore, clinical parameters (Probing Pocket Depths, Bleeding On Probing, Plaque Index) and marginal bone loss were also recorded. Esthetic outcomes of treatment were evaluated objectively using the Pink Esthetic Score and through patient reported outcomes. **Results:** Twelve patients were enrolled in this prospective study. Post-hoc analysis of the assessments with Tukey's honestly significant difference adjustment revealed that the MT had increased significantly from baseline to 1 month ($P < 0.001$), 6 months ($P < 0.001$) and 12

months (P < 0.001), and remained stable between 6 months and 12 months (P > 0.05). Based on the volumetric evaluation, a shrinkage of 23.31% occurred from 1 month to 12 months (P > 0.05).

42. Three-dimensional digital planning of class III decompensation with clear aligners: Hard and soft tissue augmentation with concomitant corticotomy to stretch the limits of safe orthodontic treatment

Brugnami F, Meuli S, Caiazzo A, Marrocco S, Scopelliti D. J Oral Biol Craniofac Res. 2021 Apr-Jun;11(2):297-302. doi: 10.1016/j.jobcr.2021.02.011.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7940984/

Purpose: Three-dimensional diagnosis has shown that orthodontic therapy could potentially move the roots of the teeth outside the original bone structure. The purpose of these case studies was to test the possibility of obtaining correct three-dimensional tooth positioning with clear aligners, thereby modifying the periodontal structure accordingly, at the same time. **Methods:** Regenerative Corticotomy (RC) was performed with clear aligners on ten adult patients (40 anterior teeth) with skeletal Class III malocclusion, for dental decompensation, prior to the orthognathic surgery. The CBCT examinations were performed before treatment (T0) and 1 year after orthognathic surgery (T1). The vertical and the horizontal hard tissue changes, the width of keratinized gingiva, the incisors proclination (IMPA) and the percentage of inclination compared to the planning were analyzed. **Results:** The distance between the Cemento-Enamel Junction (CEJ) and the Bone Marginal Level (BML) decreased in average from 5.5 ± 3.2 mm to 1.39 ± 0.53 mm. The horizontal changes were at the 3 mm level 1.42 ± 0.5 mm, at the 5 mm level 1.98 ± 0.66 mm and at the 7 mm level 2.70 ± 0.87 mm. The width of Keratinized gingiva changes were on average 1.42 ± 0.36 at T0 and 4.16 ± 2.25 at T1. All the changes were statistically significant with p < 0,05. The mean proclination based on IMPA values was +9.16 +-1.19°. The mean difference of the incisor's proclination compared to the digitally planned was −1 +-0.6° (89.87 +-6.46%). **Conclusion:** Clear Aligners with three-dimensional digital planning seems to be reliable in controlling teeth movements in the pre-orthognathic decompensation phase. Regenerative Corticotomy seems to have the ability to improve the periodontal tissues despite proclination.

43. Wound Closure and Simultaneous Soft Tissue Augmentation at Fresh Extraction Sockets: A Simplified Technique Adopting a Xenogeneic Collagen Matrix

Rossi A, Palombo D, Capilupi V, Chiapasco M. Int J Periodontics Restorative Dent. 2021 May-Jun;41(3):457-465. doi: 10.11607/prd.4288.

https://pubmed.ncbi.nlm.nih.gov/34076646/

A simplified surgical technique is presented for closure and soft tissue augmentation of fresh extraction sockets that utilizes a xenogeneic collagen matrix as a substitute for a combined onlay-interpositional connective tissue graft. Ten alveoli receiving a socket preservation procedure (n = 5) or an immediate submerged implant (n = 5) were sealed with a xenogeneic collagen matrix, stabilized under small palatal and buccal full-thickness envelope flaps. Eight weeks after surgery, full wound closure was achieved in 9 out of 10 sites with satisfactory esthetic integration (mean ΔE score: 3.76). Results from this

descriptive observational study suggest that this technique may represent a valuable and minimally invasive solution to simplify closure and soft tissue augmentation of fresh extraction sockets.

44. Efficacy of Collagen Matrix (Mucograft® and Mucoderm®) Versus Free Gingival Graft to Enhance the Width of Keratinized Tissue Around Implants

Aras DK, Özkoçer Ö, Ahu Uraz, Yalim M. ADO Klinik Bilimler Dergisi. 2021 May;10(2), 77-84.

https://dergipark.org.tr/en/pub/adoklinikbilimler/issue/62442/859212

Aim: Keratinized gingival tissue insufficiency is one of the important factors for implant survival. The purposed of this study was to test collagen matrices (Mucograft® and Mucoderm®) aimed to increase keratinized tissue around dental implants when compared with free gingival graft (FGG). Material and Method: Eighteen patients with 36 implants were included in the study. Participants were divided randomly into three groups, FGG were applied to the control group (CG), Mucograft® was applied test group 1 (TG1) and Mucoderm® was applied the test group 2 (TG2). Plaque index (PI), gingival index (GI), bleeding on probing (BoP), Probing depth (PD), the width of the keratinized mucosa (KMW) and thickness of keratinized mucosa (KMT) at augmentation site were measured. PI, GI, PD values of full mouth were obtained. These measurements were recorded at baseline, 1st, 3rd and 6th months after surgery. Results: In the terms of clinical parameters for augmentation area within and between groups; There is a statistically significant difference between the PI, GI, BoP, KMW, baseline values of the augmentation site and the values at the 1st, 3rd and 6th months ($p < 0.05$). Baseline PI, GI, BoP values were found to be significantly higher than at 1st, 3rd and 6th months. This situation is valid for all groups. For all groups, baseline KMW values were found to be significantly lower than at 1st, 3rd and 6th months. There is no statistically significant difference between groups, in term of KMT. Conclusions: In soft tissue augmentations made with different graft alternatives, the peri-implant keratinized gingiva width values increased compared to the beginning. No major differences were observed between autogenous graft (FGG) and porcine collagen graft materials (Mucograft and Mucoderm). The positive effect of this keratinized gingiva gain on gingival health was observed.

45. Collagen Matrix vs. Autogenous Connective Tissue Graft for Soft Tissue Augmentation: A Systematic Review and Meta-Analysis

Vallecillo C, Toledano-Osorio M, Vallecillo-Rivas M, Toledano M, Rodriguez-Archilla A, Osorio R. Polym. 2021 May;13(11), 1810. doi: 10.3390/polym13111810.

https://www.mdpi.com/2073-4360/13/11/1810

Soft tissues have been shown to be critical for the maintenance of both teeth and implants. Currently, regenerative soft tissue techniques propose the use of collagen matrices, which can avoid the drawbacks derived from the obtainment of autogenous tissue graft. A systematic review and meta-analysis were conducted to ascertain the efficacy of collagen matrices (CM) compared to autogenous connective tissue graft (CTG) to improve soft tissue dimensions. An electronic and manual literature searches were performed to identify randomized clinical trials (RCT) or controlled clinical trials (CCT) that compared CTG and CM. Pooled data of width of keratinized tissue (KT) and mucosal thickness (MT) were collected and weighted means were calculated. Heterogeneity was determined using Higgins (I2).

If I2 > 50% a random-effects model was applied. Nineteen studies were included based on the eligibility criteria. When using CTG a higher MT gain (0.32 mm, ranging from 0.49 to 0.16 mm) was obtained than when employing CM. Similar result was obtained for the width of KT gain, that was 0.46 mm higher (ranging from 0.89 to 0.02 mm) when employing CTG. However, it can be stated that, although autogenous CTG achieves higher values, CM are an effective alternative in terms of total width of KT and MT gain.

46. Free Gingival Graft and Collagen Matrix Revascularization in an Enoral Open Wound Situation

Preidl RH, Reichert S, Coronel TV, Kesting M, Wehrhan F, Schmitt CM. J. Oral Maxillofac. Surg. 2021 Mai;79(5), 1027-1037. doi: 10.1016/j.joms.2020.12.019.

https://www.sciencedirect.com/science/article/abs/pii/S0278239120315172

Purpose: Vestibuloplasty with free gingival grafting is a frequently performed surgical procedure to generate sufficient keratinized mucosa (KM) around dental implants. Avascular porcine collagen matrices (CM) have been proclaimed to be sufficient substitutes as alternatives to free gingival grafts (FGGs). However, the process of graft integration and vascularization is still incompletely understood. **Methods:** In 18 patients a vestibuloplasty in the lower edentulous jaw situation was performed during implant exposure, either with FGGs from the palate or a porcine CM (mucoderm). Tissue perfusion of the soft tissue grafts was measured using laser-doppler-spectrophotometer intraoperatively and on postoperative days 2, 5, 10, 30 and between days 60 and 90. With graft perfusion expressed by oxygen saturation [SO2%], the relative amount of hemoglobin [rHb], blood flow, and velocity [AU] was detected and compared between groups and the surrounding mucosa. **Results:** Healing was uneventful in both groups, with mature KM around dental implants after healing. Blood flow and velocity significantly increased until postoperative day 10, comparable to perfusion values of the surrounded mucosa. Intergroup comparisons revelated no significant differences concerning the flow between CM and FGGs. Oxygen saturation also significantly increased within the first 5 postoperative days in both groups. Hemoglobin content did not show any differences during the investigated period. **Conclusions:** The perfusion mainly progresses within the first postoperative week with only minimal further detectable alterations until the final investigation, comparable in both groups. Although integration of FGGs (revascularized) and the CM (new tissue formation) is biologically different, both transplants show comparable perfusion patterns, leading to sufficient KM.

47. Dynamics of Matrix Metalloproteinase-1 and -8 Secretion in Gingival Crevicular Fluid after Gingival Recession Therapy via MCAT with Either Subepithelial Connective Tissue Graft or Collagen Matrix

Skurska A, Dymicka-Piekarska V, Milewski R, Pietruska M.. Biomol. 2021 May;11(5):731. doi: 10.3390/biom11050731.

https://pubmed.ncbi.nlm.nih.gov/34068848/

Objectives: The objective of this study was to determine and estimate the changing levels of matrix metalloproteinases 1 and 8 (MMP-1 and MMP-8) in GCF at consecutive stages of healing after root coverage procedure via modified coronally advanced tunnel (MCAT) combined with either sub-epithelial connective tissue graft (SCTG) or collagen matrix (CM) and also to relate those changes to clinical outcomes of both therapeutic approaches. **Materials and methods:** The study involved 20 patients with a total of 91 recessions. Those on one side of the mandible received MCAT plus CM while the contralateral ones MCAT plus SCTG. The evaluation of MMP-1 and MMP-8 concentrations in Gingival Crevicular Fluid (GCF) took place at baseline, then at 1, 2, and 4 weeks, and finally at 3 months after surgery. Elisa protocol was applied to determine the levels of MMP-1 and MMP-8 in GCF. **Results:** Three-month observation revealed statistically significant changes in MMP-1, MMP-8 and Sulcus Fluid Flow Rate (SFFR) values after implementation of both techniques. A correlation was found between a difference in MMP-1 concentrations and gain in Keratinized Tissue (KT) after SCTG and CM. MMP-8 levels and a Gingival Thickness (GT) gain observed after CM was also correlated. **Conclusions:** A type of augmentative material does appear to determine the dynamics of MMP-1 secretion.

48. Comparison between a xenogeneic dermal matrix and connective tissue graft for the treatment of multiple adjacent gingival recessions: a randomized controlled clinical trial

Meza-Mauricio J, Cortez-Gianezzi J, Duarte PM, Tavelli L, Rasperini G, de Faveri M. Clin. Oral Investig. 2021 May;25(12), 6919-6929. doi: 10.1007/s00784-021-03982-w.

https://link.springer.com/article/10.1007/s00784-021-03982-w#citeas

Aim: To compare the outcomes of modified coronally advanced flap (mCAF) combined with either xenogeneic dermal matrix (XDM) or connective tissue graft (CTG) for the treatment of multiple adjacent gingival recessions (MAGRs). **Materials and methods:** Forty-two patients, in whom 130 maxillary (MAGRs) of type (RT1) were found, were randomly allocated to the two groups. Clinical, esthetic, and patient-centered outcomes were evaluated at baseline, 6, and 12 months post-treatment. **Result:** Group CAF+ CTG exhibited a higher mean root coverage value (mRC) (91.79%) (primary outcome variable) than group CAF+XDM (80.19%) without statistically significant difference at 12 months (p=0.06). The control group also had significantly higher percentage of teeth in which complete root coverage (CRC) and mean gain of gingival thickness (GT) were achieved, than the test group (p<0.05). With respect to patient-centered outcomes, patients of the test group reported having experienced significantly less pain than those of the control group until 7 days (p<0.05). Both surgical approaches were capable of significantly decreasing dentin hypersensitivity (p<0.05). No difference between groups was found in the esthetic score analysis (p>0.05). Mean surgical time was lower in the test group (p<0.05). **Conclusion:** The two treatments showed similar mRC. However, CAF+CTG was superior to CAF+XDM in providing CRC and in gaining GT. CAF+XDM demonstrated advantages over CAF+CTG with regard to patient morbidity and surgical time.

49. Treatment of multiple gingival recessions with xenogeneic acellular dermal matrix compared to connective tissue graft: a randomized split-mouth clinical trial

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8090794/

Purpose: The aim of this study was to compare the efficacy of the tunnel technique for root coverage using a new xenogeneic acellular dermal matrix vs. connective tissue grafting (CTG) for the treatment of multiple maxillary adjacent recessions (recession type 1) at 12 months postoperatively. **Methods:** This study enrolled 12 patients with at least 3 contiguous, bilateral, symmetrical maxillary gingival recessions (i.e., at least 6 recessions per patient). In total, 74 recessions were treated using the modified coronally advanced tunnel (MCAT) technique combined with a novel porcine-derived acellular dermal matrix (PADM) at 37 test sites or CTG at 37 control sites. The following clinical parameters were measured: recession height, clinical attachment level, width of keratinized tissue, probing depth, recession width, gingival thickness, mean root coverage (MRC), and complete root coverage (CRC). Comparisons between test and control groups were made for pain visual analog scale scores at 14 days. **Results:** At 12 months, the MCAT with PADM (test) yielded a statistically significant improvement in all clinical parameters studied. MRC was significantly higher on the control sides (80.6%±23.7%) than on the test sides (68.8%±23.4%). Similarly, CRC was 48.7%±6.8% on the control sides (CTG), in contrast to 24.3%±8.2% on the test sides (PADM). Statistically significant differences were observed in favor of the control sides for all clinical parameters studied. Nevertheless, the MCAT in adjunction with PADM was clearly superior at reducing mean and maximum patient-reported postoperative pain intensity and pain duration in the first week after surgery. **Conclusions:** The use of PADM to treat multiple recessions improved clinical parameters at 12 months, but these outcomes were nevertheless poorer than those observed for CTG. However, PADM reduced morbidity, particularly the pain experienced by patients.

50. Clinical Efficacy of Gingival Thickening Following the Use of Allogeneic Acellular and Xenogeneic Collagen Matrix: A 12-Month Randomized Clinical Trial

https://pubmed.ncbi.nlm.nih.gov/33819329/

This randomized controlled clinical trial with a 1-year follow-up evaluated gingival thickness changes around teeth after use of dermal allograft and xenograft matrix. A total of 116 teeth (19 patients) were separated into two groups. One group received xenogeneic collagen matrix (n = 48), while the other received allogeneic acellular dermal matrix (n = 68) via a coronally advanced flap (CAF). Gingival thickness (GT), keratinized gingival width (KGW), pocket depth (PD), and clinical attachment loss (CAL) were measured on the day of surgery (baseline) and at 3 weeks, 2 months, 6 months, and 1 year postoperative. The two groups were compared using repeated-measures ANOVA (P < .05). The mean GT at 1 year was 1.59 ± 0.31 mm in the xenogeneic group and 1.63 ± 0.33 mm in the allogeneic group (P = .60). The mean change in GT was 1.08 mm in the xenogeneic group and 1.13 mm in the allogeneic group, which was clinically relevant and statistically significant compared to baseline values (P < .001). However, changes in GT were not significantly different between the two groups at any time point (P >

.05). The GT increased in all cases treated with allogeneic and xenogeneic enriched collagen matrix. Both soft tissue substitutes were equally effective in acheiving optimal GT.

51. Early implant placement and peri-implant augmentation with a porcine-derived acellular dermal matrix and synthetic bone in the aesthetic area: a 2-year follow-up prospective cohort study

Papi P, Pranno N, Di Murro B, Pompa G. Int J Oral Maxillofac Surg. 2021 Feb;50(2):258-266. doi: 10.1016/j.ijom.2020.07.002.

https://www.sciencedirect.com/science/article/abs/pii/S0901502720302484

The aim of this study was to evaluate the 2-year follow-up results of early implant placement with simultaneous peri-implant augmentation using an acellular dermal matrix (ADM) and a synthetic bone substitute in the aesthetic zone. Twenty subjects were enrolled in this study, they were either males (eight) or females (12), with a mean age of 47.8 ± 4.45 years and each patient was treated with one implant. Simultaneous contour augmentation with guided bone regeneration was performed using synthetic bone particles (maxresorb®) and an ADM (mucoderm®). Keratinized mucosa width (KMW) and gingival thickness (GT) were assessed at baseline, 1, 3, 6, 12 and 24 months. Marginal bone loss, probing pocket depth, bleeding on probing and plaque index were also recorded. GT and KMW increased between baseline and 1 month, slightly decreased between 1 month and 12 months (P < 0.001) and remained stable between 12 and 24 months (P < 0.001). After 2 years, mean marginal bone loss level was 0.51 ± 0.63 mm, with no probing pocket depth values >5 mm and no concomitant signs of inflammation registered. Pink aesthetic score was 8.3. Combining an ADM and guided bone regeneration with early implant placement revealed a significant increase of 1.9 mm for GT and 1.6 mm for KMW after 2 years, showing good patient satisfaction regarding the aesthetic outcomes of soft tissues and prosthetic crown.

52. Long-term results after treatment of multiple adjacent gingival recessions with the modified coronally advanced tunnel and a porcine acellular dermal matrix

Cosgarea R, Miron R, Bora R, Rosu A, Buduru S, Sculean A. Quintessence Int. 2021 Jan;52(1):32-44. doi: 10.3290/j.qi.a45171. DOI. 10.3290/j.qi.a45171

https://pubmed.ncbi.nlm.nih.gov/32901241/

Objective: To evaluate the long-term clinical results after treatment of multiple adjacent recession type (RT) I and II gingival recessions treated with the modified coronally advanced tunnel (MCAT) in conjunction with a porcine acellular dermal matrix (PADM). **Method and materials:** Nine periodontally healthy nonsmoking patients (seven women, 37.5 ± 7.36 years old) with a total of 41 adjacent RT I (n = 23) and RT II (n = 18) gingival recessions exhibiting a minimum depth of 2 mm were treated by means of MCAT+PADM. Recession depth and width, width of attached and keratinized tissue, probing depths, and clinical attachment level were measured at baseline and at 1 and 4 years postsurgically. The primary outcome variable was complete root coverage (ie 100% root coverage), while secondary outcomes were mean root coverage and increase in keratinized tissue and attached gingiva widths.

Results: At 1 and 4 years, statistically highly significant (P < .001) root coverage was obtained in all nine patients compared to baseline. Mean root coverage decreased in these nine patients from 72.05 ± 30.18% at 1 year to 56.79 ± 27.53% at 4 years. Complete root coverage was obtained in 18 gingival recessions at 1 year (baseline RT: 12 RT I, 6 RT II) and in seven gingival recessions (5 RT I, 2 RT II) at 4 years. Most root coverage occurred in the first year postsurgically, showing a statistically significant decrease between the first and fourth year (P = .003). Mean width of attached gingiva increased statistically significantly (P < .05) from 2.85 ± 1.08 mm to 3.14 ± 1.08 mm at 1 year with a statistically significant decrease at 4 years. At 1 year, 78.05% of gingival recessions showed a root coverage > 50%, and 68.29% still exhibited a root coverage > 50% at 4 years. **Conclusion:** The use of MCAT+PADM represents a valuable treatment option for multiple adjacent maxillary and mandibular RT I and II gingival recessions on a long-term basis.

53. Creeping attachment following treatment of multiple gingival recession defects with xenogeneic collagen matrix: Two case reports

Meza-Mauricio J, Tavelli L, Marx M, Maximiano H, Mafra IJ, Garcia JP, Faveri M. J Int Acad Periodontol. 2021;23(3), 253-258.

https://www.researchgate.net/profile/Edwin-Meza-Mauricio/publication/353783099_Creeping_attachment_following_treatment_of_multiple_gingival_recession_defects_with_xenogeneic_collagen_matrix_Two_case_reports/links/6111d399169a1a010 3edbb9a/Creeping-attachment-following-treatment-of-multiple-gingival-recession-defects-with-xenogeneic-collagen-matrix-Two-case-reports.pdf

Aim: The aim of this report was to describe the phenomenon of creeping attachment that occurred following the use of a new xenogenic collagen matrix (CMX) for the treatment of multiple recession defects in the aesthetic region. **Methods:** Two patients with multiple gingival recession defects were treated with coronally advanced flap technique plus CMX (Mucoderm®). **Results:** Three months after grafting, the amount of root coverage obtained was partial. After a 2-year period, the previously denuded root surfaces were entirely covered by soft tissue. **Conclusions:** The new CMX combined with the coronally advanced flap technique can lead to satisfactory root coverage of multiple Cairo type I recession defects which in some cases may be due to creeping attachment. However, further clinical studies with long-term outcomes must be conducted to evaluate the stability of the outcomes obtained with CMX in the long-term.

54. Postoperative clinical studies on the perfusion behavior of xenogenic collagen matrices (Mucoderm) over 2 months

Coronell TV. Dissertation. 2020 Dec. urn:nbn:de:bvb:29-opus4-150909.

https://opus4.kobv.de/opus4-fau/frontdoor/index/index/docId/15090

Background: Free gingival grafts are used as a surgical procedure for recession coverage and creation of a stable, keratinized peri-implant soft tissue environment. In addition to soft tissue augmentation, the goal here is functional improvement with respect to aesthetic aspects. In a reconstruction via free

gingival grafts a palatal keratinized mucosal graft is removed and sewn into the correspondingly prepared recipient bed. This technique may be associated with increased risk of complications, pain and scarring in the donor region. As an alternative to this, newly developed collagen matrices (Mucoderm®, Botiss Biomaterials GmbH, Zossen, Germany) should prevent corresponding disadvantages by avoiding a second surgical field. **Material and Method:** Over an observation period of 60 days, the parameters of hemoglobin concentration and oxygenation, as well as relative perfusion and flow velocity, in the gingival tissue were documented for the first time by means of laser Doppler spectrometry O2C® ("oxygen to see"). The aim of this clinical comparative study was to show the differences between the postoperative perfusion and vascularisation course of free gingival grafts and the Mucoderm®, in order to better assess the healing process of the divergent grafts. The study included intra- and postoperative perfusion measurements on days 2, 5, 10, 30 and 60 in 9 patients who were treated with a collagen matrix. The perfusion in the matrices was compared with that of the surrounding mucosal tissue. In addition, the data collected were compared with existing perfusion data from FSTs. **Results:** According to the results, the perfusion parameters of the two membranes observed matched their adjacent mucosa over the 60-day study period. The oxygen saturation and blood flow of the augmented tissue showed a significant postoperative increase up to day 5, with subsequent adjustment of the measured values over the course of the observation period to nearby oral mucosa. At the same time, the relative hemoglobin content (rHb) showed no changes or statistical differences neither in the transplants nor in the surrounding mucosa during the examined period. After 2 months an oxygen saturation value of 78.52 ± 9.53[%] was measured for the Mucoderm®, that of the surrounding tissue was 64.20 ± 1.71[%]. They are not inferior to the measured values of the autologous grafts, which were 72.89 ± 7.94[%] on day 60. Furthermore, the parameters relative hemoglobin amount (CM $90.50 \pm$]). In comparison to the measure]) the parameters of the collagen membrane are on a par with the autologous mucosal graft. **Conclusion:** Already on day 2 after vestibuloplasty, blood flow signals were noted with increasing values up to day 5. In this respect, tissue perfusion mainly occurs within the first postoperative week and adjusts to the nearby oral mucosa with minimal changes in the subsequent course. With the completion of the (re)-vascularization phase, the integration of the transplant in the recipient bed is successfully completed on a microvascular level. Within the limits of this study, it can be concluded that the xenogeneic collagen membrane is not inferior to the autologous free mucosal graft after 2 months postoperatively. According to the results, the Mucoderm® is able to adapt and integrate into the surrounding tissue even faster.

55. Volumetric soft tissue alterations in the early healing phase after peri- implant soft tissue contour augmentation with a porcine collagen matrix versus the autologous connective tissue graft: A controlled clinical trial
Schmitt CM, Brückbauer P, Schlegel KA, Buchbender M, Adler W, Matta RE. J Clin Periodontol. 2021 Jan;48(1):145-162. doi: 10.1111/jcpe.13387.

https://pubmed.ncbi.nlm.nih.gov/33047372/

Aim: This study evaluates the early volumetric changes after buccal soft tissue contour augmentation around implants with a porcine collagen matrix (CM) vs. the subepithelial connective tissue graft (SCTG) from the palate. **Materials and methods:** 14 patients were enrolled after early implant placement with simultaneous contour augmentation and persistent buccal tissue deficits. At implant exposure, buccal soft tissues were thickened with the CM (n = 7) or the SCTG (n = 7). Impressions were taken before and after surgery, after ten days, one, three and six months. Impressions were digitized and augmented regions 3D evaluated (soft tissue volume (mm3 , %)/thickness (mm)). **Results:** Volume increase (mm3) after 6 months was 19.56 ± 8.95 mm3 (CM) and 61.75 ± 52.69 mm3 (SCTG) (insignificant, p = .058). In percentage, this was a volume loss of the initially augmented soft tissue volume (100%) of 81.76% in the CM group and 56.39% in the SCTG group (6 months). The mean soft tissue thickness increase (mm) in the buccal contour after 6 months was 0.30 ± 0.16 mm (CM) and 0.80 ± 0.61 mm (SCTG) (insignificant, p = .071). **Conclusion:** The early healing phase is associated with a significant volume loss of the soft tissues. The SCTG shows insignificant superiority compared to the CM.

56. Comparative clinicoradiologic research study of the tunnel plastics of multiple gingival recessions with Autograft and Xenogen Collagen matrix

Vedyaeva AP, Brailovskaya TV, Tarasenko SV, Bulkina NV, Garibian EA, Nebylitsin IV. J. Adv. Pharm. Educ. Res. 2020 Oct-Dec;10(4),99. E-ISSN: 2249-3379.

https://japer.in/storage/models/article/Zmmto6x28SZXzn9CFAPHQaSCbkFTfSDoEhdFXsNQ5VRXbVgGLtgnw0Mug7AT/comparative-clinicoradiologic-research-study-of-the-tunnel-plastics-of-multiple-gingival-recession.pdf

Aim: To compare the efficacy of gingival recession surgery using a tunnel surgery technique with connective tissue autograft and xenogenic collagen matrix Mucoderm. **Material and methods:** The article presents the results of a comparative clinicoradiologic analysis of the use of autograft and xenogenic collagen matrix Mucoderm in the tunnel technique of gingival recession treatment. Examination and treatment of 10 patients (6 women, 4 men) aged 35 ± 8.7 years with a diagnosis of generalized gingiva recession, Miller class 2, and with a thin phenotype were performed. Recessions occurred in the area of 49 teeth on the upper and lower jaws. **Results:** clinical results of root coverage using autograft achieved 99%, and 81% using the xenogeneic collagen matrix Mucoderm. The width of the keratinized attached gingiva for group 1 (autograft) and group 2 (Mucoderm) ranged 0.9 ± 0.44 mm and 1.14 ± 0.2 mm respectively. One month past the surgery with an autograft, it was 4.8 ± 1.1 mm, and by the sixth month it reached a stable value of 3,9 ± 0.8 mm and in comparison, with the values of the group 2 where Mucoderm was used, it was 3.6 ± 0.4 mm and 2.4 ± 0.3 mm respectively. The original thickness of the keratinized attached gingiva of 0.9 ± 0.12 mm, when using connective tissue autografts for the patients' group 1, increased to 2.4 ± 0.4 mm in a month of the treatment and remained stable by the sixth month being 1.85 ± 0.3mm, as for the patients' group 2 by the first and sixth months of the treatment it was 2 ± 0.3 mm and 1.5 ± 0.26 mm respectively. **Conclusions:** The use of the Mucoderm collagen matrix showed statistically significant clinicoradiologic results for class 2 gingival recession coverage for the thin mucous phenotype at long-term dates compared to the "gold standard" of autograft gingival surgery.

57. State of the Art on Biomaterials for Soft Tissue Augmentation in the Oral Cavity. Part I: Natural Polymers-Based Biomaterials

Toledano M, Toledano-Osorio M, Carrasco-Carmona Á, Vallecillo C, Lynch CD, Osorio MT, Osorio R. Polymers. 2020 Aug;12(8):1850. doi: 10.3390/polym12081850.

https://www.mdpi.com/2073-4360/12/8/1850

Oral soft tissue thickening or grafting procedures are often necessary to cover tooth recession, re-establish an adequate width of keratinized tissue, correct mucogingival deformities improving esthetics, prepare a site for an implant or prosthetics, for ridge preservation procedures, and soft tissue contouring around dental implants. Gingival recession and root or implant exposure are commonly associated and have led to mucogingival deficiencies that have traditionally been treated with free gingival grafts and autogenous soft tissue grafts. The latter represents the gold standard in acquiring a functionally adequate zone of keratinized attached gingiva. However, soft tissue substitutes are more usually employed because they lessen morbidity and abbreviate surgical time. This review is aimed at assessing oral soft tissue augmentation techniques and biomaterials used from existing literature, principally concerning scaffolds from both human and animal-based tissue derivatives matrices. In order to avoid the use of human donor tissue, the xenogenic collagen matrices are proposed for soft tissue augmentation. In general, all of them have provided the remodeling processes and enhanced the formation of new connective tissue within the matrix body.

58. State of the Art on Biomaterials for Soft Tissue Augmentation in the Oral Cavity. Part II: Synthetic Polymers-Based Biomaterials

Toledano M, Toledano-Osorio M, Carrasc- Carmona Á, Vallecillo C, Toledano R, Medina Castillo AL, Osorio Ruiz R. Polymers. 2020 Aug;12(8):1845 doi: 10.3390/polym12081845.

https://digibug.ugr.es/handle/10481/64146

Oral soft tissue thickening or grafting procedures are often necessary to cover tooth recession, re-establish an adequate width of keratinized tissue, correct mucogingival deformities improving esthetics, prepare a site for an implant or prosthetics, for ridge preservation procedures, and soft tissue contouring around dental implants. Gingival recession and root or implant exposure are commonly associated and have led to mucogingival deficiencies that have traditionally been treated with free gingival grafts and autogenous soft tissue grafts. The latter represents the gold standard in acquiring a functionally adequate zone of keratinized attached gingiva. However, soft tissue substitutes are more usually employed because they lessen morbidity and abbreviate surgical time. This review is aimed at assessing oral soft tissue augmentation techniques and biomaterials used from existing literature, principally concerning sca olds from both human and animal-based tissue derivatives matrices. In order to avoid the use of human donor tissue, the xenogenic collagen matrices are proposed for soft tissue augmentation. In general, all of them have provided the remodeling processes and enhanced the formation of new connective tissue within the matrix body.

59. The use of collagen porcine dermal matrix and connective tissue graft with modified coronally advanced tunnel technique in the treatment of multiple adjacent type I gingival recessions: A randomized, controlled clinical trial

Rakasevic DL, Milinkovic IZ, Jankovic SM, Soldatovic IA, Aleksic ZM, Nikolic-Jakoba NS. J Esthet Restor Dent. 2020 Jul;32(7), 681-690. doi: 10.1111/jerd.12624.

https://onlinelibrary.wiley.com/doi/abs/10.1111/jerd.12624

Objective: To assess the clinical efficacy and esthetic outcome of porcine-derived dermal collagen matrix in comparison with connective tissue graft in the treatment of multiple adjacent gingival recessions (MAGR), 6 and 12 months after the surgery. **Materials and methods:** Twenty patients with bilateral type I MAGR were treated randomly with porcine-derived dermal collagen matrix (test site) or connective tissue graft (control site) in combination with a modified coronally advanced tunnel technique. The primary objectives were to evaluate the mean and complete root coverage. The secondary objectives were to assess keratinized tissue width, gingival thickness gain, and root coverage esthetic score. **Results:** Six and 12 months postoperatively, both groups achieved significant improvements in all clinical parameters compared to baseline, with no statistically significant differences between the groups. Mean root coverage change (Δ12m – 6 m) was statistically significant between the groups in favor of connective tissue graft, and twice as many patients exhibited a complete coverage of all recessions in the control group than the test group. Conclusion: The porcine-derived dermal collagen matrix combined with a modified coronally advanced tunnel technique resulted in satisfactory clinical and esthetic outcomes, which were similar to connective tissue graft.

60. Root coverage using coronally advanced flap with porcine-derived acellular dermal matrix or subepithelial connective tissue graft: a randomized controlled clinical trial

Suzuki KT, de Jesus Hernandez Martinez C, Suemi MI, Palioto DB, Messora MR, Scombatti SL de Souza, Novaes AB, Flavia A Jr, Furlaneto C, Taba M; Jr. Clin Oral Invest. 2020 May;24, 4077–4087. doi : 10.1007/s00784-020-03280-x.

https://link.springer.com/article/10.1007/s00784-020-03280-x#citeas

Objective: The aim of this study is to investigate the use of a porcine-derived acellular dermal matrix (MD) in root coverage procedures combined with extended coronally positioned flap (eCAF), in comparison to the subepithelial connective tissue graft (SCTG) associated with the eCAF**. Material and methods:** Eighteen adult patients presenting bilateral type 1 gingival recession were randomly assigned to SCTG or MD groups. Clinical and patient-based outcomes were recorded at 3 and 6 months after the surgical procedure. **Results:** Both groups showed a significant reduction in the mean recession height of 3.33 ± 0.89 mm to 1.24 ± 1.10 mm (MD) and 3.21 ± 0.8 mm to 0.83 ± 0.86 mm (SCTG) without

difference between groups. Six patients in the test group and eight in the control group obtained complete root coverage. The keratinized tissue height and thickness (KTT) showed a significant increase after 3 and 6 months in both groups. The average KTT gains were 0.39 ± 0.4 mm (MD) and 0.51 ± 0.5 mm (SCTG) (p < 0.05). Performing multivariate analysis suggests that MD addition to coronally advanced flaps may be similar to SCTG. **Conclusion:** The MD had similar results in comparison to SCTG and in the context of reducing patient morbidity it can be used as an alternative for the treatment of gingival recessions.

61. A 3-Year Prospective Study on a Porcine-Derived Acellular Collagen Matrix to Re-Establish Convexity at the Buccal Aspect of Single Implants in the Molar Area: A Volumetric Analysis

Eeckhout C, Bouckaert E, Verleyen D, De Bruyckere T, Cosyn J. J. Clin. Med. 2020 May, 9(5), 1568. doi: 10.3390/jcm9051568.

https://www.mdpi.com/2077-0383/9/5/1568

Background: Xenogeneic soft tissue substitutes are currently being investigated as an alternative to subepithelial connective tissue grafts (CTG) with the intention to avoid postoperative morbidity associated with autologous grafting. The aim of the present study was to volumetrically evaluate the effectiveness and mid-long-term stability of a porcine-derived collagen matrix (PDCM) (Mucoderm®, Botiss gmbh, Berlin, Germany) in increasing soft tissue volume at the buccal aspect of molar implant sites. **Methods:** Periodontally healthy non-smoking patients with a single tooth gap in the molar area were selected for a prospective case series. All sites had a bucco-oral bone dimension of at least 8 mm and demonstrated a horizontal alveolar defect. A wide diameter implant was placed under the elevated buccal flap and a PDCM was applied. The primary outcome was the linear increase in buccal soft tissue profile (BSP) within a well-defined area of interest. This was performed with designated software (SMOP; Swissmeda AG, Zurich, Switzerland) on the basis of superimposed digitalized study casts taken before surgery (T0), immediately after surgery (T1), at three months (T2), one year (T3) and three years (T4). Secondary outcomes were alveolar process deficiency and clinical parameters. **Results:** Fourteen out of 15 treated patients attended the three-year re-assessment (four females; mean age 51.4 years). Mean linear increase in BSP at T1 was 1.53 mm (p = 0.001). The PDCM showed substantial resorption at T2 (1.02 mm or 66.7%) (p = 0.001). Thereafter, a 0.66 mm volume gain was observed (p = 0.030), possibly due to the installation of a permanent crown displacing the soft tissues to the buccal aspect. This resulted in a linear increase in BSP of 1.17 mm (76.5%) at T4. Alveolar process deficiency significantly reduced over time (p = 0.004). However, 50% of patients still demonstrated a slight (6/14) or obvious (1/14) alveolar process deficiency at study termination. Implants demonstrated healthy clinical conditions. **Conclusions:** The PDCM demonstrated marked resorption during the early stages of healing. Due to the matrix thickening the tissues, and the permanent crown displacing the tissues, 76.5% of the initial increase in BSP could be maintained over a three-year period. Half of the patients failed to show perfect soft tissue convexity at the buccal aspect.

62. Porcine-Derived Acellular Dermal Matrix for Buccal Soft Tissue Augmentation at Single Implant Sites: A 1-Year Follow-up Case Series

Stefanini M, Rendon A, Zucchelli G. Int J Periodontics Restorative Dent. 2020 Jan/Feb;40(1):121-128. doi: 10.11607/prd.4477.

https://pubmed.ncbi.nlm.nih.gov/31815982/

Abstract: Soft tissue augmentation procedures are crucial to obtain a successful outcome in implant therapy. The aim of this case series was to describe the 1-year clinical outcomes of a porcine-derived acellular dermal matrix for buccal mucosal thickness augmentation at osseointegrated single implants with facial peri-implant soft tissue deficiencies. Ten patients were included and treated with a prosthetic and surgical approach that combined a coronally advanced flap and a dermal matrix. Results showed the possibility to obtain an increase in buccal soft tissue thickness of 1.2 ± 0.18 mm at single implant sites in the esthetic area.

63. Dimensional changes of peri-implant tissues with connective tissue grafts vs. with xenogenic matrices

Cristancho LB, Méndez CS. Rev Cubana Estomatol. 2020 Jan;57(1), 56-69.

https://www.medigraphic.com/cgi-bin/new/resumenI.cgi?IDARTICULO=97150&idP=9189

Objective: Compare the dimensional changes of peri-implant tissues from the esthetic zone after the second surgical stage of autogenous connective tissue grafting vs. a xenogenic collagen matrix after three months' healing. **Methods:** A case-series of six patients with alveolar ridge defects underwent a soft tissue volume augmentation procedure, randomly assigning two treatment modes: subepithelial connective tissue graft and acellular dermal collagen matrix. Impressions were taken before augmentation and at 90 days to evaluate the dimensional changes. These were then emptied to obtain plaster models which were then digitalized. The two images were superimposed, and upon definition of three points of interest, the dimensional changes were estimated in millimeters with the software D500 3D dental scanner (3Shape, Copenhagen, Denmark). Inquiries were made about the pain experienced by patients using a visual analogue scale. **Results:** Ninety days after surgery, increase in thickness of peri-implant soft tissues was 0.77 mm (range 0.0-1.3) for the connective tissue graft and 0.89 mm (range 0.3-1.5) for the acellular dermal matrix. No statistically significant differences were found between the two treatment modes at any of the three points evaluated per patient (p= 0.83, p= 0.83, p= 0.51). With respect to the pain experienced between the first and the seventh days, no statistically significant differences were found in the recipient zone intergroup (p= 0.07, p= 0.12), the graft intragroup (p= 0.11) and the matrix (p= 0.32), or in the donor zone of the graft group (p= 0.11). **Conclusions:** Increase in the thickness of peri-implant tissues after 90 days was similar in the two study groups.

64. Extracellular matrix-based scaffolding technologies for periodontal and peri-implant soft tissue regeneration.

Tavelli L, McGuire MK, Zucchelli G, Rasperini G, Feinberg SE, Wang HL, Giannobile WV. J Periodontol. 2020; 91(1):17-25. Epub 2019.

https://www.ncbi.nlm.nih.gov/pubmed/31475361

This review discusses the properties, clinical application, and limitations of ECM based scaffold technologies in periodontal and peri-implant soft tissue augmentation when used as alternatives to autogenous soft tissue grafts. Presentation of clinical cases with mucoderm®.

65. Coronally advanced flap with connective tissue graft or xenogeneic acellular dermal matrix in the treatment of multiple gingival recessions: A split-mouth randomized clinical trial.

Gürlek Ö, Gümüş P, Nizam N, Buduneli N. J Esthet Restor Dent. 2019. [Epub ahead of print]

https://www.ncbi.nlm.nih.gov/pubmed/31762155

Aim: Evaluation of the clinical efficacy of a xenogeneic acellular dermal matrix (mucoderm) or connective tissue graft (CTG) combined with modified-coronally advanced flap (M-CAF) in the treatment of multiple gingival recessions. **MATERIALS AND METHODS**: Twelve participants with bilateral MGRs (multiple gingival recession) (82 gingival recessions) randomly received mucoderm® (test group, 41 teeth) on one side and subepithelial CTG (control group, 41 teeth) on the other side in conjunction with M-CAF in the same session and completed the 18-months study period. Recession depth (RD), recession width (RW), keratinized tissue width (KTW), probing depth (PD), and clinical attachment level (CAL) were recorded at baseline, and 6-18 months, postoperatively. **RESULTS:** PD was significantly higher in the test group at 18-months. PD in the test group was also significantly higher at 6 and 18 months compared to baseline. RD and RW were significantly lower at 6 and 18 months compared to baseline in both groups. Both parameters were significantly higher in the test group at 18 months. Percentage of teeth with complete root coverage in the test and control groups were similar at 6 months (78% and 70.7%, respectively) as well as at 18 months (both 87.8%). **CONCLUSION:** Within the limits of the study, M-CAF combined with mucoderm® or CTG seems to be similarly effective in RD reduction of class I and II MGRs at least in the short term. Soft tissue shrinkage and increase in PD may be observed with mucoderm®, while CTG seems to provide stable clinical outcomes for 18 months follow-up. **CLINICAL SIGNIFICANCE:** Even though the CTG and mucoderm® in conjunction with M-CAF may provide similar RD reduction in class I and II multiple gingival recessions in the short term. CTGs may be superior in terms of soft tissue shrinkage and PD values.

66. Use of bovine bone mineral, titanium mesh, and cross-linked collagen membrane in single implant site development at a maxillary central incisor tooth site: a 3 year follow-up case report.

Landsberg C. 2019. Int J Esthet Dent.;14(2):182-197.

https://www.ncbi.nlm.nih.gov/pubmed/31061998

Purpose: It can be extremely challenging to replace a hopeless tooth in the maxillary central incisor area with an implant restoration, especially when the bony housing of the tooth is severly damaged. This article describes the unique anatomical, biological, and surgical considerations in the treatment of such a case. **MATERIALS AND METHODS**: In the reconstruction of a safe housing around the implant, obliteration of the incisive canal was followed by the use of bovine bone mineral (BBM) and titanium mesh layered with a cross-linked collagen membrane. The soft tissue was augmented with a xenogeneic soft tissue matrix (mucoderm®) and further enhanced by a novel technique, the radial cuts technique. **RESULTS:** Functional and esthetic implant restoration was successfully achieved. Follow-up of the patient took place for 2 years post-implant loading and 3 years post-ridge augmentation, after which the stability of the implant and surrounding tissue was demonstrated. **CONCLUSION:** Enhanced functional and esthetic results may be achieved when BBM and Ti-mesh layered with a soft collagen membrane are utilized as augmentation materials in the esthetic zone. The key factors for success in this case were combining the advantages of the different materials with a carefully considered sequence of procedures.

67. Clinical and Histologic Evaluations of Porcine-Derived Collagen Matrix Membrane Used for Vertical Soft Tissue Augmentation: A Case Series.

Puišys A, Zukauskas S, Kubilius R, Barbeck M, Razukevičius D, Linkevičiene L, Linkevičius T. 2019. Int J Periodontics Restorative Dent.;39(3):341-347.

https://www.ncbi.nlm.nih.gov/pubmed/30986283

This case series aimed to clinically and histologically evaluate porcine-derived membrane used for vertical thickening of thin soft tissues. Twenty porcine-derived collagen membranes and bone-level implants were placed in 20 patients. After 2 months, thickened soft tissues were measured and biopsy samples were harvested. All xenografts healed successfully. The average thickness of the thin soft tissue before vertical thickening was 1.65 ± 0.36 mm, while tissue thickness increased to 3.45 ± 0.52 mm after the procedure. The mean thickness increase was 1.8 ± 0.13 mm. Histologic analysis showed complete integration of the graft and no differences in vascularization between the host and graft. It can be concluded that porcine-derived membrane can be used for vertical soft tissue thickening with substantial gain in tissue height.

68. Clinical evaluation of Miller class I and II recessions treatment with the use of modified coronally advanced tunnel technique with either collagen matrix or subepithelial connective tissue graft: A randomized clinical study.
Pietruska M, Skurska A, Podlewski Ł, Milewski R, Pietruski J. 2019. J Clin Periodontol.;46(1):86-95. Epub 2018.

https://www.ncbi.nlm.nih.gov/pubmed/30362599

AIM: To compare outcomes of modified coronally advanced tunnel technique (MCAT) combined with either collagen matrix (CM) or subepithelial connective tissue graft (SCTG) in the treatment of Miller class I and II multiple gingival recessions in the mandible. **MATERIALS AND METHODS:** The study encompassed 91 recessions in 29 patients for whom MCAT was combined with mucoderm® on one side of the mandible and SCTG on the contralateral one. The following clinical parameters were measured: gingival recession height (GR) and width (RW), probing depth (PD), clinical attachment level (CAL), width of keratinized tissue (KT), gingival thickness (GT), mean (MRC) and complete root coverage (CRC) and Root Coverage Esthetic Score (RES). **RESULTS:** The MRC proportions on the CM- and SCTG-treated sides were 53.20% and 83.10%, respectively. CRC was achieved in 9 out of 45 (20%) gingival defects treated with mucoderm® and 31 out of 46 (67%) treated with SCTG. There were statistically significant differences in MRC, CRC, GR, RW, KT, GT and RES between CM- and CTG-treated sides. **CONCLUSIONS:** Modified coronally advanced tunnel technique leads to reduction in gingival recession both when combined mucoderm® and SCTG, of which the latter is more efficient as far as root coverage and aesthetic parameters are concerned.

69. Treatment of multiple maxillary adjacent class I and II gingival recessions with modified coronally advanced tunnel and a new xenogeneic acellular dermal matrix.
Vincent-Bugnas S, Borie G, Charbit Y. 2018. J Esthet Restor. ; 30(2):89-95. Epub 2017.

https://www.ncbi.nlm.nih.gov/pubmed/28901687

Evaluation of the treatment of maxillary Miller Class I and II multiple adjacent gingival recessions using the modified coronally advanced tunnel technique (MCAT) combined with a new porcine acellular dermal matrix (PADM). **MATERIALS AND METHODS:** Twelve patients exhibiting at least six adjacent maxillary Miller Class I and II gingival recessions were consecutively treated by means of MCAT and a PADM. Recession depth (RD), recession width (RW), probing pocket depth (PD), keratinized tissue height (KT), clinical attachment level (CAL), mean root coverage (RC), and complete root coverage (CRC) were recorded. **RESULTS:** At 12 months, CRC was obtained in 43% of the 100 gingival recessions, while the mean RC measured 84.35%. Mean RD reduction was 3.16 ± 0.75 mm, mean RW reduction was 1.73 ± 0.65 mm, while the gain of CAL was 3.26 ± 1.33 mm. All patients were satisfied with the esthetic appearance and would undergo the same surgery again. **CONCLUSION:** Within their limits, the present results indicate that treatment of Miller Class I and II multiple gingival recessions using PADM in

conjunction with the MCAT could be successfully used as an alternative to connective tissue grafts, with the advantage of avoiding the discomfort and morbidity of connective tissue harvesting**. CLINICAL SIGNIFICANCE:** The modified coronally advanced tunnel technique using the new porcine acellular dermal matrix represents a clinically and esthetically satisfactory treatment of multiple Miller Class 1 and 2 recession defects.

70. The Use of a Novel Porcine Derived Acellular Dermal Matrix (mucoderm®) in Peri-Implant Soft Tissue Augmentation: Preliminary Results of a Prospective Pilot Cohort Study.
Papi P. and Pompa G. 2018. Biomed Res Int.;6406051. eCollection 2018.

https://www.hindawi.com/journals/bmri/2018/6406051/

Objective: Over the years, several techniques have been proposed for soft tissue augmentation around dental implants in order to improve keratinized mucosa width (KMW). Recently, a porcine derived acellular dermal matrix (mucoderm®) has been proposed as autogenous graft substitute in order to avoid palatal harvesting and obtain comparable results to connective tissue grafts, in terms of aesthetics and function. The aim of this study is to present the one-year follow-up results of this matrix in peri-implant soft tissue augmentation procedures. **MATERIALS AND METHODS:** Twelve patients were enrolled in this pilot prospective study: a dental implant was placed in the upper premolar area and, at implant uncovering after eight weeks, the matrix was inserted. KMW gain was considered as primary outcome variable. **RESULTS:** After one month from matrix insertion, mean KMW was 7.86±3.22 mm (100%), with no statistically significant intragroup variations. No membrane exposures or wound healing complications occurred during postoperative phase and, after one year, mean KMW was 5.67±2.12 mm (72.13%). **CONCLUSION:** The results of the present pilot study indicate that by placing a mucoderm® membrane during implant surgery the keratinized tissue width can be augmented, and the width remains stable for the assessment period of 12 months. Further studies with greater power and longer investigation period are needed to confirm the suggestion for clinical use.

71. Socket sealing post-extractive with a xenogenic porcine collagen matrix: a prospective clinical trial. (Gestione dell'alveolo post-estrattivo con una matrice xenogenica in collagene: studio clinico prospettico).
Rossi AL, Capilupi V, Palombo D, Chiapasco M. 2018. DENTAL CADMOS; 86(5):400-413.

http://www.dentistry33.com/clinical-cases/oral-surgery/29/socket-sealing-post-extractive-with-xenogenic-porcine-collagen-matrix-a-prospective-clinical-trial.html

The aim of this prospective cohort study is to test the performance of a new xenogenic collagen matrix as a socket sealing material, to allow second-intention healing of post-extractive sockets filled with a xenogenic bone substitute or with an immediate submerged implant. **MATERIAL AND METHODS:** 10

patients were recruited, presenting with a single-rooted tooth scheduled for extraction. After atraumatic tooth removal, the post-extractive alveolus received either a socket preservation procedure or an immediate submerged implant. **RESULTS:** In both cases, the gingival margins of the alveolus were sealed with a xenogenic collagen matrix (mucoderm®, botiss dental, Zossen, Germany). The following parameters were evaluated: a) exposed surface of the matrix at the end of surgery (T0); b) soft tissue healing at 1, 4, 6, and 8 weeks from surgery (T1-4); c) histological aspect of gingiva samples, harvested 20 weeks after surgery (T5); d) aesthetic performance provided by the socket sealing material (T4).

72. Management of the post-extractive site with a collagen xenogenic membrane: a prospective clinical study.

Montinari AL, Rossi A, Manera F, Capilupi V, Chiapasco M. 2018. I&J: Quintessenza Internazionale & JOMI 34(4). Article in Italian.

Evaluation of the performance of a natural 3D collagen matrix used for covering post-extractive sites to preserve the keratinized mucosa´s portion above the alveolus in preparation of an implant– prosthetic rehabilitation. **MATERIAL AND METHODS:** 17 patients that needed avulsion of a monoradicular tooth in the maxilla or mandibular site. The operative procedure of socket sealing associated to a post-extractive implant insertion or ridge preservation were carried out. Stimulation of soft tissue regeneration and the quality of the newly formed tissue were evaluated. **RESULTS:** At final clinical control (8 weeks) nearly all had complete closure of the wound and showed total keratinization and integration of the newly formed tissue. Histologies confirmed correct regeneration of the keratinized gingival tissue. **DISCUSSION/CONCLUSION:** The application of the xenogenic collagen membrane mucoderm® in covering of post-extractive sites seems to allow a correct regeneration and integration of the keratinized gingival tissue above the alveolus, from biological and aesthetical point of view.

73. Collagen matrix (mucoderm®) as an alternative for the treatment of gingival recessions.

Taba M; Suzuki K; Irie M; Faria P; Messora M; Palioto D; Souza S; Novaes Jr. A. 2018. Clin Oral Implant Res (29):17; p.315. eposter (Mansucript submitted)

https://onlinelibrary.wiley.com/doi/full/10.1111/clr.200_13358

Coronally advanced flap plus connective tissue graft (CTG) is the gold standard therapy for root coverage. The bioabsorbable porcine collagen matrix (PCM) has been widely used in periodontal and mucogingival surgery as a substitute for CTG and has achieved similar results. The PCM has the advantage of availability overcoming the limitations of donor site in autograft. The aim of this study is to investigate the use of PCM (mucoderm®) in root coverage procedures combined with extended coronally positioned flap (ECAF) in comparison to the CTG associated with the ECAF. **MATERIALS AND METHODS:** Sixteen adult patients, non- smokers, presenting bilateral Miller Class I or II gingival recessions. Clinical parameters, probing depth, clinical attachment level, recession height and

keratinized tissue height (KTH) and thickness (KTT) were recorded at baseline and 3 months after the surgical procedures by a blinded examiner. **RESULTS:** The PCM group showed a significant reduction in recession height average of 2.07 ± 1.05 mm. The average reduction in the CTG group was 2.41 ± 1.16 mm. The average amount of root coverage was not different between PCM (62%) and CTG (75%) groups (P > 0.05). KTH gain was 1.08 ± 1.04 mm in PCM group and 0.98 ± 0.71 mm in CTG control. KTT gain was 0.35 ± 0.38 mm in the PCM group and 0.49 ± 0.36 mm in the CTG group. **CONCLUSION:** and Clinical Implications: In this preliminary short time evaluation, both treatments showed a significant reduction in recession height. Considering no significant differences were observed between CTG and PCM groups for recessions height, width and thickness of keratinized tissue, it can be speculated that mucoderm® can be used as an alternative to CTG for the treatment of gingival recessions.

74. Use of Collagen Matrix for Augmentation of the Peri-implant Soft Tissue at the Time of Immediate Implant Placement.
    Zafiropoulos GG and John G. 2017. J Contemp Dent Pract.; 18(5):386-391.

    https://www.ncbi.nlm.nih.gov/pubmed/28512278

    The aim of this study was to determine the treatment outcome of the use of a porcine monolayer collagen matrix (mCM) to augment peri-implant soft tissue in conjunction with immediate implant placement as an alternative to patient's own connective tissue. **MATERIALS AND METHODS:** A total of 27 implants were placed immediately in 27 patients (14 males and 13 females, with a mean age of 52.2 years) with simultaneous augmentation of the soft tissue by the use of a mCM. The patients were randomly divided into two groups: Group I: An envelope flap was created and mCM was coronally covered, and group II: A coronally repositioned flap was created and the mCM was covered by the mucosa. Soft-tissue thickness (STTh) was measured at the time of surgery (T0) and 6 months postoperatively (T1) using a customized stent. Cone beam computed tomographies (CBCTs) were taken from 12 representative cases at T1. A stringent plaque control regimen was enforced in all the patients during the 6-month observation period. **RESULTS:** Mean STTh change was similar in both groups (0.7 ± 0.2 and 0.7 ± 0.1 mm in groups I and II respectively). The comparison of STTh between T0 and T1 showed a statistically significant increase of soft tissue in both groups I and II as well as in the total examined population. The STTh change as well as matrix thickness loss were comparable in both groups. The evaluation of the CBCTs did not show any signs of resorption of the buccal bone plate. **CONCLUSION:** Within the limitations of this study, it could be concluded that the collagen matrix used in conjunction with immediate implant placement leads to an increased thickness of peri-implant soft tissue independent of the flap creation technique and could be an alternative to connective tissue graft. **CLINICAL SIGNIFICANCE:** The collagen matrix used seems to be a good alternative to patient's own connective tissue and could be used for the soft tissue augmentation around dental implants.

75. Bone augmentation and simultaneous soft tissue thickening with collagen tissue matrix derivate membrane in an aesthetic area. A case report.
    Puišys A, Žukauskas S, Kubilius R, Vindašiūtė E, Linkevičius T. 2017. Stomatologija.; 19(2):64-68.

https://www.ncbi.nlm.nih.gov/pubmed/29243686

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

76. Changes of the peri-implant soft tissue thickness after grafting with a collagen matrix.
Zafiropoulos GG, Deli G, Hoffmann O, John G. 2016. J Indian Soc Periodontol.; 20(4):441-445.

https://www.ncbi.nlm.nih.gov/pubmed/28298828

The aim of this study was to determine the treatment outcome of the use of a porcine monolayer collagen matrix (mCM) to increase soft-tissue volume as a part of implant site development. **MATERIAL AND METHODS:** Implants were placed in single sites in 27 patients. In the test group, mCM was used for soft-tissue augmentation. No graft was placed in the control group. Soft-tissue thickness (STTh) was measured at the time of surgery (T0) and 6 months postoperatively (T1) at two sites (STTh 1, 1 mm below the gingival margin; STTh 2, 3 mm below the mucogingival margin). **RESULTS:** Significant increases (P < 0.001) in STTh (STTh 1 = 1.06 mm, 117%; STTh 2 = 0.89 mm, 81%) were observed in the test group. Biopsy results showed angiogenesis and mature connective tissue covered by keratinized epithelium. **CONCLUSION:** Within the limitations of this study, it could be concluded that mCM leads to a significant increase of peri-implant soft-tissue thickness, with good histological integration and replacement by soft tissue and may serve as an alternative to connective tissue grafting.

77. Clinical evaluation of a porcine acellular dermal matrix for the treatment of multiple adjacent class I, II, and III gingival recessions using the modified coronally advanced tunnel technique.
Cosgarea R, Juncar R, Arweiler N, Lascu L, Sculean A. 2016. Quintessence Int.; 47(9):739-47.

https://www.ncbi.nlm.nih.gov/pubmed/27446998

Evaluation of the clinical efficacy of a new porcine acellular dermal matrix (PADM) for the treatment of Miller Class I, II, and III multiple gingival recessions using the modified coronally advanced tunnel technique (MCAT). **METHOD AND MATERIALS:** Twelve non-smoking, systemically healthy patients presenting at least two adjacent Miller Class I, II, or III gingival recessions (GR), with a minimal depth of 2 mm, were treated consecutively with MCAT in conjunction with PADM. At baseline and 12 months postoperatively, complete root coverage (CRC, e.g. 100% root coverage), mean root coverage (RC), recession depth, recession width, attached gingiva (AG), keratinized tissue (KT), periodontal pocket depths (PD), and clinical attachment level (CAL) were evaluated. The main outcome variable was CRC. **RESULTS:** Postoperative healing was uneventful in all cases, without any matrix loss or exposure or infection. Statistically significant improvements were observed 12 months postoperatively in 53 of the included 54 GR (98.15%). Twenty two recessions (40.74%) showed CRC while the mean RC measured 73.20 ± 27.71%. Mean GR reduction was 2.06 ± 1.18 mm while the gain of AG amounted to 0.84 ± 0.73 mm and of KT to 0.69 ± 0.51 mm, respectively. There were no statistically significant changes for PD at 12 months; CAL showed a significant decrease at 12 months from 3.77 ± 1.28 mm to 2.30 ± 1.02 mm. **CONCLUSION:** PADM in conjunction with MCAT may be successfully utilized for the treatment of Miller Class I, II, and III multiple adjacent GR.

78. Gingival recession coverage:　Do we still need autogenous grafts?

Kasaj A. 2016. Quintessence Int.; 47(9):775-83.

https://www.ncbi.nlm.nih.gov/pubmed/27660847

More recently, 3D collagen matrices of human and porcine origin have been introduced as possible alternatives to autogenous connective tissue grafts in recession coverage procedures. This paper aims to give an overview on the possible use of collagen matrices as soft tissue substitutes and a possible alternative to connective tissue grafts in the surgical treatment of gingival recession defects.

79. Tunnel Technique With Collagen Matrix Compared With Connective Tissue Graft for Treatment of Periodontal Recession: A Randomized Clinical Trial.

Cieślik-Wegemund M, Wierucka-Młynarczyk B, Tanasiewicz M, Gilowski Ł. J Periodontol. 2016. J Periodontol.; 87(12):1436-1443.

https://www.ncbi.nlm.nih.gov/pubmed/27424564

The aim of this study is to compare efficacy of the tunnel technique for root coverage using collagen matrix (CM) versus connective tissue graft (CTG) for treatment of multiple recessions of Miller Classes I and II over a short period of time. **METHODS:** Twenty-eight patients were enrolled in the study. Patients in the control group were treated with the tunnel technique using CTGs, whereas patients in the test group were treated with the tunnel technique using xenogeneic CM. Clinical recordings were

obtained at baseline and after 3 and 6 months. Percentages of average recession coverage (ARC) and complete recession coverage (CRC) were evaluated 3 and 6 months after surgery. **RESULTS:** Significant decreases were recorded in both groups of recession parameters compared with baseline measurements. Mean recession depth (0.21 versus 0.39 mm) and recession area (0.31 versus 0.53 mm^2) after 6 months were significantly higher in the test group. Mean keratinized tissue width (KTW) increased at a similar rate in both groups (1.0 versus 0.8 mm for control and test groups, respectively). ARC after 6 months was 95% in the control group and 91% in the test group, and CRC was 71.4% (10/14) in the control group and 14.3% (2/14) in the test group. **CONCLUSION:** Xenogeneic CM combined with tunnel technique leads to satisfactory ARC and increase in KTW similar to CTG, but yields lower unsatisfactory CRC.

80. ## Presentation of a modified method of vestibuloplasty with an early prosthetic loading.
Konstantinova D, Djongova E, Arnautska H, Georgiev T, Peev S, Dimova M. 2015. J of IMAB.; 21(4):964-968.

http://dx.doi.org/10.5272/jimab.2015214.964

The purpose of the investigation is to introduce a method of vestibuloplasty for edentulous jaws by which the dentures are better held in place and retained. The use of xenoderm grafts with early insertion of the prostheses subsequent to surgical manipulation shows excellent results**. MATERIAL AND METHODS:** Patients were divided into two groups - with the first group the prosthesis was made prior to surgery and placed on the 7th day after removal of sutures. With the second group the prostheses were made following a complete healing of soft tissue, i.e. 1 month after surgery. With both groups xenoderm grafts were applied to cover the open wound surface area. **RESULTS:** The post-operative period for both groups of patients proceeded normally and without complications. For the group with early prosthetic loading due to the method of vestibuloplasty it was possible to maintain the depth of the vestibule. **CONCLUSION:** The method proposed by the authors using xenoderm grafts and early loading on the newly-formed vestibule has proved a success and implies further in-depth application with larger group of patients.

81. ## Extensive keratinized tissue augmentation during implant rehabilitation after Le Fort I osteotomy: using a new porcine collagen membrane (mucoderm®).
Nocini PF, Castellani R, Zanotti G, Gelpi F, Covani U, Marconcini S, de Santis D. J. 2014. Craniofac Surg.; 25(3):799-803.

http://www.ncbi.nlm.nih.gov/pubmed/24777008

The aim of this study was to test a new collagen matrix (mucoderm®) positioned during oral implant abutment connection. A patient previously treated with Le Fort I for bone augmentation and 8 implants

showing minimal amount of keratinized tissue was selected for an extensive keratinized tissue augmentation and deepening of the oral vestibule by apically positioning a split palatal flap and palatal grafting with mucoderm®. Clinical data at 9 and 14 days and 1 and 2 months showed resorption of the collagen graft, augmentation of the keratinized tissue around the implants, and deepening of the vestibule, with minimal morbidity and reduced surgical treatment time. However, some vestibular keratinized tissue contraction was evident. The new collagen matrix may be a promising material as a substitute for an autologous gingival/connective tissue graft. Despite the preliminary results of this innovative article, before drawing any general conclusion, the benefit of the procedure should be further evaluated by prospective clinical trials.

82. Options to avoid the second surgical site: a review of literature.
Ramachandra SS, Rana R, Reetika S, Jithendra KD. 2014. Cell Tissue Bank.; 15(3):297-305. [Epub 2013].

https://www.ncbi.nlm.nih.gov/pubmed/24002077

Periodontal plastic surgical procedures involving soft tissue grafts harvested from the palate have two surgical sites; a recipient site and another donor site. Many patients are apprehensive about the soft tissue graft procedures, especially the creation of the second/donor surgical site in the palate. In the past decade, newer techniques and products have emerged, which provide an option for the periodontist/patient to avoid the second surgical site. MucoMatrixX, Alloderm®, Platelet rich fibrin, Puros® Dermis and Mucograft® are the various options available to the practicing periodontist to avoid the second surgical site. Use of these soft tissue allografts in an apprehensive patient would decrease patient morbidity and increase patient's acceptance towards periodontal plastic surgical procedures.

*Study refers to MucoMatrixx, which is a private label of mucoderm®.

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

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