Bosshardt DD, Sculean A, Windisch P, Pjetursson BE, et al. Effects of enamel matrix proteins on tissue formation along the roots of human teeth. J Periodont Res 2005;40;158–67. (68 Refs)

Purpose: A detailed structural analysis of the newly formed tissue on the roots affected by periodontitis following the application of EMD.

Materials and Methods: 10 patients (5 females and 5 males; mean age of 50 years) with 12 advanced intrabony periodontal defects around teeth scheduled for extraction were selected. Full thickness flaps were raised and a notch was placed in the root surface at the apical level of the calculus present on the root surface. If no calculus was present, the notch was placed at the base of the periodontal defects. After SRP, EMD was filled in the defects and patients were advised to rinse with 10 ml of 0.2% CHX solution twice daily postoperatively .2-6 weeks after surgery, teeth were removed and sectioned for observation with light and transmission electron microscope.

Findings and Conclusions: Postoperative healing was uneventful in all cases with no adverse tissue reactions such as root resorption or ankylosis.
Light microscopy: Of the 12 defect, 4 revealed the presence of a newly formed mineralized tissue in the notch area on the root surface. In 2 of these, the new tissue extended apically over the native cementum. In 2 other defects, a localized thickening of the native cementum layer was observed at a site that was unrelated to the notch area. In 5 defects, new tissue formation was evident on scaled root surface at sites unrelated to the notch area. In 6 defects, a mineralized tissue was observed seemingly “free-floating” in the PDL and they resembled mature bone and revealed necrosis. The newly formed tissue in the root notch was thick, had an irregular surface contour, was devoid of extrinsic fibers, contained embedded cells, and the cells on the matrix surface were very large. The superficial thickened tissue layers that were observed apical to the notch area or at sites where no notch was discernible were clearly distinguishable from the old cementum by their lighter staining. These layers were less thick than the tissues that formed in the notch and were found on both the root surfaces with or without scaling markings. A gap was consistently observed between the treated root surfaces and the newly formed mineralized tissues in the coronal-most portion of the instrumented area. The gap appeared empty or was filled with an organic material resembling scattered or colonies of bacteria.
TEM: The matrix of the newly formed tissue on the root was collagenous. The collagen fibrils were randomly oriented and loosely packed and a distinct mineralization front was not discernible. However, large electron dense matrix patches were scattered in and adjacent to the new tissue. The cells that lined the new tissue were very large and possessed abundant cisternae of rER and a prominent Golgi complex. The coronally located gap was filled with scattered or colonies of bacteria occasionally with RBCs or WBCs. It may be stated that instead of the development of AEFC (acellular extrinsic fiber cementum), a partially mineralized CT formed that contained many embedded cells, but no extrinsic fibres. This tissue may be thus classified as bone-lide or as cementum-like tissue resembling CIFC (cellular intrinsic fiber cementum).

Trejo PM, Weltman RL. Favorable periodontal regenerative outcomes from teeth with presurgical mobility: a retrospective study. J Periodontol 2004;75:1532-28.

Purpose: To evaluate the effect of presurgical tooth mobility on periodontal regenerative outcomes of intrabony defects after 1 year of healing.

Materials and Methods: The data in this study were derived from three previously conducted clinical trials which had evaluated regenerative procedures. 64 patients (average 49.5 years) with one intraosseous defect each met the inclusion and exclusion criteria required for this study. The grouping yielded 36 teeth with physiologic mobility score 0, 13 teeth with mobility of 1, and 15 teeth with mobility of 2. Different regenerative therapies in intrabony defects received one of the following treatment: e-PTFE barrier, polyactic acid (PLA) barrier, PLA combined with DFDBA allograft, EMD, and EMD combined with DFDBA. Patients completed the hygienic phase of therapy 1 to 2 months before the baseline examination. Patients received a baseline examination were monitored at several intervals immediately post-surgically, and were marinated for a period of 1 year. After 1 year, the periodontal parameters were reevaluated. The following variables were measured at baseline and at 12 months post-surgery: PD, CAL, position of the gingival margin from CEJ (REC), BOP, PI, GI, O'Leary plaque control, and tooth mobility ™ using the Miller index. In each of the independent trials the post-surgical follow-up and maintenance periods were carried out to achieve the best possible control.

Findings and Conclusions: All patients achieved and maintained a plaque control record value of <20% throughout the duration of the studies. In all three tooth mobility, regenerative therapy resulted in increased gingival recession 12 months after surgery. The probing depth reductions from baseline to 1 year with TM score 0 was 3.67mm; for TM score 1, 2.81mm; and for score 2, 3.73mm. The gain in clinical attachment level in the TM 0 group, 2.73mm, group TM 1 1.96, and group TM2 2.36mm. Comparison results between the tooth mobility groups utilizing the delta values; i.e. change in the primary outcome variables of PD, CAL, and REC after 1 year in each group was not statistically different.

1. Maintenance therapy on intrabony defects results in stable attachment levels over time.
2. Interproximal, intraosseous defects of teeth with limited presurgical tooth mobility (Miller's Class 1 and 2), will respond favorably to regenerative therapy.

Stavropoulos F, Dahlin C, Ruskin JD, et al. A comparative study of barrier membranes as graft protectors in the treatment of localized bone defects: An experimental study in a canine model. Clin Oral Impl Res 2004; 15(4): 435-42. (32 Refs)

Purpose: To compare a new resorbable membrane composed of 67% glycolide (PGA) and 33% trimethylene carbonate (TMC) with a resorbable collagen membrane, with assayed DFDB serving as GM in an experimental bone defect

Materials and Methods: 5 adult male foxhound dogs were included in the study. Prior to the surgical protocol, the mandibular first, second, third and fourth premolars and the first molars were extracted bilaterally. Three osseous saddle-type defects, measuring 8mm (apicocoronal) x 10mm (mesiodistal), were prepared in the edentulous mandibular premolar area by removing the buccal and lingual plates and associated cancellous bone. 5 membranes were used in this study: 4 membranes were composed of 67% PGA: 33%TMC (Groups A-D), each with a different porosity, and a fifth membrane was a collagen membrane (Group E). Each surgical site was filled with canine DFDB and selected to receive one of 5 membranes. One site in each animal did not receive a membrane and served as a control (Group F). After 3 months, the animals were euthanized, and three sections were prepared from each defect: central, mesial, and distal sections. A section of about 100 μm thickness was microradiographed and it was further ground to about 10 μm for light microscopic investigation. With the aid of a grid, the following estimators were examined: 1. new bone, 2. soft tissue, 3. DFDB (GM), and 4. bone + DFDB (GM).

Findings and Conclusions: All the surgical sites demonstrated uncompleted healing, and the DFDB showed a high turnover and incorporated within the newly regenerated bone. Group F (DFDB only) exhibited noticeable deformation in the profile of the regenerated bone, and a knife-edge ridge was created via a partial collapse of the buccal and lingual walls. Group F also demonstrated significantly less new bone formation compared with all the other groups using barrier protection. In Group E (collagen membrane), a thicker soft tissue layer could be seen within the regenerate compared with Groups A-D (PGA:TMC-type membranes). Regardless of the different level of porosity, Groups A-D demonstrated significantly more bone content and higher percentage of new bone within the regenerate compared with Group E. The reason for above results is as yet unknown. However, it has been proposed that differences in mechanical properties, degradation time and lack of integrated biologic components could be factors influencing the regenerative outcome. This study provides evidence that the combination of a PGA:TMC biodegradable membrane + DFDB offers a viable alternative in the treatment of localized bone defects in the clinical setting.

Sculen A, Windisch P, Chiantella G. Human histologic evaluation of an intra bony defect treated with enamel matrix derivative, xenograft and GTR. J Clin Perio: 2004. Vol 24; 327-333. (28 Refs)

Purpose: The purpose of this case report was to clinically and histologically evaluate the healing of one advanced intra bony defect following treatment with an enamel matrix derivative (Emdogain EMD) combined with a bovine-derived xenograft (BDX) and guided tissue regeneration.

Materials and Methods: A 54 year old man who was a non smoker and in good general health with a history of chronic adult periodontitis was selected for this study. The patient had one intra bony defect localized at the mesial, palatal and distal aspects of the maxillary right central incisor. This tooth was deemed to be unsalvageable and was scheduled for extraction. Two months prior to the surgical procedure, the patient received full mouth Sc/RP. The clinical parameters evaluated prior to the surgery included probing depth (PD), gingival recession (GR) and clinical attachment level (CAL). Radiographs were taken prior to and after extraction. Following reflection of mucoperiosteal flaps and degranulation of the osseous defect, the root surface was thoroughly root planned. Notches were prepared on the root surface at the level of the calculus and alveolar crest. The root surface adjacent to the osseous defect was treated with 24 % EDTA for two minutes. The defect and adjacent mucoperiosteal flaps were thoroughly rinsed with saline and EMD was then applied on the root surface. The remaining EMD was mixed with BDX and the defect completely filled with the mixture. A bioresorbable collagen membrane was adapted over the defect and 2-3 mm of surrounding alveolar bone. The surgical site was closed and the patient placed on a one week course of antibiotics. Recall appointments were carried out once per week for the first week and once per month for the next seven months. Following this period the patient underwent a second surgery at which time, mucoperiosteal flaps were reflected, and the tooth extracted with some of its surrounding hard and soft tissue. The specimen was then sent for histologic analysis.

Findings and Conclusions: Pre operatively the PD was 9mm and the CAL loss was 11 mm. The intrabony defect measured 4 mm as measured during surgery. The 7-month post-operative examination revealed a PD of 3mm and a CAL of 7 mm. An increased radioopacity was also noted at this time. Histological analysis showed that the healing was characterized by formation of a new PDL, cellular cementum and bone. Most of the BDX particles were surrounded by bone-like tissue. No direct contact between the graft material and the tooth surface was observed. Healing in the suprabony defect occurred through epithelial down growth that stopped at the level of the coronal notch. Here no cementum or bone formation was observed and the BDX particles were completely encapsulated in connective tissue.

Schulean A, Pietruska M, Schwarz F, et al. Healing of human intrabony defects following regenerative periodontal therapy with an enamel matrix protein derivative alone or combined with a bioactive glass. J Clin Periodontol 2005; 32: 111-117.

Purpose: To compare clinically the treatment of deep intrabony defects with a combination of an enamel matrix protein derivative (EMD) and a bioactive glass (BG) to EMD alone.

Materials and Methods: 30 patients with advanced periodontitis were included in the study. The inclusion criteria included presence of at least one intrabony defect with PD ≥ 6mm & an intrabony component of at least 3mm as detected on radiographs. One week prior to the therapy and 1-year post operatively, PI, GI, BOP, PD, GR, & CAL were recorded. Pre & post treatment radiographs were taken with its paralleling technique. The defects were randomly assigned to treatment group of EMD + BG & EMD alone. During the surgery, CEJ-BD (CEJ to bottom of the defect), CEJ-BC (CEJ to bone crest), was measured & INTRA (intrabony component) was measured. Statistical analysis was performed.

Findings and Conclusions: The post operative healing was uneventful. The mean PI did not reveal a statistically significant difference in either group. PI & BOP improved in both the groups. No differences in distribution of defects were found in both the groups. At 1 year, the EMD+BG group showed reduction in mean PD from 8.5 ± 1.1 to 4.4 ± 1.2mm and a change in mean CAL from 10.2 to 6.3.In the test group, 12 sites gained at least 3mm or more of CAL, whereas in the control group a CAL gain of 3mm or more was measured at 13 sites. No statistically significant differences in terms of PD reduction & CAL gain were observed between the two groups. A re-entry surgery was performed in 2 cases from each group (T=4 cases) indicating a fill of osseous defects. At 1 year after surgery both therapies resulted in significant PD reductions & CAL gains and the combination of EMD+BG does not seem to additionally improve clinical results.

Scabbia A, Trombelli L. A comparative study on the use of a HA/collagen/chondroitin sulphate biomaterial (Biostite) and a bovine –derived HA xenograft (Bio-Oss) in the treatment of deep intra-osseous defects. J Clin Periodontol 2004; 31: 348-355. (64 Refs)

Purpose: To evaluate the clinical outcome of deep intra-osseous defects following reconstructive/regenerative surgery comparing the use of Biostite and Bio-oss materials.

Materials and Methods: A parallel-group, randomized, clinical trial was performed with 24 healthy patients with moderate to advanced periodontitis, comprising 11 females and 13 males, mean age 47.5 yrs (seven smokers among them), were selected. Patients were divided into (13 test and 11 control) and were treated for 1 defect (interproximal intra-osseous defect ≥4mm confirmed both radiographically and clinically at surgery) comprising a total of 24 defects. Presurgery, all patients received an examination with records, oral hygiene instruction, and multiple scaling and root planings. A minimum of 4 weeks elapsed between non-surgical therapy (baseline) and surgery. 13 defects were treated with Biostite and 11 defects with Bio-oss. Clinical recordings were repeated at 6 and 12 months post-surgery. Radiographic assessment repeated at 12 months post-surg.

Findings and Conclusions:

Table 2

	PPD			CAL	
	Baseline	6 months	12 months	baseline	6 months 12 months
Biostite (N=13)	7.8+/-1.3	4.5+/-2.1*	3.6+/-1.6*	9.0+/-1.6	6.7+/-2.3* 6.1+/-1.9*
Bio-Oss(N=11)	7.5+-2.0	3.6+/-1.3*	3.1+/-1.0*	9.0+/-2.0	5.8+/-1.5* 5.0+/-1.5*
P	0.6988	0.3878	0.7793	0.9503	0.3028 0.2190

Table 3.

Outcome Variable	Biostite N=13	Bio-Oss N=11	p-value
CAL gain	2.9+/-1.9	4.0+/-2.5	0.2190
PPD reduction	4.2+/-2.1	4.4+/-2.3	0.7793
REC increase	1.2+/-1.9	0.4+/-1.8	0.2696
DEPTH gain	2.5+/-1.4	3.1+/-1.8	0.3940

Table 4.

	CAL		
	0-2 mm	>2 to 4 mm	>4 mm
Biostite N=13	6	3	4
Bio-Oss N=11	4	2	5

The outcomes clearly show improvement with the use of both materials that can be measured clinically and statistically in PPD, CAL, and radiographic DEPTH gain.

Rothamel D et al. Biocompatibility of various collagen membranes in cultures of human PDL fibroblasts and human osteoblast-like cells. Clin Oral Impl Res 2004;15:443-449.

Purpose: To evaluate the biocompatibility of differently cross-linked collagen membranes in cultures of human PDL fibroblasts and osteoblast-like cells.

Materials and Methods: Four commercially available membranes used for GTR/GBR procedures viz Biogide, Biomend, Ossix and Tutodent were tested for their biocompatibility. 12 specimens of each membrane type were used. Six of them were covered with PDL fibroblasts and the other six in osteoblasts. Controls were cells plated on culture dishes. The incubation period was 7 days. All samples were examined for cell count under light microscope. SEM observation was done as well.

Findings and Conclusions: The highest number of PDL fibroblasts were seen on the positive control. Biogide and Ossix membranes had the next greatest number of fibroblasts with the difference between them being insignificant. Biomend had least number of PDL fibroblasts attaching and proliferating on it. In the osteoblast culture, the controls had the highest cells, followed by Biogide and Tutodent, with the difference between them being statistically insignificant. Ossix showed much less cells, while Biomend showed no detectable osteoblasts. SEM observations on the morphology of cells revealed that PDL fibroblasts that adherent on Biogide, Tutodent, and Ossix resembled the cells on the controls appearing spindle shaped and flat. The osteoblasts like cells on the control were star shaped and flat but mostly round in shape on the Biogide, Tutodent and Ossix samples, while there was no attachment or proliferation on Biomend. As a conclusion, the authors opine that Biogide, Tutodent and Ossix promoted, while Biomend inhibited the attachment and proliferation of human PDL fibroblasts and human Osteoblast like cells.

Murphy K, Gunsolley J. Guided tissue regeneration for the treatment of periodontal intrabony and furcation defects. A systematic review. Ann Periodontol 2003;8:266-302. (198 Refs)

Purpose: To assess the efficacy of GTR procedures in patients with periodontal osseous defects compared with surgical controls on clinical, radiographic, adverse, and patient-centered outcomes.

Materials and Methods: Literature review. The following comparisons were made:

1. GTR versus open flap debridement (OFD).
2. GTR using a barrier plus some form of augmentation, usually a particulate bone graft, versus GTR procedure alone.
3. GTR using ePTFE barrier versus GTR using a bioabsorbable barrier type.
4. GTR using one surgical protocol versus GTR using a different surgical protocol but the same barrier material type, based upon the flap closure technique employed.
5. GTR using one post-operative recall care regimen versus GTR using a different post-operative recall care regimen.

Outcomes:
Short-term: CAL measured in both a vertical (VPAL) and horizontal (HPAL) direction, PD measured in both a vertical(VPD) and horizontal(HPD), gingival recession (REC) increase, for furcation-defects, bone levels assessed radiographically and/or at re-entry for intra-bony defect studies and HOPA and VOPA for furcation-defect studies and oral hygiene efficacy and compliance using full mouth bleeding scores (FMBS) and complications related to surgical treatment were recorded.
Long term: Tooth retention, FMBS and disease recurrence was measured.
Patient-centered: complications related to surgical treatment, ease of maintenance-residual PD and esthetics as defined by REC in anterior teeth were considered.

Findings and Conclusions:
Long-term results:

- The review failed to identity any studies which evaluated patient outcomes for more than 5 years. Therefore no statement can be made regarding the efficacy of periodontal therapy using physical barriers enhancing tooth retention.
- Providing patients with a periodontium that is easier to maintain is indirectly related to probing depth reduction and is manifested in post-treatment gingival bleeding indices. Reductions in PD and gain in CAL as surrogate variables were uniformly enhanced in GTR procedures as compared to OFD controls.
- Patient-centered outcomes, such as surgical complications and esthetically unacceptable results were not consistently reported. When reported, the incidence of abscess formation was 15% or less.

Intrabony defect studies:

- Barrier vs OFD: GTR resulted in a greater gain in CAL and reduction in PD when compared to OFD controls independent of the barrier type employed. REC between the test and control were not significant, but usually were larger in the test group regardless of the barrier type. However, studies that utilized some form of advanced flap management resulted in a decrease in post-treatment recession as compared to OFD controls.
- ePTFE vs bioabsorbable barriers: No significant difference when evaluating CAL gain or PD reductions or REC detected.
- Barrier vs barrier plus augmentation material: DFDBA when used in the test group did not produce any difference in CAL gain or PD reductions.
- Hard tissue changes: Only one study favored OFD when using re-entry assessment was done. None of the studies demonstrated a loss or lack of bone volume gain in the GTR group, while one study revealed a lack of bone volume gain in the OFD control group.

Furcation studies:

- Barrier vs OFD: GRT resulted in greater gain in VPAL when compared to OFD controls. Analysis on the effect of furcation location (maxillary vs mandibular; proximal vs facial or lingual) failed to show a difference between sub-groupings. GTR results in a greater VPD reduction as compared to OFD. Collagen barrier usage usually resulted in greater gains in VOPA, however, statistical analysis was not performed to confirm this trend. The re-entry outcome variable HOPA was in favor of GTR when all barrier types were compared. Post-treatment PEC induced by the use of the physical barrier was also not significant when compared to OFD.
- ePTFE vs bioabsorbalble barriers: A statistical difference in favor of bioabsorbable barrier types over ePTFE could be detected for VPAL, but not for VPD.
- Barrier vs barrier plus augmentation material: VPAL was significantly enhanced by the addition of a particulate bone graft compared to ePTFE alone. Polymeric or cellulose barrier treatments were not enhanced by the use of a graft. VPD reductions were also enhanced by the addition of a particulate graft when all barriers were collectively reviewed especially with ePTFE. Outcome variable HOPA demonstrated an advantage to the use of augmentation material in addition to the GTR barrier.

Possible prognostic factors:

Flap closure: Most studies utilized a “standard” flap closure.

Flap closure ranking:

Grade 1: No attempt to cover barrier with flap or a standard technique.

Grade 2: Periosteal fenestration or split-thickness dissection to facilitate passive flap adaptation; interrupted sutures. Some form of papilla retention is used.
Grade 3: MPPT or SPPT with some from of mattress suturing.

- Examining intrabony defects and considering all barrier types, no significant differences between the rankings could be detected. However, when considering only ePTFE barriers, the mean gain in CAL utilizing a specialized flap closure technique was 3.76 as compared to 2.90 mm and 2.84 mm for grades 2 and 1 respectively, though not statistically significant.
- Flap closure technique grade 3 was not used for any of the furcation-defect studies examined. With the exception of HPD reduction, no other difference in any outcome variable was seen. HPD reduction was enhanced when a passively adapted, coronally repostitioned flap technique was employed.
- The use of specialized flap techniques may enhance clinical outcomes, but there are insufficient data at this time to demonstrate superiority with the use of these techniques.

Frequency of postoperative recall care:

Recall protocol:

Grade 1: No weekly care stated in protocol or wound stabilization for 6 weeks or 2 or less interventions for the first month; longer than monthly intervals for the remainder period or 3 or more interventions for the first month, longer than a monthly interval but less than or equal to a 3-month interval for the remainder period.
Grade 2: At least bi-weekly for the first 6 weeks, then every month thereafter.
Grade 3: Weekly for the first 2 months, then bi-weekly or monthly thereafter.

- Studies that utilized a more frequent recall interval, especially in the time period after 3 months, showed a tendency for greater gains in CAL, VPAL, HPAL, HOPA.
- A monthly frequency maintenance schedule (Grade 2) results in PD reduction, but the use of this regimen does not statistically improve CAL outcomes in GTR.

Timing of barrier removal:

- The most commonly used time rage was 4 to 6 weeks. Therefore, differences in the effect of barrier removal at the 4- and 6-week time intervals could not be discerned from this dataset.
- 2 studies allowed the barriers to remain for 8 weeks but reported to statistically significant enhancement in VPAL.

Meyle J, Gonzales JR et al. A randomized clinical trial comparing Enamel Matrix Derivatives and membrane treatment of buccal Class II furcation involvement in mandibular molars. Part II: Secondary outcomes.
J Periodontol 2004;75:1188-1195

Purpose: to compare Enamel Matrix Derivatives (EMD) and membrane treatment of buccal class II furcations in mandibular molars with regard to secondary outcomes.

Materials and Methods: 45 patients with 90 comparable defects on contralateral molars were included. Patients were recruited at four university dental schools and one private periodontal practice. Patients all had buccal Class II furcation involvements (horizontal probing depth of >3mm) in both lower first or second molars. The selected teeth were required to have proximal bone levels at or above the fornix of the furcation. In addition, they had to present with a zone of keratinized tissue of at least 2 mm adjacent to the furcation defect, in order to provide coverage of the furcation entrance during surgery. Defects were randomly assigned to EMD or bioabsorbable barrier membrane; the contralateral defect received the alternative treatment. Assessment at baseline and 8 and 14 months included gingival margin levels(GM), probing depths(PD), bleeding on probing(BOP), vertical attachment levels(AL), and vertical bone sounding(BS) from a stent at five buccal sites/tooth, which included the primary outcome. Defect dimensions were recorded at surgery and during reentry at 14 months. The secondary outcome was reported here: changes in hard tissue boundaries describing the anatomical situation of the furcation defect and changes in the clinical parameters (GM, PD, BOD, AL) between baseline and 14 months. The hard tissue boundaries in the furcation defect and the clinical parameters were measured twice, using as reference the CEJ and the individually manufactured acrylic stent with grooves at five sites. Descriptive statistics were applied for changes in clinical parameters and measurement of hard tissue boundaries. The differences observed under treatment with EMD or membrane were analyzed by means of the Wilcoxon two-sample test.

Findings and Conclusions: the median reduction of PD in the mid-furcation site changed from 3.5mm at baseline to 3.0mm after 14 months in sites treated with EMD, and in membrane treated sites from 3.25 to 3.0mm. The median reduction of AL in the mid-furcation site changed from 7.5mm at baseline to 7.0mm after 14 months with EMD treatment, and from 7.38mm to 7.0mm with membrane treatment. A reduction in the frequency of BOP in the mid-furcation site was determined with both treatments, changing from 40% at the beginning of treatment to 21.3% (EMD) and 23.4% (membrane) after 8 months. However, after 14 months, a further reduction of BOP was shown only with EMD treatment and not with the membrane treatment. Different treatment effects could be detected for the distances from the stent or cemento-enamel junction (CEJ) to the buccal bone crest, mid-mesial root and the distance from the stent or CEJ to the buccal bone crest, mid-mesial root. There was no measurable bone resorption in EMD sites, whereas a slight resorption occurred with membrane treatment. Furcation morphology at the time of surgery was not associated with clinical outcome, irrespective of the treatment. This study demonstrates equivalent clinical results when treatment with EMD was compared with GTR using bioabsorbable membranes in treating mandibular Class II furcations. Evaluation of clinical and osseous changes associated with this study indicated that treatment with EMD led to similar regenerative outcomes as the GTR procedures.

Kostopoulos L, Karring T. Susceptibility of GTR-regenerated periodontal attachment to ligature-induced periodontitis. An experiment in the monkey. J Clin Periodontol 2004; 336-40 (20 Refs)

Purpose: To compare the susceptibility of GTR-regenerated periodontal attachment to ligature-induced periodontitis with that of the pristine periodontium.

Materials and Methods: Four monkeys were used. In each monkey, a first maxillary premolar and molar and a mandibular lateral incisor were selected as test teeth and subjected to periodontal breakdown by placing orthodontic elastics around them. After 2-3 months the elastics were removed and tooth cleaning once a week was instituted. After 1 month a mucoperiosteal flap was elevated around test teeth and the root surfaces were scaled and planed. A notch was prepared in the root surface at the level of apical extension of the infrabony defect. Subsequently, the crowns of the teeth were cut off at CEJ and root canals filled. For multi-rooted teeth the buccal roots were extracted and only the palatal root was retained. An e-PTFE membrane was adapted over each root and was covered by a coronally displaced flap. Five weeks later the membrane was removed. At this time, a flap operation was also performed on the contra-lateral control teeth. The teeth were similarly cut off at CEJ, root canals prepared and flaps sutured back. After a 3 month period of tooth cleaning twice a week, the cleaning was abolished and cotton floss ligatures were placed around all experimental teeth to facilitate plaque accumulation. After 6 months the ligatures were removed and 2 weeks later the animals were sacrificed. The jaws were fixed and stained with H&E or Heidenhain's azan variant stain. Five sections from midpoint of the root, 80 um apart were used for analysis. The following linear distances were measured; PD, LOA, coronal bone level, apical bone level, amount of newly formed attachment and bone.

Findings and Conclusions: The results of 24 control and test surfaces were analysed with the Wilcoxon test for paired observations (split mouth design). Except for the cementum on the root surface, the control and test roots exhibited similar histologic features.

1. New cementum was identified on all test roots coronal to the notch in the root surface and below the attachment level, covering about 2/3 of the entire length of the instrumented surface.
2. New cementum was of the reparative, cellular, extrinsic and intrinsic fiber type. However, the pristine cementum on the control roots was mainly acellular, extrinsic fiber cementum with areas of cellular, extrinsic and intrinsic fiber types.
3. The new cementum in the apical portion was considerably thicker than the pristine cementum in the control specimens and frequently a split was present between the new cementum and the root surface.
4. Epithelium was never seen between the detached cementum and the root surface.
5. Regrowth of alveolar bone had occurred in all test specimens.
6. Histometric analysis reveled only the difference in pocket depth between test and control roots to be statistically significant ($P<0.05$).

Klepp M. Histologic evaluation of demineralized freeze-dried allografts in barrier membrane covered periodontal fenestration wounds in ectopic sites in dogs. J Clin Periodontal 2004:31;533-44 (48 Refs)

Purpose: To histologically examine the healing responses of periodontal fenestration defects grafted with Ethylene Oxide (EO)-sterilized, heat-treated or non-sterilized DFDBA beneath barrier membranes as compared with ungrafted control sites beneath barriers. A secondary objective was to compare the healing characteristics of DFDBA embedded in ectopic sites in the animals and to contrast the response with those observed in the fenestration defects.

Materials and Methods: Fifteen adult mongrel dogs with no clinical evidence of periodontitis were selected. Bone allograft material was obtained from the American Red Cross Transplantation services and additional material, specifically cortical bone, procured from mongrel dogs. All barrier membranes for both test and control groups were ePTFE in construction. 8 mm in diameter, circular fenestration defects were created bucally at all four canines in each of 14 dogs. Each site then received one of the following grafts beneath the membranes: (a) EO-sterilized DFDBA allograft, (b) heat-treated DFDBA, (c) non-sterilized DFDBA and (d) ungrafted control. 12 dogs had three subcutaneous chest wall pouches created and one of the three graft materials (0.1cm3) placed. Animals were evaluated for healing complications at 4 weeks and data recorded, then all were euthanized and block specimens obtained. Sections were quantitatively analyzed for: (1) total defect area, (2) graft particle area within the defect and (3) new bone within the defect. Subcutaneous specimens were evaluated histologically and quantified for associated inflammatory cell infiltrate.

Findings and Conclusions: Defects healed incompletely with partial bone fill and cementum regeneration and formation of a periodontal ligament. Graft particles present in the healing defects were typically isolated from the sites of osteogenesis, although some were incorporated into the newly formed bone. No statistically significant differences in new bone formation were observed between treatment groups within animals, but significant inter-animal variation did exist. Overall, bone augmentation was successful when the barrier was present and stable, in the majority of sites. Subcutaneously, in close proximity to the graft material, inflammatory infiltrates of varying intensity were observed between specimens. In conclusion, the present study's choice of 8mm defects was chosen based on previous research with the addition of a barrier. Previous research using barrier membranes found more emphasis on healing time than defect size. The authors demonstrated relative predictability of tissue regeneration with total success likely dependent on surgical execution and, specifically, available osteogenic factors found in graft material.

Kawaguchi H, Hirchi A, Hasegawa N, et al. Enhancement of periodontal tissue regeneration by transplantation of bone marrow mesenchymal stem cells. J Periodontol 2004;75:1281-7.

Purpose: To evaluate the potential of bone marrow mesenchymal stem cells (MSC), expanded by the culture system, on periodontal tissue regeneration in vivo.

Materials and Methods: The study was conducted on 12 female beagle dogs. Scaling and tooth brushing was performed to obtain good oral health. Bone marrow aspirates were taken from the iliac crest of each animal. The cells were cultured and harvested. Class III furcation defects were surgically created at the 2^{nd}, 3^{rd}, 4^{th} premolars in each dog. Each defect measured 4 mm from the CEJ to the reduced alveolar crest. The root surface was denuded and the periodontal ligament and cementum were removed. Reference notches were placed. MSC-collagen gel was used in the experimental defects while atelocollagen alone was used in the control group. The flaps were coronally repositioned and sutured. After 1 month the animals were sacrificed, block sections were obtained, processed and studied.

Findings and Conclusions: In the experimental group, a significant amount of new bone and adequate width of periodontal ligament were seen. The denuded root surface was almost completely covered with new cementum, and regenerated periodontal ligament separated the new bone from the new cementum. Complete bone reconstruction was not obtained. Epithelial cell invasion, bone ankylosis, and root resorption were not seen on the root surface. In the control group, epithelial cells invaded into the top of the furcation and no cementum regeneration was observed in the area. Less bone regeneration was present. Bone ankylosis and root resorption were not seen. The % of new cementum length ranged from 91.3% to 96.7 % in the test group compared to 70.5 % in the control. The % of new bone area in the test group ranged from 62.5 % to 68.1% compared to 54.8% in the control. The % of bone area in the normal specimen was 73%.

Hartman GA et al. Clinical and Histologic Evaluation of Anorganic Bovine bone Collagen with or without a Collagen Barrier. Int J Periodontics Restorative Dent 2004; 24:127-135.

Purpose: To evaluate an anorganic bovine-derived xenograft (Bio-Oss Collagen) in the treatment of human periodontal defects.

Materials and Methods: Four patients with radiographic evidence of one or more osseous defects with deep vertical bone loss on teeth that were scheduled for extraction were enrolled in the study. Presurgical measurements of probing depth, clinical attachment levels, and recession were recorded. The surgical procedure consisted of flap reflection, debridement of the osseous defects and root surface, placement of a notch through calculus into the root surface, topical application of a tetracycline paste to the root surface, grafting with Bio-Oss Collagen, and flap closure. Three of the eight defects examined received a resorbable collagen barrier (Bio-Gide) in addition to the bone graft. Patients were seen every 2 weeks for plaque control and review of oral hygiene measures. Six months postsurgery, clinical parameters were rerecorded prior to en bloc resection of teeth and adjacent graft sites.

Findings and Conclusions: Overall the results showed a substantial amount of probing depth reduction and clinical attachment level gain for all sites tested. The range of clinical attachment level gain was 0 to 8mm, probing depth reduction varied from 1 to 10mm, and recession varied from 0 to 5mm. The defects examined in this study were all either one or two walled defects, suugesting that he major portion of the defects was non contained. There was no apparent correlation between the number of osseous walls of the defect and the clinical parameters. Histologic evaluation and histomorphometric measurements demonstrated new bone, cementum, and periodontal ligament coronal to the reference notch in two of the eight specimens. Two sites demonstrated new attachment, and four showed a long junctional epithelium. Clincally, there were no differences in the results between the sites that received the combination of the graft and membrane versus those with the graft alone. There appeared to be a greater degree of mean probing depth reduction (6.8mm vs 4.3 mm), as well as mean clinical attachment level gain (5.3mm vs 2.3 mm), for the defects treated with bone replacement graft alone. However, the number of samples was too small to make meaningful comparisons. Periodontal regeneration is possible following a bone-replacement graft of Bio-Oss Collagen.

Hagenaars S, Louwerse HG, Timmerman et al. Soft-tissue wound healing following periodontal surgery and Emdogain application. J Clin Periodontol 2004;31:850-856.

Purpose: To compare the effect of Emdogain on soft-tissue healing by clinical and patient-perspective means.

Materials and Methods: 22 subjects that were scheduled for flap surgery were selected. Initial therapy was performed and at re-evaluation, patients were included for surgery if PPD≥5mm. Randomization was done and it so happened that all smokers were in the test (EMD) group. MWF was performed on each patient and minimal bone recontouring was performed if necessary. The distances from the marginal gingival to the alveolar bone and the CEJ to the alveolar bone was measured with a periodontal probe. Presuturing was done and Emdogain was used in the test group that had 11 patients while the control group with 12 patients received none. Clinical parameters used were swelling of the soft tissues, color of the gingival, PPD, CAL, BI, PlI. During the first 7 days, the patients filled out a questionnaire to evaluate the experience of post-operative complaints using a VAS. The clinical parameters were measured at 1, 4, 8 weeks post surgery.

Findings and Conclusions: At 8 weeks, the gain in clinical attachment was .042 and 0.67 for the test and control group. The reduction in PPD was 0.71 and 0.74 mm respectively. The mean BI was 0.18 and .016. Swelling and redness showed no significant differences either. On the VAS for pain, on a scale from 0 to 10, the test group Vs the control was 3.35 and 1.90 on day 1. On day 7, the score was insignificant. Swelling of the mucosa and face was observed in both groups with no significant difference. The day after surgery twice as many patients in the control group experienced oozing of blood from the site. In conclusion, the initial wound healing with or without Emdogain presents with no significant results.

Gurinsky B, Mills M, Mellonig J. Clinical evaluation of Demineralized Freeze-Dried Bone Allograft and Enamel Matrix Derivate alone for the treatment of periodontal osseous defects in Humans. J Peridontol 2004: 75; 1309-18 (52Ref)

Purpose: To evaluate the use of DFDBA in combination with EMD compared to EMD alone in the treatment of human intrabony defects

Materials and Methods: Forty systemically healthy patients (23 females, 17 males) between ages of 19 and 76years were selected for this single-mask, parallel design, randomized, controlled clinical trial. Patient were selected based on the following criteria: **1-** at least one site was determined to be in need of periodontal surgery after initial therapy; **2-** PD > 5mm; **3-** intrabony lesions with a depth > 3mm and **4-** age between 18-80 years. Soft and hard tissue measurements were recorded. Soft tissue measurements included: **1**- distance from the CEJ to the FGM; **2-** FGM to the base of the pocket and **3-** CEJ to base of the pocket to calculate pocket depth, gingival recession and clinical attachment gain. Hard tissue measurements were taken at baseline and 6-months at reentry surgery to determine defect depth, defect fill, % defect fill, defect resolution and alveolar crest resorption. These measurements included**: 1-** distance from CEJ to the base of the defect; **2-** CEJ to the alveolar crest; **3-** alveolar crest to the base of the defect; **4-** Description of the osseous wall morphology and **5**- periapical radiograph. A total of 67 sites were selected randomly as experimental group (34 sites) treated with DFDBA + EMD or as control group (33 sites) treated using EMD alone. All patients received prophylaxis at baseline and at each POT visit at 7-10 days, 25-30 days, 3 and 6 months. A paired t-test was used to compare soft and soft tissue measurements the day of surgery and 6-months POT. Distributions of defects by geometry (# wall defect), arch (mandibular/maxillary) and tooth location in the arch were analyzed by treatment mode and quality of result

Findings and Conclusions: Clinical evaluation, Post operative healing was similar for both groups. Analysis of the sites based on maxillary versus mandibular sites, tooth type, age and gender revealed no significant difference in any measured parameters (P<0.10 chi-square test). Initial PD, CAL and defect depth were 7.5mm, 8.1 mm and 4.9 mm respectively for control group and 7.5 mm PD, 8.2mm CAL and 5.2mm DD for the experimental group. At 6-months soft tissue measurements demonstrated significant improvement from baseline, however no significant difference was observed between the two groups. Probing depth reduction (PDR) for experimental group was (3.6mm+- 0.2), while for EMD alone PRD was (4.0+-0.3); CAL for DFDBA + EMD group was (3.0mm +-0.3) and EMD alone (3.2mm+-0.3). Mean increase in recession was 0.7mm+-0.2 for EMD group and 0.5mm+-0.3 for DFDBA+EMD group. Hard tissue measurements demonstrated a greater amount of crestal resorption for the EMD group (0.9mm+-0.2) than EMD+ DFDBA group (0.1mm+-0.2) (P0.04). Mean value for bone fill for EMD group was (2.6mm+-0.4)/ 55.3% and for the DFDBA+EMD group was (3.07mm+-0.2)/ 74.9%. Percentage for defect resolution for the DFDBA + EMD group was 75.7% and for the EMD alone group was 69.2%. Percentage of sites gaining more than 50% bone fill were 26.9% for EMD+DFDBA and 47.8% for EMG alone. Sites gaining greater than 90% bone

fill were 26.9% for EMD+DFDBA group and 17.4% for EMD alone group. This study demonstrated that EMD alone and in combination with DFDBA is a clinical safe product to use in treating human intrabony defects and can improve soft and hard tissue parameters from the baseline measurements. However DFDBA+EMD demonstrated an improvement in the hard tissue parameters over that achieved with EMD alone.

Yukna RA, Vastardis S. Comparative evaluation of decalcified and non-decalcified freeze-dried bone allografts in rhesus monkeys. I. Histologic findings. J Periodontol 2005;76:57-65. (49 Refs)

Purpose: To compare new bone formation associated with undecalcified and decalcified allogenic freeze-dried bone allografts in orthotopic alveolar bone sites in rhesus monkeys.

Materials and Methods: Six rhesus monkeys were used in the present study. The animals were sedated and a full thickness flap was elevated. Either DFDBA or FDBA was implanted into surgically created vertical grooves (4 mm deep and wide and 10-12 mm long) on the facial aspects of all posterior quadrants. Nylon mesh of 250 µm pore size was used a container of grafting bone. Each quadrant received three cylinders containing one type of bone and one empty cylinder. The cylinders were retrieved at 1, 2, and 3 months and processed for histologic and histometric evaluation.

Findings and Conclusions: FDBA chambers contained more new bone and total bone than either the DFDBA or E chambers at all time periods. DFDBA was not statistically significantly different than empty control at any time period. FDBA had less old bone than DFDBA at 3 months.

The results suggested that FDBA may stimulate earlier, more rapid, and more substantial new bone formation than DFDBA in a monkey jaw defect model.

Table1. New bone formation following implantation

chamber	1 month	2 months	3 months
FDBA	163.3 ± 80.9	213.7 ± 103.0	443.5 ± 60.8
DFDBA	7.7 ± 0.6	26.8 ± 33.1	217.3 ± 111.1
Empty	92.0 ± 130.1	55.7 ± 38.6	142.7 ± 107.7

Table 2. Amount of original graft material present

chamber	1 month	2 months	3 months
FDBA	219.5 ± 35.5	240.7 ± 32.3	57.0 ± 15.6
DFDBA	297.5 ± 73.3	237.6 ± 106.6	170.3 ± 57.7

Villaca J, Rodriguez D, Novaes A, Taba M et al. Root trunk concavities as a risk factor for regenerative procedures of class II furcation lesions in humans. J Periodontol 2004: 75; 1493-99. (17 Refs)

Purpose: To evaluated clinically the effect of root trunk concavities on the regeneration of class II furcation lesions in humans and to determine a modification in membrane design could improve the results

Materials and Methods: A total of 10 patients with chronic periodontal disease were selected for this study. The criteria for selection were as follows:

1. At least 2 mandibular molars with class II furcation involvement (clinically and radiographically determined)
2. No remarkable medical history
3. Non-smokers
4. No systemic antibiotic or chemotherapeutic agent in the previous 6-months

Full mouth SRP was performed and after 4 weeks baseline evaluation was performed with a computerized probe at three sites per tooth (mesial, central and distal buccally). Baseline and 12 months evaluations included the following clinical parameters: PD, CAL, intravertical measurements of vertical (VD) and horizontal defects depths (HD)

Intrasulcular measurements were performed by the reflection of a mucoperiostial, open flap debridement plus root condition using EDTA 24% for 2 min and then the vertical component was recorded using an acrylic stent at the presurgical midline reference points. Vertical measurements were obtained from the base of the stent to the bottom of the defect. The horizontal depth of the furcation defect was measured from a line tangential to the buccal root surfaces extending horizontally to the deepest portion of the defect. After measurements were recorded sites were assigned randomly for treatment with ePTFE membrane or the modified membrane (MM). The membranes were modified by removing the collars from the unused membranes, cutting into 2 mm segments and then suturing the segments to the collar of a normal membrane. The membranes were trimmed to cover the lesions and extended to the adjacent bone between 2-3mm apically and laterally. They were then placed in position 2-3mm below to the CEJ and secure with ePTFE sutures. Flaps were coronally positioned. Amoxicilin plus clavulanic acid was prescribed. Sutures were removed at 2 weeks after procedures and all membranes remained in placed for 6 months. During the 12 months control program was performed. Mann- Whitney test was used for statistical analysis.

Findings and Conclusions:

Both MM and NM showed significant PD reduction at 1 year. MM from 2.93+-1.35mm to 1.95mm and Nm from 3.27mm to 2.46mm. Percentage of PD reduction was 33.4%+-28% for MM and 24.7%+-20.4% for NM

CAL: from the MM reduction was from 9.7 to 9.4mm and for the NM from 10.2 to 10.5mm

VD: For the MM was from 8.9 to 6.7 mm and NM from 9.2 to 7.7 mm

HD: For the MM reduction was 4.0 to 2.2mm and for NM from 4.1 to 3.1mm

The characteristics and anatomy of the root trunks influence negatively the results of GTR because the adequate adaptation of the membranes when placed 2-3mm apically to the CEJ does not occur allowing the apical migration of the JE and thus impeding the regenerative procedure. The modified membrane resulted in greater horizontal defect resolution of class II furcation defects. The collars of the membranes should be modified to improve results when root concavities are present.

Tsitoura E., Tucker R, Suvan J, et al. Baseline Radiographic defect angle of the intrabony defect as prognostic indicator in regenerative periodontal surgery with enamel matrix derivative. J Clin Periodontol 2004; 31: 643-7.

Purpose: To investigate whether an association exists between baseline radiographic defect angle and treatment outcome when enamel matrix derivative (EMD) is used in periodontal regenerative surgery.

Materials and Methods: The radiographs obtained for this study, to measure the intrabony defect angles, were originally taken as part of a multicenter clinical trial, using a population of 166 patients, which evaluated the clinical outcomes following treatment of intrabony defects with papilla preservation flap surgery with or without application of EMD. At study baseline and 1 year after treatment, the following parameters were evaluated: full mouth plaque score (FMPS), full mouth bleeding score (FMBS), probing pocket depth (PPD), recession of gingival margin (REC) and clinical attachment level (CAL). Routine diagnostic radiographs were taken with a long cone paralleling technique. A calibration exercise was carried out to obtain an acceptable intra and interexaminer reproducibility for probing pocket depth, recession of the gingival margin and evaluation of the defect. The radiographic angle of intrabony component of the defect was measured with the assistance of DSR, which is a customized software program.

Findings and Conclusions: The baseline evaluations show a mean PPD of 8.1 $\pm$ 1.6mm. Mean CAL was 9.6 $\pm$ 2.2mm. The mean distance from the CEJ to the bottom of the defect was 10.3 $\pm$ 2.5mm, with an intrabony component of 5.7 $\pm$ 2mm. The clinical outcome after one year past the therapy showed that the mean CAL gain was 3.2 $\pm$ 1.6 mm. The mean decrease in PPD was 4.1 $\pm$ 1.6mm. A highly significant correlation was observed between the radiographic defect angle and the baseline PPD, the depth of the intrabony component of the defect as well as the distance between the CEJ and the bottom defect. The probability of obtaining CAL gain > 3mm was 2.46 times higher when the radiographic defect angle was $\leq$ 22 degrees than when it was $\geq$ 36 degrees. There was a statistically highly significant center effect in the CAL gain probability analysis. The study showed that there was a significant association between baseline radiographic defect angle and CAL gain at 1 year. The observed increased odds ratio of obtaining CAL gain of $\geq$ 4mm after regenerative surgery with EMD is used in narrow ($\leq$ 22 degrees) intrabony defects, suggests that the baseline radiographic defect angle might be used as prognostic indicator of treatment outcome.