

**Machtei EE, Dunford R, Grossi SG, Genco RJ. Gingival recession and exposure of barrier membrane: Effect on guided tissue regeneration of Class II furcation defects. Int J Periodont Rest Dent 1995; 15: 591-9. (26 refs)**

**Purpose:** The purpose of the study was to evaluate the effect of postsurgical gingival recession and consequent membrane exposure on the success of guided tissue regeneration in Class II furcation defects.

**Materials and Methods:** 26 subjects, 12 men and 14 women, mean age  $42.6 \pm 9.1$  years, were included in the study. Each patient had a mandibular Class II furcation defect with sound interproximal bone and no intrabony defects. The patients received initial therapy, including OHI and S&RP. Good plaque control (Plaque Index = 0 in 75% of sites) was required for the patient to qualify for surgery. Guided tissue regeneration surgery was performed with a full-thickness flap extending from the mesial aspect of the adjacent mesial tooth to the distal aspect of the adjacent distal tooth and 3-5 mm beyond the defect margin. The area was debrided, root-planed with hand instruments and an ultra-fine diamond bur, and surgical measurements were taken. The e-PTFE membrane was trimmed to extend 2-3 mm beyond the defect, positioned under the flap, and sling sutured around the tooth. The flaps were then repositioned and secured with Gore-Tex interrupted sutures and the membrane was totally submerged. The patients were instructed to rinse daily with CHX and were given systemic tetracycline for 14 days. The sutures were removed 2 weeks after surgery and the membrane was removed at 4 weeks. The patients returned biweekly for a prophylaxis and OHI during the first 3 months and then once a month for the rest of the year. 12 months after surgery, the area was surgically reentered, soft tissue was debrided from the furcation area, and surgical measurements were made.

Clinical measurements (Plaque Index, Gingival Assessment Index, Probing depth, Vertical probing attachment Level (PAL-v), and Horizontal probing attachment level (PAL-h) were made at baseline, and 6, 9, and 12 months postoperatively. Following surgery, at each visit until the membrane was removed, the extent of the membrane exposure was recorded in accordance with the following exposure index: 0=no exposure-the membrane was totally submerged; 1=slight exposure-the membrane was at or <2 mm coronal to the free gingival margin; 2=moderate exposure-the membrane was 3-5 mm coronal to the free gingival margin; 3=substantial exposure-the membrane was >5 mm coronal to the free gingival margin. Surgical measurements were recorded at the initial surgery and at the time of reentry. Furcation height was measured vertically at midline from bone crest to the furcation dome. Furcation width was measured mesiodistally at the orifice. Furcation depth was measured from the buccal alveolar bone horizontally. Intrabony depth was measured vertically from the crest of the base of the bone to the osseous base. For volumetric measurement, a polyvinylsiloxane impression was taken and the weight of material in the area corresponding to the furcation defect was converted into volume by using the specific gravity of the impression material.

**Findings:** An overall improvement in all clinical parameters was observed for all subjects at 1 year postop. The mean probing depth reduction was 2.55 mm; the mean horizontal attachment gain was 2.32 mm. similar gains was observed in the vertical dimension 2.64 mm, of which 0.82 mm was soft tissue change (PAL-v) and 1.82 mm was bony change.

The mean intrabony defect resolution (1.82 mm) corresponded to the resolution of approximately 87% of the original defect. The mean reductions in furcation depth (1.75 mm), width (1.20 mm), and height (0.50 mm) were all statistically significant. The mean overall furcation volume was reduced from 16.76 L to 9.11 L, or a 46% decrease in the furcation space.

Next, the patients were grouped by gingival recession as reflected in their exposure index. In half of the patients, the membrane remained submerged for the entire 6 weeks (exposure index 0). The other 13 subjects experienced mild to pronounced gingival recession (exposure index 1-3). Both groups showed comparable improvement in all clinical and surgical parameters. Improvement in intrabony depth was greater for the group with exposed membranes (2.38 vs 1.15 mm), while the reduction in furcation depth was greater in the group with submerged membranes (2.20 vs 1.38 mm). Subjects who maintained good OH throughout the study, especially in the furcation area, had consistently better regenerative responses than did subjects with poor plaque control.

**Conclusions:** Both sites in which the membrane was exposed and remained submerged responded favorably to treatment, suggesting that in patients with good oral hygiene, gingival recession, and moderate exposure of the e-PTFE membrane do not significantly retard the regenerative response.

**Moses O, Pitaru S, Artzi Z, Nemcovsky C. Healing of dehiscence type defects in implants placed together with different barrier membranes: a comparative clinical study. Clin. Oral Impl. Res. 16, 2005; 210–219.**

**Purpose:** To evaluate the effect of three types of barrier membranes on the clinical soft tissue and bone healing in buccal dehiscence type defects around implants placed simultaneously with the barrier membrane, in general, and with premature membrane exposure, in particular.

**Materials and Methods:** Three groups were established: Group OS (Ossix, n=73 implants, 41 patients), Group BG (Bio-Gides, n=53 implants, 28 patients) and Group GT (e-PTFE, Gore-Texs, n=34 implants, 17 patients). Defect height and width were measured at the time of implant placement and at second stage surgery. Surface area was calculated as half ellipses.

When several implants were placed simultaneously, a mean of their defect width and height was calculated.

**Findings and Conclusions:** When all patients within each group and especially patients with uneventful gingival tissue healing were compared, the three types of membrane were similarly effective in supporting significant reduction of the bony defects. Although no significant statistical difference was observed between groups among patients with unexposed membranes, GT membranes were slightly more effective than the other two. Mean percentage reduction of defect area (92.2 ± 13.78% Group OS, 94.6 ± 6.69% Group BG, and 97.3 ± 4.91% Group GT) and height (81.6 ± 23.19%, 85.4 ± 12.26%, and 93.4 ± 9.39% respectively) did not show statistically significant differences between groups.

e-PTFE membranes exhibited a higher incidence of premature membrane exposures. However, there were no statistically significant differences between the three groups, which suggest that the premature membrane exposure could be related more to the patient wound healing capacity and the surgical procedure than to the type of membrane.

Among patients with prematurely exposed membranes, a significantly higher bony defect healing was shown in the OS than in the other two groups. Mean percentage reduction of defect area among cases where membrane exposure occurred was 91.5 ± 10.86% Group OS, 71.5 ± 8.61% Group BG, and 73.7 ± 13.97% Group GT.

While premature exposure of the BG membranes resulted in exposure of the implant cover screw in all patients except one, soft tissue healing and closing were observed in 68.7% of patients with prematurely exposed OS membranes.

Furthermore, defect reduction in the prematurely exposed patients within OS was statistically similar to that of unexposed membranes. Exposure of implant cover screw resulted in less defect reduction in all groups, which further substantiates the importance of soft tissue healing over prematurely exposed membrane barriers.

Premature exposure of membranes and subsequent and consequent exposure of implants results in impaired bone healing. Certain barrier membranes, as used in group OS, are apparently capable of supporting gingival healing even when prematurely exposed that could be advantageous in GBR procedures.

**Pradeep AR, Karthikeyan BV. Peri-implant papilla reconstruction: Realities and limitations. J Periodontol 2006;77:534-544. 76 (Refs)**

**Purpose:** To study the anatomical and histologic factors along with the various mechanical limitations impeding the formation of natural peri-implant papilla.

**Materials and Methods:** Literature review.

**Findings and Conclusions:**

The level of peri implant papilla is determined by the following variables.

1. vertical distance from the contact point to the alveolar crest:  
The presence of an interdental papilla between 2 teeth is directly related to the distance between the contact point and the interdental alveolar crest. The peak of interproximal bone determines the level of papilla.
2. interproximal distance between adjacent implant and tooth and implant:  
It has been reported that a distance of 3-4mm is necessary between the 2 implants and 1.5mm between tooth and implant to maintain the interproximal height of the bone after remodeling of the biologic width. If the 2 implants are less than 3 mm apart the angular defects which usually extend up to 1.5mm appear to cross over, creating a horizontal interimplant crestal bone defect.

Biology of peri-implant Mucosa: In implants the CT fibers of the peri-implant mucosa are parallel to the implant surface. The supra crestal fibers (gingivo dental, transeptal fibers) do not exist in the gingival tissue surrounding the implant abutment. There is restricted blood supply, which is due to the absence of periodontal ligament. The blood supply to the peri-implant mucosa is by blood supply from the bone and the oral soft tissue. The peri-implant mucosa has high amount of collagen and a low no. of fibroblasts.

Dimension of Biologic width around natural teeth and implant: The average biologic width around an implant is ~3mm (consisting of JE: 1.88mm and CT: 1.05mm) where as in natural tooth is 2mm. between an implant and abutment a space or microgap always exists. A biologic width forms apical to the microgap, leading to crestal bone loss of ~2mm irrespective of whether the micro-gap is located at or below the alveolar crest. This indicates that the crestal bone changes are not dependent on surgical technique (submerge or non submerge) but on the location of the interface (microgap).

Anatomical consideration in location of the biologic width:

2 adjacent natural teeth: when 2 adjacent natural teeth are present, there is supracrestal formation of biologic width.

Implant adjacent to a healthy tooth: the implant abutment junction must be sunk 4mm apically into the labiogingival margin to hide the metal collar and establish a cosmetically pleasing gingival profile around the crown. This leads to subcrestal formation of the biologic around an implant i.e. below the inter-abutment junction.

2 adjacent implants: when 2 adjacent implants are placed there is loss of interproximal bone, for 2 reasons. First, the interproximal bone contour around implant does not follow the contour around the natural teeth due to the flat inter-abutment junction. Second, when 2 adjoining implants are placed with <3mm of separation the subcrestal

formation of biologic width around the implants results in two adjacent angular defects, with a lateral component of bone loss of ~1.5mm each. The interproximal papilla is a small area with reduced blood perfusion, which seems to be a major limiting factor in surgical reconstructive and augmentation techniques. Therefore true peri-implant papilla regeneration is not possible. The volume of soft tissue that can be predictably generated around implants is less than the natural teeth.

Pre-surgical planning: the current trend is to preserve rather than reconstruct interimplant papilla. Some factors to be considered in the pre-surgical phase include bone and soft tissue quantity and quality, peri-implant biotype, and hard and soft tissue management in the case of implant site deficit, implant size selection, implant positioning and emergence profile.

Bone Quantity and Quality: the minimum interdental space of 7mm is needed to provide osseous support and maintain the interdental papilla. Facio-lingually a minimum of 6mm of bone is required for the placement of the standard 3.75mm diameter implant.

Soft tissue quantity and quality: sufficient broad cuff of keratinized mucosa is necessary because it not only allows for predictable manipulation of the soft tissue surrounding the implant gingival tissue but also leads to long term success of oral endosseous implant.

Peri-implant Biotype: A thick biotype is prone to pocket formation; whereas thin biotype is prone to gingival recession.

Hard tissue management: the most effective means to recreate a papilla is to prevent the loss of the underlying bone at the time of tooth removal. The limitation of an intermediate implant placement into an extraction socket is that it requires adequate buccal bone and absence of infection.

Implant size selection: implants that are 3.75 and 4mm in diameter are generally considered ideal for anterior restoration.

Implant positioning:

apico-incisal: studies have shown that when the flat implant shoulder is placed sub-crestally there is greater bone loss 1.72mm around the implant neck compared to an implant placed at the alveolar crest .68mm. A new implant with interproximal scalloping was designed that maintains bone at different levels around the implant, facially and interproximally.

Mesio-distal: the implant is placed so that there is a minimum of 3mm bone between the implant thread and the adjacent root surface

Labio palatal: the implant is placed slightly lingual to a predetermined facio lingual width of the final restoration.

**Rothamel D et al. Biodegradation of differently crosslinked collagen membranes: an experimental study in the rat. Clin Oral Impl Res 2005; 16:369-78.**

**Purpose:** To compare the biodegradation of differently cross-linked collagen membranes in rats.

**Materials and Methods:** 40 albino rats were used in this study. The animals were divided into five groups (2, 4, 8, 16 and 24 weeks) each group consisting of 8 rats. Five commercially available and three experimental GBR/GTR collagen membranes were included: 1) Biogide (BG), 2) BioMend (BM), 3) BioMendExtend (BME), 4) Ossix (OS), 5) TutoDent (TD), 6) VN (1), 7) VN (2), and 8) VN (3). After shaving and disinfecting an area 8cm in length and 4cm in width a skin incision was made right parmaedian along the vertebral column followed by the separation of four unconnected subcutaneous pouches. The membranes were placed in the resulting 160 pouches. Animals were sacrificed at (2, 4, 8, 16 and 24 weeks). Remains of the membrane were removed along with surrounding connective tissue and fixed in 10% formalin. 3 random sections (4microns in thickness) from each sample were investigated histologically and histomorphometrically. Parameters investigated included: biodegradation over time, vascularization of the membrane body, tissue integration, and foreign body reaction.

**Findings and Conclusions:** 3 rats had to be sacrificed prematurely because of severe infections. In all other cases postoperative healing was uneventful.

Histometric analysis revealed that the BG thickness was significantly reduced between 2 and 4weeks. BM, BME and VN (1), and VN (2) showed significant change in membrane thickness 8 weeks following implantation. For the rest of the study period no statistical significant changes were apparent in BM, BME and VN (1). At 8 weeks following implantation, TD and VN2 exhibited around 60% of thickness recorded at 2 weeks. A significant reduction was observed at 16-24 weeks following implantation. However, compared with the 2 weeks scores these changes were non-significant. OS showed no reduction of membrane thickness during the entire study period of 24 weeks.

Histological analysis revealed obvious differences in the structure of each membrane examined. The membrane body of BG, TD and VN (1-3) seemed to be structured like an interconnective porous system, while TD appeared more compact. In contrast BM and BME had a stratified appearance with large interstices. OS exhibited a dense membrane body without the presence of any interstices. At 2 weeks BG showed almost complete vascularization, and that was the highest vascularization and tissue integration noted for all membranes followed by BM, BME, TD, VN(1); and VN(2) at 4-8 weeks, and VN(3) showed prolonged vascularization, while OS exhibited only a slight superficial vascularization at the end of the observation period.. Inflammatory cells were noted to accompany the biodegradation of TD, BM, BME, VN (2), and VN (3).

**Tsao Y, Neiva Rodrigo, Al-Shammari K, et al. Effects of a mineralized human cancellous bone allograft in regeneration of mandibular class II furcation defects. J Periodontol 2006; 77: 416-425.**

**Purpose:** to clinically evaluate the effects of a mineralized bone allograft material in treating class II furcation defects in mandibular molars.

**Materials and Methods:** Thirty subjects with Hamp's Class II buccal or lingual furcation defects in lower molars were randomly assigned to open flap debridement (OFD), mineralized bone allograft (MBA), or MBA with a bioabsorbable collagen membrane groups. The study was a controlled, randomized, examiner masked clinical trial. Clinical and defect measurements were obtained at the initial visit and at 6-month re entry surgeries. The data were analyzed for intra- and intergroup comparisons and associations of treatment with probability of clinical improvement.

**Findings and Conclusions:** Out of the thirty subjects, 27 individuals completed the study. At the 6-month follow up, 6 out of the 27 patients had converted to class I furcations, whereas others remained class II. The remaining vertical defect depth measured at re-entry was 1.0mm in the MBA group, 1.6mm in the GTR + MBA group, and 3mm in the OFD group. No difference in crestal bone resorption among the groups were found. When examining the vertical bone fill, the MBA and the GTR+MBA groups showed significant improvement, whereas the OFD group had a loss of vertical bone height. Results obtained from the study indicate that solvent-preserved, mineralized human cancellous allograft, with or without collagen membrane, can significantly improve bone fill in mandibular class II furcation defects. In addition, initial vertical defect depth was found to be the only factor that was associated with a higher probability of clinical improvement.

**Trombelli L, Annunziata M, Belardo S, et al. Autogenous bone graft in conjunction with enamel matrix derivative in the treatment of deep periodontal intra-osseous defects: a report of 13 consecutive treated patients. J Clin Periodontol 2006; 33:69-75.**

**Purpose:** to investigate the effectiveness of a regenerative procedure based on supra-crestal soft tissue preservation in association with combined autogenous bone (AB)/enamel matrix derivative (EMD) application in the treatment of deep periodontal intra-osseous defects.

**Materials and Methods:** Subjects- 7 females, 6 males; age ranged 30-65years (avg. age 50.7 years). 3 subjects used  $\leq 5$  cigarettes per day. Total of 15 one to two walled intraosseous defects were analyzed, 5 in anterior areas, and 10 in posterior areas. Immediately before surgery and at 6 months postop: pocket probing depth (PPD), clinical attachment levels (CAL), recessions (REC) were recorded along with local plaque score (LPS) and local bleeding score (LBS). Intraoperatively, probing bone level (PBL) and intrabody component of defect (IBD). Surgical procedure utilized sulcular incisions with simplified papilla preservation technique. Full thickness flap raised, scaling and root planing of root surfaces, autogenous bone graft harvested from buccal cortical plate. The exposed root surfaces were conditioned with 24%EDTA. A sandwich technique was used: 1) EMD to condition bony defect 2) AB graft to fill IBD 3) second layer of EMD to cover AB particles and root surface. Surgical site was closed with monofilament or polypropylene sutures. Postop rx: augmentin 2g/day for 6 days, CHX BID x 6 weeks. Sutures removed in 2 weeks, monthly recalls for 6 months.

**Findings:** The PBL ranged from 8-15mm (mean  $11.1 \pm 2.3$ mm), and the IBD varied from 5 to 9mm (mean  $6.9 \pm 1.1$ mm). Preop PPD amounted  $9.4 \pm 1.8$ mm before surgery, and decreased to  $4.7 \pm 1.2$ mm post surgery. CAL varied from  $10.5 \pm 2.0$ mm preop to  $6.2 \pm 1.7$ mm post surgery, with CAL gain averaging  $4.3 \pm 1.4$ mm. 93.3% (14) defects had  $\geq 3$ mm gain. Recession changes were  $0.4 \pm 0.7$ mm.

**Conclusions:** the results from this study appear to support combination of autogenous graft with EMD application in the treatment of deep, non-containing intra-osseous defects. A longer period of observation may be needed to confirm the stability of clinical outcome.

**Zhu S, Choi B, Huh J et al. A comparative qualitative histological analysis of tissue-engineered bone using bone marrow mesenchymal stem cells, alveolar bone cells, and periosteal cells. Oral Surg Oral Med Oral Pathol Oral Radiol Endo 2006; 101:166-71. 32 (Refs)**

**Purpose:** To review the information for the creation of successful cell-based strategies for tissue-engineered bone formation

**Materials and Methods:** Six mongrel dogs were used for the purpose of this study. Bone marrow samples were collected from the Ilium of each dog using a syringe with an 18-gauge needle. The BMCs were isolated and then cultured. Periosteal cells were isolated from the periosteum. Alveolar bone specimens were obtained from the lateral cortex border of the mandible of each specimen. PRP was obtained from the specimens and then incubated in iced water for 20-30 minutes. The fibrinogen solution was prepared using the PRP. After centrifugation and separation of the precipitated fibrinogen, a thrombin solution was prepared using the remaining PRP. After clot formation, the thrombin solution was collected and diluted to 10% with 0.05 M CaCl. The fibrin glue was formed by mixing the 2 separated fibrinogen and thrombin solution at a 3:1 ratio. A total of 9 athymic nude mice were obtained at 6 weeks of age, and were assigned to 3 different groups:

Group 1:  $1 \times 10^6$  BMSCs were mixed with 400mg of autologous fibrin glue that served as a carrier, and then mixed with 2mg of rhBMP-2 with a total of 2 injections per mice

Group 2: 400 mg of the autologous fibrin glue containing  $1 \times 10^6$  alveolar bone cells and 2mg of rhBMP-2

Group 3: 400 mg of autologous fibrin glue containing  $1 \times 10^6$  periosteal cells and 2mg of rhBMP-2

Grafting procedures were carried out 3.5 weeks after harvesting the periosteal tissues and 4.5 weeks after harvesting both the alveolar bone specimens and the bone marrow samples, indicating that gathering sufficient numbers of cells is possible in a shorter period of time when using periosteal cells. All animals were sacrificed at 12 weeks after the injections to harvest the specimens. Samples were fixed and stained using H&E and examined under light microscope. The percentages of newly formed bone within the specimen outline were calculated. Significant differences for the amount of new bone formed in response to the different cells were identified by ANOVA.

**Findings and Conclusions:** After injection the fibrin glue/BMSCs/BMP-2 into one group of mice, fibrin glue/alveolar bone cells/BMP-2 into the second group and fibrin glue/periosteal cells/BMP-2 composites into the third group of mice, subcutaneous nodules were noted to have formed by 12 weeks. These nodules were hard and resisted compression. Upon dissection nodules were observed with well defined margins. The volume of nodules was higher in the third group followed by the first and second group consecutively. This demonstrated difference in response according to the different cells. A histological examination of the nodules revealed that they were encapsulated in a fibrous capsule, and that there was trabecular bone as well as an amorphous calcified matrix in the nodule of all samples. The trabeculae included many osteocytes and were regularly lined with many osteoblasts, indicating bone-forming activity. At the periphery of the nodules,

the bone had a laminar pattern similar to normal bone. There was no evidence of inflammation or foreign-body reaction in the host tissue adjacent to the new bone, nor was there any evidence of cartilage generation. The percentage of formed bone were 26.9%±10.2% in group 1, 41.1%±8.6% in group 2 and 58.2%±11.7% in the third group. This demonstrated that there were differences in the amount of new bone formed in response to different cells.