Influence of a Collagen Membrane and rhPDGF on Early Bone Formation after Vertical Augmentation with Bovine Bone in Rabbits

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Introduction: Combination of bone substitute materials with growth factors may enhance prognosis of vertical bone augmentations (VBA). The aim of the study was an evaluation of the effect of a collagen membrane (Bio-Gide, Geistlich, Wolhusen, Switzerland) and a signal protein (rhPDGF, Sigma, St. Louis, USA) on VBA together with an implant-fixed bovine bone block (DBB; Bio-Oss, Geistlich, Wolhusen, Switzerland) in a rabbit animal model.

Materials and Methods: In 16 rabbits, a DBB-block was implant fixed on the tibia in a split-leg design (figure 1). The groups were:
1) DBB only (control; n=8),
2) DBB+collagen membrane (test; n=8),
3) DBB+rhPDGF (test; n=8) and
4) DBB+collagen membrane+rhPDGF (test; n=8).
Prior operation as well as 1h, 24h, 72h, 7d, 2 weeks and 3 weeks after operation, blood samples were taken and evaluated for alcalic and acid phosphatase (ALP, AP). Histomorphometric evaluation for new bone area (NBA; %)) and new vertical bone height (VBH; mm) was conducted after 3 (n=16) and 6 weeks (n=16).

Results: ALP and AP were significant higher in the membrane-groups after 1h and 72h (all p<0.05). After 7d, values were similar in all groups and after 2 and 3 weeks, the values in the groups without membranes were significant elevated (all p<0.05; exemplary figure 2).
Histological analysis revealed no significant differences after 3 weeks. After 6 weeks, NBA and VBH were significantly elevated in the membrane groups (both p<0.01). rhPDGF (additional and alone) showed a non-significant early increase of bone metabolism and formation only.

Discussion: In vertical bone augmentation, the use of a collagen membrane led to an initially increased bone turnover manifesting in increased bone formation in a later phase of healing. Early rhPDGF-effects were seen for both bone metabolism and bone formation but turned out to be non-significant.

Figure 1: Fixation of the DBB-block with dental implants (NobelActive, 3.5 x 11.5 mm, Nobel Biocare, Zürich, Switzerland)

Figure 2 (left): Development of AP-concentrations over the different time points. Significant differences are shown. Same significant differences were seen for ALP.

Figure 3: Representative histological specimen of the DBB+membrane+rhPDGF group after 6 weeks.

Figure 4: Representative histological specimen of the DBB only group after 6 weeks. Less new woven bone is seen.

Discussion: In vertical bone augmentation, the use of a collagen membrane led to an initially increased bone turnover manifesting in increased bone formation in a later phase of healing. Early rhPDGF-effects were seen for both bone metabolism and bone formation but turned out to be non-significant.

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