Guided bone regeneration of Experimental Maxillary Alveolar Cleft Defects in Growing Rabbits with a New Bioabsorbable Composite Membrane of Polyactive® and Bioactive Glass n:o 13-93

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Indication

In cleft surgery resorption of grafted bone is a hazard, which may lead to a non-optimal surgical outcome sometimes necessitating a re-operation. In the fields of clinical periodontology and dental implantology the principle of guided tissue regeneration with barrier membranes has successfully been used to promote bone formation in maxillary and mandibular bone defects. In a previous study we obtained encouraging results with a two-layer bioabsorbable composite membrane used to promote bone formation by guided bone tissue regeneration in an experimental maxillary alveolar cleft defect. In this pilot study, a new bioabsorbable membrane was investigated for the same purpose. Combining two bioabsorbable materials with known bone-bonding properties to form a composite membrane seemed theoretically advantageous, as it may increase the possible osteoconductive effect of the barrier membrane.

Materials and methods

A bioabsorbable composite membrane (0.2 x 10 x 15 mm) of polyethylene oxide terephtalate and polybutylene terephtalate (Polyactive® 70/30) combined with bioactive glass n:o 13-93 was investigated in this study. Polyactive® 70/30 was used as matrix material of the membrane, its favourable biomechanical and handling properties and good biocompatibility being previously demonstrated. This polymer was compounded with Bioactive glass n:o 13-93 having bone-binding and osteoconductive capacities by formation of biologically active apatite layer on its surface.

A standard maxillary alveolar osseous defect (6 x 6 mm) was made bilaterally in the maxilla and filled with autogenous bone grafts in 12 growing rabbits. The test defect was covered with the composite membrane and the other one was left uncovered to serve as control. Follow-up was 10 weeks.

Radiographs of the skulls were taken at 0, 2, 6 and 10 weeks postoperatively. At each observation time healing of the defects was evaluated by a veterinary radiologist. Histological sections were stained with Masson-Goldner trichrome stain. The sections were microscopically inspected and a semi-quantitative scoring system was used to analyse the amount of osteoblasts, osteoclasts, inflammatory cells, degree of foreign tissue reaction and connective tissue formation. All results were confirmed by an experienced pathologist. Histomorphometric measurements for quantity of bone in the defect areas and osteogenic activity at the membrane-bone interface were performed.

Results

All results were statistically analysed. In radiological results of healing scores, at 6 weeks the control defects had a significantly higher score than the test defects. No other

statistically significant differences were found. In histological evaluation the composite membrane was found to have a local enhancing effect on osteogenic activity at the membrane - bone interface and the foreign body reaction elicited by the membrane was mild. The membranes were observed to have lost their rectangular shape due to swelling of the implants. In histomorphometry there were no significant differences between membrane covered and control defects in quantity of bone or in osteogenic activity.

Conclusions
In this experimental pilot series the composite membrane of Polyactive® 70/30 and Bioactive Glass n:o 13-93 was found to have a local enhancing effect on osteogenic activity at the membrane-bone interface. The membrane was also found to be biocompatible. On the other hand, the in-vivo swelling of the membrane was stronger than presumed and clearly a negative finding. This and the lack of histomorfometrically significant positive results in bone promotion indicate that the membrane is not ideal for this experimental cleft defect study design. Nevertheless, other indications for this surgically easy-to-handle composite membrane would be worthwhile to investigate, for example repair with bone grafting of cranial or long bone defects .

Keywords
experimental maxillary cleft, bone grafting, bone healing, GTR, bioabsorbable membrane, bioactive glass