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BONE REGENERATION WITH RESORBABLE POLYLACTIDE MEMBRANE AND SPONGE IN AN UNSTABLE FRACTURE MODEL IN RABBIT RADIUS

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BACKGROUND:

Healing of segmental diaphyseal bone defects in animals can be enhanced by covering the defects with resorbable polylactide membranes. Based on the results of bone healing in defects 10 mm long in the rabbit radii, it was suggested that the membranes prevents muscle and soft tissue from invading the defect and maintains osteogenic cells and osteogenic substances within the space covered with membrane, thus promoting new bone formation.

OBJECTIVES:

1. To investigate and compare bone regeneration with resorbable polylactide membrane and polylactide sponge in a 20 mm bone defect in rabbit radii.

2. To determine and compare the biomechanical strength of the bone fixation construct with reinforcement by membrane and sponge of such bone defect which were rendered unstable by ulnar osteotomy

MATERIAL AND METHOD:

The material used was poly (L/DL-lactide) 80/20% in the form of membranes and sponges. The membrane was 0.1 mm thick and was porous in the defect side. The sponge has an average pore size of 300-500 μm with pore to volume ratio 95%. 20 mm long diaphyseal segmental defects were made in the left radii of adult New Zealand rabbits. Transverse ulnar osteotmies were made at midshaft to make the forearm unstable. The rabbits were divided into 5 groups. In Group 1, no fixation of the bone were performed and the limbs were immobilized in a plaster for 8 weeks. In Group 2, the bone defects were fixed with 1.5 AO miniplate, with 2 screws on each side of the defect. In Group 3, the bone defects were fixed similarly and polylactide membranes were used to cover up the bony defect. In Group 4, the bone defects were fixed similarly to Group 2 and the defects were bridged by sponge of 20 mm long, 3 mm in diameter, In Group 5, the bones were fixed similarly and the defects were bridged by a sponge of same dimensional and wrapped by polylactide membrane same as these in Group 2 from rabbit of same species. Histological study and biomechanical study were performed on the explanted forearm at 8 weeks.

RESULTS:

In Group 1, there was bone healing bridging the bone ends at 8 weeks. However, there was marked shortening of the limbs and all the limbs were deformed.

In Group 2, there was bone formation at the ends of both proximal bone stumps and distal bone stumps at 8 weeks. There was no bone bridging the defect.

In Group 3, 4, 5, there was bone formation dispersed across the defect. There was more abundant bone regeneration in Group 4 and 5. Evaluation at 1 year revealed good bone formation in the groups with sponges.

DISCUSSION AND CONCLUSIONS:

Polylactide membrane and sponge promote bone regeneration in 20 mm bone defect in the rabbit radii model.
It was postulated that membrane serves as a barrier to prevent fibrous tissue to grow into the bone defect and preserve the osteogenic factors and cells. It was highly likely that membrane surface served as an anchorage site for osteoblasts so they can proliferate and express their phenotype sponge provided more surface area for osteoblasts to proliferate and differentiate so more bone regeneration occurred. The size, 20 mm, well exceeded the critical size defect of the rabbit so resorbable polylactide sponge can be used to regenerate long segmental defect.

Key words: bone defects, bone regeneration, polylactide membrane, polylactide sponge