STUDY OF BIODEGRADABLE RODS IN RABBIT LONG BONE MODEL

W.Y.Ip , H.N.Diwaker and P.W.L.Wong

Department of Orthopaedic Surgery, The University of Hong Kong,

INTRODUCTION: Bone healing of extra/intra-articular fractures, in animal long bone, can be enhanced by providing a stable environment for the fracture. Absorbable pins have been used in the fixation of fracture. During the healing period, the degradable device maintains the required fixation and decomposes gradually so that the stress is transferred gradually to the healing bone without stress shielding.

This study was to investigate the bone regeneration with resorbable polylactide pin fixation in animal models, which simulated phalangeal and metacarpal fractures.

METHODS: 12 adult New Zealand rabbits' radii were used. Oblique radial osteotomies were made at mid-shafts or at distal radii to create unstable fractures. The rabbits were divided into 2 groups with 6 in each.

Group 1. Oblique fracture in radius

Group 2. Intra-articular fracture at distal end of radius

The fracture was fixed by 2 self-reinforced poly-lactide rods (SmartPin)[1]. The fragments were fixed to promote bone healing. At the end of the observation period at 3 and 6 weeks, the animals are killed by intravenous overdose of thiopential. The implanted bones as well as the contralateral bones were explanted for histological study and biomechanical study. The contralateral radii were used as control.

RESULTS: There were no infection or severe deformities in all groups.

a. Histological evaluations

No necrosis was found. The collagen of the newly formed woven bone of the 6-week group was shown and the collagen layer was obviously denser and much organized than the 3-week.

b. Biomechanical evaluations

The purpose of the biomechanical testing was to evaluate the rigidity of the healing bone after biodegradable rod fixation at 6 weeks fixation.

Group 1- Extra-articular oblique fracture – oblique pin insertion

Group 2- Intra-articular fracture – oblique pin insertion

% change in Stiffness	Compression compared with control side	Torsion compared with control side
Group 1	+18.8(9.5)	+32.3(24.9)
Group 2	+37.6 (9.3)	+80.7(58.5)

In both groups, the results showed that the stiffness of constructs was greater that the controls overall. Therefore we can conclude that the construct of the fixed fracture with PLLA rod is stronger than the contralateral untreated forearm in rabbit radii.

DISCUSSION & CONCLUSIONS:

This PLLA rods used in our study caused no infection and provided a stable environment for bone healing. Generally, the healing of the rabbit's radii for a stable fracture required 6 to 8 weeks. According the specification given, the rod would lose its strength in 20-50 weeks; therefore it should provide adequate stability during the healing period. Moreover, the rod would be completely absorbed in 2 to 4 years time, as a result that no secondary operation is required.

Histological examination with Giemsa/Eosin staining of the specimens showed that the new formed woven bone was seen as early as the 3-week. There were no inflammatory cells in the specimens. The pins showed a very slow degradation rate. Moreover, the interface of the pin to bone has showed osteoconductive activity no osteolysis. As regards to the mechanical properties, it is quite interesting that the bone-pin constructs were stiffer than the intact lamb control in both compression and torsion. The may be due to the strong initial strength of the PLLA rods. It was observed that the resorbable pins can provide a high degree of stability for fracture healing as there were no deformities or re-fracture observed in this study. In other words, it can maintain its strength and withstand the physiological loading environment during healing period.

Therefore, it is believed that the PLLA rods can be an alternative treatment for extra/intra-articular finger fractures with its potential advantages.

REFERENCES:[1]SR Polylactide pin, Bionx Bioscience Ltd, Tampere, Finland.