AIT Research

PRECLINICAL ASSESSMENT OF BIOMIMETIC AND BIOACTIVE BONE REGENERATION SCAFFOLD IN FEMORAL CONDYLE DEFECT OF SPRAGUE DAWLEY RATS

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INTRODUCTION: A fabricated biomimetic bone scaffold, incorporating osteogenic factors, presents a promising alternative to traditional autologous and allogeneic bone fracture treatments. Here, the principles of biology and engineering are combined in the development of viable tissue regeneration scaffolds designed to restore and maintain the function of human (bone) tissue. Our aim is to produce a cost effective bone healing biodegradable scaffold that overcomes current technology limitations and provides better safety than current mainstay market products. To date, the initial development phase of this project has been completed and in vitro studies have been performed providing positive outcomes. A preclinical assessment, where the scaffolds was implanted in Sprague Dawley rat defective femoral condyles has been carried out to investigate the efficiency of the scaffold in promoting bone healing. Histological analysis of the osteogenic and bioactive properties of the scaffolds has been conducted validating the efficacy of controlled low dose growth factor release compared with equivalent commercially available bone healing products.

METHODS:

Surgical Implantation
Implantation of scaffold composite into femoral condyle defects in Sprague Dawley rats

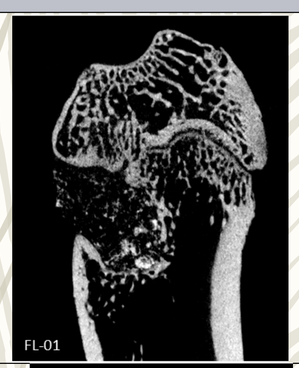
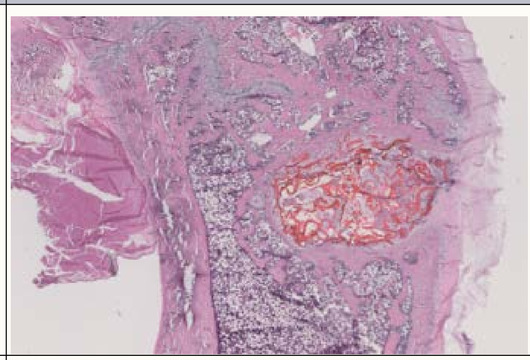
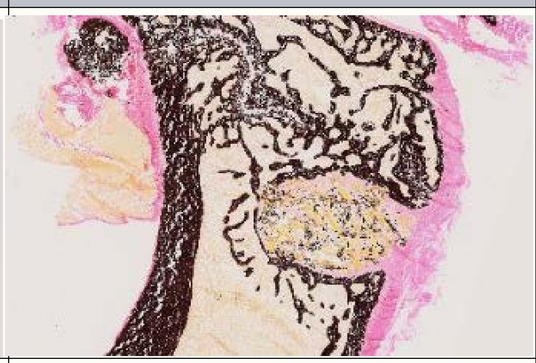
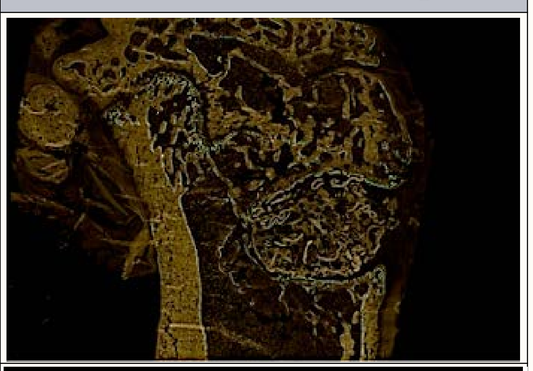
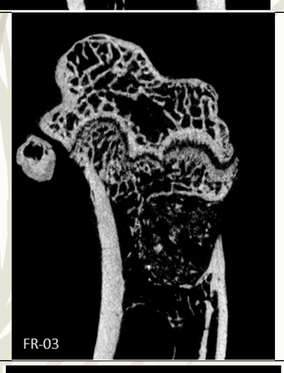
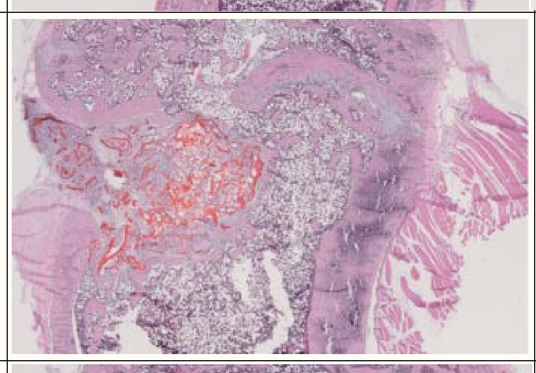
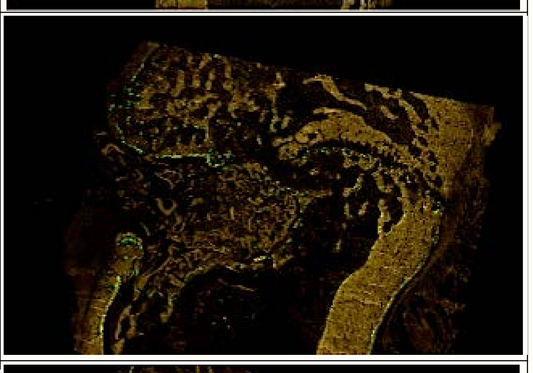
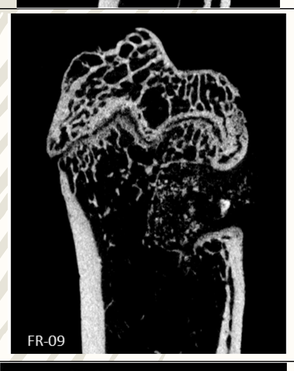
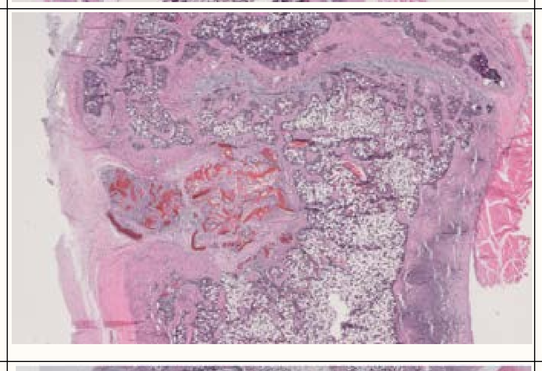
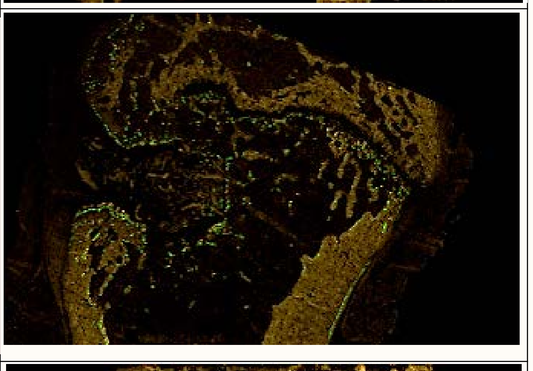
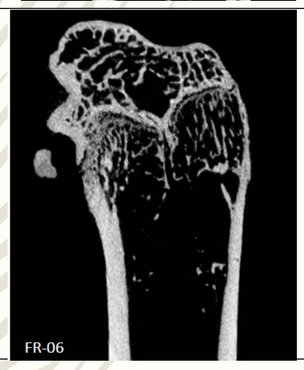
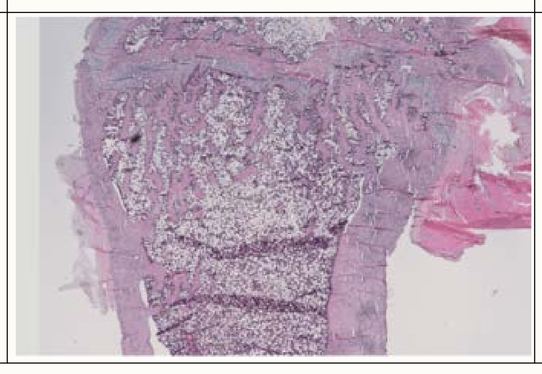
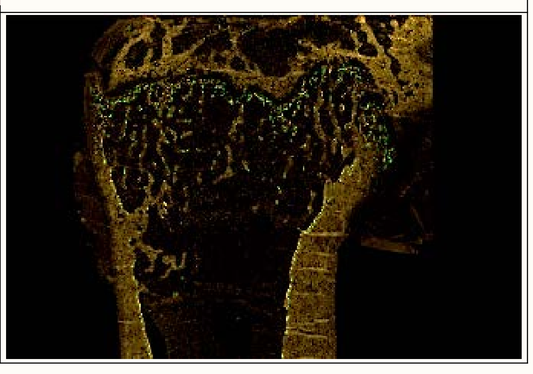
Post-operative Assessment
Clinical follow up for 8 weeks before euthanasia

Tissue Harvesting and Fixation
Harvesting the femoral condyles and fixed in 10% neutral buffered formalin

Micro CT Scan
- Bone volume, BV (mm^3)
- Bone volume fraction, BV/TV (%)
- Bone mineral density, BMD (g/cm^3)

Histological Staining
- Hematoxylin & Eosin (H&E)
- Von Kossa
- Tartrate-Resistant Acid Phosphatase
- Fluorescent Labelling

RESULTS:

	MicroCT Scan	H&E Staining	Von Kossa Staining	Fluorescent Labelling
Chitosan Composite				
Chitosan Composite + Protein				
★ **Chitosan Composite + Peptide**				
Commercial Delivery System + Protein				

★ Scaffold was observed in the defect, but reduced in size compared to other chitosan composite groups. Islands of bone formation were observed in the defect, highlighting the peptide as an alternative to protein.

CONCLUSION: The fabricated scaffold composite with growth factors showed promising bioactive functionality in the femoral condyle defects healing comparable to the commercial protein delivery system. The chitosan composite with peptide out performed the protein incorporated chitosan composite, addressing industry requirement to have a clean supply chain.

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