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Properties Of Regenerated Tissue In An Ovine Meniscal Defect Packed Using A Fibre Reinforced Collagen Sponge Pre-Absorbed with Platelet Rich Plasma

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Summary:
We investigated the efficacy of implantation of a novel fibre reinforced collagen sponge material combined with thrombocytes, for filling a meniscal defect in an ovine model.

Abstract:

As menisci are an integral part of the knees complex function, damage to the menisci can result in the degeneration of the articular surfaces. It has been demonstrated that replacement materials may be of use to repair meniscal tissues but require well matched mechanical properties, biocompatibility and extensive long term mechanical testing. We have developed a novel fibre reinforced collagen sponge material previously shown to be compatible with meniscal cells and growth factor releasing thrombocytes in vitro. In this study we investigated the efficacy of implantation of this novel biomaterial into a meniscal defect in an ovine model.

Meniscal implants were manufactured comprised of embedded collagen fibres within a freeze dried collagen sponge. Scaffolds +\- autologous platelets were used to fill to a 3mm diameter defect in the anterior red white zone boundary of the left lateral menisci. Control defects were left empty. Each group contained 8 animals. Samples were retrieved at 8 weeks. The outcomes measured included functional assays of weight bearing on the operated limb using a force plate and durometer measurements. Histology was evaluated using Saffranin O staining and immunohistochemistry.

At 8 weeks post-surgery no difference in gait response was found between groups following surgery. Durometer readings demonstrated a significant increase in tissue infilling (5-45 shore unit range) for defects filled with scaffolds and further increases for scaffolds + platelets, but no return to full mechanical strength. Histology showed an increase in tissue accumulation in the defect regions for scaffold groups compared to controls. Staining for the cytoskeletal component vimentin showed marked staining within the defects and within a thin (<100 micron) surface layer of the menisci, possibly representing migrating cells. Polarising microscopy and staining with Agglutinin showed significant disruption remained to the proteoglycan content and tie fibres of the menisci for defects and implants.

This study demonstrated that addition of a reinforced collagen sponge with platelets into a meniscal defect increases the infill by meniscal tissue at 8 weeks. These observations support the potential for the development of this composite (sponge plus fibres) material for the treatment of meniscal defects.