Introduction

- Acellular natural tissue scaffolds for musculoskeletal regeneration (e.g., ACL repair) show great promise.
- Achieving adequate fixation of these scaffolds into the joint is challenging.
- Incorporation of the bony attachment sites of acellular musculoskeletal scaffolds may improve fixation.
- It is thought this will provide superior scaffold integration and regeneration.
- Aim: To investigate the capacity of decellularised porcine bone to osteointegrate and regenerate when implanted in situ in an ovine condyle.

Decellularisation: Decellularised porcine bone contained no cell nuclei (Fig 1). DNA content of decellularised bone was 20.2 ± 8.5 ng mg⁻¹ dry weight [native porcine bone 546.5 ± 216.8 ng mg⁻¹].

Compatibility: No contact or extract cytotoxicity was observed with BHK or L929 cells. No adverse host response to the decellularised porcine bone when implanted in mice at 4 or 12 weeks.

Materials and Methods

- Decellularisation: Porcine bone plugs from the distal femur (6 mm diameter, 10 mm long; n=6) were decellularised using a process incorporating water flossing, followed by acetone treatment and washing in low concentration sodium dodecyl sulphate (SDS) with protease inhibitors, sonication was used throughout. Decellularisation was assessed by resin (toluidine blue/basic fuchsin, DAPI) and frozen section (sudan black) histology. DNA was extracted from tissues using Qiagen kits.

Results

- Table 1. Semi-quantitative histopathological analysis of the host healing response to allograft and decellularised porcine bone implants. Healing response parameters were graded 0-4 (0 = absent, 1 = slight, 2 = moderate, 3 = marked and 4 = severe).
- Table 2. Semi-quantitative histopathological analysis of the host response to allograft and decellularised porcine bone implants.

Discussion

- Porcine bone was fully decellularised and the resultant scaffold was cytocompatible and biocompatible.
- The decellularised porcine bone fully integrated and regenerated in the ovine condylar model, with the level of integration comparable to that of allograft bone.
- Although an initial lymphocytic response to the acellular xenogeneic bone was observed, this was greatly reduced after 12 weeks.

Conclusion

- These studies supported the hypothesis that inclusion of bony attachment sites in bone-soft tissue-bone scaffolds will enable improved fixation and integration into the joint.
- The successful in vivo integration and regeneration of decellularised porcine bone indicates it may have clinical use as a bone substitute biomaterial.
- Further work is required to understand the biomechanical function of the acellular porcine scaffold prior to and following regeneration, to provide insight into the potential clinical applications of this biomaterial.

References


Financial Disclosure

E Ingham and J Fisher are academic founders of Tissue Regenix and are shareholders and advisers to Tissue Regenix Group PLC.