A system for developing a tissue engineered meniscal enthesis
Meniscus Anatomy and Function

• Two semi-circular fibrocartilaginous menisci (medial and lateral)
• Menisci attach to tibia plateau via ligamentous insertions (anterior and posterior)
Why develop a tissue engineered meniscal enthesis?

- To prevent meniscal extrusion
  - Meniscal margin extending beyond the tibial margin

- Precursor to developing osteoarthritis\(^1\)

[Guo+ Stem Cells Intl 2015]\(^1\)

Previous Work

- Seek to further refine soft tissue interaction with bone
- Seeded mesenchymal stem cells (MSCs) onto bone plugs

[McCorry+ Acta Biomaterialia 2016]
Objective

• To refine a tissue engineered enthesis model to further integrate soft tissue with bone to generate a meniscal implant
Methods: Bone Plug Generation

• Extracted from 1-3 day old bovids

• Decellularized to remove bone marrow and cellular debris

• Seeded MSCs onto decellularized bone plugs

[McCorry+ Acta Biomaterialia 2016]
Methods: Collagen and FCCs Preparation

• Collagen extracted from Sprague-Dawley rat tails

• Menisci fibrochondrocytes of bovids digested in 0.3% collagenase

[Rajan+ Nature Prot 2007]
Methods: Construct Generation

- Bone plugs placed 20 mm apart in 60 mm Tygon tubing
- Collagen + FCCs + working solution injected into center of tubing
- ~150 x 10^6 cells/ml

[McCorry+ Acta Biomaterialia 2016]
Methods: Culture Period (~2 weeks)

- 5 constructs
  - Clamped in dishes
  - 50 ml meniscus media

- 6 constructs
  - Diffusion reactor
  - 30 ml meniscus media
  - 24 ml osteogenic media

[Mccorry+ Acta Biomaterialia 2016]
Mechanical Testing

- EnduraTEC ElectroForce 3200 system
- 0.75%/sec strain rate to mimic quantitative loading
Mechanical Testing: 0 week co-culture enthesis sample

Stress vs. Displacement

$\Delta x = 3.755\text{mm}$
Next Steps

• Confocal Imaging
  • Look closely at morphology of constructs
  • Examine effects of media on constructs

• Histology
  • Picrosirius red staining to examine collagen fibrils
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