Lubricin Injections for Integrative Articular Cartilage Repair

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Articular Cartilage and Lubricin

Articular cartilage
- Connective tissue of diarthrodial joints
- Function: smooth joint articulation
- Poor intrinsic repair

Lubricin
- Glycoprotein in synovial joint
- Provides boundary lubrication
- Decreases friction

Motivation

– Cartilage lesions affect the knees of ~900,000 individuals annually in the US alone\(^1\)
– Although there are several techniques for cartilage repair, integration remains a problem.

Study Introduction

- Animal model: New Zealand White male rabbits
- Defect: unilateral osteochondral lesions
- Treatment:
  - The control group: saline injection (n=18)
  - The treatment group: lubricin injection (n=18)
Objective

• This study will analyze the effect of lubricin injections as a therapy for integrative articular cartilage repair.

• Understand the model being used

  Characterize healthy joint environment using **histology**

  Compare by:
  - 2 animals
  - 3 anatomical locations
Methods

• What is Histology?
  • Study of microscopic structures of cells and tissues
  • Thin sections analyzed under microscope

Safranin-O

• Basic, cationic dye
• Stains proteoglycans red
• Hematoxylin and fast green
• Brightfield microscopy
• 4x objective

Picosirius Red

• Stains collagen fibers
• Polarized light microscopy
• 10x objective
• ImageJ then used to quantify cells
Cartilage thickness varies between anatomical location

- Densely charged proteoglycans as evident by intensity of stain.

**Cartilage thickness:**
- **Condyle:** 230 ± 80 µm, n=16
- **PFG:** 150 ± 30 µm, n=16
- **Tibia:** 200 ± 20 µm, n=4
Rabbit Picrosirius Red Results

Collagen fibrils crisscrossed in superficial layer; become parallel to chondrocytes

- Chondrocytes in columns throughout zones

- **Cell Count:**
  - 50 cells/1000 $\mu$m$^2$ $\pm$ 20 $\mu$m, n=36
Discussion

Results further characterize this model and allow us to understand how defect groups compare to healthy control.
Summary

• Moving forward
  – Continue to analyze/ compare between anatomical location and interspecies
    • Quantify lubricin concentration using IHC
    • Staining intensity in Picrosirius Red samples
    • Cell shape
    • Zone organization
    • Mechanical properties
  – Compare my results to examples in scholarly articles

• Significance
  – Characterizing native healthy joint environment to determine if lubrication therapy for osteochondral repair will restore native joint composition and mechanical function.
    • Determine if lubricin injections is an effective therapy.
“Skill Toolbox”

- Safranin-O and Picrosirius Red staining
- Brightfield and Polarized Light microscope image acquisition
- ImageJ scaling, measurements, cell counting
- Dissections

- Gaining lab skills, data analysis, scientific data presentation skills
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