Medial Capsule Knee - Update
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David Crane MD

Declarations
- Consultant for Arthrex
- Discussing off-label use of technology

Balloon, Boing-Boing, Bioreactor
- I. Static and Dynamic Stabilization of the Joint Capsule and Supporting Ligament, Tendon, and Myofascial structures.
- II. Mechanotransduction of the Articular cartilage and Meniscus
**Scope of the problem**

- Meniscal injuries may be the most common knee injury. The prevalence of acute meniscal tears is 61 cases per 100,000 persons.
- The overall male-to-female incidence is approximately 2.5:1.
- Peak incidence of meniscal injury for males is in those aged 31-40 years. For females, the peak incidence is in those aged 11-20 years.


- In patients older than 65 years, the rate of degenerative meniscal tears is 60%.
- Root tears are observed in 28% of medial meniscal tears.
- Surgical procedures of the meniscus are performed on an estimated 850,000 patients each year.


**Meniscus Anatomy**

- The microanatomy of the meniscus is dense fibrocartilage composed of cells and an extracellular matrix of collagen fibers in network. The cells are termed fibrochondrocytes because they appear to be a mixture of fibroblasts and chondrocytes. These cells are responsible for the synthesis and maintenance of the extracellular fibrocartilaginous matrix.

Meniscus Anatomy

- The most abundant component of the menisci is collagen (70%)—mainly type I collagen (~80%) but it also contains types II, III, V, and VI. Collagen fibers are arranged mostly along a longitudinal or circumferential direction, with some interwoven radial and oblique fibers. The circumferential fibers are related directly to the menisci’s functional ability to dissipate compressive loads. The other fibers act primarily as ties to enhance structural rigidity and to help prevent longitudinal splitting. The extracellular matrix also includes proteoglycans, glycoproteins, and elastin.


Meniscus Anatomy

- Arnoczky and Warren demonstrated the important vascular anatomy of the menisci. The limited peripheral blood supply originates from the medial and lateral inferior and superior geniculate arteries. Branches from these vessels give rise to a perimeniscal capillary plexus within the synovium and joint capsule, which, in turn, supplies the meniscus periphery.


Meniscus Anatomy

- Studies have shown that 10-30% of the periphery of the medial meniscus and 10-25% of the lateral meniscus receives a vascular supply. The remainder receives its nutrition from the synovial fluid from passive diffusion and mechanical pumping. A few terminal branches of these vessels, along with the middle geniculate artery through the synovial covering of the anterior and posterior horn attachments, supply increased vascularity to the meniscal horns.


Meniscus Anatomy

- Important functions, which include load bearing, load and force distribution, joint stability, joint lubrication, and proprioception.
- One of the primary functions is to provide load bearing across the knee joint.
- Fifty percent of the compressive load in the knee is transferred by the menisci in extension, whereas up to 85% of the load is transferred at 90° of flexion. The collagen orientation makes this load bearing possible by converting the compressive forces to tensile forces.


Meniscus Anatomy

- Load and forces are distributed across a much larger surface area because of the menisci, which:
  1. Decrease focal contact pressure by increasing the contact area.
  2. Protect the underlying articular cartilage.
- Resection of 15-34% of a meniscus may increase contact pressure by more than 350%. Normal knees have 20% better shock-absorbing capacity than meniscectomized knees.


Scope of the problem

- Osteoarthritis
  - Most common form of arthritis.
  - Classified as: Idiopathic (localized or generalized) or Secondary (traumatic, congenital, metabolic/endocrine/neuropathic and other medical causes).
  - Characterized by focal and progressive loss of the hyaline cartilage of joints, underlying bony changes.
Scope of the problem

- Osteoarthritis
  - OA affects 13.9% of adults aged 25 years and older and 33.6% (12.4 million) of those 65+ in 2005
  - 26.9 million US adults in 2005 up from 21 million in 1990 (believed to be conservative estimate).

CDC data 2015

Anatomy

Capsular Anatomy
Three layers of the medial capsule:

I. Crural fascia
II. Superficial portion of the MCL
III. Deep portion of the MCL including the meniscotibial and meniscofemoral extensions of the deep MCL.
Coronal proton-density-weighted MR image (3,000/15) obtained along the middle third of the medial knee joint shows the fascia (layer I [I], arrowheads) and the sartorius (straight arrow), gracilis (gr), and semitendinosus (st) tendons. Note the superficial portion of the MCL (layer 2 [II], curved arrows).

Note the area where a split (S) occurs in layer 2. Both the vertical (V) and oblique (O) portions of the MCL are shown.

Transverse section of the medial joint capsule above the level of the joint line:
- Layers I and II are fused anteriorly
- Layers II and III are fused posteriorly
Cadaver Study
Instron Data

- 19% increase in meniscal extrusion can be expected from baseline to lesion conditions
- 13% decrease is expected between lesion and repair
- There was a 6% difference between baseline and repaired values

Clinical Cases

- 8 Patients to date
- 2 had failed to improve with prior arthroscopic partial medial meniscectomy > 9 mos prior
- All had pain > 1 year

Case 1
Case 2
Clinical Update

- All patients to date have shown improved pain and function at three mos.
- All pts with repair have shown a change in mechanics for 8–12 weeks
- Most within 2-4 cm range
- Most MCL to posterior horn in location
- Outliers and decision tree change…