Meniscal Tears

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Described originally as functionless remains of leg muscles


Meniscus – *Meniskos* – “Crescent”
*Mene* – “Moon”

Embyologic remnants which when torn were potent generators of arthritis


“A far too common error is shown in the incomplete removal of the injured meniscus”


Incidence

- One of most common injuries treated by orthopedic surgeons
- ABOS – most common procedure reported during Part-II Examination was meniscal debridement.


Incidence

- Approximately 1 Million meniscal surgeries performed each year.
- Incidence in athletes reported to be 61/100,000.


Medial Mensicus

- C-shaped (semicircular)
- 3.5 cm in length
- Wider posterior than anterior
- Attached to MCL and medial capsule
- Semimembranosus attached to post horn and causes post translation of MM during knee flexion
- Injured 2-5 times more than LM

Lateral Meniscus

- Circular, O-shaped; 4/5 ring
- Similar width anterior and posterior
- 2 times as much mobility as medial meniscus
- Popliteus tendon attaches to post horn of LM causing post translation during knee flexion
Lateral Meniscus

- Lateral (80%) covers larger surface area of tibia than medial (60%) meniscus

Anterior and Posterior Meniscofemoral Ligaments

- Run from posterior horn of lateral meniscus to medial femoral condyle
- Just in front of or behind the posterior cruciate ligament
- Anterior – Ligament of Humphrey
- Posterior – Ligament of Wrisberg

Ultrastructure

- Debate as to whether cells of meniscus are fibroblasts, chondrocytes, or mixture of both
- Classified as fibrous tissue or fibrocartilage?

Ultrastructure

- Generally termed “fibrochondrocytes” because of their chondrocyte appearance and their ability to synthesize a fibrocartilage matrix


Ultrastructure

- Extracellular matrix of collagen (60-70% of dry weight).
- 90% type I collagen
- Types II, III, V and VI have been identified


Ultrastructure

- Electron Microscopy
- Three different collagen framework layers
Ultrastructure

- **Superficial layer**
  - Fine fibrils woven into mesh-like matrix


- **Surface layer**
  - Just below superficial layer
  - Irregularly aligned collagen bundles

- **Middle layer**
  - Collagen coarser, larger and oriented in parallel circumferential direction

Ultrastructure

- **Middle layer** that allows meniscus to resist tensile forces and functions to transmit loads across knee joint.


Material Properties

- Different from that of other collagen tissues such as tendons and ligaments.
- Because of meniscus triangular shape – compressive forces tend to extrude meniscus outward toward periphery.
- Circumferential tensile stress often referred to as “hoop stress.”
- Derived from hoops of a barrel.

Mensicus

- General features
- Meniscopatellar ligaments
- Transverse ligament
- Meniscofemoral ligaments

Anatomy of the Meniscus

- Peripheral 1/3
  - Vascular
  - “Red – Red” Zone
  - Ability to heal if torn
  - Aneural
- Middle 1/3
  - Less Vascular
  - Border of vascular supply
  - “Red-White” Zone
  - Aneural
  - White portion

- Medial (inner) 1/3
  - Even Less Vascular
  - “White-White” Zone
  - Aneural
  - White portion
Anatomy of the Meniscus

- Relatively avascular
- Blood supply from superior and inferior medial and lateral genicular arteries
- Branch of popliteal artery

Meniscus

- Vascular penetration
  - 10-30% width of medial meniscus
  - 10-25% of lateral meniscus


Meniscus

- Birth – entire meniscus vascularized
- Avascular with age – weight bearing?
- 2nd decade only peripheral rim


Meniscus

- Remaining portion of each (65-75%) receive nourishment from synovial fluid via diffusion


Anatomy of Mensicus

- Vast majority of mensicus is avascular
- Derive nutrition through passive diffusion or mechanical pumping
- Intermittent compression


Anatomy of Mensicus

- Some feel that because of the denseness of the tissue, diffusion into central core may be marginal.

**Anatomy of Meniscus**

- Thus “mechanical pumping” (e.g., joint motion) may be essential for continued tissue nutrition.


**Coronary Ligaments**

- Highly innervated
- Attach menisci to tibial plateau
- Source of joint line pain with meniscal tear

**Neuroanatomy**

- Nerve fibers and sensory receptors
- Found mainly in peripheral, vascular zone
- In outer 1/3 of meniscus
- Pacinian and Ruffini corpuscles and free nerve endings are found in the anterior and posterior horns
- Provide some proprioceptive benefit when stimulated by motion and deformation

Neuroanatomy

- Most abundant in horns of meniscus
- May play important proprioceptive role during extremes of knee flexion and extension when horns become taut.
- May provide CNS with information regarding joint position


Meniscus Movement

- Unequal movement
- Become distorted
- Inefficient as a chop block
- Forward during extension
- Backward during flexion

Biomechanics of Meniscus

- Total excursion
  - AP
  - Medial
    - 6 mm
  - Lateral
    - 12 mm

Biomechanics of Meniscus

- Morphologic changes of OKC deep knee flexion
- 20 healthy adults
- 0-147° flexion
- Superconductive open-type MR system


Biomechanics of Meniscus

- Backward excursion of anterior horn sig greater than posterior horn


Biomechanics of Meniscus

- No difference in excursion of anterior horn of medial vs lateral meniscus

Biomechanics of Meniscus

- Excursion of posterior horn of lateral meniscus sig greater than that of medial meniscus


<table>
<thead>
<tr>
<th>Position</th>
<th>Medial Anterior horn</th>
<th>Medial Posterior horn</th>
<th>Lateral Anterior horn</th>
<th>Lateral Posterior horn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep Knee Flexion</td>
<td>16.79 mm</td>
<td>8.91 mm</td>
<td>15.97 mm</td>
<td>13.15 mm</td>
</tr>
</tbody>
</table>

Biomechanics of Meniscus

- Excursion greater than Thompson
  - Frozen cadaveric knees
  - Age of subjects
  - Mean flexion angles of 120° vs 147°
Biomechanics of Meniscus

- AP diameter significantly reduced in both medial and lateral meniscus


Biomechanics of Meniscus

- Indicates movements of meniscus ensures maximal congruency with articulating surfaces


Biomechanics of Meniscus

- This dynamic congruity facilitates:
  - Load transmission
  - Shock absorption
  - Stability and lubrication

**Knee Extension**
- Patella moves cephalically
- Tightens patellomeniscal ligaments (Kaplan’s Lig.) which attaches to anterior horn of meniscus and pulls anteriorly

**Functions of Meniscus**
- Distribute weight bearing loads over a larger surface area and increase stability
  - Medial = 50% of load in medial compartment
  - **Lateral** = 70% of load in lateral compartment


**Functions of Meniscus**
- Joint stability
- Increase joint congruency by deepening tibial plateau
- Limits abnormal movements which you get with a meniscectomy
- Guides normal movements
Functions of Meniscus

- **Joint Stability**
- **Cadaver Study**
  - Significant increased varus and valgus laxity with absent ACL and medial meniscus as compared to ACL deficiency alone with intact medial meniscus.


- **Meniscectomy alone may not significantly increase joint instability.**
- **Meniscectomy with ACL insufficiency significantly increases anterior laxity.**


- **Cadaver Study**
  - Significant increased load on ACL graft after medial meniscectomy.

Meniscus Crucial

- Fairbank described changes that accompany meniscal removal:
  - Narrowing of joint
  - Flattening of femoral condyle
  - Formation of osteophytes


Functions of Meniscus

- Improved articular nourishment (?)
- Chondrocytes the cells of articular cartilage receive nutrition via imbibition
- Joint approximation causes joint compression which forces the nutrients near the articular surface
- CPM helps maintain the integrity of the articular cartilage

Problems When Meniscus Removed

- Abnormal path mechanics
  - Results in OA
  - Results in DJD
- Partial meniscectomy
  - Results in joint instability
  - Leads to degeneration of articular cartilage
- ACL deficient knees
  - Leads to tears of the menisci within 6 months, secondary to instability
Normal Load Distribution
- When meniscus is removed contact area drops to 40% that of normal
- Right: Contact area of intact meniscus

Abnormal Load Distribution
- Less contact area gives rise to increased stress on articular cartilage, mechanical damage to chondrocytes and matrix
- Resection of as little as 15-34% of meniscus increased contact pressures by over 350%.
- Partial meniscectomy not benign!

Abnormal Load Distribution

- 11 models used to investigate effect of location of meniscectomy on tibial articular cartilage


Abnormal Load Distribution

- Extent of degenerative changes are directly proportional to amount of excised meniscus

Mechanism of Injury

- Flexion/Rotation injury
  - Torsion and axial loading
  - In a flexed position and trying to turn or extend
  - Coupled movements occur commonly in athletic endeavors

- Trapped posterior horn
- May create a bucket handle tear


Mechanism of Injury

- Older – degenerative tears may be asymptomatic

Mechanism of Injury

- More common with ACL tears as a result of abnormal tibial translation
  - Lateral meniscal injury usually associated with acute ACL tear
  - Medial meniscal injury more often in persons with chronic ACL insufficiency


O’Donoghue Triad

- Lateral meniscus?


Names of Medial Tears

- Bucket handle
- Flap
- Horizontal cleavage
- Radial
- Degenerative
- Double radial

Names of Medial Tears

- Bucket handle
- Flap
- Horizontal cleavage
- Radial
- Degenerative
- Double radial
Names of Lateral Tears
- Bucket handle

Symptoms of Meniscal Injury
- Popping, catching, and locking
- Pain – Poor localization.
- Effusion (?)
- Pain or popping along joint line with forced flexion and rotation


Knee Locking
- 16 year old boy motorcycle accident
- Fractured pelvis and injuries to both limbs
- 10 cm laceration lat knee

Knee Locking

- Immediate debridement
- Long saphenous vein grafting to severed femoral artery
- Fasciotomies
- Skin grafts applied to faciotomies
- Non displaced patellar fracture
- Uneventful recovery
- Returned 6 months later with locking in knee

www.casesjournal.com/content/3/1/72
**Physical Examination**

- Diagnosis can be made accurately in 75% of knees based on history alone!


- Joint line tenderness – 77-89% sensitivity
  - McMurray test – 79% sensitivity


**Examination**

Examination Pearls

- Vertical vs. horizontal pain.
- Vertically oriented pain probably MCL/LCL pain
- Horizontal pain probably meniscus
- Most posterior horn so pain posterior to midline


Effect on High Level Athletes

- Describe risk, time lost effect on performance of isolated meniscus tears in NBA.
- Preinjury and postinjury player efficiency ratings used to compare

Effect on High Level Athletes

- Lateral more likely up to age of 30 years
- Then after medial
- BMI > 25 higher chance of tear
- 19.4% did not return to play
- For those that did return no sig change in PER


Treatment Options

- No treatment
- Total meniscectomy
- Partial meniscectomy
- Meniscus repair

Meniscal Healing

- Formation of fibrin clot
- Acts as scaffold for repair
- Meniscal and synovial cells migrate into fibrin clot
- Vessels from capillary plexus and synovial fringe grow into clot

Meniscal Healing

- Heal by formation of fibrovascular scar tissue
- 2 weeks fibrin clot


Meniscal Healing

- 5 weeks histological evidence of regeneration
- In the canine model occurs by 10th week
- Full remodeling of scar - up to 6 months


Meniscal Healing

- Full strength of repair tissue as a function of time has not been delineated!
No Treatment

- Not all tears symptomatic
- Prevalence of tears found in asymptomatic individuals 5-36%
  


No Treatment

- Small stable asymptomatic tears do not need to be treated surgically
  - Vertical longitudinal tears < 1 cm long
  - Small radial split tears < 3 mm
- If significant and left alone can degrade hyaline cartilage

Partial Meniscectomy

- For tears in the white, inner area that won’t heal on own
  - Flap tears
  - Radial tears in the inner avascular (white-white) area
  - Horizontal cleavage tear
- Very common procedure
- Motorized shaver to smooth out edges
- No soft tissue healing restraints
- Rehab symptom limited
- 100% return in 3-4 weeks
Treatment

- Young or middle aged?
- Presence or absence of arthritis?

Meniscus Repair

- Save meniscus at all cost
- Most common for peripheral, vascular area tears
- Small tears in this region may heal on own, while larger tears may require sutures
- Have attempted to pack fibrin clot to speed-up and improve healing
- Creation of vascular channels


Fibrin Clot

- Have attempted to pack fibrin clot to speed-up and improve healing
- Brings hematoma chemotactic factors to tissue


Trephination

- Creation of vascular channels from peripheral (red zone) to central avascular area (white zone)
- Fox – patient survey and clinical exam (90% good to excellent results)
- Zhang 25% healing in goat model


Synovial Abrasion

- Use of surgical rasp
- Activates chemotactic factors stimulate healing
- Abrade margins and superficial layer


Inside-Out Meniscus Repair

- Placement of sutures depend on tear size and location
- All inside repairs may use fewer sutures and may require a delay in full weight bearing
Meniscal Repair

- Requires soft tissue healing restraint times
- Slower rehabilitation
- Now performing meniscal allografts

Outside-In Techniques

- Passage of spinal needle through skin into meniscus tear with arthroscopic visualization
- Tied off in the joint
- Fairly weak construct

All-Inside Using Implants

- Use of nonsuture implants for fixation
- FastT-Fix
- Meniscal arrows
- Surgeon must be cognizant of potential for articular cartilage damage
- Watch for proud head!

Distinction: Repair vs Meniscectomy

- Important to know how rehabilitation is affected by meniscus repair vs. meniscectomy
- Standard exercises detrimental to meniscus repair
- Very small stresses may disrupt healing process
- Full ROM may place undue stress on meniscus repair

Distinction: Repair vs Meniscectomy

- Repair must heal without stress or abnormal laxity
- Undue stress may cause scar to elongate
- Weight-bearing limited initially
- Watch for over aggressive therapy, postoperative synovitis, or overuse synovitis
- Need normal inflammatory cycle to run its course

Distinction: Repair vs Meniscectomy

- Must treat each patient with individualized program
- Understand biomechanics of the joint, the healing process and the biomechanics of therapeutic exercise program
Tear Location and Sport

- Medial > Lateral Meniscus
  - Soccer
  - Basketball
  - Skiing
  - Baseball

- No difference
  - Volleyball
  - Gymnastics
  - Sailing
  - Rowing
  - Wrestling
  - Judo
  - Handball


Partial Meniscectomy Post Operative Protocol

- Immediate ROM and WBAT
- Patients will normally resume work after 1-2 weeks
- Full activity 2-4 weeks
- Competition in 4-6 weeks


Meniscectomy

- 120 patients
- RCT = 3 groups
  - HEP = 47
  - NSAIDS = 52
  - PT = 21
- Follow-up = 42 days


- Neither routine administration of NSAIDs nor routine physiotherapy is justified after arthroscopy of the knee

Partial Meniscectomy

- Early supervised PT has not been associated with better outcomes when compared to a HEP
- 84 patients; 41 HEP; 45 PT + HEP
- Blinded sessions 5 and 50 days after surgery


Partial Meniscectomy

- Outcome measures subjective scales
- Kinematic knee function
  - Level walking
  - Stairs
- Horizontal and vertical hops


Partial Meniscectomy

- 3x/wk x 6 wks
- No significant change between supervised with home program and home program only.

Partial Meniscectomy

- Prospective study
- 30 patients following arthroscopic PMM
- HEP (15); Supervised PT (15)
- Supervised PT vs. HEP
- Function at 2, 4, 8 weeks


Partial Meniscectomy

- Outcomes included isokinetic strength tests and subjective outcomes
- No difference in strength or outcomes between two groups
- % Deficit in quadriceps peak torque
  - HEP = 22%
  - Supervised PT = 22.1%


Partial Meniscectomy

- Prospective RCT
- 31 men; PT + HEP (15); HEP only (16)
- Assessed pre op and 3 weeks PO
- Maximum voluntary isokinetic strength quads
- Supervised 9 visits (15) vs instruction in PO management (16)

Partial Meniscectomy

- Experimental group (supervised therapy) had better knee extensor strength recover than control group
- Strength difference was 26% better in supervised therapy group
- Pain and patient reported knee function – NSD


Partial Meniscectomy

- Significant isokinetic torque deficits of knee extensors for as long as 6 months after arthroscopic meniscectomy.


Partial Meniscectomy

- 16 patients
- Early training delayed 2 weeks + HEP
- Late training delayed 6 weeks + HEP
- NSD
- Training in early stages did not improve recovery of strength

Partial Meniscectomy

- These knee flexor and extensor deficits increase the need for supervised rehabilitation.


Partial Meniscectomy

- Many have persistent medial knee pain, narrow medial joint space, and varus alignment when compared to non-operative knees.


Partial Meniscectomy

- Results in degenerative arthritis and ligamentous laxity.
- Patients do worse after lateral than after medial meniscectomy.

Partial Meniscectomy

- A partial medial meniscectomy generally does better than a partial lateral meniscectomy.


- 54% satisfactory results after lateral meniscectomy.
- Increased interval from injury to surgery resulted in less satisfactory results.


- 15 years after meniscectomy – 46% of patients reduced sporting activity.
- 89% had degenerative changes on radiographs.
- Some seen as early as 4.5 yrs.
- Radiographic changes more often lateral compared to medial.

Partial Meniscectomy

- 210 patients at 10-22 years after meniscectomy
- 61% satisfactory results
- Adverse factors
  - Increased age
  - Abnormal alignment
  - Lateral vs medial meniscectomy


Partial Meniscectomy

- Search 1950-2013
- 18 RCT – 6 for MA
- PT + HEP improved function and ROM more than HEP alone
- Most studies have high to moderate bias risk


Methodological flaws of studies

- Small sample size
- Lack of standardization of outcomes
- Not using standardized guidelines - CONSORT

- Case control study
- Assessed for adverse events
- 17,774 patients PMM
- 208 had adverse events
- Patients with diabetes and pulmonary disorders had higher risk
- Smokers had increased odds of readmissions
- Smoking cessation?


Meniscal Repair

- Two schools of thought
- **Conservative**
  - Limit early weight bearing
  - Limit knee flexion > 90 for 4-6 weeks
  - Hold sports competition for 5-6 mo.
- **Accelerated**
  - Full early weight bearing
  - Unrestricted ROM
### Repair Guidelines

<table>
<thead>
<tr>
<th>ROM of Brace</th>
<th>Week</th>
</tr>
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<tbody>
<tr>
<td>30-70</td>
<td>Week 1</td>
</tr>
<tr>
<td>20-80</td>
<td>Week 2</td>
</tr>
<tr>
<td>10-90</td>
<td>Week 3</td>
</tr>
<tr>
<td>0-135</td>
<td>Week 4</td>
</tr>
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### Conservative Repair Guidelines

<table>
<thead>
<tr>
<th>Weight Bearing</th>
<th>Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>NWB</td>
<td>Week 1-2</td>
</tr>
<tr>
<td>PWB (25%)</td>
<td>Week 3</td>
</tr>
<tr>
<td>PWB (50%)</td>
<td>Week 4</td>
</tr>
<tr>
<td>PWB (75%)</td>
<td>Week 5</td>
</tr>
<tr>
<td>FWB</td>
<td>Week 6</td>
</tr>
</tbody>
</table>

### Meniscus Repair Weight Bearing Status

<table>
<thead>
<tr>
<th>Authors</th>
<th>FWB Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeHaven KE, <em>Clin Orthop</em> 1985;198</td>
<td>FWB delayed 8 weeks</td>
</tr>
<tr>
<td>McLaughlin et al, <em>Orthopedics</em> 1994;17</td>
<td>FWB delayed 3 weeks</td>
</tr>
</tbody>
</table>
All Had Successful Healing Rates
Despite Varying Protocols

Aggressive Protocols
- Immediate unrestricted weight bearing
- Unlimited brace ROM
- 50% failure
- Changed their protocol to restricted weight bearing, crutches 4 weeks, no squatting for 4 months.


Postoperative Immobilization
- To protect sutured cartilage, motion may be restricted to safe portion of range
- Motion may be controlled to allow 0-90 or 20-90 degrees of knee flexion
- May be required to wear protective motion brace
- Cryotherapy, compression, and elevation
Maximum Protection Phase (0-4 weeks)

- Goals
  - Wound healing
  - Quadriceps activation
  - Decreased effusion
  - Normal patellar mobility
  - Proximal strengthening (TLS)

- Restrictions
  - WBAT with crutches (braced locked at 0 or 20)
  - PROM limited 0-90 for 4-weeks
**Maximum Protection Phase**  
(0-4 weeks)

- One exception to early weight bearing is a radial tear in the periphery that may cause a distraction force.


**WB rationale**

- Fibrin clot formation at 2 weeks
- Shear stress detrimental
- Hoop stress may be beneficial?
- The most stable position seen in full extension (with arthroscopy)!
- Clinical application of Wolff’s law!


**WB rationale**

- Hoop stresses are primarily absorbed at the periphery of the meniscus
- May actually approximate healing tissue

WB rationale

- Weight bearing with tibiofemoral rotation during knee flexion
- Produce shear forces capable of disrupting healing meniscal tissue


ROM Rationale

- Active ROM (dogs)
- More collagen laid down
- Increased uniformity of repair at 10 weeks


ROM Rationale

- Dogs with no motion restrictions
- Allowed immediate weight bearing
- Fibrin clot becomes fibrovascular scar tissue
- Complete healing

**Immobilization**
- Immobilized dogs
- Negative impact on outcomes
- Loss of meniscus dry weight


**Maximum Protection Phase (0-4 weeks)**
- **Treatment**
  - RICE
  - EMS
  - Patellar mobilization
  - Scar tissue mobilization
  - AAROM
  - Strengthening - Hip (TLS) – SLR x 4
  - Quad/Ham isometrics


**Clinical Milestones**
- Minimal effusion
- Good quad tone
- Good patellar mobility
- Min to no pain
- AROM 0-90
- Single limb stance without compensation
Moderate Protection Phase
(4 to 6 weeks)

- Goals
  - WBAT with crutches braced locked 0-90
  - Progression of CKC exercises
  - No patellar pain

- Restrictions
  - Gradually increase ROM of flexion to 90 based on pain assessment
  - Flexion to 90 after 4 weeks
  - Progress slowly after to protect posterior horn tears

- Treatment
  - Pain management
  - Control effusion
  - NMS of quads
  - Mini-squats – slowly introduce more CKC
  - Step-ups
  - AROM
Moderate Protection Phase
(4 to 6 weeks)

- Treatment
  - Flexibility exercises
  - CV training
  - Toes raises
  - Cycling (ROM only – low load)

Clinical Milestones
- Full weight bearing with no compensation
- Normal gait
- AROM 0-90
- Good quad tone
- SLR without lag
- Normal patellar mobility

Minimum Protection Phase
(6-10 weeks)

- Progression dependent on ROM, knee strength, endurance, absence of effusion
- Progress strengthening with step-ups, step-downs, lunges, slide board
- Continue to progress general endurance
- When meniscal integrity tests are normal may begin light jogging, and mini plyometrics increasing to sprinting and jumping as patient tolerates
Minimum Protection Phase
(6-10 weeks)

- Goals
  - Increase:
    - Strength
    - Power
    - Endurance
  - Normal knee ROM
  - Prepare athlete for full participation/work

Minimum Protection Phase
(6-10 weeks)

- Restrictions
  - Avoidance of pivoting
  - Flexion ROM to 130°

Minimum Protection Phase
(6-10 weeks)

- Treatment
  - All exercises as previous
  - Progress quad strengthening
  - Balance training
  - Leg presses
  - Mini-squat
  - Lunge
  - Step-ups (6” step)
Minimum Protection Phase
(6-10 weeks)

Clinical Milestones

- Improved stability with unilateral stance
- Minimal to no pain
- Full ROM
- Equal hip strength
- Quad strength < 20% of contralateral side

When Safe to Return to Pivoting

<table>
<thead>
<tr>
<th>Study</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barber FA, Arthroscopy 1994;10(2)</td>
<td>ASAP</td>
</tr>
</tbody>
</table>

Return to activity Phase (11-16 weeks)

Goals

- Increased power and endurance
- Return to skills
- Preparation for return to full unrestricted activity
Return to activity Phase (11-16 weeks)

- **Restrictions**
  - Avoidance of full hyper-flexion (deep squatting) for up to 6 months

Return to activity Phase (11-16 weeks)

- **Treatment**
  - Exercise as previous
  - Endurance exercises
  - Agility drills (low - level)
  - Plyometric training (14 weeks)
  - Sport specific training
  - Initiation of running
  - Initiation of cutting drills

Return to activity Phase (11-16 weeks)

- **Clinical Milestones**
  - Full confidence in knee
  - Pain free activity at 5 months
  - Satisfactory clinical examination
  - Functional testing 90% of contralateral leg
  - Isokinetic testing 90% of contralateral leg
Discharge Criteria

- Satisfactory clinical exam
- No swelling
- No joint line tenderness
- Negative McMurray and Apley test
- Satisfactory isokinetic test
- Satisfactory functional tests
- Physician approval

Thank You!