Evaluating Injuries of the Knee and Shoulder

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• Off label use of some products will be discussed
Sports Medicine Biomechanics

Rising from Chair 2.5 x bodyweight
Downstairs 3.3 x bodyweight
Walking 3 - 6 x bodyweight

10 pound weight loss decreases forces on knee by 30 to 60 pounds with each step
What type of forces are we talking about?

- Force of gravity pulling you toward Earth
  - Sitting in a chair: 1 g
  - Roller Coaster: 2.5 g’s to 6 g’s
    - Formula Rossa, UAE (149MPH)
    - Kingda Ka, Six Flags NJ (456 ft)
    - Tower of Terror, Gold Coast Australia (8.2g)
  - Fighter Jet: 9 g’s

http://www.youtube.com/watch?v=sNu200WkYZw

Forces in the throwing arm

- Shoulder: 12,000 deg/sec
- Elbow: 3600 deg/sec
- Wrist: Over 1000 g’s

MGH Sports Medicine
Today’s Goals

• Correlate anatomy, physical examination, and diagnosis
  • Shoulder
  • Knee
    • Anterior knee pain
    • Lateral knee pain
    • Medial knee pain
  • When to refer?
  • When is this arthritis?
    – What arthritis can be fixed?
    – Cartilage defects vs DJD

HISTORY

1. Onset
2. Location
3. Duration
4. Quality/Quantity
   – Swelling
   – Mechanical symptoms
5. Aggravating Factors
6. Relieving Factors
7. Associated Symptoms
8. Effect on Function **

What is the major problem?

- Pain
- Swelling
- Stiffness
- Locking
- Instability
History: Onset

• Injury
  – Torn ligament
  – Meniscus
  – Fracture
  – Patella dislocation
  – Rotator cuff tear

• No Injury
  – CMP, tendinitis
  – DJD
  – Meniscus
  – Rotator cuff tendinitis
  – Rotator cuff tear

• Non-contact

Contact Injury - Torn MCL

History: Onset

• Pain and Instability
• Blow to lateral aspect of knee (valgus force)
• Focal tenderness of medial knee along course MCL
History: Age Matters

• Less than 30-35 years of age
  – Dislocations/subluxation common
    • Falls on outstretched arm, abduction injuries
    • Throwing or overhead labral injuries
  – A-C joint injuries with direct fall injuries
  – Rotator cuff sprains common but tears unusual
  – Fractures only in high energy injuries
Shoulder: Patient’s Age

- Greater than 40 years of age
  - Fractures more common
  - Arthritic conditions of A-C joint and glenohumeral joint
  - Rotator cuff injuries more common
    - Strains, partial thickness tears
    - Full thickness tears

Symptoms - Patella

- Click / snap
- Grind
- Pain stairs
- “Movie Theatre sign”
Symptoms - ACL

- Instability (giving way)
- Can run straight ahead but cannot pivot

Hemarthrosis

- ACL
- ACL
- ACL
- Patellar dislocation
- Osteochondral fracture
- Peripheral meniscal tear
- PCL

- Patellar sleeve fracture
- Joint capsule tear
- PVNS
- Sickle Cell
- Hemophilia
- Anticoagulant therapy
- Ruptured aneurysm
Shoulder pain is not always shoulder pain:

- Cervical radiculitis/radiculopathy
- Myofascial pain
- Viral brachial plexopathy
- Thoracic outlet syndrome
- Pancoast tumor
- Neoplasm of humerus/shoulder girdle (mets)
- Thoracic disc herniation
- Abdominal problems (gall bladder, pancreatitis, etc.)
- Diaphragm irritation

Knee pain is not always knee pain:

- Hip Pain
  - Child/Adolescent
  - Arthritis
- Lumbar
The Simplified Knee Exam

- Hip / Lumbar spine exam
- Gait
- Alignment
- Effusion
- ROM
- Stability
- Palpation
- PF Crepitus
- Special tests

Radiography

- Lateral
- Merchant view(Patella)
  Not more than 30°!
- *Standing* Bilateral AP
- *Standing* PA view @ 45 deg flex
Standing PA 45 Flexion

Imaging alone should not dictate treatment

MRI

For suspected intra-articular abnormalities
Imaging alone should not dictate treatment

Medial Knee Pain

- Medial meniscus
- OA / DJD
- MCL Sprain
- Osteonecrosis
- Osteochondritis dessicans (OCD)
- Pes anserinus bursitis
- Semimembranosis tendinitis
- Stress fracture
- Physeal Injury
- Popliteal cyst
- Saphenous Neuritis
Two types of cartilage:

- Patella
- Femur
- Articular Cartilage
- ACL
- Meniscus
- Collateral Ligament
- Patella
- Tibia
- Fibula
- Tendon

Knee In Extension Knee In Flexion

Joint Line

Medial Knee Pain
Symptoms - Meniscus

Meniscus
- Pain
  - medial
  - lateral
- Clicking
- Popping
- Locking

DJD
- Aching
- Stiffness
- Pain

Medial Knee Pain

Meniscal Injuries
- “Popping” sensation
- Knee feels painful and tight
- Stiffness and swelling
- Exam:
  - Tenderness at joint line
  - Pain with extension or flexion
  - Effusion
- Meniscus can loosen drift into joint
  - Locking or catching of knee
  - “Pebble in the knee”
Incidental Meniscal Tears

• MRI diagnosed meniscal tears evident in 40% asymptomatic patient older than 50 years¹
• 56% in 70-90yrs old²
• Arthritis
  – 63% : if knee pain, aching, stiffness most days
  – 60% without those symptoms

1 Jerosh Archive Orthop Trauma Surg 1996
2. Eglund NEJM 2008

Arthroscopy in Osteoarthritis

• Ineffective pain / arthritis alone
• Does not alter the natural history of osteoarthritis
• Mechanical symptoms¹, loose bodies
• Factors to consider
  – Prior arthroscopy²
  – Correlation of symptoms to pathology
  – Severity of cartilage loss and bone marrow edema in the same compartment of meniscal tear³
  – Severity of meniscal extrusion
  – Meniscal root tear
  – Age > 70⁴
  – Alignment

¹Chang Arthritis Rheum 1993
²Spahn Arthroscopy 2006
³Kijowski Radiology 2011
⁴Wai JBJS 2002
Arthrocentesis

- Diagnostic
- Therapeutic

Treatment: Meniscal Injuries

- Injections, NSAIDS
- Menisectomy
- Meniscal Repair
  - Young person
  - Acute injury
  - Consider repair
  - Tear has to be in “red zone”
Meniscectomy

Medial Knee Pain

Meniscal Transplantation
Posterior Knee Pain

- Popliteal cyst (?ruptured)
- Popliteus rupture
- Torn meniscus
- DVT
- Popliteal artery aneurysm
- Hamstring strain (?)
- Referred pain
  - Swelling in knee
  - Chondromalacia patella

Anterior Knee Pain

- Osgood Schlatter’s disease
- Patella tendinitis – “jumper’s knee”
  - Sinding-Larsen-Johannson
- Patella instability
- Pre-patellar bursitis
- Patella or trochlea chondrosis (CMP)
- Patellofemoral Syndrome
- Bipartite patella
- (Synovial plica)
- Referred pain – back/hip/femur/foot
Patellar Tendinitis

- "Jumpers knee"
- Sinding-Larsen-Johannson
- Examination - Tenderness
  inferior pole of patella
Patellar Tendinitis

- Very common
- Usually non-op Tx
- Surgery in <1% - excise abnormal tissue at inferior pole of patella

Malalignment

- Bony alignment
- Joint geometry
- Soft tissue restraints
- Neuromuscular control
- Functional demands

\[ \text{Abnormally directed load} \rightarrow \text{Exceed physiological threshold} \rightarrow \text{PAIN} \]
Etiology

• Acute trauma
• Overuse
• Abnormal lower limb alignment / mechanics
• Immobilization
• Soft tissue tightness

Despite uniform clinical picture - the etiology of PF problems is multifactorial and not consistent for all pts.

Not all patellar malalignment causes pain,
Not all anterior knee pain is from malalignment

• Excessive weight
• Muscle weakness
• Prolonged synovitis

Treatment - Patellofemoral

Avoid excess load
• Squats, Lunges, deep knee bends
• Stairmaster
• High impact aerobics
• Step aerobics
• Plyometrics
• Dryland training, stadium steps

Cycling
Rowing
Walking
Swimming
**Lateral Knee Pain**

- Lateral meniscus tear
  - Discoid
  - (Torn ACL)
- Runner’s knee - ITB syndrome
- OA / DJD
- Proximal tibiofibular joint

**Iliotibial Band Syndrome**

- Pain or burning located over the lateral aspect of the knee
- Aggravated by activity with repeated knee motion and relieved by rest
- Caused by friction of the ITB as it rubs over the lateral femoral condyle-may pop/snap
- Pain may radiate to thigh or hip
Lateral Knee Pain

ITB Syndrome Continued

- Physical Examination
  - tenderness over the ITB at the lateral femoral condyle
  - tightness with positive Ober's test
  - possible snapping with flexion/extension
  - no instability and usually no swelling

  - Hip examination
  - Core Strength
  - Standing limb alignment: Femoral version, tibial torsion, hindfoot varus/valgus
  - Shoe examination
ITB Syndrome Continued

• Treatment
  – physical therapy
    • U/S, massage, stretch, strengthen muscle imbalance
  – relative rest
  – ice
  – NSAID’s
  – correct biomechanical or training errors
    • Change shoes!

Anterior Cruciate Ligament (ACL)
ACL Tear

- Common sports injury
  - basketball, football, skiing, soccer
- Hx:
  - twisted knee
  - heard or felt a “pop”
  - immediate swelling
  - difficult to walk initially
- Most are non-contact
- Deceleration to a stop or landing
- Landing from a jump
- Cuts and pivots

Effusion
Anterior Drawer
Sensitivity 0.2 Specificity 0.88
ACL Tear

**Lachman**
Sensitivity 0.86  Specificity 0.91

**Pivot Shift**
Sensitivity 0.40  Specificity 0.98

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Partial ACL Tears

• Definitions:
  1. Injured but functional ACL
     • Appropriate injury mechanism, asymmetric KT-1000 difference, MRI suggestive of ACL injury AND negative pivot shift
  2. One bundle injury
     • Anatomic Location: anterolateral vs posteromedial bundle\(^1\)
     • A rare event
• Treatment should fit individual patient’s needs
• Therapeutic decision based on occupation, activity, amount of time in high demanding activities, presence of associated knee lesions
• Physiological age and activity more important than chronological age

Who Benefits?
Differentiate:
“Pain” from “Instability” from “Pain from instability”

• Surgical options: Prevent recurrent instability leading to higher quality of life

• Nonsurgical Options: (Older) No high demand activities, coping well with instability, pain
Nonsurgical management

- Patients who return to preinjury level activity may be significant risk for re-injury
- Bracing in higher risk activities considered
- May not be successful in preventing re-injury
  - Reliance on a brace to return to pre-injury levels of activity may lead to significant re-injury rates.

Expected Value Decision Analysis

Operative versus nonoperative treatment of anterior cruciate ligament rupture in patients aged 40 years or older: an expected-value decision analysis.

Seng et al. Arthroscopy 2008

- 69 Subjects
- Surgical reconstruction was optimal treatment strategy in patients 40 and older
- Averse to risk of possible re-injury, instability or modified return to activity
1. Glenohumeral Joint (Shoulder)
2. Acromioclavicular Joint (AC)
3. Sternoclavicular Joint (SC)
4. Scapulothoracic Joint (ST)

Dynamic Factors

- Rotator Cuff
- Scapular Rotators
- Long Head Biceps
- Ligament Dynamization
- Proprioception
Dynamic Factors

- Rotator Cuff

Primary Function
- Stabilize humeral head

Secondary Function
- Glenohumeral motion
- Dynamic Joint Compression
- Increased stability

- Shoulder
- Forward Flexion
- Abduction
- External Rotation
- Internal Rotation

Physical Exam: Shoulder
Forward Flexion

Supine Eliminates Scapular Motion

External Rotation

In Abduction
External Rotation

Internal Rotation

- T₇ – Inferior Angle
- T₃ – Spine Scapula
- T₁ – Superior Angle
Physical Exam

• ROM:
  – If PASSIVE range of motion is restricted
    • Arthritis  (xray: true AP)
    • Adhesive capsulitis (frozen shoulder)
  – If ACTIVE range of motion restricted (but not passive)
    • Pain
    • Rotator cuff tear (partial versus full)
      – Lag (bounce back): If passive > active

True AP shoulder

True AP  Standard AP
Strength: Supraspinatus

- Forward Flexion
- Pain & Weakness w/ Resisted Abduction in Scapular Plane
Strength: Infraspinatous

External Rotation

Strength: Subscapularis

Lift-off

Belly-Press
Palpation

Sternocostoclavicular (SC) joint Pain

Acromioclavicular (AC) joint Pain

Biceps Tendinitis
  Bicipital groove/tendon

Greater tuberosity (supraspinatus insertion)

IMPINGEMENT SYNDROME

- Cuff, bursa impinged by:
  - anterior acromion
  - CA lig.

Stage I: bursitis, edema
Stage II: tendinitis, fibrosis (25-40 yo)
Stage III: cuff tear

Impingement Signs (Hawkins/Neer)
**ROTATOR CUFF INJURIES**

- On autopsy:
  - 70% of people over 80 y.o.
  - 30% of people under 70 y.o.

- Not all are symptomatic

- Natural History:
  - Tears tend to get larger
  - Larger tears correlate level of disability

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**Mechanism of Injury**

- Acute
  - Younger patient, associated with trauma

- Chronic
  - “Wear and tear”
  - Progression of pathology
    - RTC tendonitis – Impingement – Partial thickness tear – Full thickness tear – Massive tear – RTC Arthropathy
History

• Pain located lateral arm
• Pain when reaching overhead
• Can’t sleep at night
• Night Pain

Physical Exam

• INSPECT/PALPATE

• SHOULDER ROM
  – Lag - Difference between Passive and Active Motion

• SHOULDER STRENGTH**
  – Weakness, drop-arm

• IMPINGEMENT SIGNS
**Rotator Cuff Tear**

- MOST COMMON IS SUPRASPINATUS
  
- +/- Impingement sign
  
- Weakness on strength testing

**What to do?**

- Full thickness
  - Surgery (depending on chronicity)

- Partial thickness
  - PT
  - NSAID's
  - Cortisone Injection
  - Surgery
Shoulder Arthritis

- Degenerative disease shoulder
  - Arthroscopic debridement more effective than at the knee
- Injections
- Cartilage procedures
- Hemiarthroplasty, total shoulder arthroplasty
- Reverse total shoulder arthroplasty

"Knee pain is the malady – not osteoarthritis"
(Warner, 1992)

- Cartilage degeneration does not necessarily cause pain
- Synovial / capsular tissues are primary sources of pain
- Subchondral pain – late event

... Pain drives osteoarthritis treatment
Types of Cartilage Repair

1) Bone-marrow stimulation
   - microfracture
2) Transplantation of osteochondral grafts
   - OATS, mosaicplasty, allografts
3) Implantation of autologous cells (chondrocytes)
   - ACI
4) Matrices / scaffolds
   - +/- cells, +/- growth factors
### Treatment Algorithm

<table>
<thead>
<tr>
<th>Small defects (≤2 cm²)</th>
<th>Large defects (&gt;2 cm²)</th>
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<tbody>
<tr>
<td><strong>Very small</strong> (≤2 cm²)</td>
<td><strong>Small</strong></td>
</tr>
<tr>
<td>OATS</td>
<td>no donor site morbidity</td>
</tr>
<tr>
<td>+ mature articular cartilage</td>
<td>+ arthroscopic procedure</td>
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<tr>
<td>+ primary bone healing</td>
<td>- complex rehab (CPM and TDWB 6-8w)</td>
</tr>
<tr>
<td>+ quicker recovery and return-to-play than microfracture</td>
<td>- prolonged Return-to-play 6-9 months</td>
</tr>
<tr>
<td>- technically difficult (mini-open)</td>
<td>- cost</td>
</tr>
<tr>
<td>- donor site morbidity with multiple plugs</td>
<td>- prolonged RTP 12-18 months</td>
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### Trochlear Resurfacing

- [Image of Trochlear Resurfacing](image)
THANK YOU