Beyond the Lateral Ankle Sprain; High Ankle Sprains and role of the Deltoid.

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About this presentation

- Background, anatomy, clinical exam, review of imaging

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- Surgical options for care, associated considerations
Disclosure

• I have no disclosures
Because ankle injury rarely happens with a single MOI
Objectives:

- Identify athletes with multi-ligament injury to their ankle.
- Review relevant ankle anatomy.
- Adapt treatment options based on clinical symptoms.
- Analyze conservative and surgical options for athletes with chronic ankle sprains.
Background

- 28,000 ankle sprains/day
- Most common injury in sports
- 45% of all athletic injuries
- Most involve lateral ligaments
  - Inversion

Only consistent risk factor
  - Hx prior ankle sprain
    - Benyon 2002
Conclusion: Lack of understanding “can impact how care is delivered”
Background

- Outcomes associated with injuries is less than optimal
  - High recurrence rates
  - Prolonged symptoms
  - Diminished QOL
  - Reduced physical activity
  - Propensity toward CAI
  - Heterotopic Oscification
  - Increased risk for ankle OA
Background: Additional Considerations

- Chronic ankle instability is commonly associated with other lesions

**Could there be other things contributing to the problem?**

- Osteoarthritis

- 32-74% of individuals w/ prev hx sprain, have residual symptoms, CAI, perceived instability

- Literature shows 13-35% report pain after successful ligament reconstruction
  - Choi WJ, AJSM 2008
Additional Considerations

- **Most congruent joint in body**
  - Large weight bearing surface
  - Tibia/Fibula act like wrench gripping nut (talus)

- **Intact syndesmosis is key to ankle function**
  - 1mm of widening of syndesmosis changes contact area by 42%,
  - Greatest effects seen in first 1mm
  - 2mm - 56% - *Ramsey & Hamilton JBJS, 1976*
Chronic Lateral Ankle Instability

The Effect of Intra-Articular Lesions on Clinical Outcome

Woo Jin Choi,* MD, Jin Woo Lee,*† MD, PhD, Seung Hwan Han,‡ MD, PhD, Bom Soo Kim,* MD, and Su Keon Lee,* MD
From the *Department of Orthopaedic Surgery, Yonsei University College of Medicine, Seodaemun-gu, Seoul, South Korea, and the ‡Department of Orthopaedic Surgery, Ajou University School of Medicine, Yeongtong-gu, Suwon, South Korea

- 65 ankles arthroscopy, CAI
- **63/65 (96.9%)** intra-articular lesions
  - 81.5% Soft tissue impingement
  - 38.6% ossicles at lateral malleolus
  - 29.2% syndesmosis widening
  - 23.1% OCL
  - 10.8% osteophyte formation
- **Syndesmosis widening** was strongest risk indicator for patients lack of satisfaction
- Odds Ratio 11.1(95%, CI: 2.2-55.4)
Background: Additional Considerations

- Syndesmotic injury CAN occur in athletes enduring chronic inversion and axial loading
- Traditionally 1-20% of ankle sprains are syndesmotic injury
- Sports 40-74% of all ankle sprains demonstrate syndesmotic involvement
Few Studies ACCURATELY identify injured structures with Imaging.
Must know your Anatomy and Biomechanics!
Anatomy Considerations

- **Ankle classically synovial hinge joint**
  - Triplaner motion
  - Functions much like a torque converter

- **Ankle really multiple joints**
  - Distal Tibiofibular joint
  - Talocrural
  - Subtalar
  - Consider the whole picture

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Ankle Motion

- Primarily in Sagital plane
  - DF – 15-20 deg
  - PF – 45-55 deg
- Most stable in DF – (Closed packed)
- Some slight talar ext rotation w/ DF
  - 5-6 deg
  - Foot Pronates slightly w/ DF
- Similar internal rotation w/ PF
- Syndesmosis stressed w/ Extremes of motion
  - DF/PF
  - **Functional throughout ROM**
  - Fibula is dynamic bone
    - Migrates distally, posteriorly, ER w/ PF, opposite for DF
    - Sarafin Anat Foot Ankle 1993
Lateral Ligaments

- AITFL
- ATFL
- CFL
- PTFL
Medial Side – Deltoid Ligament

- Superficial and Deep layers
  - Stabilize medial ankle
  - Limit A/P, Lateral trans of talus
  - Restricts talus Abd at TCJ
  - Sup: (3-4 bands)
    - resists hindfoot eversion
  - Deep: (2 bands)
    - resists ER Talus, Valgus load
Interosseus Membrane

• Thick tissue between Tibia/Fibula
• Active role in tib/fib function
• Helps to transfer compressive forces to tensile forces
• Lateral support to fibula for wt bearing
• Broader above vs below
Syndesmosis

- Binds distal tibia/fibula together
  - Provide lateral support
  - Attenuate forces
  - Stability for movement
- Fibula oriented from posterior proximal to anterior distal
- Four ligaments
  - AITFL
  - PITFL
  - Transverse
  - IOL
A Ring of Stabilization
Talus

- Large weight bearing surface
  - Multiple articulations
- Wider Anterior vs Post 2.5mm
- 60% of talus surface articular cartilage
  - Avg thickness 1.1mm W
  - Avg thickness 1.3 mm M
    - Less elastic vs knee
      - vanDijk CN, KSSTA 2010
- Chondral lesions
  - Medial vs Lateral
    - Ant Lateral
    - Post Medial
Syndesmotic Recess

Incisura:

- Fluid filled recess
- Connects with TCJt.
- Mean height 12.6mm
- Single celled synovium
- Linear recess increase with injury – 16.2mm vs. 12.6
- 54 vs. 1.4 cm

Kim JS, Radiology 2007;242:225-235
Tenderness Length

- Injury height varies HAS
- "Tenderness Length"
  - From tip of Fibula
- Predict disability
  - $5 + 0.93(TL) = \text{Days}$
  - ($P = 0.0001$)
- Important landmark
  - IOL
  - 5-6cm
Study by Hoefnagels

“Biomechanical Comparison of the Interosseus Tibiofibular Ligament and the Anterior Inferior Tibiofibular ligament
FAI 2007, 28(5) May

- IL Sig Stiffer then AITFL
  - 234 +/- 122 N/nm vs 162 +/- 64 N/mm (31%)

- Mean Failure Greater
  - 822 +/- 298 vs 625 +/- 255 (24%)

- During loading most failed via substance tears

- Plays key role in stabilizing ankle
HAS

- Above the Talocrural Jt
- Traditionally rotational in nature
  - Hyper-pronation injury
  - Often involve contact w/ another athlete
  - Inability to “push-off”, cut to affected side
- Involved in more treatments and disability time vs lateral
- Can have lasting long-term implications
Special Tests - Palpation

- **Palpate for tenderness**
  - Depends on evaluator's ability to find ligament/IM
  - Most frequently positive test – *Alonso*, JOSPT, 1998
  - 100% *Nussbaum*, AJSM 2001

- **Highly significant relationship between clinical and MRI findings** (P<.0001)
  - *Calder J*, Arthroscopy 2016
Background: Additional Considerations

• Location of swelling may indicate structures involved
  – Amount of swelling does not correlate with self-reported function after acute sprain
    • Man IO, MSSE 2005

• Point tenderness over injured ligaments is a good indicator of injured structures.
  • Fallat L, J Foot Ankle Surg 1998

• Sometimes HAS have minimal swelling

• Injury RARELY involves a single directional force.
Single Leg Hop Test

- **Functional Testing**
  - Inability to raise on their toes
    - Taylor

- **Progressional Assessment**
  - Double leg, single leg heel raise
  - Double leg hop, single leg hop
  - From toes, heel doesn’t touch the ground

- > Fib Loading at heel rise
  - Axial load exceeds BW
    - Whittle

- Raising on toes produces hindfoot inversion
- At heel lift, ankle DF, force vector lateral to ankle because of toe out
  - **Stress the syndesmosis!**

- Great sideline test!

Ring disruption = Functional disability

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Special Tests:

• **Dorsiflexion/External Rotation Stress Test**
  - **Kleiger Test**
  - Doesn’t measure instability
  - If present indicative of injury/irritation
    - Oglivie-Harris-JARS, 1994
  - Best inter-tester reliability
    - Alonso, JOSPT, 1998
    - Nussbaum 55/60, AJSM 2001
Squeeze Test

- **Squeeze Test**
  - Compress at mid calf
  - Causes separation of distal joint
    - Teitz Foot Ankle Int, 1998

- Least Positive Test,
  - + w/ Significant Inj
    - Alonso JOSPT, 1998
    - 20/60 - Nussbaum AJSM 2001

- + Test correlates w/ longer return
  - Hopkinson 1990, Taylor 1992,

- 9.5 x increased likelihood surgery
  - Calder 2016
Other Special Tests:

- **Cotton** –
  - Ankle N, grasp heel, M/L rock talus
  - + when extreme injury
  - Excessive translation only in sever
- **Fibular Translation Test**
  - + if excessive translation, boggy end feel
  - High rate FP
- **Tape Test**
  - Circumferential taping, Improve function/pain
    - Amendola N,
Limited Literature – 114 papers
- Evaluated 8 clinical tests
- Can’t rely on single test
  - Imaging necessary for diagnosis
- IR Reliability “Good” for ER Test (ICC\(_{2,1} > 0.70\))
- Other tests: “Fair-Poor” reliability
PLAIN RADIOGRAPHS

Rule out Fracture
- Frank vs Latent Diastasis

ANKLE SERIES

Lateral

Mortise
Radiographic Measurements

- Tibia fibula relationship
  - Tibiofibular clear space \{TFC\} (A-B)
    - 1 cm above plafond
    - <6mm AP, mortise
  - Tibiofibular overlap \{TFO\} (C-B)
    - 6mm or greater
    - < 42% of fibular width
  - Medial clear space \{MCS\} (E-F)
    - < 2-4mm
  - Measurements may vary w/ positioning
Stress Radiographs

- Debated Value
- Latent Diastasis
- AP/ Mortise views TFO, MCS
- Evidence: Category B

Porter, D. 2009 AAOS ICL. 58:575-581
- More sensitive vs Mortise view (>2mm)
  - Better ID partial and complete injuries
- <50% fibular overlap
  - Sensitivity – 0.67  PPV – 0.91
  - Specificity – 0.89  NPV – 0.63
- Rarely found + when wasn’t present
Bone Bruise/Occult fx

- Not much written in literature
- Don't frequently get MRI's acutely
- They do occur

Brown, KW – Am J Roentgenol; 182(1) 2004 - MRI study of 53 syndesmotic sprains - Evidence of Bone Bruise 24% acute, 4/36 chronic - Additional finding ATF injury 70%

Pinar, H – KSSTA, 1997; 5 (2) - MR w/ Gadolinium • 50% w/ injury to both ATF/CF • 16% isolated ATF sprains • More frequently Medial then lateral

Talus

Chan VO, Clin Radiol 2013
- Inversion, Medial Mal/Medial talus edema
- 92% complete ATF tear
- Delayed recovery, prolonged RTS

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Musculoskeletal Ultrasound

- Point of care use
- Dynamic
  - AITFL
- A lot of potential
  - Need more literature
- Learning curve
  - User dependent
  - Must know anatomy
High ankle sprain = Syndesmosis Injury

- Inherently Stable
- Normal Mortise

- Unstable Injury
- Widened Mortise

+ clinical exam
- Xrays

High ankle sprain
Syndesmosis disruption

Do you need additional imaging?
Additional Imaging: MRI

MRI:
- Not often done acutely
- Soft tissue + bone
  - Individual ligaments
  - stretched, wavy, irregular
  - Edema, bone bruise, OCL
  - Lambda Sign
    - Ryan PR, FAI 2014
- Cuts <3mm
- Doesn’t do a great job w/ instability
  - 50-65% sensitive

MRI/Arthrogram:
- Proximal dye leakage
- Increased recess ht
- Significantly increases sensitivity >90%
  - Kim JS, Radiology 2007
  - Brown KW, AJR 2004
  - Requires physician injection
**Syndesmotic injury:**

<table>
<thead>
<tr>
<th></th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exam</strong></td>
<td>Pain with Squeeze or ER stress test</td>
<td>Pain with Squeeze or ER stress test</td>
<td>Pain with Squeeze or ER stress test</td>
</tr>
<tr>
<td><strong>Tenderness</strong></td>
<td>Mild</td>
<td>Moderate</td>
<td>Intense</td>
</tr>
<tr>
<td><strong>Weight Bearing</strong></td>
<td>Full</td>
<td>Difficult</td>
<td>Impossible</td>
</tr>
<tr>
<td><strong>Radiographs</strong></td>
<td>No mortise widening</td>
<td>No mortise widening</td>
<td>Mortise Widening</td>
</tr>
<tr>
<td><strong>Edema</strong></td>
<td>Minimal</td>
<td>Moderate</td>
<td>Diffuse</td>
</tr>
</tbody>
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- **Non-Fx**
  - Based on ligaments (1-4)
  - Tenderness
  - Wt Bearing
  - Frank vs Latent diastasis
- **Based on height of tenderness**

**West Point Grading Scale**

*Gerber et al., 1998 FAI*

- 3 Injury of the posterior inferior tibiofibular ligament or avulsion of the posterior malleolus
- 4 Medial malleolus fracture or injury to the deltoid ligament
A Sub Category:
The “Low – High Ankle” Sprain

- Pain above talocrural joint
- Tenderness over AITF ligament
- Tenderness length < 6cm
- Mechanism primarily inversion—Can also be hyper–pronation
- Associated w/ individuals w/ 2nd degree lateral laxity (CFL inj)
- Previous Hx of lateral ankle sprain (Progression in injury?)
- Functional disability—Can’t hop from toes
- Shorter disability than traditional HAS
- More common than previously thought
- Painful ligament, anterior impingement, synovitis
- ATF injury, syndesmosis is less likely to be unstable
- Calder J, Arthroscopy 2016

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Proposed Grading Scale
Non-Fracture Syndesmotic Injury

First Degree:
- Low HAS
- <6cm prox tenderness
- Pt tender AITFL
- Can’t hop from toes
- Normal Xrays
- Associated with lateral laxity
  - CFL Injury
- Treatment conservative
  - NWB 2-4 days
  - 5-7 days avg disability

Second Degree:
- HAS
- > 6-10 cm prox tenderness
- >2 ligament tenderness
- Can’t hop
- Rotational mechanism
- Lateral View Stress Xray
- Consider MRI w/ gadolinium actuely
- 2-4 week avg recovery,
- Non-wt bearing 4 days
- Consider arthroscopy

Third Degree:
- Tenderness >10cm
- Suspect diastasis, assoc PMT injury, deltoid injury
- Stress Xrays
- MRI w/ gadolinium
  - Consider 3D Wt Bearing CT if neg MRI
- Most likely surgical candidate,
Syndesmosis and Lateral Ankle Sprains in the National Football League

DARYL C. OSBAHR, MD; MARK C. DRAKOS, MD; PADHRAIG F. O’LOUGHLIN, MD; STEPHEN LYMAN, PHD; RONNIE P. BARNES, MA, ATC; JOHN G. KENNEDY, MD; RUSSELL F. WARREN, MD

Polled NFL Team Physicians:
- Non-Diastasis injury
- Conservative Tx
  - 28 would use a boot
    - 14 WBAT
    - 12 PWB
    - 6 NWB
  - 3 Cast
Motion even w/ immobilization

Kadakia A, FAI Apr 2008

Weight bearing in a boot the ligament is stressed

Cast—Fiberglass Cast (8.4°); XP—Pneumatic Walker(15.4°); FP—Foam Walker (16°);
DJ—MaxTrax Walker (19°); SP—SP Walker (39°);
None—No immobilization
Conservative/Aggressive Approach

- Need a period of NWB
  - 4 days
- Most stable in neutral
- Posterior splint vs boot
- Remove daily for therapy
  - Modalities
  - MREs
  - ROM
- Progress intensity/duration
- Low level sport specific drills
- Hop 10x from toes before start running
- Control posterior ankle pain
  - Nussbaum AJSM 2001
“HAS often don’t respect academic degrees or fancy tape jobs”

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