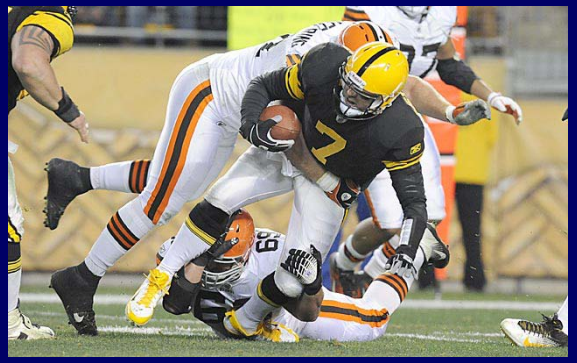


Treatment of Syndesmotic Injuries

Kenneth J. Hunt, M.D.
Stanford University
Department of Orthopaedic Surgery

STANFORD
SCHOOL OF MEDICINE

Syndesmosis Injuries

My disclosures are up to date on AAOS web site

No disclosures pertinent to this topic

Introduction

Syndesmosis Injury (High Ankle Sprain)

Introduction

Syndesmosis Injury (High Ankle Sprain)

High ankle sprain = Syndesmosis Injury

High ankle sprain

- Inherently Stable
- Normal Mortise
- Able to WB

Syndesmosis disruption

- Unstable Injury
- Widened Mortise
- Disabling

Injuries to the Syndesmosis

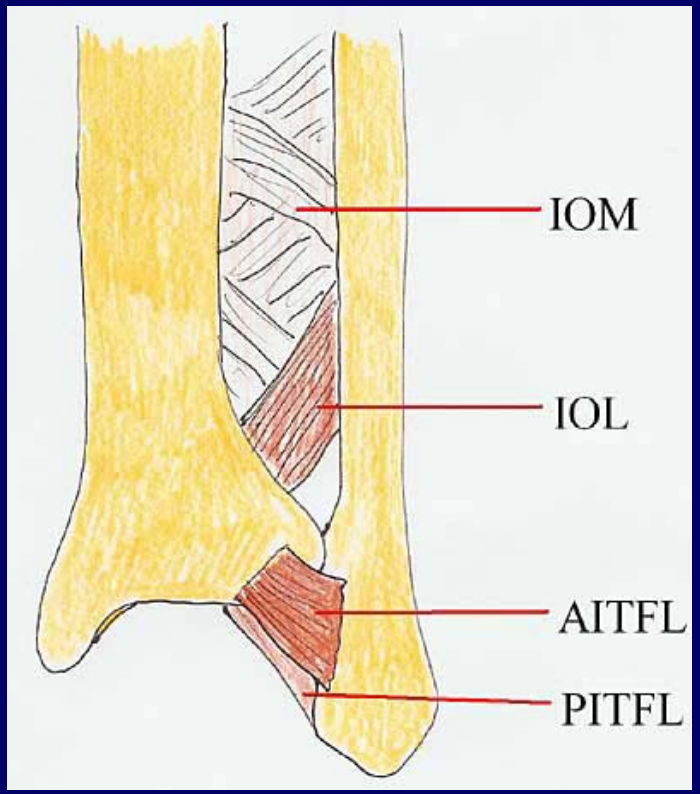
–Anatomy

–Mechanism & Incidence

–Diagnosis

–Injury Kinematics

–Treatment Indications



Injuries to the Syndesmosis

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–Mechanism & Incidence

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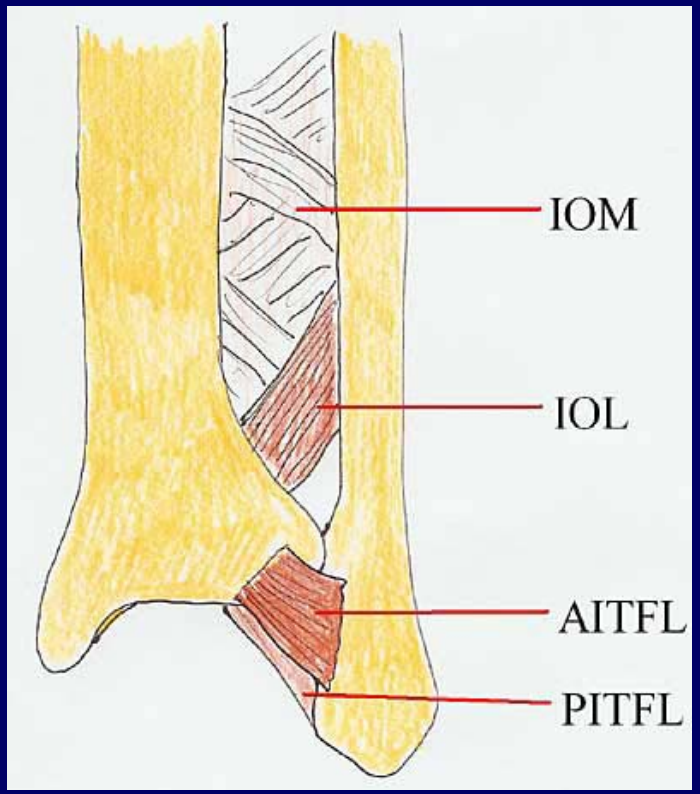
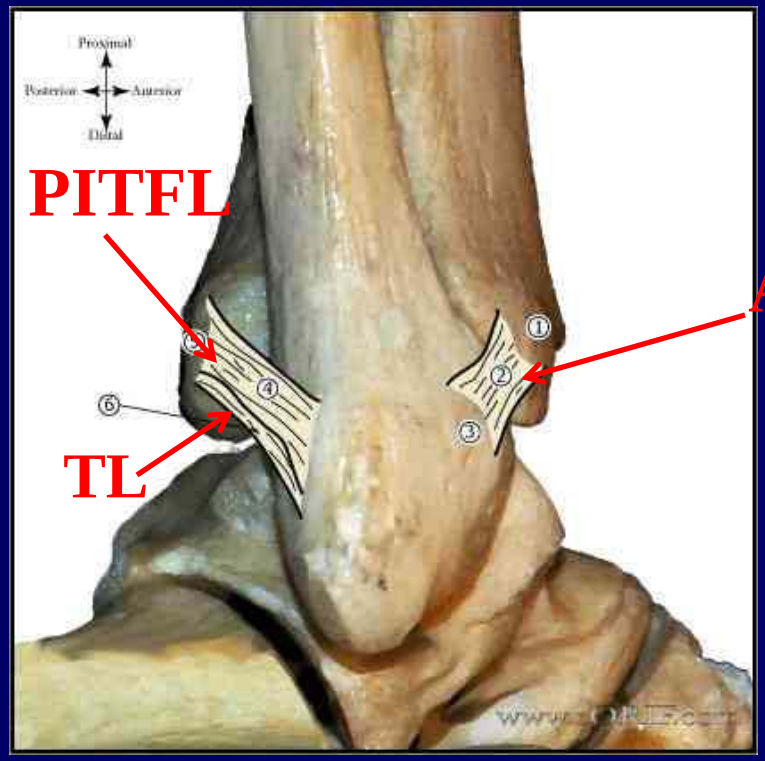


Syndesmosis Anatomy

Syndesmosis Ligaments

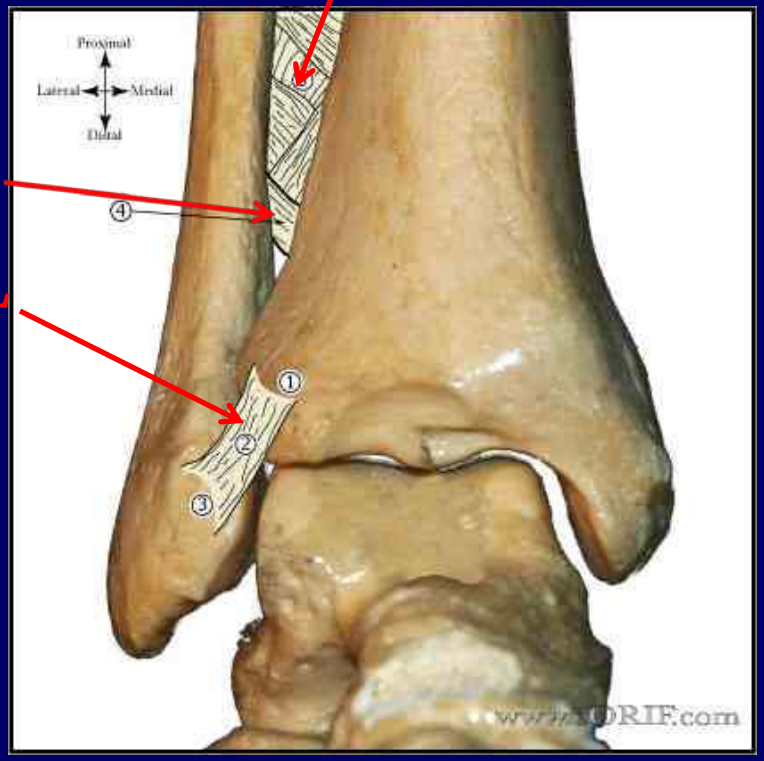


Lateral view

IOM

IOL

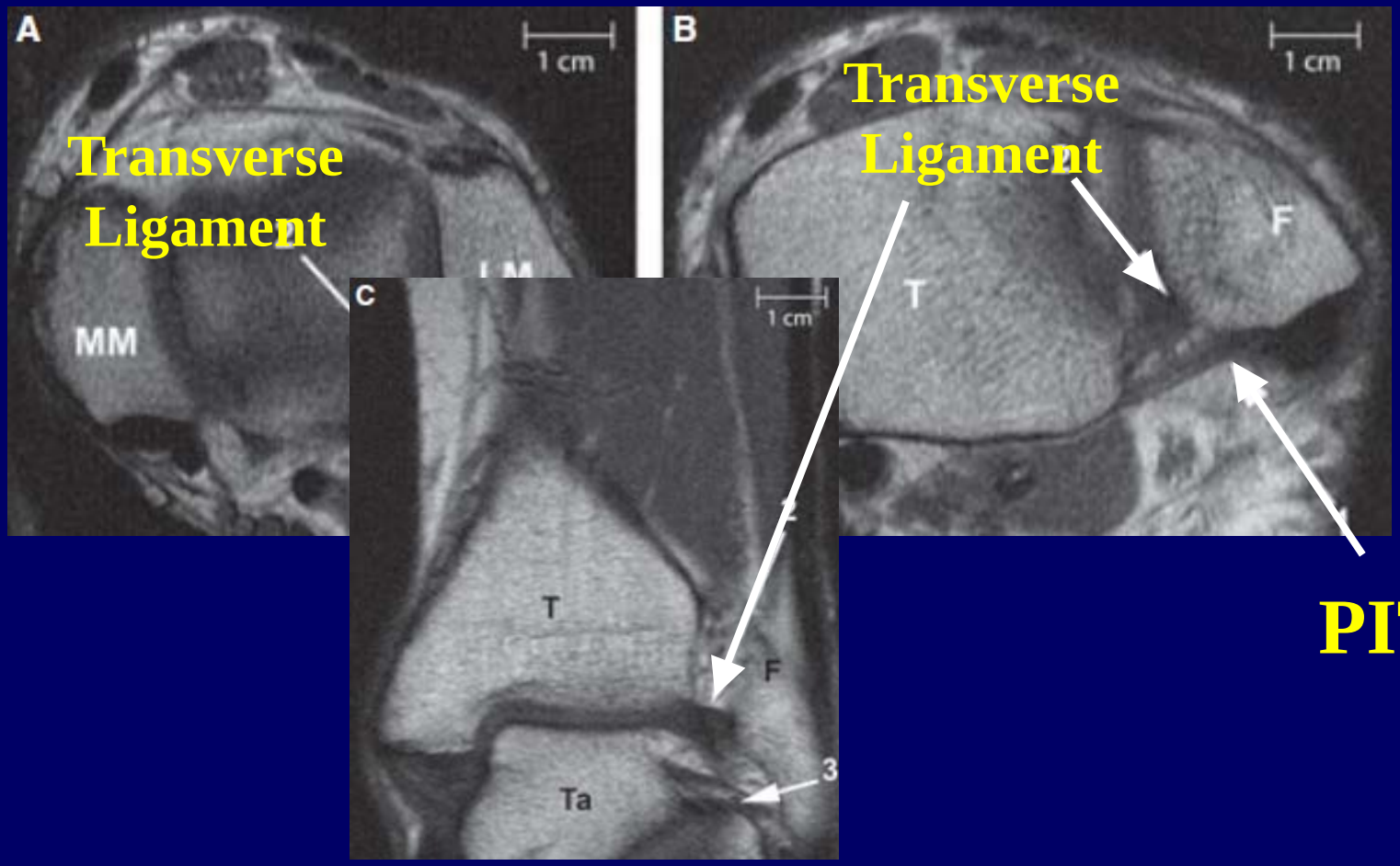
AITFL



Anterior view

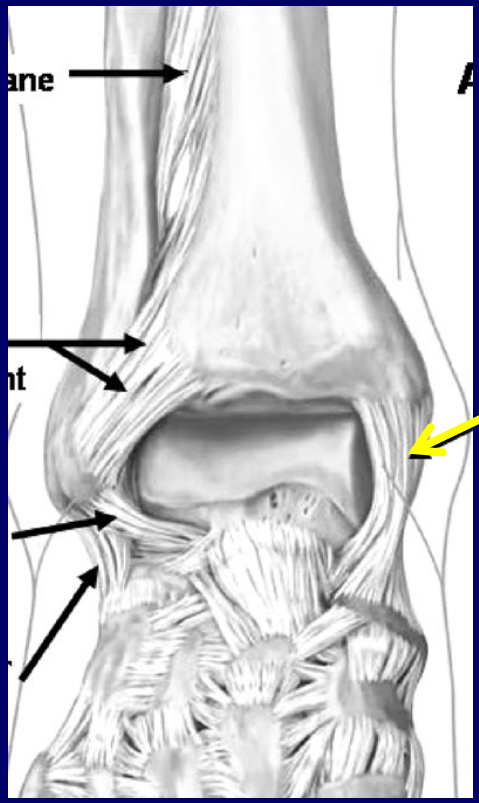
Syndesmosis Anatomy

Transverse Ligament



Syndesmosis Anatomy

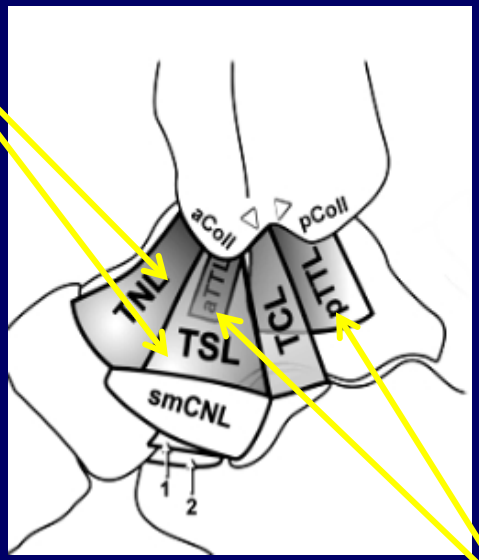
Deltoid Ligament



Syndesmosis Anatomy

Deltoid Ligament

Superficial



Deep

Injuries to the Syndesmosis

–Anatomy

–Mechanism & Incidence

–Diagnosis

–Injury kinematics

–Treatment Indications

Injury Mechanism

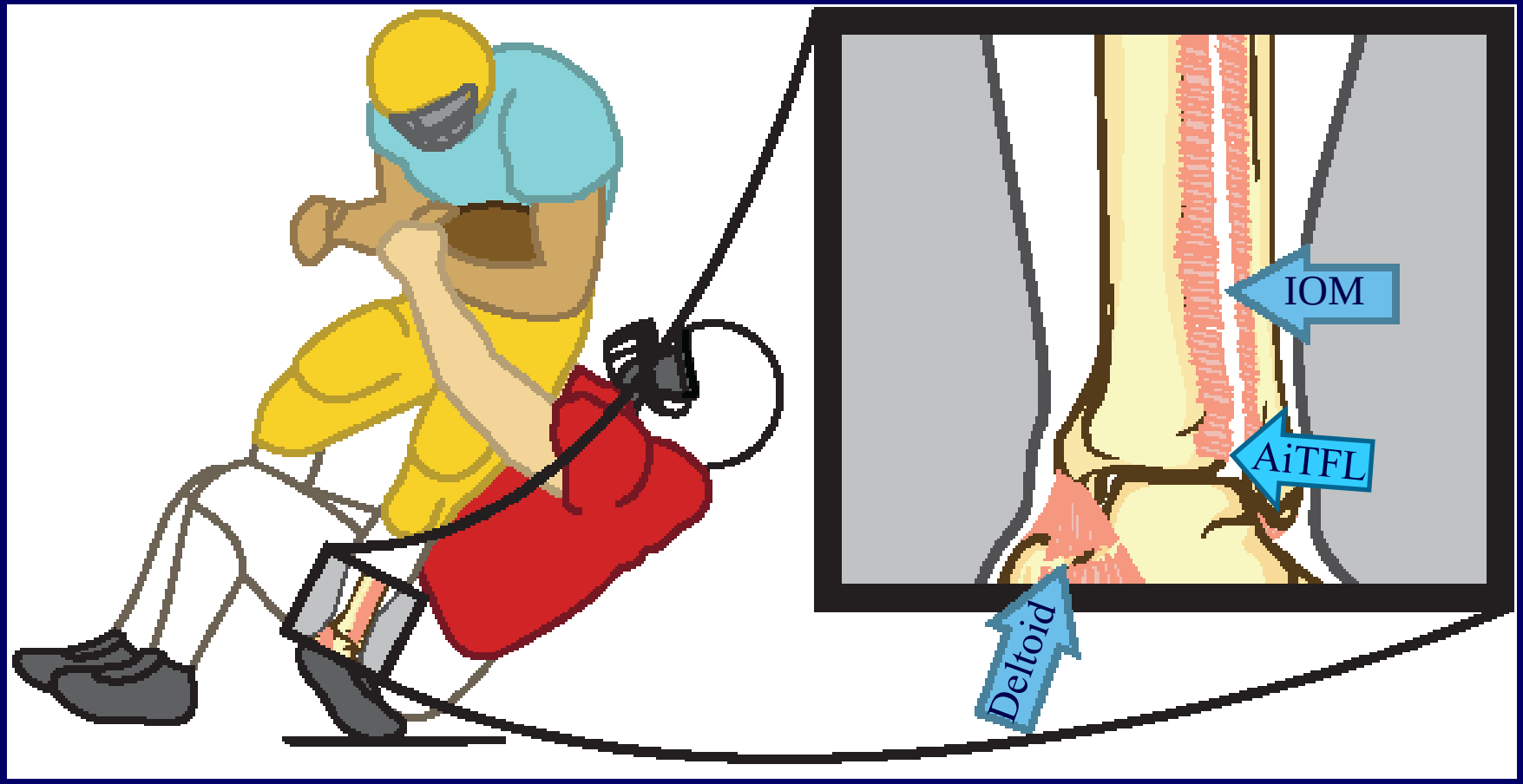
Ankle Eversion

Injury Mechanism

Ankle External Rotation

Injury Mechanism

Syndesmosis Injury (High Ankle Sprain)



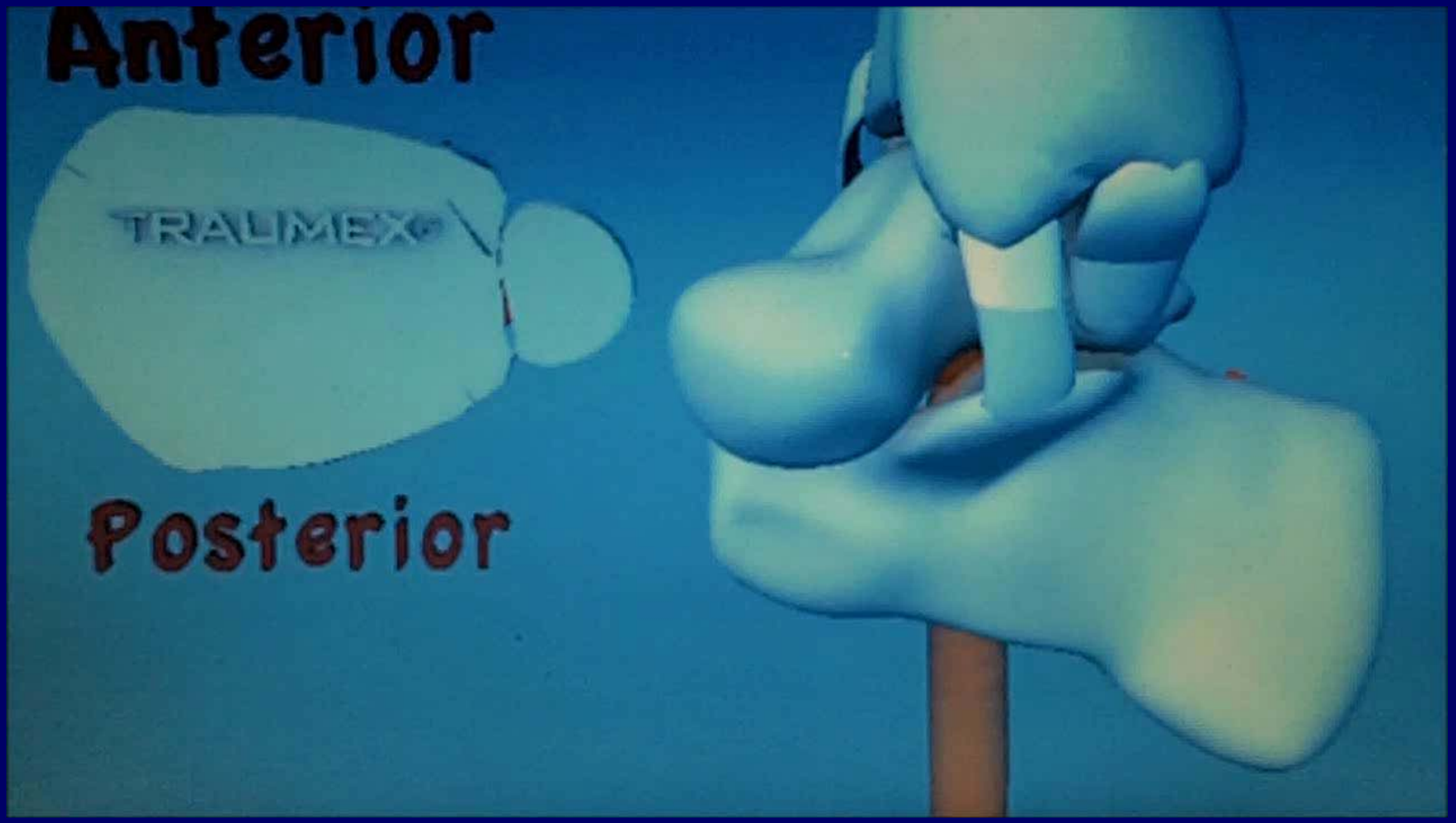
Injury Mechanism

Associated with Fracture

- We most often see complete syndesmosis disruption with fractures

Injury Mechanism

Pronation External Rotation



http://www.youtube.com/

Incidence

Incidence of Syndesmosis Injury

Reported Incidence Increasing

- West Point studies
  - Hopkinson et al., (1990 FAI)
    - 1% of ankle sprains (15 in 3.5 yrs)
  - Waterman et al., (2011 AJSM)
    - 6.7% of all ankle sprains

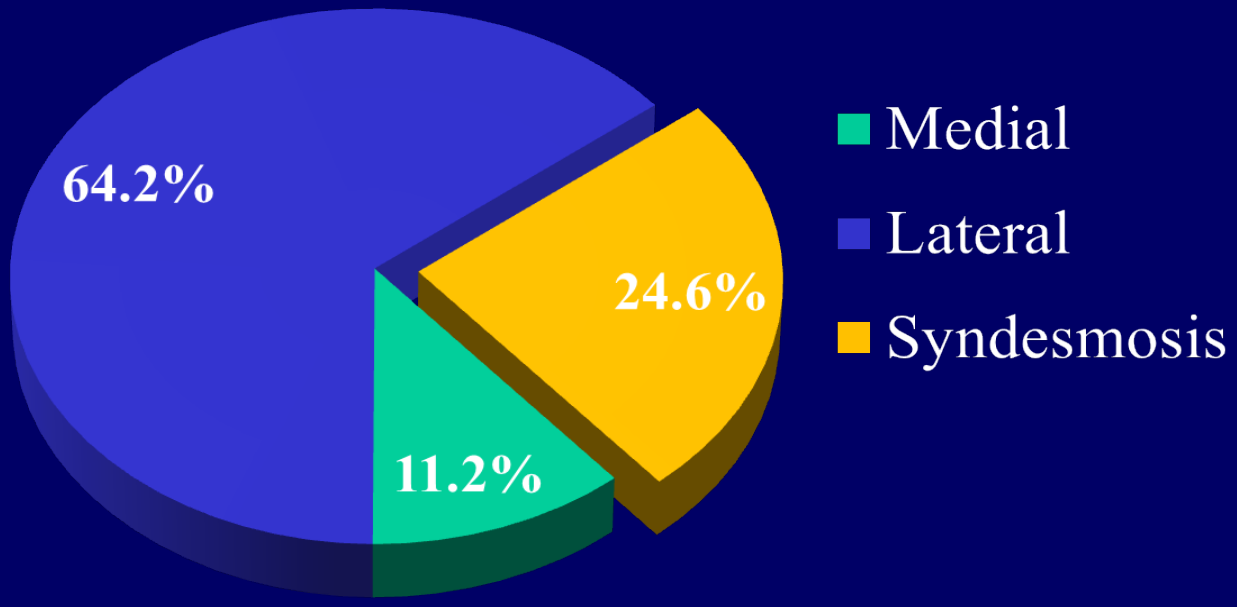
- NFL combine (2006)[1]
  - 15% of players reported history of syndesmosis injury
- Predictive of long-term dysfunction[2]

1. Kaplan et al., 2011 AJSM
2. Gerber et al., 1998

Incidence

Incidence in Football

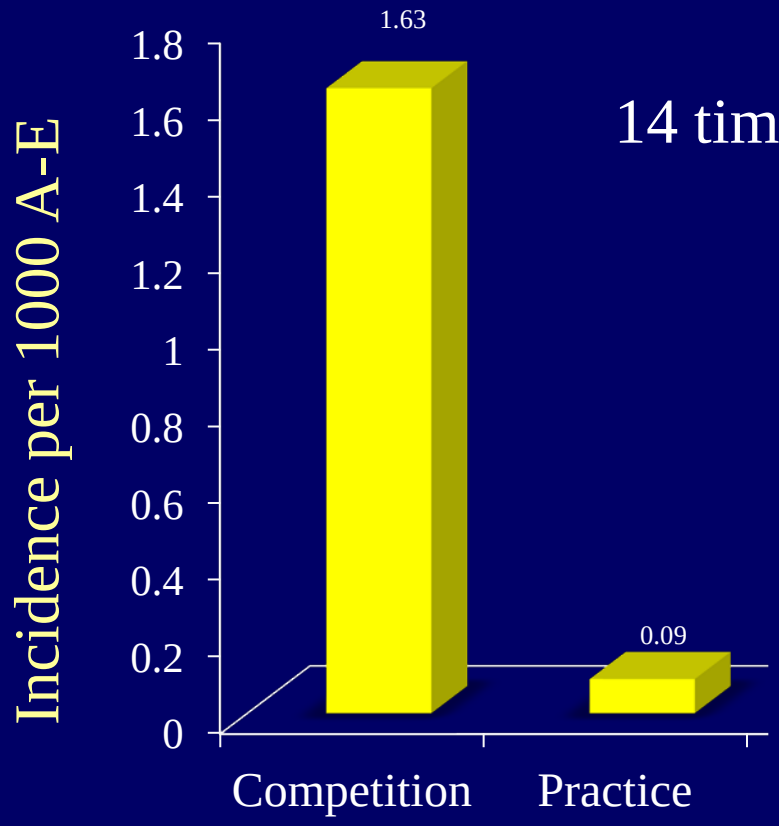
- NCAA Injury Surveillance System (ISS)
  - 2004 through 2009



Hunt et al., 2013 CJSM

Incidence

Practice Vs. Competition

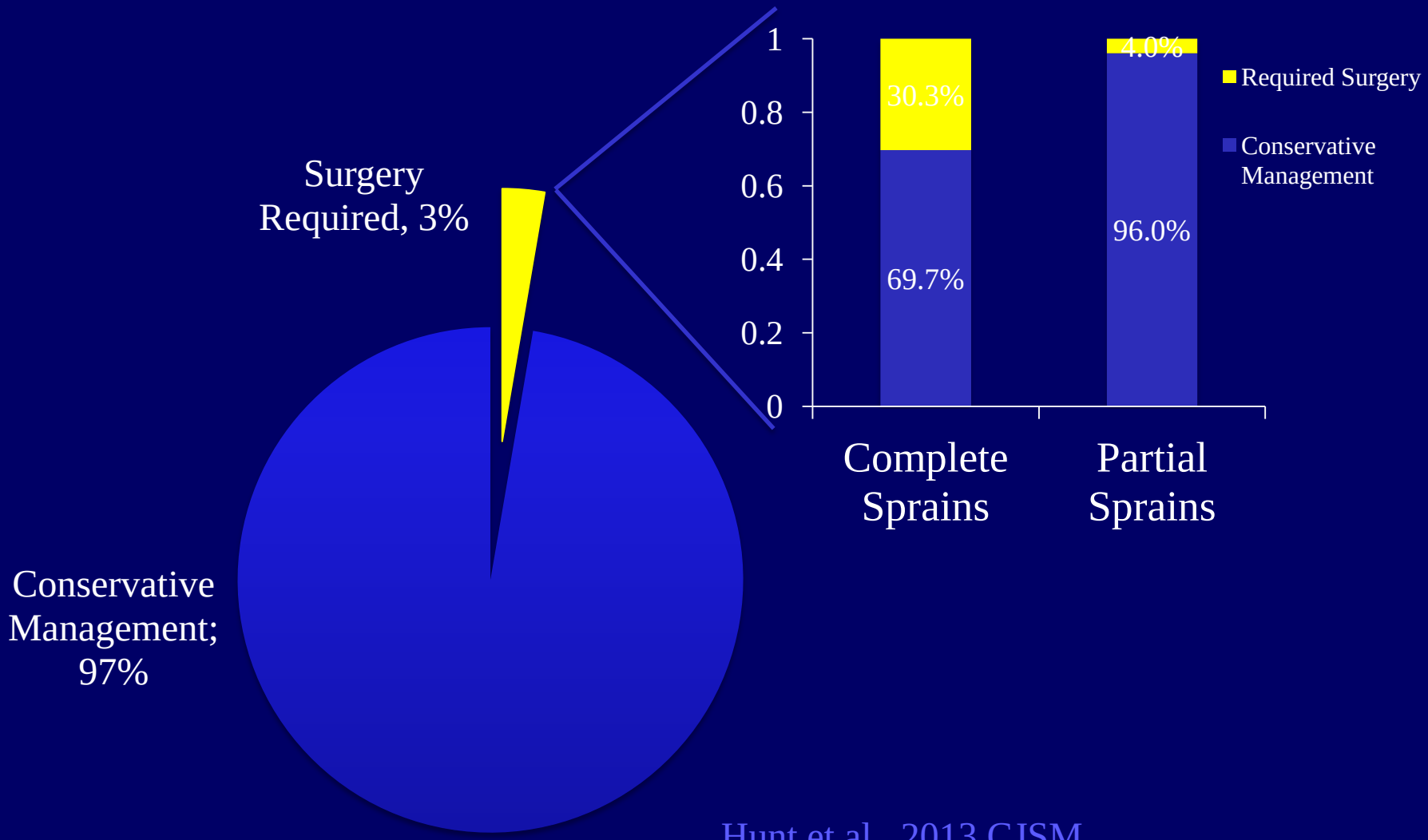


14 times higher

Hunt et al., 2013 CJSM

Incidence

Surgical Intervention



Hunt et al., 2013 CJSM

Syndesmosis Injury

Associated with Fracture

- 12-17% of ankle fractures have syndesmotic injury
  - Mostly PER (Weber C)
    - Weening and Bhandari, 2005
    - Parikenen et al., 2011 JBJS
- In cases with **no widening** on static x-ray
  - 33% of Weber B injuries (SER)
    - Jenkinson et al. 2005 JOT

Injuries to the Syndesmosis

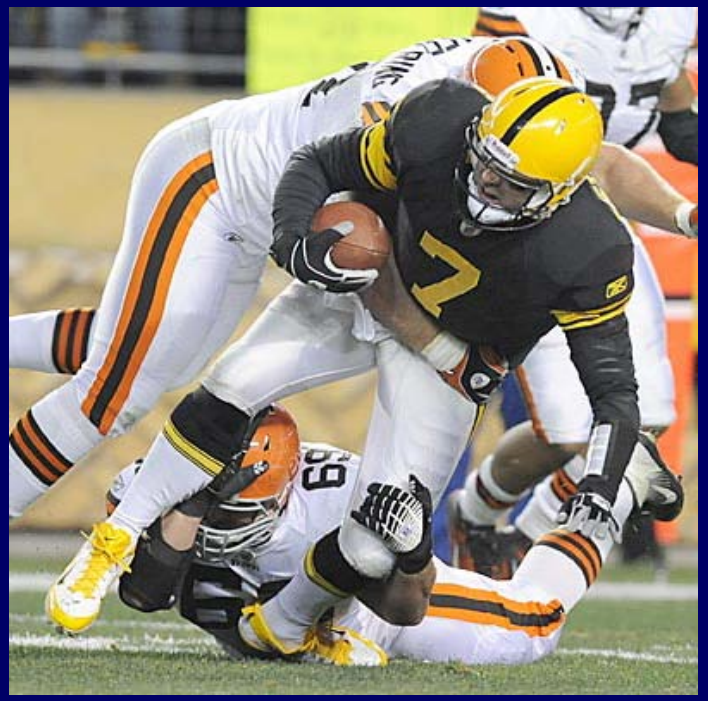
–Anatomy

–Mechanism & Incidence

–Diagnosis

–Injury kinematics

–Treatment Indications



Classification

- No broadly accepted classification scheme
- West Point Grading System

	Grade I	Grade II	Grade III
Exam	Pain with Squeeze or ER stress test	Pain with Squeeze or ER stress test	Pain with Squeeze or ER stress test
Tenderness	Mild	Moderate	Intense
Weight Bearing	Full	Difficult	Impossible
Radiographs	No mortise widening	No mortise widening	**Mortise Widening**
Edema	Minimal	Moderate	Diffuse

Gerber et al., 1998 FAI

Syndesmosis Injuries

Physical Examination

- Gait

Syndesmosis Injuries

Physical Examination

- Gait
- Palpation
  - Tender over syndesmosis
  - Deltoid ligament
  - Malleoli
  - Check proximal fibula
    - (Maissoneuve)

Syndesmosis Injuries

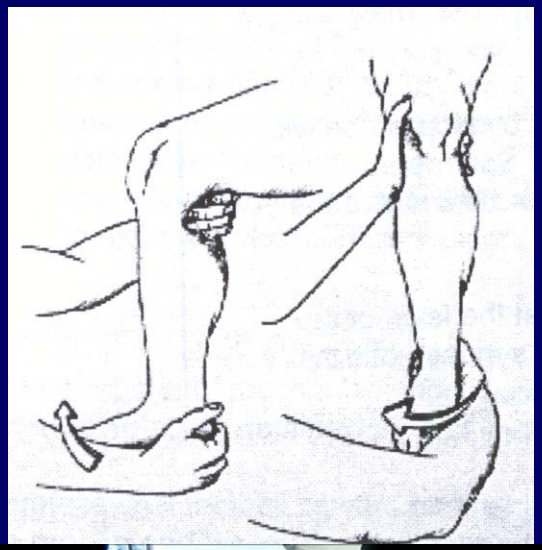
Physical Examination

- Gait
- Palpation
- Squeeze test
  - Produces pain in syndesmosis
  - Very reliable (Hopkinson)

Syndesmosis Injuries

Physical Examination

- Gait
- Palpation
- Squeeze test
- External rotation test
  - Sitting and standing
  - Produces pain in syndesmosis



Syndesmosis Injuries

Physical Examination

- Gait
- Palpation
- Squeeze test
- External rotation
- Hook test
  - Lateral Heel Translation

Syndesmosis Injuries

Physical Examination

- Gait
- Palpation
- Squeeze test
- External rotation test
- Hook test
- Heel rise test
  - Decreased strength
  - Pain with push-off

Spaulding S. 1995. FAI

Syndesmosis Injuries

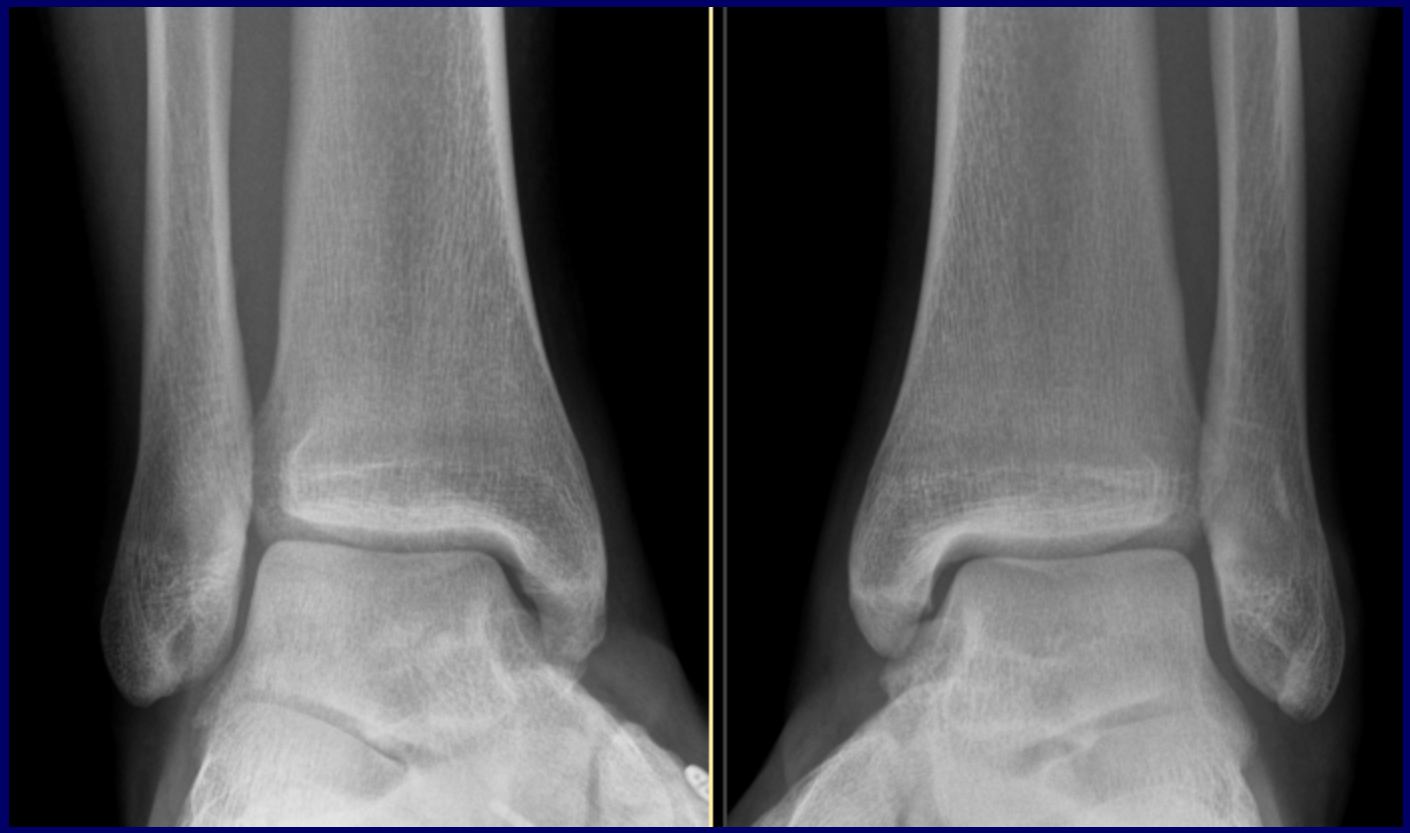
Physical Examination

- Gait
- Palpation
- Squeeze test
- External rotation test
- Hook test
- Heel rise test
- Stabilization test

Williams, Amendola 2007 AJSM

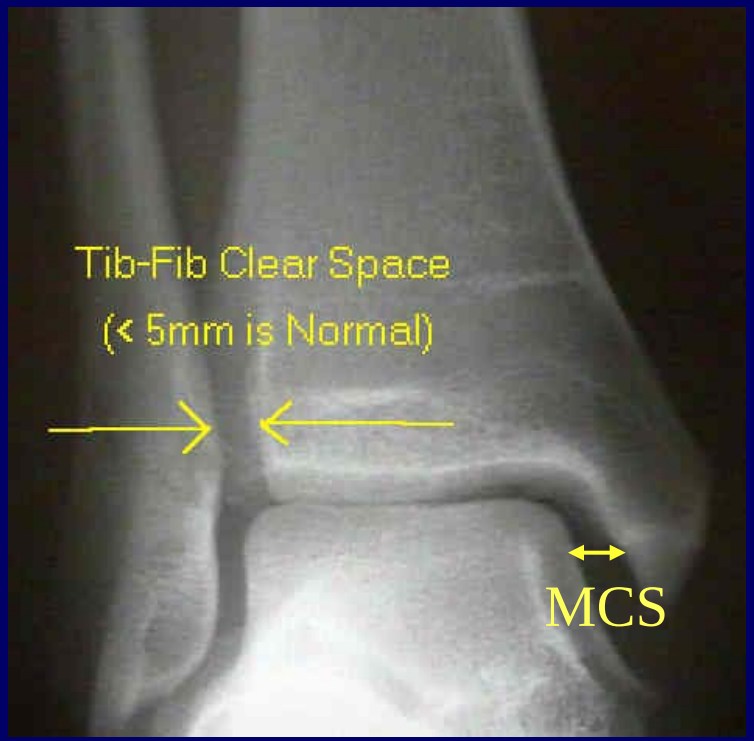
Radiographic Analysis

- WB x-rays
  - Three views



Radiographic Analysis

Stress Radiographs



>2 mm >2 mm

Porter, D. 2009 *AAOS ICL*. 58:575-581.

Radiographic Analysis

Stress Radiographs

Syndesmosis Injury

Diagnostic studies

- Radiographs are not reliable to detect injury

Beumer et al., 2003 Acta Orthop Scand

Syndesmosis Injury

Diagnostic studies

- Radiographs are not reliable to detect injury
- Intraoperative stress radiography

Test	Sensitivity	Specificity
External Rotation Stress	0.58	0.96
Hook Test (Lateral Translation)	0.25	0.98

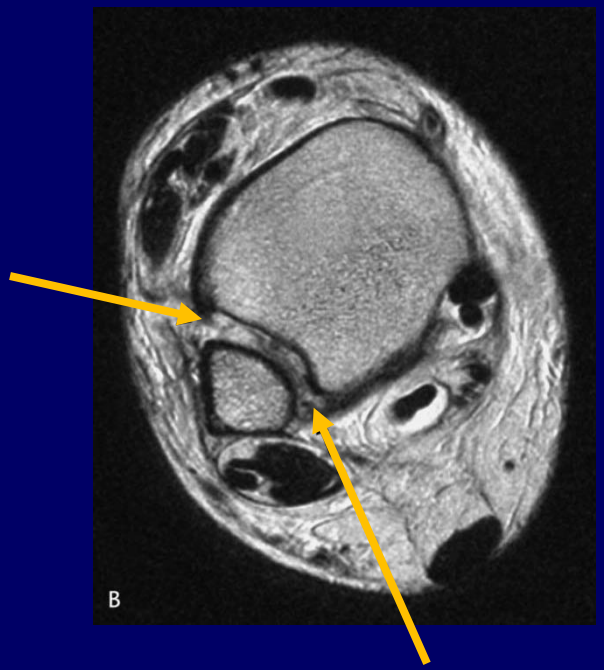
Mild and Moderate Injuries much more difficult to detect

Parakinen et al., 2011 *J Bone Joint Surg Am*

Syndesmosis Injury

Diagnostic studies

- Radiographs are not reliable to detect injury
- Intraoperative stress radiography
- MRI more sensitive and accurate



Hermans et al., 2012 *Skeletal Radiology*. 41:787-81
Oae, Takao, et al. 2003 *Radiology*. 227:155–161.

Syndesmosis Injury

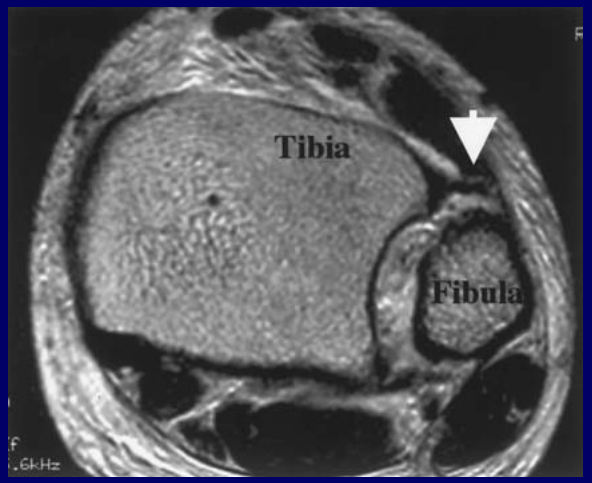
Diagnostic studies

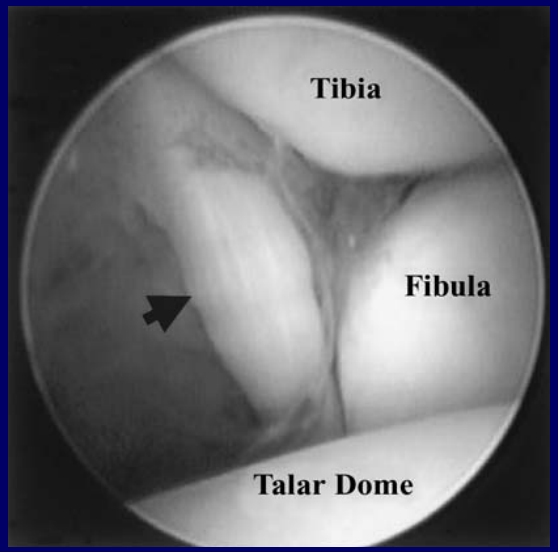
Arthroscopy

Syndesmosis Injury

Diagnostic studies

- Accuracy
  - AP x-ray 63%
  - Mortise x-ray 71%
  - MRI 96%
  - Arthroscopy 100%





Takao et al. 2003 JBJS Br

Injuries to the Syndesmosis

–Anatomy

–Mechanism & Incidence

–Diagnosis

–Injury Kinematics

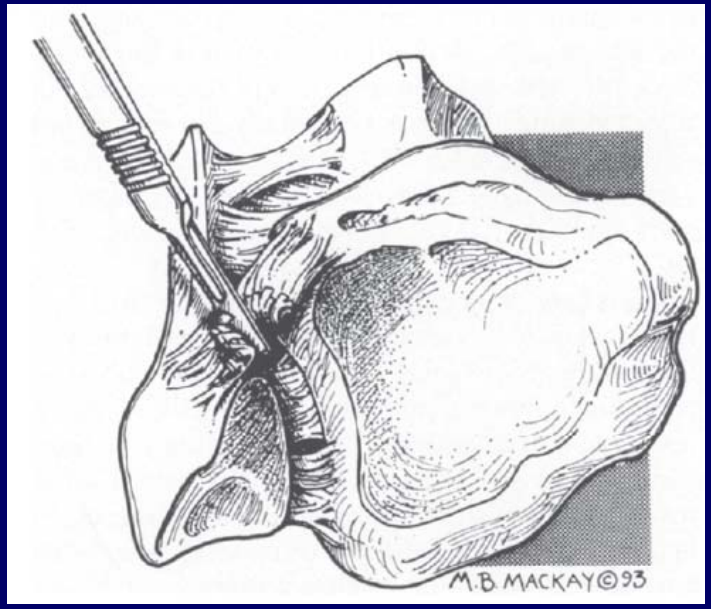
–Treatment Indications

Syndesmosis Ligaments

Relative Importance

Disruption of the Ankle Syndesmosis: Biomechanical Study of the Ligamentous Restraints

Ogilvie Harris et al. 1994



- 35% for the AITFL
- 33% for TL
- 22% for IOL
- 9% for the PITFL

Syndesmosis Injury

Stress Radiography vs. Kinematic Data

Cadaveric model used to determine:

1) Radiographic widening
2) Rotational and linear displacement

of the talus and the fibula relative to the tibia with sequential syndesmosis ligament injury

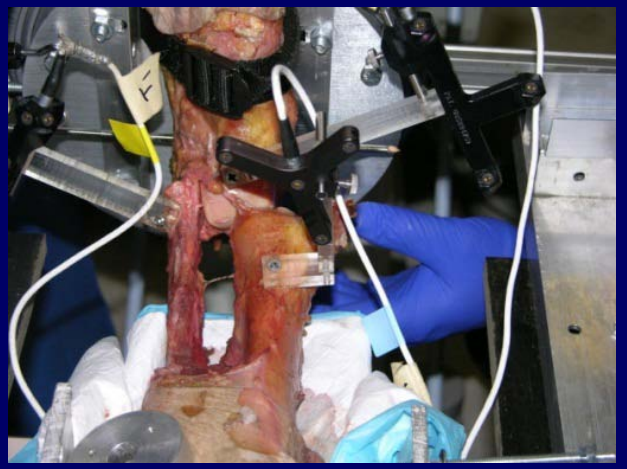
Hunt et al., 2012 AOSSM

Syndesmosis Injury

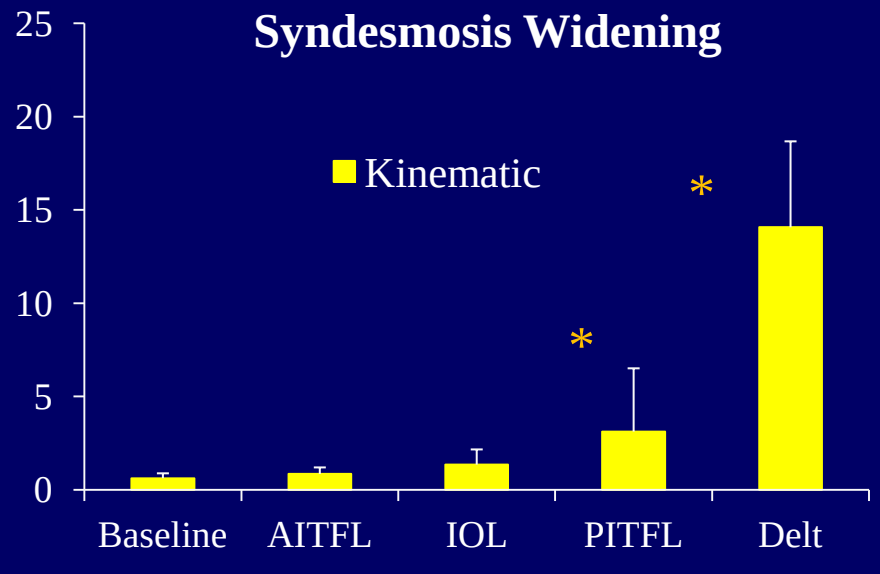
Stress Radiography vs. Kinematic Data

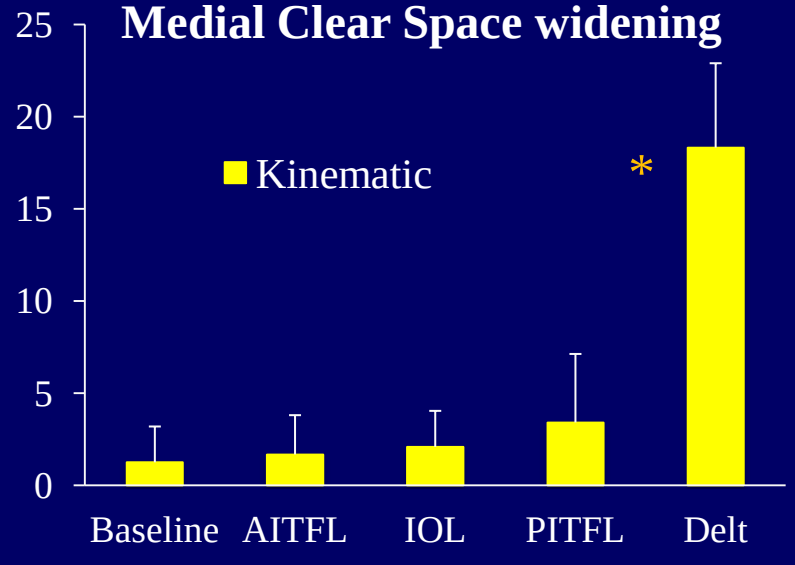
Hook test (lateral translation)

- Widening of syndesmosis and medial clear space only significantly different after release of PITFL and deltoid
- No significant rotation of talus or fibula



*p<0.5



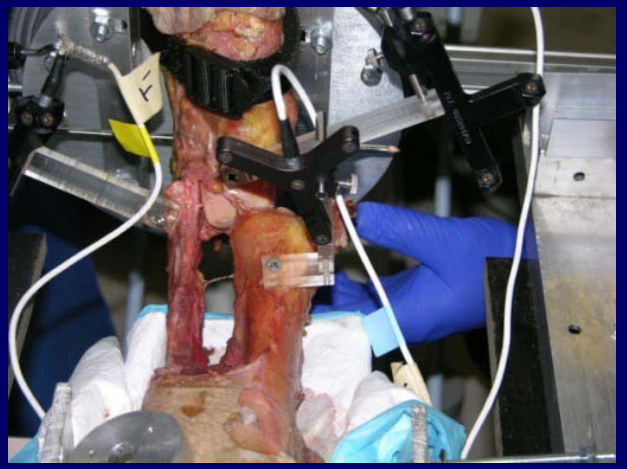


Syndesmosis Injury

Stress Radiography vs. Kinematic Data

Hook test (lateral translation)

- Widening of syndesmosis and medial clear space only significantly different after release of PITFL and deltoid
- No significant rotation of talus or fibula
- High correlation between x-ray and kinematics



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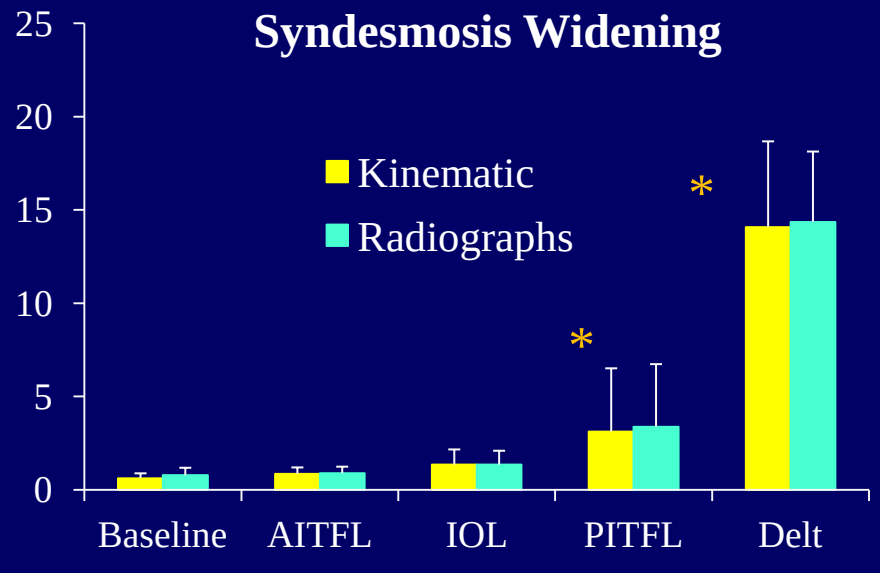
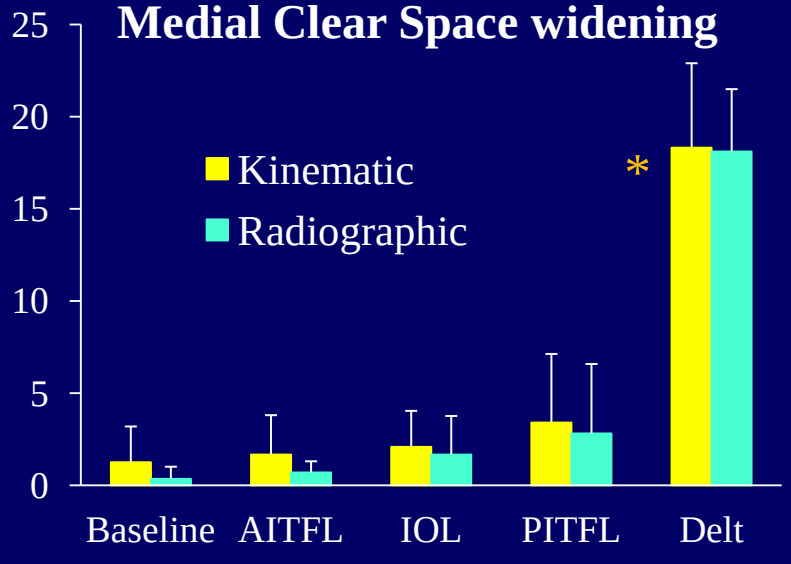


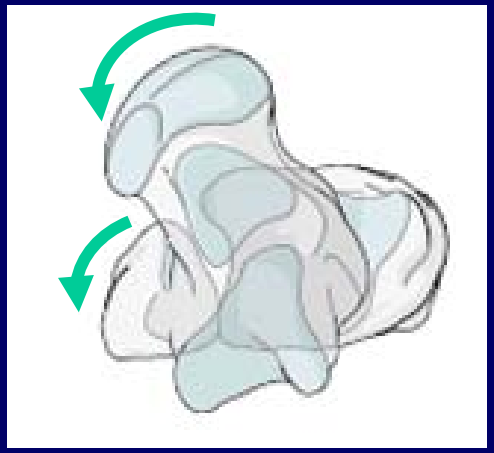


Syndesmosis Injury

Stress Radiography vs. Kinematic Data

External Rotation

- Syndesmosis widens after PITFL release
- Medial clear space widens after PITFL release
- Radiographic values lower



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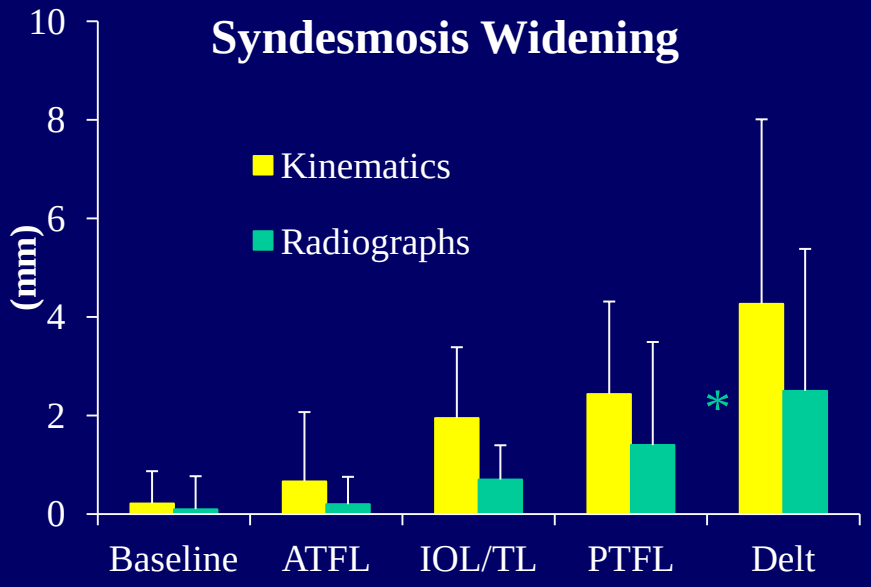
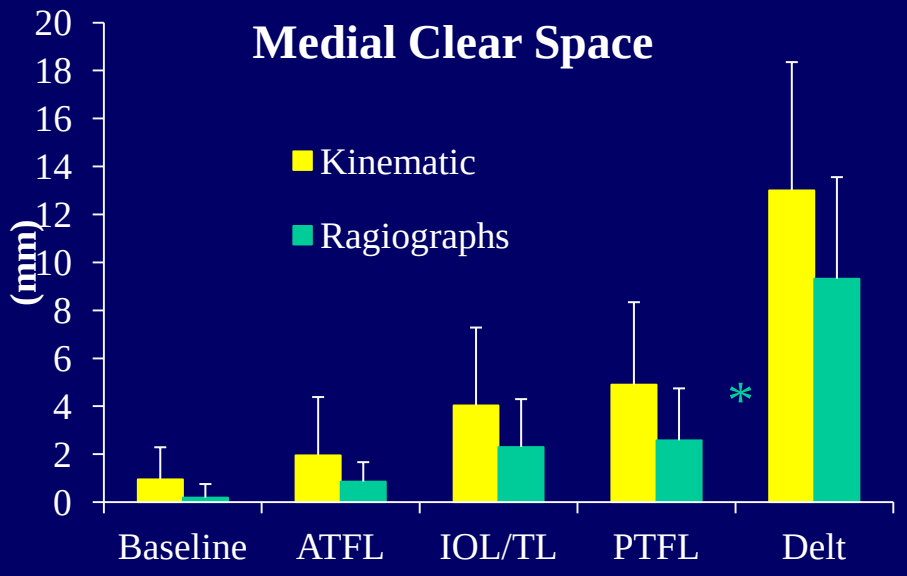


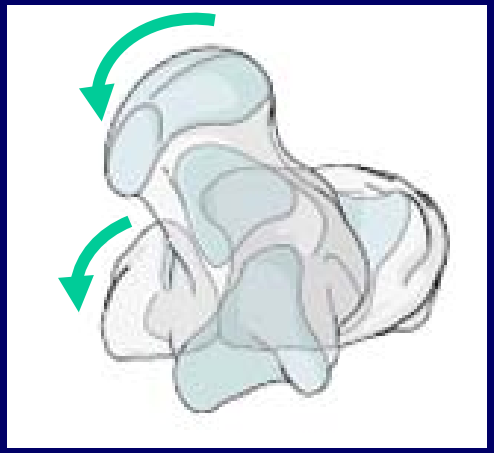


Syndesmosis Injury

Stress Radiography vs. Kinematic Data

External Rotation

- Talus external rotation increased significantly after AITFL sectioning
- Fibular external rotation increased significantly after AITFL and IOL



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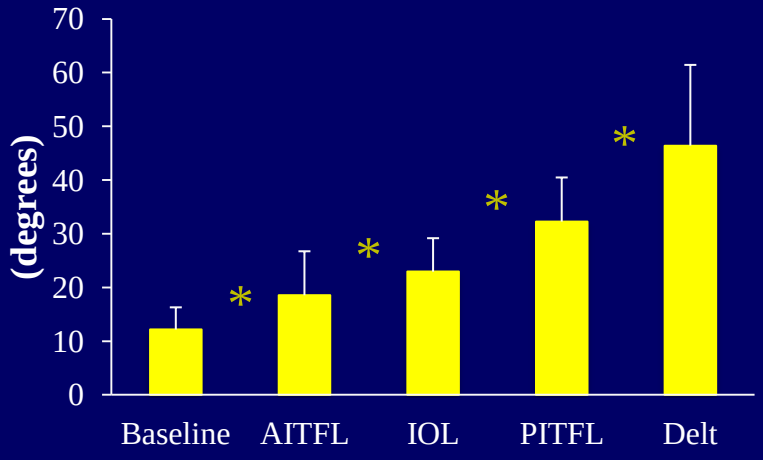
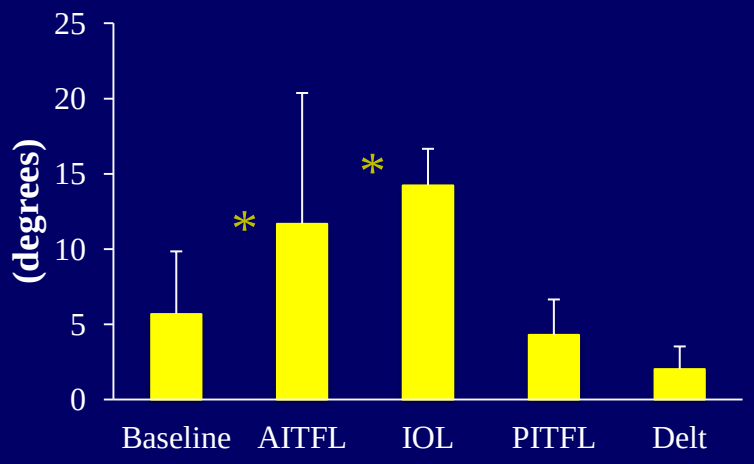
Talus Rotation



Fibula Rotation



Syndesmosis Injury

Stress Radiography vs. Kinematic Data

Point 1: Stress radiography not a reliable indicator of mild or moderate syndesmosis injuries.

Particularly External Rotation Stress

Hunt et al., 2012 AOSSM

Syndesmosis Injury

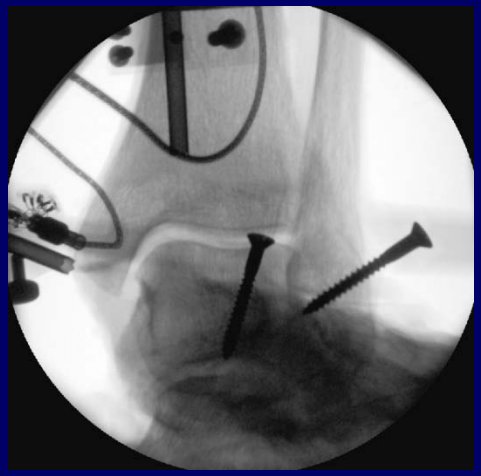
Stress Radiography vs. Kinematic Data

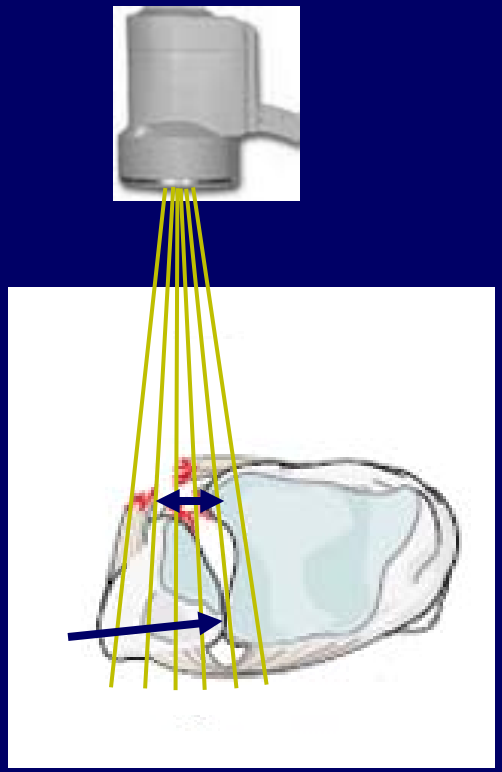
Point 1: Stress radiography not a reliable indicator of mild or moderate syndesmosis injuries.

Syndesmosis Injury

Stress Radiography vs. Kinematic Data

Point 1: Stress radiography not a reliable indicator of mild or moderate syndesmosis injuries.



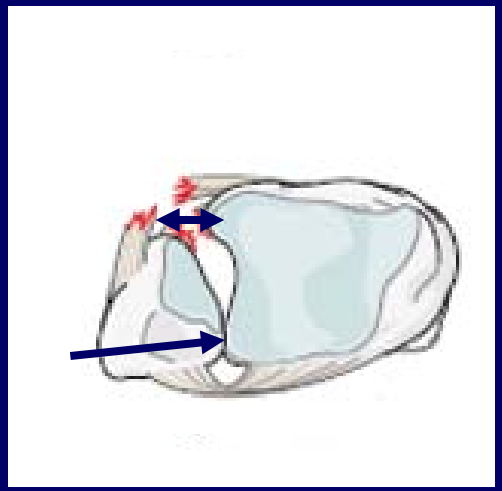


Syndesmosis Injury

Stress Radiography vs. Kinematic Data

Point 1: Stress radiography not a reliable indicator of mild or moderate syndesmosis injuries.

MRI likely more reliable

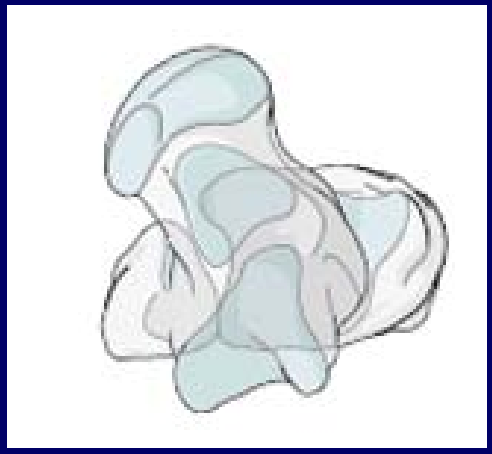


Syndesmosis Injury

Stress Radiography vs. Kinematic Data

Point 1: Stress radiography not a reliable indicator of mild or moderate syndesmosis injuries.

Point 2: Significant rotation of talus and fibula occur during external rotation, even with moderate syndesmosis injury



Injuries to the Syndesmosis

–Anatomy

–Mechanism & Incidence

–Diagnosis

–Injury Kinematics

–Treatment Indications

Syndesmosis Injuries

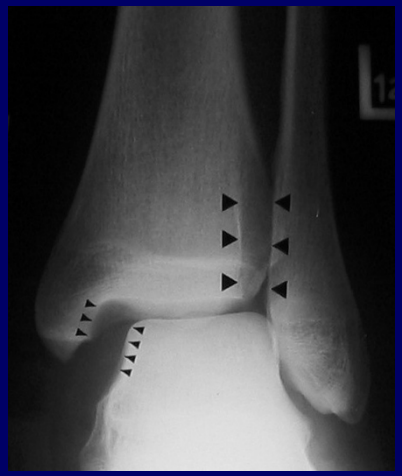
Surgical Indications

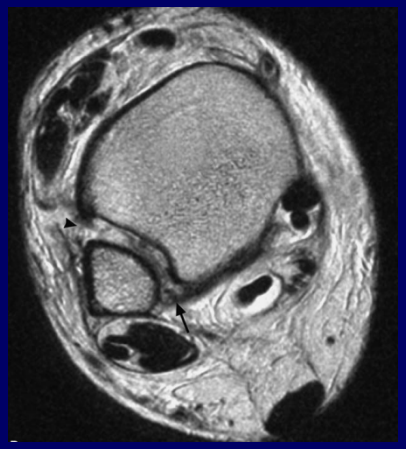
- General Points
  - Most ligamentous injuries treated conservatively
    - Complete ligamentous injuries treated surgically
  - Most fractures treated surgically
  - Very little prospective outcomes data
    - Primarily Grade "**B**" and "**Insufficient**" Evidence
    - Almost all on fracture-associated

Syndesmosis Injuries

Surgical Indications

- Conservative treatment
  - Mild and moderate high ankle sprains
- Surgical Stabilization
  - Clear widening of medial clear space
    - Standing x-ray
    - Stress x-ray
  - Disruption of PITFL and Deltoid
    - MRI scan
  - Most fractures with syndesmosis injury





Syndesmosis Injuries

High Ankle Sprain

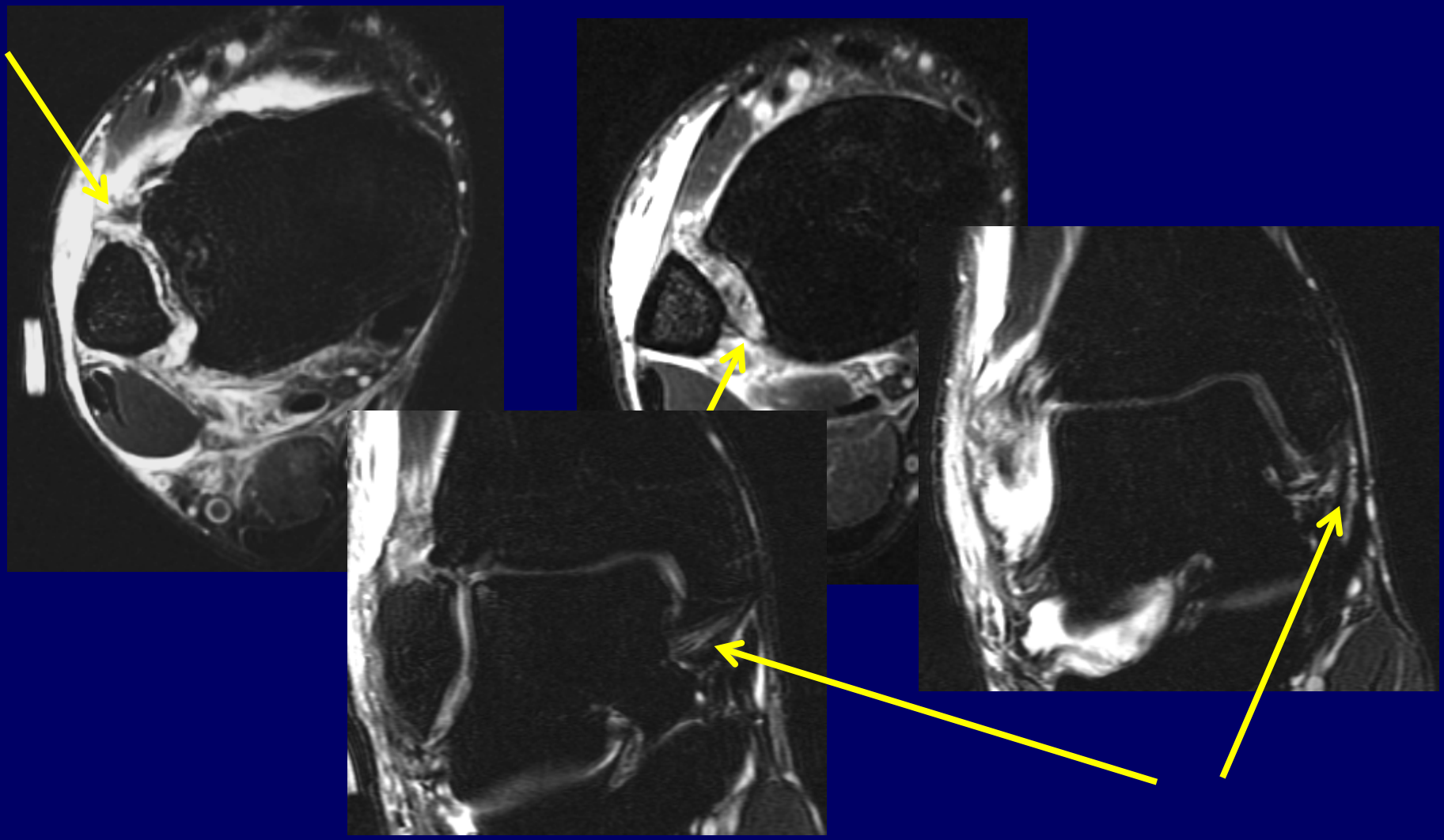
Syndesmosis Injuries

High Ankle Sprain

- Examination
  - Syndesmosis TTP
  - Pain with ER
  - Pain with Hook test
  - Pain with squeeze
  - No instability
  - Able to heel rise

Syndesmosis Injuries

High Ankle Sprain



Syndesmosis Injuries

High Ankle Sprain

- Treatment course
  - CAM boot until pain-free
  - Transitioned to brace
  - On field progression
  - Bracing and taping
- Returned to play 3 weeks

Syndesmosis Injuries

Surgical Indications

- In cases requiring stabilization
  - 2 fixation Options:

Screws

Suture Buttons

Syndesmosis Injuries

Surgical Indications

- In cases requiring stabilization
  - 2 fixation Options:

Evidence-based Approach to Treatment of Acute Traumatic Syndesmosis (High Ankle) Sprains

Dec 2006

Annunziato Amendola, MD, Glenn Williams, PhD, PT, ATC,† and Dan Foster, PhD, ATC‡*

Ankle Syndesmotic Injury

JAAOS, 2007

Charalampos Zalavras, MD, PhD
David Thordarson, MD

No mention of suture button

Screws

Suture Buttons

Syndesmosis Injuries

Surgical Indications

- Outcomes with screws
- Level IV Retrospective, 39 patients
  - Functional status similar to US norms
  - Anatomic reduction of syndesmosis
    - Only predictor of outcome
  - Not associated with outcome:
    - Age
    - Number of cortices
    - Screw removal
    - Medial mal fx

Weening and Bhandari. 2005 *JOT*

Syndesmosis Injuries

Screw Fixation Options

- Outcomes with screws
- Screw material?
  - No diff between steel and titanium[1]
- 3 or 4 cortices?
  - No diff in pain, motion or biomechanics[2]
- Screw diameter?
  - No biomech advantage 4.5 over 3.5[3]
- Number of screws?
  - Two more stable than one
- Screw removal?
  - Most retained screws loosen or break, ? symptomatic

1. Beumer et al. Injury 2005
2. Nousianen et al. JOT Br 2008
3. Thmopson & Gesink. 2000. FAI

Syndesmosis Injuries

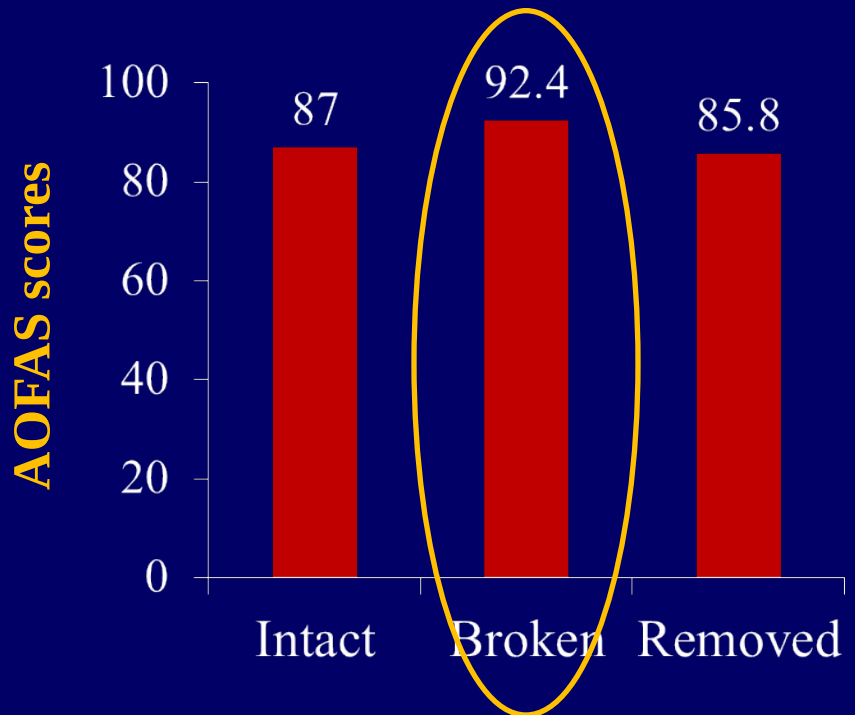
Screw Fixation Options

THE JOURNAL OF BONE & JOINT SURGERY (BJ)

Outcome after fixation of ankle fractures with an injury to the syndesmosis

THE EFFECT OF THE SYNDESMOSIS SCREW

- Level IV - Retrospective Review, 52 pts



Hamid et al. 2009 JBJS Br

Syndesmosis Injuries

Screw Removal

To retain or remove the syndesmotic screw: a review of literature

T. Schepers

Arch Orthop Trauma Surg (2011) 131:879–883
DOI 10.1007/s00402-010-1225-x

- Meta-analysis of 7 studies
  - Screw retention/removal does **not** impact clinical outcomes
  - Remove screws if prominent or limited ROM
  - Minimum 12 weeks post-op

Schepers T. 2011 AOTS.

Syndesmosis Injuries

Purported Advantages of Suture Button

- So what about the “Tightrope” (suture button)?

Can this solve the hardware dilemma?

Syndesmosis Injuries

Purported Advantages of Suture Button

- Flexible Fixation may be better for ligament
  - Less rigid, micro-motion allows ligament healing
- Easy to use
- No need for routine removal
  - No visual failure
  - Low profile

- Used in 10% of syndesmosis repairs in US
  - Bava et al. 2010 *Am J Orthop*

Syndesmosis Injuries

Suture Button Evidence

Acute distal tibiofibular syndesmosis injury: a systematic review of suture-button versus syndesmotic screw repair

Tim Schepers — International Orthopaedics (SICOT)

Tightrope	**Screws**
• AOFAS: 89.1	• AOFAS: 86.3
• Removal: 10%	• Removal: 52%
• Earlier return to work	• Longer f/u (42 mo)

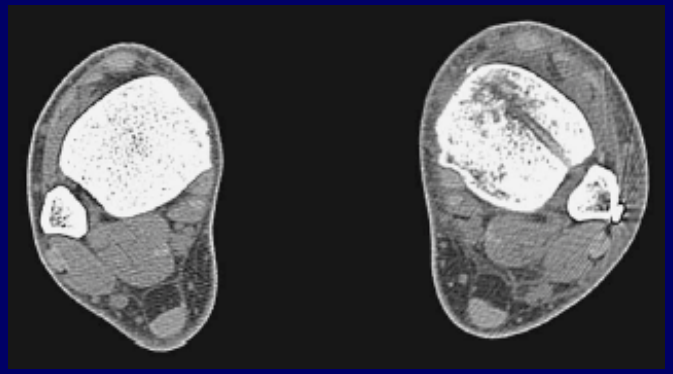
Similar outcomes
Similar complication rates

Schepers et al. 2012. *SICOT*

Syndesmosis Injuries

Suture Button Evidence

- Clinical outcomes:
  - Level III Retrospective Cohort, 32 patients
    - Suture-button *vs.* 3.5 screws
  - Suture Button:
    - Better AOFAS scores
    - Faster return to work – 2.8 months vs 4.6 months
    - Reduction maintained (CT scan)
    - No additional surgery

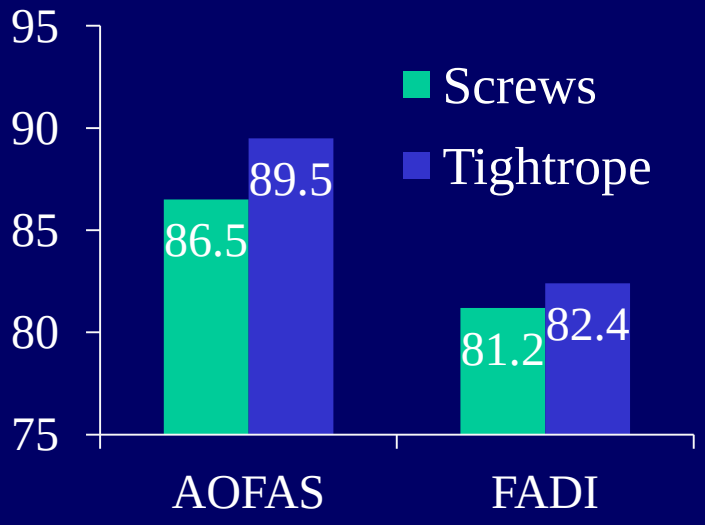


Thornes et al. CORR 2005

Syndesmosis Injuries

Suture Button Evidence

- Clinical outcomes:
  - Level II Prospective Cohort study, 46 patients
    - Suture-button *vs.* single screw
  - Results:
    - No difference in outcomes
      - AOFAS
      - FADI
    - Syndesmotic reduction (CT)
      - 21.7% malreduced in screw group
      - 0% malreduced in Suture button group
      - Only independent predictor of the clinical outcome



Naqvi et al. *AJSM* 2012

Syndesmosis Injuries

Case Example

- Collegiate soccer player
  - External rotation injury
  - Unable to ambulate
  - Pain over deltoid and fibula

Syndesmosis Injuries

Case Example

Syndesmosis Injuries

Case Example

Syndesmosis Injuries

Case Example

Take Away Points

- Surgery rare for purely ligamentous injuries
  - Common for fractures
- Radiographs not reliable for moderate injuries
- Reduction of syndesmosis is key
- Screws and suture buttons both effective
  - Suture button may provide advantages
  - More evidence needed

Thank You

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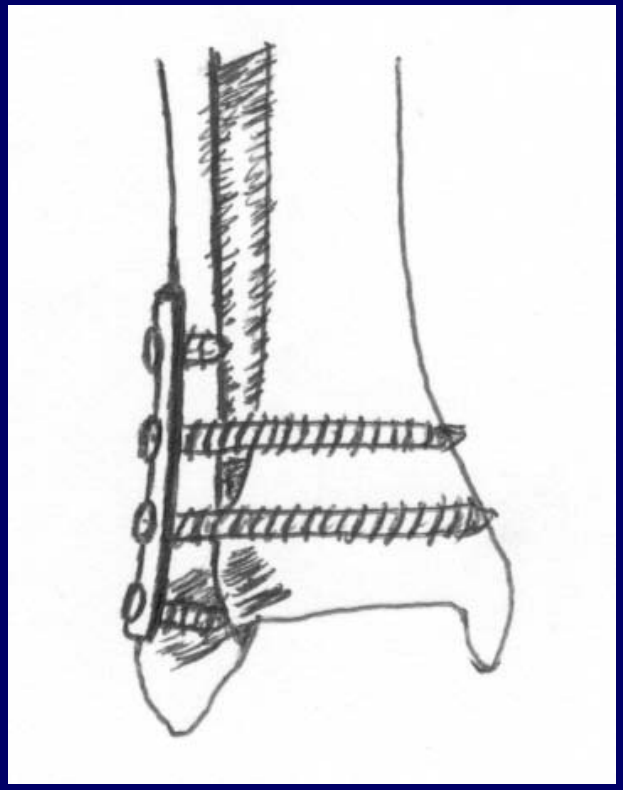
Syndesmosis Injuries

Elite Athletes

- *In the elite athlete…*
  - Addition of fibular plate
    - May allow for earlier and safer return to play
    - May protect from stress risers, after screw removal
    - Less implant cut-through



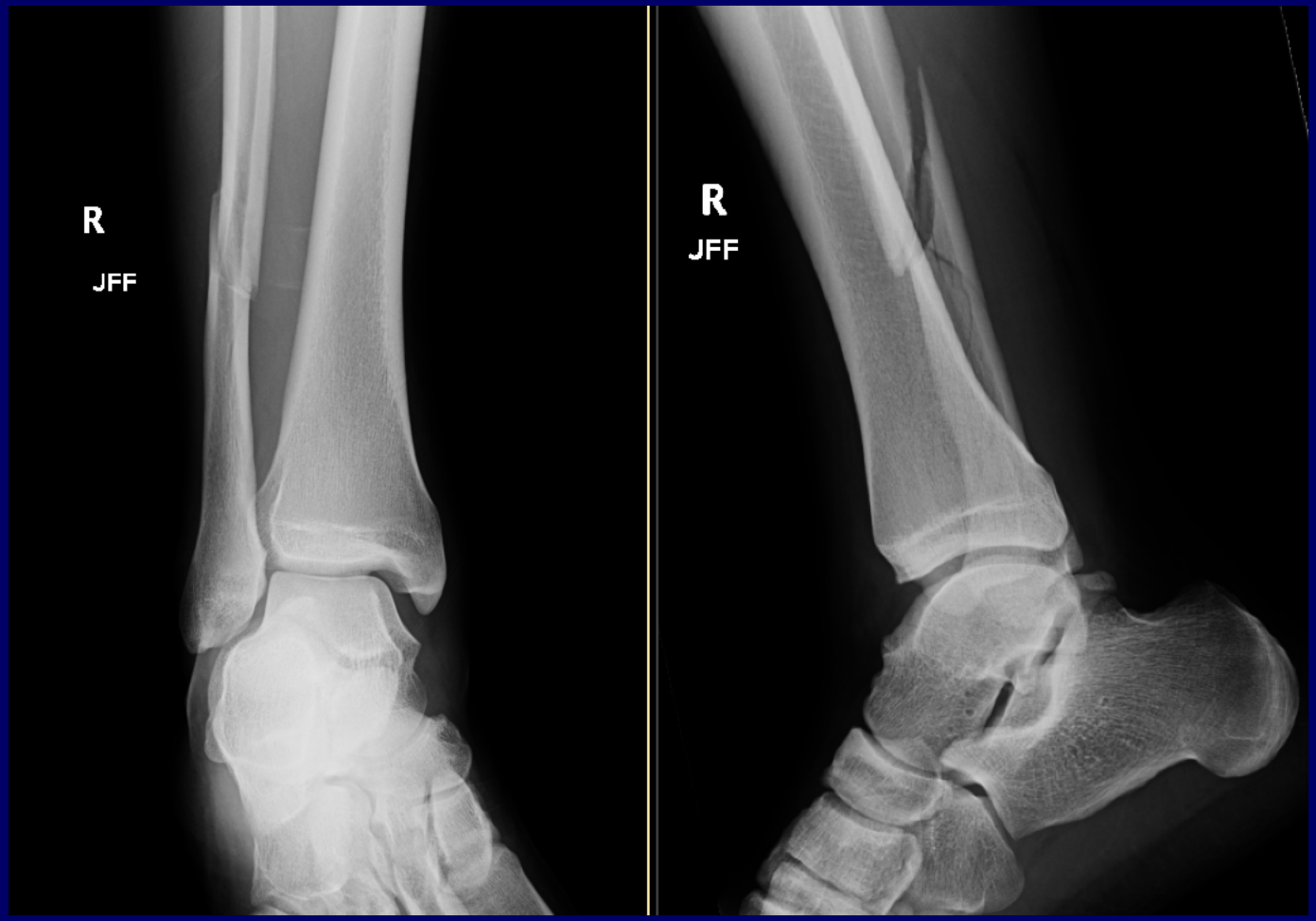
Syndesmosis Injuries

Elite Athletes

- Collegiate Running Back
- Planted foot
- Internal rotation of tibia
  - Significant pain and swelling
  - Pain with ambulation

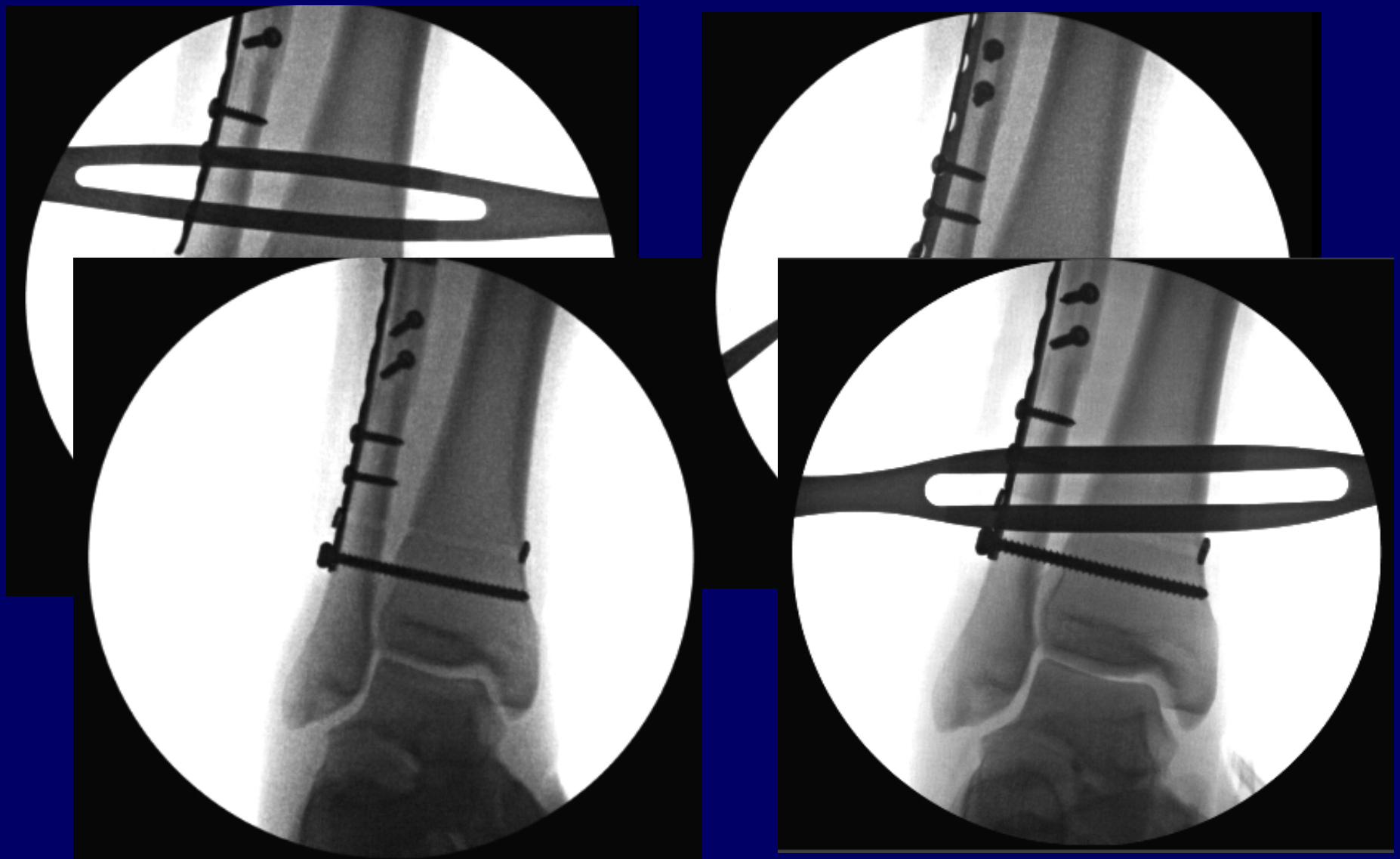
Syndesmosis Injuries

Elite Athletes



Syndesmosis Injuries

Elite Athletes



Syndesmosis Injuries

Elite Athletes

- Screw removal
  - 14 weeks post-op
  - Replace with tightrope

Syndesmosis Injuries

Elite Athletes

- WBAT in boot
- Begin rehab
- Training 2 weeks post-HWR

  (4 months post-injury)