US Army Orthopaedics

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Orthopaedic: Foot & Ankle
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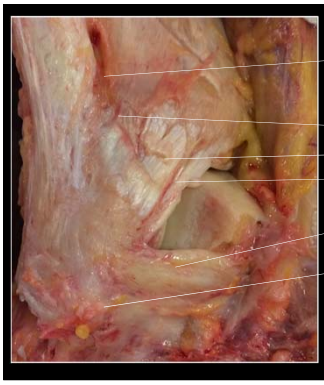
Syndesmosis Start to Finish

* What do I DO?

Syndesmosis Anatomy

- Anterior-Inferior tibiofibular ligament (AITFL)
  - 35% stability, Sectioning- 4mm
- Interosseous ligament (IOL)
  - 22% stability, Sectioning- 1cm with AIFTFL
- Interosseous Membrane
- Posterior-inferior tibiofibular ligament (PITFLT)
  - 44% stability
- Inferior transverse ligament
- **Deltoid ligament contributes to syndesmotic stability



- **Interosseous Membrane**
- **AITFL**
  - **Proximal Ass. Band**
  - **Primary Bands**
  - **Distal Ass. (Bassett)**
- **Anterior Talofibular Ligament**
- **Calcaneofibular Ligament**

- Posterior-Inferior Tibiofibular Ligament
  - Volkmann Tubercle
- Posterior Talofibular Ligament
- Peroneal Groove

Ankle Syndesmosis: A Qualitative and Quantitative Anatomic Analysis

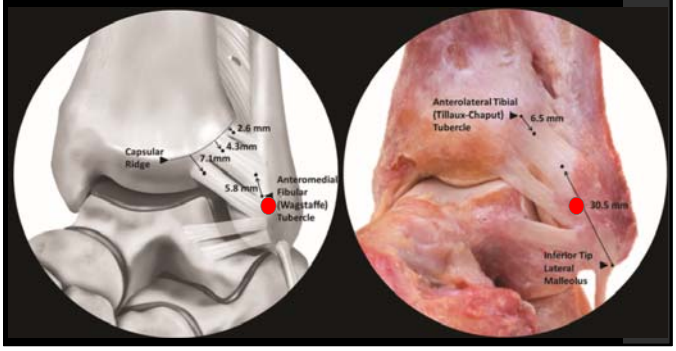
Brady T. Williams, Annette B. Ahrberg, Mary T. Goldsmith, Kevin J. Campbell, Lauren Shirley, Coen A. Wijdicks, Robert F. LaPrade and Thomas O. Clanton

Am J Sports Med published online October 31, 2014
DOI: 10.1177/0363546514554911

TABLE 2
Quantitative Anatomic Features of the Anterior Inferior Tibiofibular Ligament (AITFL)*

	AITFL Bands		
	Proximal Accessory Band(s)	Primary Band(s)	Distal Accessory Band (Bassett Ligament)
Tibial footprints			
Area, mm²	8.6 (6.7-10.5)	33.2 (30.3-36.1)	13.3 (11.3-15.3)
Distance to (mm):			
Proximal point, anterior ridge, incisura	3.1 (2.3-4.0)	9.4 (8.0-10.9)	19.2 (17.4-20.9)
Anterolateral tibial (Tillaux-Chaput) tubercle	10.7 (9.2-12.3)	6.5 (5.4-7.6)	11.1 (10.1-12.0)
Capsular ridge	2.6 (2.0-3.2)	4.3 (3.4-5.3)	7.1 (5.9-8.3)
Tibial plafond, anterolateral corner	16.6 (15.3-17.8)	9.3 (8.6-10.0)	5.8 (5.2-6.5)
Fibular footprints			
Area, mm²	8.5 (6.8-10.2)	34.2 (30.2-38.1)	16.4 (14.2-18.6)
Distance to (mm):			
Anteromedial fibular (Wagstaffe) tubercle	14.6 (12.4-16.8)	5.8 (4.4-7.3)	7.0 (4.9-9.1)
Inferior tip, lateral malleolus	36.9 (34.7-39.1)	30.5 (28.5-32.4)	25.5 (23.3-27.7)

Wagstaffe tubercle serves as anatomic anchor point



Vascular Anatomy of the Tibiofibular Syndesmosis

Peroneal artery supplied the perforating branch that supplied the syndesmosis
- 3cm prox. joint
- 63%
- Injury results in loss of the primary blood supply to anterior ligaments

Mechanism of Injury

- Classis syndesmosis injuries occur when the foot is subjected to an external rotation force while in a dorsiflexed position.
  - Maisonneuve fracture
  - Extreme ankle dorsiflexion-talus geometry
- High-Grade injury to the syndesmosis was typically associate with minimally traumatized lateral ankle ligaments.
  - (Uys Am J Sports Med 2001)
- Lateral ankle sprains have a 17% rate of concurrent low-high grade syndesmosis injury
  - (de Cesar et. al Foot Ankle Int 2011)

Diagnosis

- History
  - Fell in a hole
  - Worse walking up hills, pivoting
- Stand and Walk
  - Single and Double leg heel raise
- Pain- Anterolaterally at the level of the joint
  - There is a **strong correlation** between the distance of tenderness up the tibia and the length of time taken to return to sport (Nussbaum et al, 2001)
- Squeeze test- knee bent 90deg, compress tib/fib superior to the midpoint of the calf

Dorsiflexion External Rotation Stress Test

- Dorsiflexion then External rotation of the foot and ankle relative to the tibia
  - Can also have pt stand and rotate
- Pain is a positive test
- Only test with high intra-rater and inter-rater reliability
- No single test has been found to have high diagnostic accuracy (Br J Sports Med 2013)

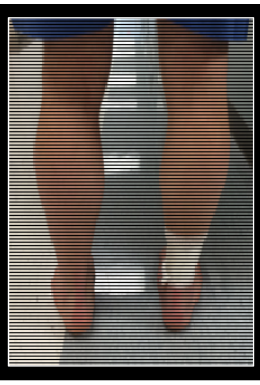
Crossed-leg Test

- Instruct the pt to place the injured leg across the kneecap of the opposite leg, with the pivot point at the junction of the middle and distal thirds of the tibia.
- Pain reproduced with gentle force on the medial knee indicates a positive test

Stabilization Test

- Tightly tape the leg just above the ankle in order to stabilize the syndesmosis
- Positive test- if toe raises, walking, and/or jumping are **less** painful after taping

High Ankle Sprain and Syndesmosis Injuries in Athletes.
Ned Amendola JAAOS 2015 23:661-673



Fibular Translation Test

- Grasp the Fibula and translate in the Sagittal plane

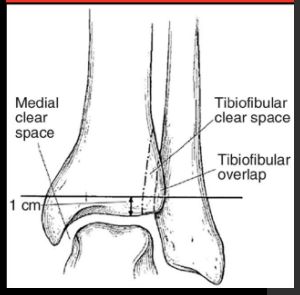
Radiographic Evaluation

- Standard Weight-bearing
  - Ankle
  - Tib/Fib- remember Maisonneuve Injury
  - Gravity Stress
    - Optional
- MRI
  - Sensitivity(100%), Specificity (93%), accuracy (96%)
    - JBJS Br 2003

Syndesmosis indicators:

- **Increased tibiofibular clear space**
  - Medial border of the fibula and the lateral border of the posterior tibia at the incisura
  - 1 cm prox. to joint line
  - < 6mm (A/p and Mortise)
- **Decreased tibiofibular overlap**
  - Overlap of the lateral malleolus and anterior tibial tubercle
  - >6mm A/P
  - >1mm mortice
- **Increased medial clear space**
  - Should be equal to superior clear space, not greater than 4mm
- Usefulness of plain films for the diagnosis of syndesmosis injury is limited (CORR 2004)

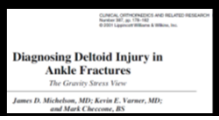
Figure 5

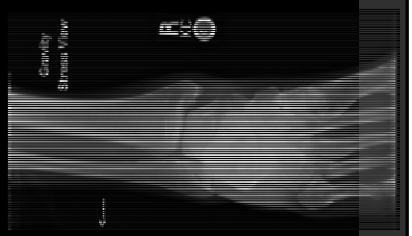


Comparison of Manual and Gravity Stress Radiographs for the Evaluation of Supination-External Rotation Fibular Fractures
J. Brian Gill, MD, MBA; Timothy Risko, MD; Viorel Raducan, MD; J. Speight Grimes, MD; Robert C. Schutt Jr., MD
J Bone Joint Surg Am. 2007 May; 89 (5): 994 -999 .

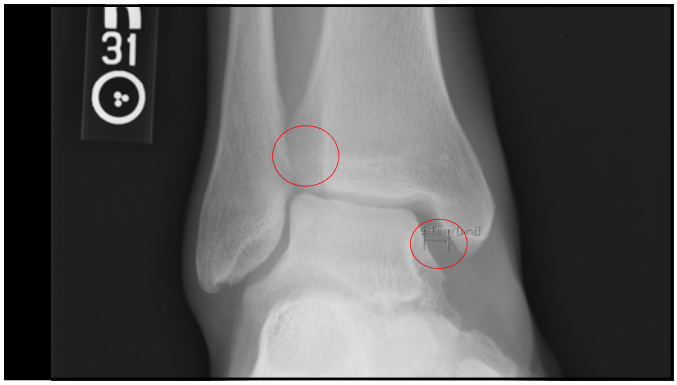
Conclusions: The gravity stress radiograph is equivalent to the manual stress radiograph for determining deltoid ligament injury in association with an isolated distal fibular fracture, and thus it can be used to determine ankle stability in patients who present with an isolated distal fibular fracture.

Level of Evidence: Diagnostic Level I.


Diagnosing Deltoid Injury in Ankle Fractures
The Gravity Stress View
James D. Michelson, MD; Kevin E. Varner, MD; and Mark Checcone, BS



Medial clear space should not exceed 4mm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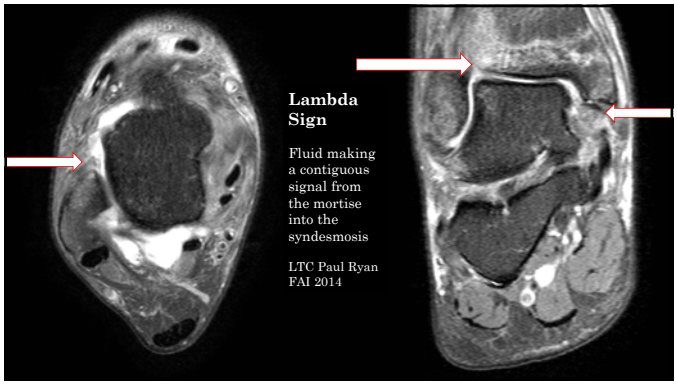
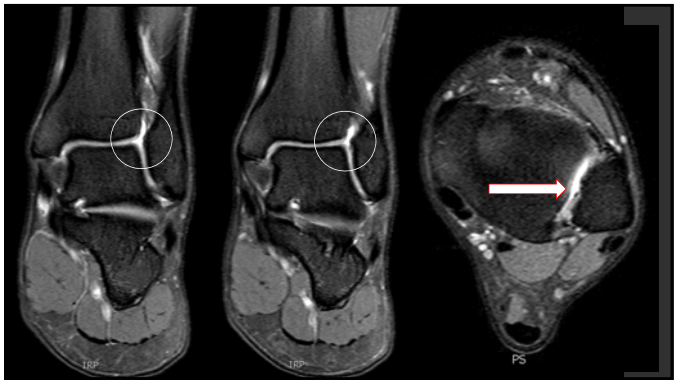
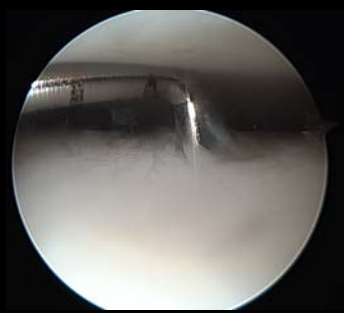

Lambda Sign
Fluid making a contiguous signal from the mortise into the syndesmosis
LTC Paul Ryan FAI 2014

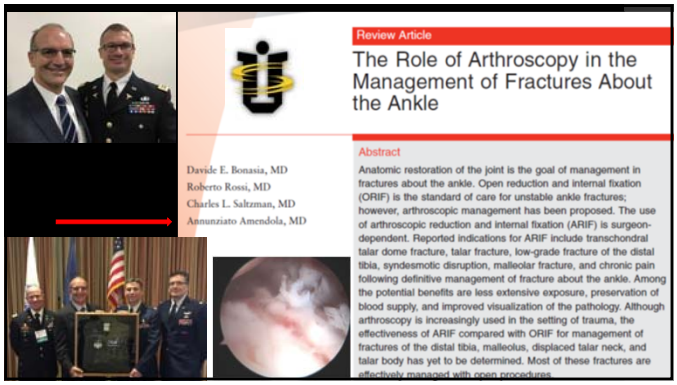

IRP
IRP
PS

4.5mm Shaver in the Syndesmosis

- Remember sectioning the AITFL=4mm

- Why to perform an Arthroscopy
- 75% of syndesmosis injuries had traumatic lesions
- Journal of Arthroscopy (Ferkel)





Review Article

The Role of Arthroscopy in the Management of Fractures About the Ankle

Davide E. Bonasia, MD
Roberto Rossi, MD
Charles L. Saltzman, MD
Annunziato Amendola, MD

Abstract

Anatomic restoration of the joint is the goal of management in fractures about the ankle. Open reduction and internal fixation (ORIF) is the standard of care for unstable ankle fractures; however, arthroscopic management has been proposed. The use of arthroscopic reduction and internal fixation (ARIF) is surgeon-dependent. Reported indications for ARIF include transchondral talar dome fracture, talar fracture, low-grade fracture of the distal tibia, syndesmotic disruption, malleolar fracture, and chronic pain following definitive management of fracture about the ankle. Among the potential benefits are less extensive exposure, preservation of blood supply, and improved visualization of the pathology. Although arthroscopy is increasingly used in the setting of trauma, the effectiveness of ARIF compared with ORIF for management of fractures of the distal tibia, malleolus, displaced talar neck, and talar body has yet to be determined. Most of these fractures are effectively managed with open procedures.

Comparison of Radiologic and Arthroscopic Diagnoses of Distal Tibiofibular Syndesmosis Disruption in Acute Ankle Fracture

Tun Hing Lui, M.B.B.S.(HK), F.R.C.S.(Edin), F.H.K.A.M.(Orth), F.H.K.C.O.S.,
KaiYuen Ip, M.B.Ch.B.(CUHK), M.R.C.S.(Edin), and
Hung Tsan Chow, M.B.B.S.(HK), M.R.C.S.(Edin)

Purpose: The purpose of this study was to compare intraoperative stress radiography and ankle arthroscopy in the evaluation of distal tibiofibular syndesmosis disruption in acute ankle fracture. **Type of Study:** Prospective study. **Methods:** We treated 53 Weber type B or C ankle fractures without radiographic evidence of frank syndesmosis diastasis. Intraoperative stress radiography and ankle arthroscopy were performed. Syndesmotic screws were inserted in those patients with syndesmosis diastasis. Screws were removed 12 weeks later and second-look ankle arthroscopy was performed at the same time. **Results:** Sixteen cases (30.2%) had positive intraoperative stress radiographs; 35 cases (66.0%) had positive arthroscopic findings of syndesmosis diastasis, including various combinations of coronal, sagittal, and rotational planes of instability. During second-look arthroscopy, 31 of 34 patients with syndesmotic screws showed healing of the syndesmotic ligaments and the syndesmosis became stable. **Conclusions:** Ankle arthroscopy excels intraoperative stress radiography in detecting syndesmosis disruption. It also provides assessment of different planes of instability and assists anatomic reduction of the syndesmosis. Intraoperative radiography still does play an important role in assessing fracture reduction and proper restoration of fibular length and longitudinal orientation of the syndesmosis. **Level of Evidence:** Level 2. **Key Words:** Ankle

THE JOURNAL OF BONE & JOINT SURGERY

Diagnosis of a tear of the tibiofibular syndesmosis

THE ROLE OF ARTHROSCOPY OF THE ANKLE

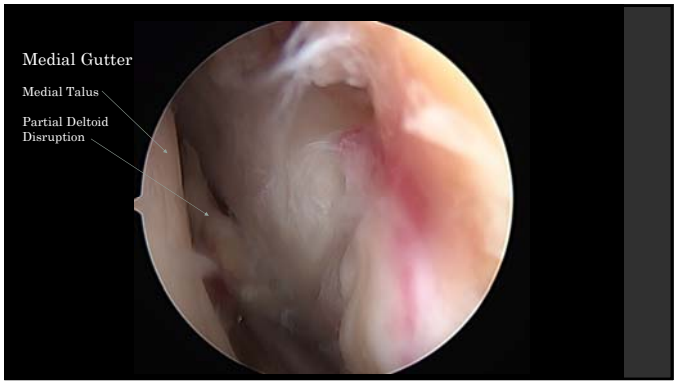
M. Takao, M. Ochi, K. Oae, K. Naito, Y. Uchio
From Shimane Medical University and Hiroshima University, Japan

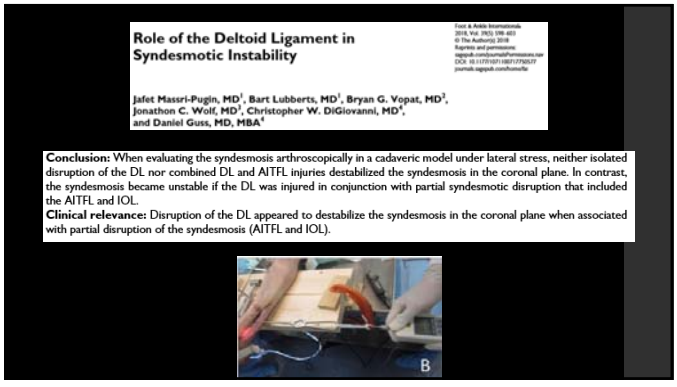
In 52 patients we compared the accuracy of standard anteroposterior (AP) radiography, mortise radiography and MRI with arthroscopy of the ankle for the diagnosis of a tear of the tibiofibular syndesmosis. In comparison with arthroscopy, the sensitivity, specificity and accuracy were 44.1%, 100% and 63.5% for standard AP radiography and 58.3%, 100% and 71.2% for mortise radiography. For MRI they were 100%, 93.1% and 96.2% for a tear of the anterior inferior tibiofibular ligament and 100%, 100% and 100% for a tear of the posterior inferior tibiofibular ligament. Standard AP and mortise radiography did not always provide a correct diagnosis. MRI was useful although there were two-false positive cases. We suggest that arthroscopy of the ankle is indispensable for the accurate diagnosis of a tear of the tibiofibular syndesmosis.

J Bone Joint Surg [Br] 2003;85-B:324-9.
Received 17 January 2002; Accepted after revision 27 June 2002

dial and the PITFL from the anterolateral portal. A stress test of the distal tibiofibular joint is performed by moving the ankle from internal rotation to external rotation under arthroscopy. Close[11] reported that the maximum opening of the distal tibiofibular joint was approximately 1.5 mm in the normal ankle and we considered that there was instability if an opening of 2 mm could be identified (Fig. 4). The diagnostic criteria for a torn ligament were[12] an abnormal course or discontinuity of the ligament, a decrease in its tension, an avulsion at its attachment to the fibula and tibia, and a positive arthroscopic stress test.

The diagnosis of a tear was made if there was one or more of these criteria (Fig. 5).

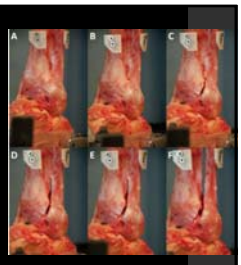

Medial Gutter
Medial Talus
Partial Deltoid Disruption


Role of the Deltoid Ligament in Syndesmotic Instability
Jafet Massri-Pugin, MD[1], Bart Lubberts, MD[1], Bryan G. Vopat, MD[2], Jonathon C. Wolf, MD[3], Christopher W. DiGiovanni, MD[4], and Daniel Guss, MD, MBA[4]
Conclusion: When evaluating the syndesmosis arthroscopically in a cadaveric model under lateral stress, neither isolated disruption of the DL nor combined DL and AITFL injuries destabilized the syndesmosis in the coronal plane. In contrast, the syndesmosis became unstable if the DL was injured in conjunction with partial syndesmotic disruption that included the AITFL and IOL.
Clinical relevance: Disruption of the DL appeared to destabilize the syndesmosis in the coronal plane when associated with partial disruption of the syndesmosis (AITFL and IOL).
B

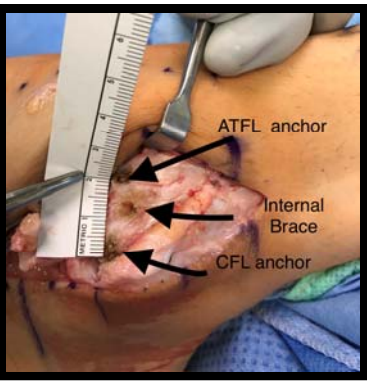
Article

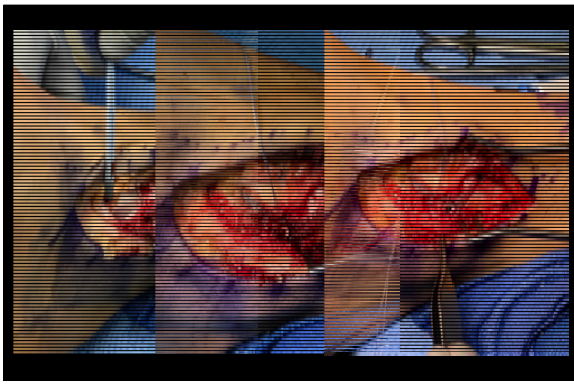
Biomechanical Analysis of the Individual Ligament Contributions to Syndesmotic Stability

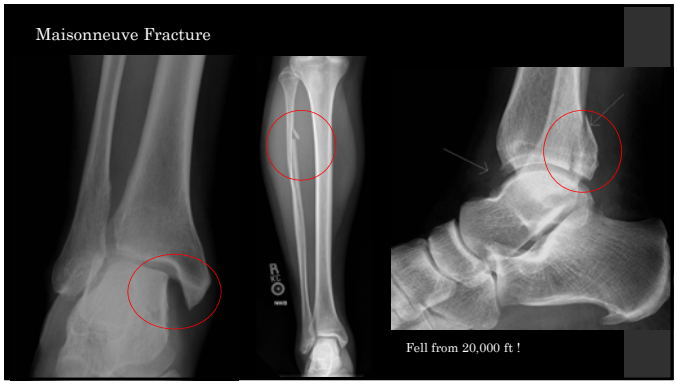
Thomas O. Clanton, MD[1,2], Brady T. Williams, BS[1], Jonathon D. Backus, MD[1,2], Grant J. Dornan, MS[1], Daniel J. Liechti, MD[1], Scott R. Whitlow, MD[1,2], Adriana J. Sarokhi, BS[1], Travis Lee Turnbull, PhD[1], and Robert F. LaPrade, MD, PhD[1,2]

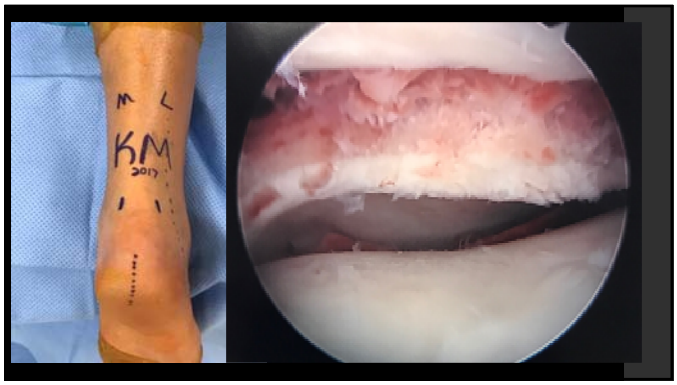


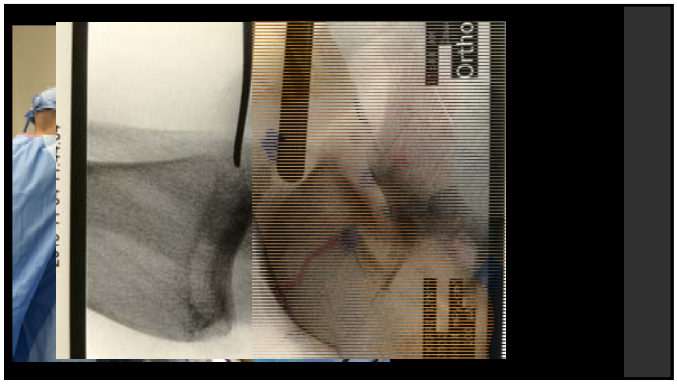
Conclusion: The ligaments of the syndesmosis provide significant contributions to rotary stability of the distal tibiofibular joint within the physiologic range of motion.
Clinical Relevance: This study defined normal motion of the syndesmosis and the biomechanical consequences of injury. The degree of instability was increased with each additional injured structure; however, isolated injuries to the AITFL alone may lead to significant external rotary instability.

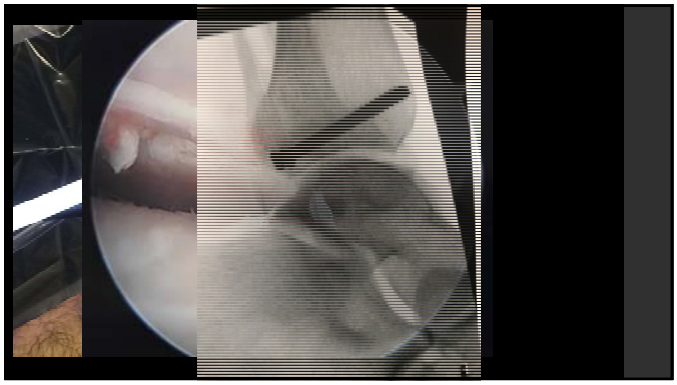

ATFL anchor
Internal Brace
CFL anchor

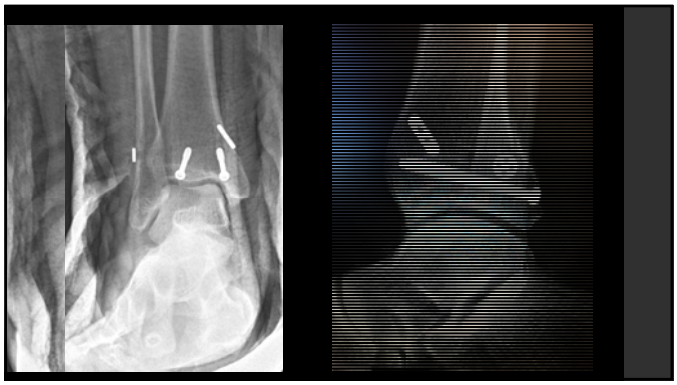



Maisonneuve Fracture
Fell from 20,000 ft !




ortho



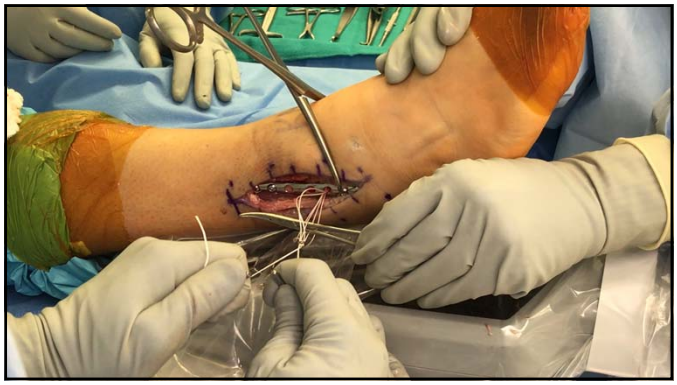


Notice the absent, torn AITFL

Mercedes Sign: Anatomic Reduction

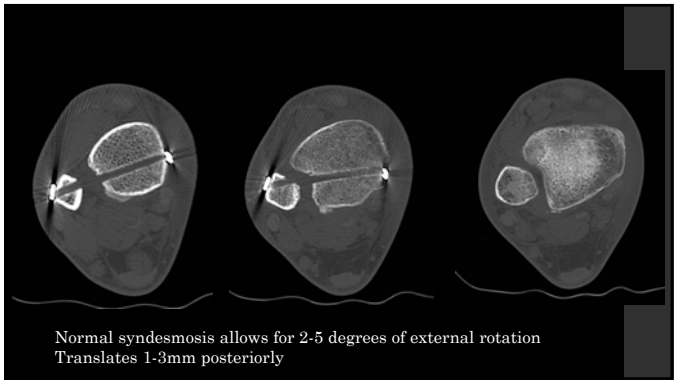
Drop your hand approximately 30deg

Drill parallel to the joint line



Clamp position was defined as applying clamps on the lateral malleolar ridge of the fibula and the center of the anteroposterior width on the tibia 10mm above the joint line

* Forceps Reduction of the Syndesmosis in Rotational ankle Fractures Phisitkul, Marsh. JBJS 2012



Normal syndesmosis allows for 2-5 degrees of external rotation
Translates 1-3mm posteriorly

Article

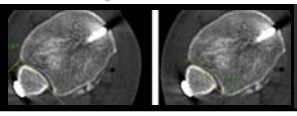
Increased Reduction Clamp Force Associated With Syndesmotic Overcompression

Jacob Haynes, MD[1], Steven Cherney, MD[1], Amanda Spraggs-Hughes, MA[1], Christopher M. McAndrew, MD, MSc[1], William M. Ricci, MD[1], and Michael J. Gardner, MD[1]

Results: Syndesmotic overcompression (fibular medialization greater than 1.0 mm when compared with noninjured ankle) was seen in 11 of 21 patients (52%). Increased clamp force significantly correlated with syndesmotic overcompression. The mean reduction clamp forces were 88 N for the undercompressed group, 130 N for the adequately compressed group, and 163 N for the overcompressed group.

Conclusion: This study demonstrated a significant correlation between increased clamp forces and syndesmotic overcompression, and determined objective forces that lead to overcompression. Our results indicate that surgeons should be cognizant of the clamp force used for syndesmotic reduction.

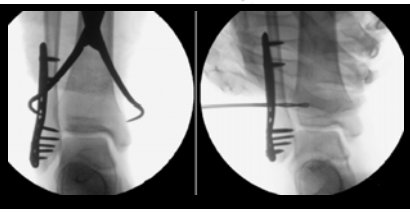
Level of Evidence: Level III, case-control series, in accordance with STROBE guidelines.



Comparison of Clamp Reduction and Manual Reduction of Syndesmosis in Rotational Ankle Fractures: A Prospective Randomized Trial

Young Hwan Park, MD [1], Jeong Hwan Ahn, MD [1], Gi Won Choi, MD [2], Hak Jun Kim, MD, PhD [3]

differed significantly between the 2 groups ($p < .05$). The clinical outcomes did not differ significantly between the 2 groups ($p > .05$). Although differences were found in the radiographic measurements, most syndesmoses in both groups were within the normal range at the final follow-up visit, and the 2 methods of syndesmosis reduction provided similar clinical outcomes. Accordingly, the results of the present study suggest that both of these methods are effective and reliable for reduction of the syndesmosis in rotational ankle fractures.



Article

3D Model Analysis of Ankle Flexion on Anatomic Reduction of a Syndesmotic Injury

Jason M. Schon, BS[1], Jacob D. Mikula, BS[1], Jonathon D. Backus, MD[1,2], Melanie B. Venderley, BS[1], Grant J. Dornan, MS[1], Robert F. LaPrade, MD, PhD[1,2], and Thomas O. Clanton, MD[1,3]

Conclusion: This study failed to reject the null hypothesis and demonstrated that ankle flexion at the time of syndesmotic fixation with a suture-button construct had no significant in vitro effect on volume changes, fibular displacement, or dorsiflexion capacity. However, in comparison to the preinjured state, suture-button repair resulted in significant overcompression with respect to syndesmosis volume and medial displacement of the fibula.

Clinical Relevance: Ankle position at the time of syndesmotic fixation did not affect overall ankle ROM when using a suture-button construct; however, overcompression was observed in all positions. The clinical impact of syndesmotic overcompression remains largely unknown.

The Effect of Suture-Button Fixation on Simulated Syndesmotic Malreduction: A Cadaveric Study

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Investigation performed at the Department of Orthopaedic Surgery and Rehabilitation, University of Iowa Hospitals and Clinics, Iowa City, Iowa

Discussion

The principal aim of the present study was to assess whether suture-button syndesmotic fixation could mitigate a deliberate malreduction produced by off-axis clamping in a cadaveric model. We used a standardized off-axis clamping technique[9] to directly compare suture-button fixation and syndesmotic screw fixation. Comparative fixations were placed through the same tibial and fibular drill-holes. With clamp-induced malreduction, suture-button syndesmotic fixation resulted in distal tibiofibular alignment that closely resembled measurements of the intact specimens. Suture-button constructs were associated with a more anatomic post-fixation position compared with screw constructs, most notably in the sagittal plane. While medial-lateral reductions were closer to anatomic alignment with suture-button use, differences in medial-lateral fibular positioning did not reach significance. The ability of the suture-button constructs to allow for correction of deliberate malreductions was most apparent in posterior fibular malreduction patterns. A second pertinent finding was the presence of subtle malreductions with use of suture-button constructs. Although distal tibiofibular syndes-

were malreduced compared with no malreduced ankles in the suture button group, and no difference was found in the clinical outcomes of both groups. Several studies have suggested that syndesmotic malreduction is the most important independent predictor of clinical outcomes.[1,5,5] Suture buttons may play a role in optimizing reduction and mitigating the need for implant removal; however, an implant-

Fixation of Ankle Syndesmotic Injuries: Comparison of TightRope Fixation and Syndesmotic Screw Fixation for Accuracy of Syndesmotic Reduction

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Am J Sports Med 2012 40: 2828 originally published online October 10, 2012

Background: Ankle syndesmotic injuries are complex and require anatomic reduction and fixation to restore the normal biomechanics of the ankle joint and prevent long-term complications.

Purpose: The aim of this study is to compare the accuracy and maintenance of syndesmotic reduction using TightRope versus syndesmotic screw fixation.

Study Design: Cohort study; Level of evidence, 2.

Methods: This cohort study included consecutive patients treated for ankle syndesmotic diastases between July 2007 and June 2009. Single slice axial computed tomography (CT) scans of both the ankles together were performed at the level of syndesmosis, 1 cm above the tibial plafond. A greater than 2-mm widening of syndesmosis compared with the untreated contralateral ankle was considered significant malreduction. Clinical outcomes were measured using the American Orthopaedics Foot and Ankle Society (AOFAS) and Foot and Ankle Disability Index (FADI) scores.

Results: Forty-six of 55 eligible patients participated in the study; 23 patients were in the TightRope group and 23 in the syndesmotic screw group. The average age was 42 years in the TightRope and 40 years in the syndesmotic screw group, and the mean follow-up time was 2.5 years (range, 1.5-3.5 years). The average width of normal syndesmosis was 4.03 ± 0.89 mm. In the TightRope group, the mean width of syndesmosis was 4.37 mm (SD, ±1.12 mm) ($P = .30$, *t* test) compared with 5.16 mm (SD, ±1.92 mm) in the syndesmotic screw group ($P = .01$, *t* test). Five of 23 ankles (21.7%) in the syndesmotic screw group had syndesmotic malreduction, whereas none of the TightRope group showed malreduction on CT scans ($P = .04$, Fisher exact test). Average time to full weightbearing was 8 weeks in the TightRope group and 9.1 weeks in the syndesmotic screw group. There was no significant difference between the TightRope and syndesmotic screw groups in mean postoperative AOFAS score (89.56 and 86.52, respectively) or FADI score (82.42 and 81.22, respectively). Regression analysis confirmed malreduction of syndesmosis as the *only independent variable that affected the clinical outcome (regression coefficient, −12.39; $t = -2.43$; $P = .02$).*

Conclusion: The results of this study indicate that fixation with TightRope provides a more accurate method of syndesmotic stabilization compared with screw fixation. Syndesmotic malreduction is the most important independent predictor of clinical outcomes; therefore, care should be taken to reduce the syndesmosis accurately.

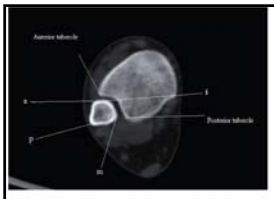
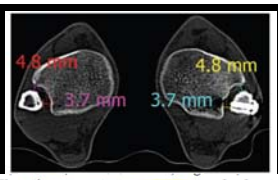


Figure 2. Axial computed tomography scan of the untreated ankle showing the cross-sectional anatomy of the tibia and fibula at the level of the syndesmosis. The anterior and posterior tubercles of the tibia are used as reference points for syndesmotic measurements. Note also the 4 borders of the fibula: a, anterior; p, posterior; l, interosseous; m, medial.



The primary outcome measure, malreduction of syndesmosis, was diagnosed on the basis of the predefined criterion of a >2 mm difference in width from the contralateral side (Table 3). No case of malreduction was observed in the TightRope group. However, of the 23 ankles in the syndesmotic screw group, 5 (21.7%) showed malreduction of the syndesmosis ($P = .04$, Fisher exact test) (Figure 6). The risk of malreduction was 21.7% higher in the syndesmotic screw group than in the TightRope group.

Article

AMERICAN ORTHOPAEDIC FOOT & ANKLE SOCIETY

Incisura Morphology as a Risk Factor for Syndesmotic Malreduction

Steven M. Cherney, MD[1], Amanda G. Spraggs-Hughes, MA[1], Christopher M. McAndrew, MD, MSc[1], William M. Ricci, MD[1], and Michael J. Gardner, MD[1]

Results: There was a significant correlation between more shallow syndesmoses and increased anterior translation of the fibula in the incisura ($r = -0.63$, $P \leq .001$). Six of 8 patients with "shallow" (≤2.5 mm) incisura were anteriorly malreduced greater than or equal to 1.5 mm compared to the contralateral ankle. The anterior malreduction rate in those with a shallow incisura was significantly greater than in the "non-shallow" patients ($P < .001$). There were 9 patients with incisurae greater than or equal to 4.5 mm deep. Five of the "deep" patients had posterior malreductions greater than or equal to 1.5 mm. The posterior malreduction rate in the "deep" group was significantly greater than the "non-deep" patients ($P = .02$). There was a significant correlation between increasing syndesmotic depth and increased malrotation ($r = .46$, $P = .01$).
Conclusion: Syndesmotic morphology was found to be associated with specific malreduction patterns. Shallow syndesmoses were correlated with anterior fibular malreduction, and were less likely to be malrotated. Conversely, deep syndesmoses predisposed to posterior sagittal plane and rotational malalignment. Preoperative CT scans that assess the syndesmosis morphology may allow surgeons to alter reduction strategies to avoid syndesmotic malreduction.
Level of Evidence: Level III, retrospective cohort study.

Weeks 0-2:

- **Splint NWB**
- ASA 81mg BID (5,600ft)

Weeks 2-4:

- CAM boot, Foot Flat weight bearing
- Active ankle range of motion 5- 10 times daily out of boot
- Calf pumping
- Alphabet rotations, write the alphabet with your foot, motioning each letter in the air, twice daily or more
- Ice as needed (20 minute intervals)
- Compressive stocking
  - Pain/swelling/DVT

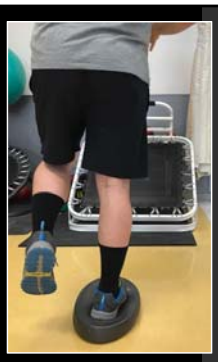
Weeks 4 – 6:

- CAM Boot 50% WB
- Stationary bike (recumbent) daily IN or Out of Boot (start slow and easy)
- Theraband gradually increase reps (minimal resistance)
- Gentle water(pool) range of motion, non-weight bearing
- Underwater treadmill (IRONHORSE GYM), Chest deep water

Joint Forces and Torques when walking in shallow Water
Vol 44, Issue 6, April 2011 pg 1170-1175

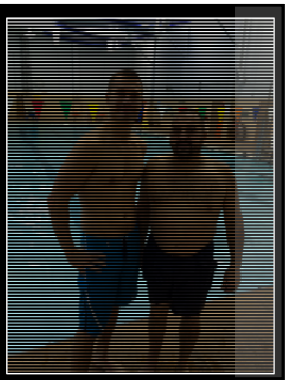
The observed subjects' apparent weight in water was about 35% of their weight on land and they were about 2.7 times slower when walking in water. When the subjects walked in water compared with walking on land, there were no differences in the angular displacements but there was a significant reduction in the joint torques which was related to the water's depth. The greatest reduction was observed for the ankle and then the knee and no reduction was observed for the hip. All joint powers were significantly reduced in water. The compressive and shear joint forces were on average about three times lower during walking in water than on land. These quantitative results substantiate the use of water as a safe environment for practicing low-impact exercises, particularly walking.

Proprioception/ Balance/ Intrinsic



Pool Therapy

- Drastically under utilized by my patients
  - Phase I
  - Phase II
- Sometimes you have to "Trust by Verify"



Weeks 6 – 8:
- Continue appropriate previous exercises
  - Week 6 100% you should be Full WB in boot
  - Discontinue Crutches/Boot when you feel stable at 100%
    - Transition to ankle lace up brace
  - Night splint

Week 8:
- Treadmill – Walking progression program
  - Ankle lace up brace
  - Increase time then speed
    - 20 minutes 3 times per week without pain then try to jog
      - Progression is on treadmill, avoid uneven surfaces

Weightbearing Advancement
- Underwater Treadmill at 3 wks, chest level water (Iron Horse Gym)
- Ultra G
- Curve, Standard Flat treadmill, Then Outside on flat ground

← 30% more work
← Works quads more than hamstrings

Thanks for the opportunity to present

- Anybody Need a FOOT & ANKLE guy in 2020??? Lets Talk…