8:30 – 9:20 am

SESSION 2:
SYNDESOMATIC

Moderators:
J. Chris Coetzee, MD
(Edina, Minnesota)

Matthew M. Buchanan, MD
(Arlington, Virginia)
8:30 – 8:40 am  
SESSION 2:  
SYNDESmosis

Syndesmosis Fixation 2012:  
Should I use screws, suture or is the whole thing overrated?

J. Chris Coetzee, MD  
(Edina, Minnesota)

The new focus of study is whether conventional screw fixation is still the gold standard, or if the perceived advantages of flexible fixation is truly beneficial

Syndesmotic Function

- Maintains talar reduction
- Transfers load to fibula
- Allows for fibular motion

Fibular Motion

- 2.4 mm distal motion during stance
- From plantarflexion to dorsiflexion
  = 1mm of widening
  = 2 -4 deg of external rotation


Implications of Subluxation

- Ramsey & Hamilton: 1976
  - 1mm lateral subluxation = 42% loss of contact
  Ramsey PL, Hamilton W. Changes in tibiotalar area of contact caused by lateral talar shift. JBJS-A 1976; 58:356-367

- Zindrick 1985
  - 2 mm subluxation = 49% increase in pressure

- Lloyd et al 2006
  - 1mm of lateral shift result in a 40% loss of contact surface area compared to 42% in the original experiment

Reduction

- FAI Oct 2006 :Gardner, Helfet et al
  - Malreduction of the tibiofibular syndesmosis in ankle fractures
  - 52% !! Had a malreduction of the syndesmosis in the incisura in a Level one trauma center
What does the Literature say about treatment?


“In this paper, a systematic review of the literature was conducted to provide an evidence-based rationale in the diagnosis and treatment of syndesmosis (high ankle) sprains in athletes. It is obvious from the low level of evidence available in the literature on this topic that a great deal of work is needed before conclusive statements regarding the management of these injuries can be made with confidence. Although the recognition and diagnosis of these injuries have improved, there still exists a paucity of information on optimal conservative and operative management.”

If there is no widening compared to the opposite side – treat conservatively
If there is widening of the mortise or lateral shift of the talus – FIX IT!

= The jury might still be out on what the best fixation is, and even if it matters.

REFERENCES


MATERIALS AND METHODS:
Forty-nine patients with ankle diastasis, treated with Arthrex tightrope™, were reviewed retrospectively, using American Orthopaedic Foot and Ankle Society (AOFAS) and Foot and Ankle Disability Index (FADI) scores and radiographic parameters for syndesmosis integrity. The operative technique was slightly modified by the senior author in 31 cases to avoid soft-tissue complications requiring removal of the implant. The aim of this study was to assess the rate of hardware removal after tightrope fixation and the effect of the author’s modification to avoid soft-tissue complications.

RESULTS:
The mean radiological follow-up was 6 months. Final data were collected using a confidential questionnaire and FADI score at an average of 24 (12-38) months postoperatively. The average time to full weight bearing was 7.7 weeks and to return to normal activities was 11.2 weeks. Postoperative radiographic measurements demonstrated satisfactory reduction of syndesmosis. The Mean AOFAS score was 85.57 (95% confidence interval (CI) 77.96-93.18) and the mean FADI score was 81.20 (95% CI 73.86-88.53). There were three cases of hardware removal in the standard technique group as compared to none in the group with the modified technique.

CONCLUSION:
Arthrex Tightrope™ provides an effective method of syndesmosis stabilisation, which obviates the need for routine removal of implant and facilitates dynamic stabilisation. The results of this study are satisfactory and comparable to previously reported studies.

Treatment of tibiofibular syndesmotic ankle injury remains controversial in regard to the best method, although surgeons agree that the goal of treatment is reduction and operative stabilization. Ideally, the implant should stabilize the syndesmosis and allow physiologic micromotion and early mobilization, and conventional screws are limited in this regard. We reviewed use of the Ankle TightRope® fixation device for repair of syndesmotic injuries. From April to September 2006, 16 patients with evidence of syndesmotic injury were treated by means of ankle fracture open reduction with internal fixation, combined with use of the Ankle TightRope® device for repair of the syndesmosis. The mean age of the 16 patients was 36.6 ± 16.71 (range 15 to 69) years; they were followed up for at least 2 years. Mean follow-up duration was 26 ± 3.94 (range 24 to 38) months. The mean American Orthopaedic Foot and Ankle Society score at 2-year follow-up was 86.88 ± 11.49 (range 48 to 100). The mean time to full weight-bearing was 4.5 ± 0.87 weeks. Two (12.5%) patients had postoperative superficial wound infections, each of which was treated with oral antibiotics. One (6.25%) patient had the TightRope® removed because of irritation from the knot. There was no failure of syndesmotic fixation, despite early weight-bearing in the postoperative phase. The results of this case series indicate that tibiofibular syndesmosis repair with the Ankle TightRope® yields satisfactory results.


BACKGROUND:
Suture-button fixation for tibiofibular syndesmosis injuries is a relatively new surgical technique thought to provide semirigid dynamic stabilization. However, adequate information is still not available and there are controversies as to whether it provides enough fixation for syndesmosis injuries.

HYPOTHESIS:
Optimally directed suture-button fixation brings physiologic dynamic stabilization of the ankle syndesmosis.

STUDY DESIGN:
Controlled laboratory study.

METHODS:
Stabilization of the ankle syndesmosis fixed by a suture-button construct was examined using 6 normal fresh-frozen cadaver legs. After initial tests of intact and injured models, suture-button fixation and screw surgical techniques were performed sequentially for each specimen, with single suture-button fixation, double suture-button fixation, anatomic suture-button fixation, and metal screw. Anterior and medial traction forces, as well as external rotation force, were applied to the tibia; the diastasis of the syndesmosis and the rotational angle of the fibula related to the tibia were measured using a magnetic tracking system.

RESULTS:
Each traction and rotation force significantly increased the diastasis and fibular rotational angles in the created injury models. With single fixation, the diastases increased significantly compared with the intact model with an anterior traction force (P < .001), a medial traction force (P = .005), and an external rotation force (P = .015). The fibular rotational angles increased significantly with a medial traction force (P = .005) and an external rotation force (P < .001). With double fixation, the diastases increased significantly with a medial traction force (P = .004) and an external rotation force (P = .012). The fibular
rotational angles increased significantly with a medial traction force \((P = .035)\) and an external rotation force \((P = .002)\). With anatomic fixation, there were no significant differences compared with the intact model. With the metal screw, the diastases decreased significantly with an external rotation force \((P = .037)\).

**CONCLUSION:**

Neither single nor double fixation for syndesmosis injuries provided multidirectionally stabilizing syndesmosis. Anatomic fixation directed from the posterior cortex of the fibula to the anterolateral edge of the tibia allowed dynamic stabilization of intact cadaver specimens. The metal screw provided very rigid fixation.

**CLINICAL RELEVANCE:**

Optimal direction of the suture button can provide adequate stabilization of the ankle and could benefit athletes with syndesmosis injuries.


The purpose of this study was to evaluate the radiographic changes of the tibiofibular position and the ankle mortise after removal of trans-syndesmotic fixation to determine if there is loss or maintenance of correction. In addition, the effect of the type of rotational injury, early weight bearing, and the number of trans-syndesmotic screws used on the integrity of the inferior tibiofibular articulation or ankle mortise after screw removal were evaluated. An analysis was conducted of 86 patients, with an unstable rotational ankle fracture requiring open reduction with syndesmosis screw stabilization. Routine radiographic parameters were measured just after open reduction and just before syndesmotic screw removal. There was a high correlation of loss of the integrity of the syndesmotic parameters after screw removal. However, the medial clear space of the ankle changed an insignificant amount, suggesting that although there appears to be some loss of maintenance, the talus did not shift laterally at the expense of a mobile syndesmosis. Ankle injuries requiring stabilization of syndesmotic instability with use of temporary trans-syndesmotic fixation achieve a stable ankle mortise after removal. Tibiofibular diastasis is commonplace upon removal of the syndesmotic hardware, but the ankle mortise remains unchanged. Based on the radiographic criteria described in this study, the postoperative change in medial clear space or tibiofibular diastasis has no bearing on fracture type, deltoid injury, or the use of 1 or 2 cortical screws. As such, other unknown mechanisms affecting the integrity of the syndesmosis after screw removal are in place.


**MATERIALS AND METHODS:**

We reviewed the clinical and radiographic results of 24 patients with acute injuries to the distal tibiofibular syndesmosis who were treated with suture button fixation. Average followup was 20 months. The primary outcomes measure was the AOFAS ankle hindfoot score. Secondary outcomes measures included a calibrated measurement of the tibiofibular clear space and tibiofibular overlap.

**RESULTS:**

The average AOFAS score was 94 points. Syndesmotic parameters returned to normal after surgery and
remained normal throughout the followup period. One in four patients required removal of the suture endobutton device due to local irritation or lack of motion. Osteolysis of the bone and subsidence of the device into the bone was observed in four patients.

**CONCLUSION:**
The suture button device is an effective way to repair the syndesmosis. In our series, the reduction of the syndesmosis was maintained throughout the followup period. However, reoperation for device removal was more common than anticipated. Osteolysis of the bone near the implant and subsidence of the device may occur.


**BACKGROUND:**
Diagnosis and reduction of syndesmosis injuries in ankle fractures can be challenging. Previous studies have demonstrated that standard radiographic measurements used to evaluate the integrity of the syndesmosis are inaccurate. The purpose of this study was to determine the adequacy of standard postoperative radiographic measurements in assessing syndesmotic reduction compared to CT and to determine the prevalence of postoperative syndesmotic malreduction in a patient cohort.

**METHODS:** Twenty-five patients with ankle fractures and syndesmotic instability who had open reduction and syndesmotic fixation were evaluated. All patients had a standard radiographic series postoperatively followed by a CT scan. Radiographic measurements were made by three observers to determine the tibiofibular relationship. Axial CT scan images were judged for quality of reduction of the syndesmosis by measuring the distance between the fibula and the anterior and posterior facets of the incisura. Differences between the anterior and posterior measurements of more than 2 mm were considered incongruous.

**RESULTS:**
Six patients (24%) had evidence of postoperative diastasis using the radiographic criteria, four of whom had evidence of malreduction on postoperative CT scan. Conversely, 13 patients (52%) had incongruity of the fibula within the incisura on CT scan (average 3.6 mm, range 2.0 to 8.0 mm), only four of whom had one or more abnormal radiographic measurements. In 10 (77%) of the 13 malreductions seen on CT scan, the posterior measurement was greater, indicating that internal rotation or anterior translation of the fibula may have occurred. Sensitivity of radiographs was 31% and the specificity was 83% compared to CT.

**CONCLUSIONS:**
Many syndesmoses were malreduced on CT scan but went undetected by plain radiographs. Radiographic measurements did not accurately reflect the status of the distal tibiofibular joint in this series of ankle fractures. Furthermore, postreduction radiographic measurements were inaccurate for assessing the quality of the reduction. Although we did not seek to correlate functional outcomes, the known morbidity of postoperative syndesmotic malreduction should lead to heightened vigilance for assessing accurate syndesmosis reduction intraoperatively.


Ankle sprains in the athlete are one of the most common injuries, and syndesmosis or "high-ankle" sprains seem to being diagnosed at an increasing rate. As a result, there has been a heightened interest
in recognizing and treating these difficult injuries on a timely basis, particularly in the athlete. Although the recognition and diagnosis of these injuries have improved, there still exists a paucity of information on optimal conservative and operative management. In this paper, a systematic review of the literature was conducted to provide an evidence-based rationale in the diagnosis and treatment of syndesmosis (high ankle) sprains in athletes. It is obvious from the low level of evidence available in the literature on this topic that a great deal of work is needed before conclusive statements regarding the management of these injuries can be made with confidence. The current diagnostic tests are not very specific. Because this is a spectrum of injury, there is a lot of variability in the time lost from sport. It is clear that we need a much more definitive diagnostic process for this injury that allows us to predict the severity of the injury, time loss from sport, and the treatment required.

8) J Chris Coetzee, MD, Patrick B Ebling, MD: Treatment of syndesmoses disruptions: A prospective, randomized study comparing conventional screw fixation vs TightRope® fiber wire fixation – medium term results
SA ORTHOPAEDIC JOURNAL Autumn 2009 Page 32-37

BACKGROUND:
Open reduction and screw fixation is the current standard treatment for displaced injuries of the ankle syndesmosis. Despite reduction and stable internal fixation, however, these injuries do not uniformly have excellent outcomes. In addition, screw fixation has potential disadvantages.

MATERIALS AND METHODS:
An ongoing prospective, randomized clinical trial comparing conventional screw fixation with TightRope® fiber wire fixation for syndesmosis injuries. The objective of this paper is also to provide an overview of the important anatomical and biomechanical issues relating to syndesmosis injuries.

RESULTS:
At medium term follow-up the TightRope® fiber wire fixation group had a statistically significant better range of motion compared to conventional screw fixation. The AOFAS ankle and hindfoot score did not show a significant difference between the two groups.
Syndesmotic Reduction:

*Why does it matter; how can you tell and is there a role for arthroscopy?*

Matthew M. Buchanan, MD
(Arlington, Virginia)

**Why does it matter?**
Anatomic Reduction ensures stability of the talus in the mortise.
Malreduced Syndesmosis leads to Early Arthrosis and Poor Clinical Outcome:
As little as 1mm of lateral displacement in the fibula reduces the tibiotalar contact area in weight bearing by 42%.

**How can you tell?**
Direct Visualization (currently the best method)
Mini C-Arm:
May miss up to 30 degrees of External Rotation Malreduction
Radiographic Parameters (consider comparing with normal side):
  - Medial Clear Space
  - Tibiofibular Clear Space at Incisura Fibularis (fibular recess)
  - Tibiofibular Overlap
Stress Radiographs:
  - External Rotation and Abduction
Manual Tests
  - Hook Test/Cotton Test

**Is there a role for arthroscopy?**
Acute Injuries:
100% incident of cartilaginous lesion in Lauge-Hansen Pronation-Eversion fractures.
Chronic Injuries:
  - Syndesmotic Impingement
    - Inferior fascicle of the AITFL is called the accessory AITFL ligament and can be a source of pathologic impingement.
  - Arthroscopic resection of:
    - Torn portion of interosseous ligament
    - Chondroplasty for cartilage lesions (often posterolateral tibial plafond)

**References:**


SESSION 2: SYNDESMOSIS

Moderators:
J. Chris Coetzee, MD
(Edina, Minnesota)
Matthew M. Buchanan, MD
(Arlington, Virginia)

SESSION 2: 8:50 am

The Effect of Syndesmosis Screw Removal on the Reduction of the Distal Tibiofibular Joint:
A Prospective Radiographic Study

Presenting:
Daniel J. Song, MD (Honolulu, Hawaii)
Joseph Lanzi, MD; Adam Groth, MD; Matthew L. Drake, MD; Joseph R. Orchowski, MD; Kenneth K. Lindell, MD

Summary
The purpose of this study is to prospectively evaluate syndesmotic reduction with CT scan, and
determine the effect of screw removal on both the anatomically reduced and malreduced syndesmosis.

Introduction
Injury to the tibiofibular syndesmosis is frequent with rotational ankle injuries. Although there is
controversy regarding the treatment of these injuries (size of screws, number of cortices, postoperative
weight-bearing, need and timing for screw removal), studies show statistically significant improvements
in subjective and objective outcomes with anatomic reduction of the syndesmosis. In a retrospective
radiographic study in 2006, Gardner et al reported a 52% syndesmotic malreduction rate in their 25
patient cohort. The purpose of this study is to prospectively evaluate syndesmotic reduction with CT
scan, and determine the effect of screw removal on both the anatomically reduced and malreduced
syndesmosis.

Methods
This is an IRB-approved prospective radiographic study. Patients over 18 years of age treated at one
institution between August 2008 and December 2010 with intra-operative evidence of syndesmosis
disruption were enrolled. Post-operative CT scans were obtained within 2 weeks of operative fixation of
the injured and uninjured ankle. A second CT scan was then obtained 30 days after syndesmosis screw
removal. All CT scans were evaluated by a single musculoskeletal radiologist to evaluate the reduction of
the syndesmosis. Using axial CT images, differences of more than 2 mm between the anterior and
posterior fibula-incisura distances were considered malreduced in accordance with the standard
established by Gardner et al.

Results
Fifteen patients were enrolled in this prospective study. The average age was 24.1 with three females
and 12 males. Six patients (40.0%) had evidence of tibiofibular syndesmosis malreduction on their initial
post-operative axial CT scans. In the post-syndesmosis screw removal CT scan, five (83.3%) of six
malreductions showed adequate reduction of the tibiofibular syndesmosis. In the five initial
malreductions that became reduced after syndesmosis screw removal, the average difference in the
anterior and posterior fibula-incisura distance was 2.54 mm. In the one initial malreduction that
remained malreduced after syndesmosis screw removal, the difference in the anterior and posterior
fibula-incisura distance was 6.0 mm.
Conclusion
Tibiofibular syndesmosis injuries are common with ankle fractures and require surgical fixation. In 2006, Gardner et al. showed an alarming 52% tibiofibular syndesmosis malreduction rate on immediate post-op CT scans. Weening & Bhandari in 2004, reported a much lower 16% malreduction rate using plain radiographs, and also showed that adequate reduction of the syndesmosis was the only statistically significantly predictor of functional outcome. To our knowledge, this study is the only prospective study evaluating the rate of tibiofibular syndesmosis malreduction with CT scans, as well as the only study to report the effect of syndesmosis screw removal on tibiofibular syndesmosis reduction. Similar to Gardner et al., we also found a high rate of tibiofibular syndesmosis malreduction of 40.0%. Despite this high rate of initial malreduction, 83.3% of the malreduced syndesmoses spontaneously reduced after screw removal. Syndesmotic screw removal may be advantageous to achieve final anatomic reduction of the distal tibiofibular joint and continues to be recommended.
Stress Examination of Supination External Rotation Ankle Fractures: Prospective Randomized Trial of Emergency Department Lateral Gravity Stress versus Manual Stress

Presenting:
Clifford B. Jones, MD (Grand Rapids, Michigan)
Debra L. Sietsema, PhD; Enesi O. Momoh, MD

Summary
LGS is as effective as MS in determining deltoid ligament injury and instability of SER ankle fractures but is less painful and can be performed without orthopaedic resident assistance or time delays. Timely and effective deployment of the LGS could improve diagnosis of deltoid ligament injury, ED throughput, patient satisfaction, and lessen orthopaedic resident services in busy Level-1 trauma centers.

Introduction
Supination External Rotation (SER) ankle fractures are common injuries presenting with varying amounts of fracture displacement and mortise congruency. Manual stress (MS) has been the gold standard of determining deltoid ligament injury and associated ankle instability. The goal of this study was to determine the effectiveness and satisfaction of MS versus lateral gravity stress (LGS) in a prospective randomized trial.

Methods
With IRB approval, 73 consecutive isolated SER ankle fractures over a 2-year period (2007-9), at a Level-1 Trauma Center, were randomized to LGS versus MS. No patients were given sedation during the procedure.

Results
Of the 73 total SER ankle fractures, 38 (52.1%) and 35 (47.9%) were randomized to LGS and MS, respectively. Males and females comprised 50.7% (37) and 49.3% (36), respectively. The average age was 46 (range 18-87). No statistically significant differences were noted in relation to age, sex, or BMI. Average time from ED admission to stress was 169 minutes (range 26-413) with LGS and MS averaging 166 min and 171 min, respectively. Time did not vary based upon day of week. Pain averaged 5.5/10 and 5.3/10 for pre and post stress, respectively. Pain was significantly less for LGS as compared to MS after stress at 4.3/10 versus 6.4/10, respectively (p=0.005). The amount of pain, length of time in ED, and overall satisfaction were 1.9/4, 1.8/4, and 1.5/4, respectively. Patients with more pain after stress were less satisfied with amount of pain during stress procedure (r=0.537, p<0.001).

Conclusion
LGS is as effective as MS in determining deltoid ligament injury and instability of SER ankle fractures but is less painful and can be performed without orthopaedic resident assistance or time delays. Timely and effective deployment of the LGS could improve diagnosis of deltoid ligament injury, ED throughput, patient satisfaction, and lessen orthopaedic resident services in busy Level 1 trauma centers.
Forceps Reduction of the Syndesmosis in Rotational Ankle Fractures: A Cadaveric Study

Presenting:

Thomas Ebinger, MD (Iowa City, Iowa)
Phinit Phisitkul, MD; J. Lawrence Marsh, MD; Jessica Goetz, PhD; Yubo Gao, PhD

Background
Recent studies have shown that it is difficult to accurately reduce and assess the reduction of the syndesmosis after ankle injury. The syndesmosis is most commonly reduced using reduction clamps to compress across the tibia and fibula. However, intraoperative techniques to optimize forceps reductions to restore syndesmotic relationships accurately have not been systematically studied. The purpose of this study was to evaluate the accuracy of syndesmosis reduction with different rotational vectors of clamp placement.

Methods and Materials
Ten through the knee cadaveric specimens were used. Markers were placed on the tibia and fibula to produce consistent clamp placement and radiographic evaluation. An ankle CT was taken as a control followed by a stepwise destabilization of the AITFL, syndesmosis, deltoid ligament, small posterior malleolus fracture, and large posterior malleolus fracture. Following each step in the destabilization, clamps were applied to compress the syndesmosis at varying angles and CT was performed at each step and used to measure the alignment of the syndesmosis as compared to the control.

Results
In all degrees of induced instability and for all vectors of clamp placement, a small but consistent amount of over-compression of the syndesmosis was observed compared to controls. Both obliquely oriented clamp arrangements tested consistently caused fibular malreductions. Placing the clamp in the neutral anatomical axis reduced the syndesmosis most accurately through all degrees of instability.

Conclusions
Clamp placement in the neutral anatomical axis reduces the syndesmosis most accurately although slight over-compression frequently occurs. Oblique clamp placement malreduced the unstable syndesmosis.

Clinical Relevance: Clamp placement in neutral anatomical axis may be preferred in the syndesmosis reduction.
SESSION 2: 9:05 am

Syndesmosis and Lateral Ankle Sprains in the National Football League

Presenting:
Daryl O. Osbahr, MD (Birmingham, Alabama)
Mark C. Drakos, MD; Padhraig F. O'Loughlin, MD; Stephen Lyman, PhD; Ronnie P. Barnes, MA, ATC;
John G. Kennedy, MD, FRCS (Orth); Russell F. Warren, MD

Summary
Syndesmosis sprains in the NFL can be a source of significant disability compared to lateral ankle sprains. Successful return to play with non-operative management can be achieved for both syndesmosis and lateral ankle sprains. With modern treatment algorithms for syndesmosis sprains, more aggressive non-operative treatment is necessitated. Although return to play will be delayed when compared to lateral ankle sprains, the time loss from participation is not as prolonged as previously reported in the literature.

Introduction
Syndesmosis compared to lateral ankle sprains in the National Football League (NFL) can present a significant source of disability with non-standardized treatment methods and an ill-defined algorithm for return to play. This study evaluated diagnostic, treatment, and outcome measures of syndesmosis and lateral ankle sprains in NFL football players to better enable orthopaedic surgeons to identify and manage these complex injuries.

Methods
All syndesmosis and lateral ankle sprains from a single NFL team database were reviewed over a 15-year period, and all 32 NFL team physicians completed a questionnaire detailing their management approach to these injuries. A comparative analysis was performed analyzing several variables, including diagnosis, treatment methods, and time loss from participation. Descriptive and/or statistical analysis was then performed for all variables. An independent sample t-test with corresponding p-values were then calculated for foot and ankle protective gear, playing surface, field condition, mechanism of injury, place of injury, and time loss from participation.

Results
36 syndesmosis and 53 lateral ankle sprains occurred in our cohort of NFL players during the 15-year study period. The mechanism of injury most often resulted from direct impact in the syndesmosis group and torsion in the lateral ankle sprain group (p=0.034). All players in both groups were managed non-operatively. Time loss from participation was 15.4 days in the syndesmosis group and 6.5 days in the lateral ankle sprain group (p<0.001). NFL team physicians vary their treatment for syndesmosis sprains depending upon the category of diastasis, including immobilization for no diastasis, variability of treatment depending upon imaging results for latent diastasis, and surgery for frank diastasis. Most team physicians recommended non-operative management with a form of immobilization and weight-bearing as tolerated for lateral ankle sprains.
Conclusion
Syndesmosis sprains in the NFL can be a source of significant disability compared to lateral ankle sprains. Successful return to play with non-operative management can be achieved for both syndesmosis and lateral ankle sprains. With modern treatment algorithms for syndesmosis sprains, more aggressive non-operative treatment is necessitated. Although return to play will be delayed when compared to lateral ankle sprains, the time loss from participation is not as prolonged as previously reported in the literature.