Disclosures

- Smith & Nephew - Design Surgeon - Royalties, Consulting Fees
- DJO - Consultant
- We do not know everything we need to know

Learning Objectives

- You will learn:
  - The rational behind imaging the normal ankle every time
  - How to diagnose syndesmosis instability
  - How to perform an open reduction
  - What fixation makes sense in your patient
  - When to consider posterior malleolus repair
  - When to consider deltoid ligament repair
What We do know
- Diagnosis is missed at times:
  - Must document intraoperatively:
    - External rotation stress test
    - Cotton Test

Preop Xrays
- Obvious

Preop Diagnosis
- Niebo Jr, et. Al. CORR 2005
  A medial tear space greater than 4 mm
Current Controversies:

- **Screws:**
  - 1 VS. 2
  - 3 Cortices Vs. 4
  - Removal
  - No Difference
    - Michelson JD, et al., JOT 2018

- **Endobutton Devices:**
  - No difference in outcome, but less frequent implant removal
    - Nagel GA, et al., AJSM 2012
    - Cotton JA, et al., JFAS 2009
    - Michelson JD, et al., JOT 2018
  - Better outcome, lower reoperation rate
    - Laflamme M, JOT 2015
  - Similar outcome but faster return to work/sport, fewer complications
    - Chong P, et al., BMC Musculoskelet Disord. 2014 systematic review
    - Colcuc C, et al., KSSTA 2017

- **Reduction:**
  - Open Vs. Closed (Fluoscopic)
  - Open is Better
  - Arthroscopic may be best
  - Posterior malleolar / PITFL injuries?
    - Miller AN, et al., CORR 2010
      - Equivalent to ORIF syndesmosis
  - Deltoid repair?
    - Jones CR, Nunley JA 2nd JOT 2015
      - Equivalent (Only Weber B)
Intraop Diagnosis
Stoffel K, et. Al. JBJS 2009
lateral stress test - superior to the external rotation stress test
• Consider Stress test in the sagittal plane

Reduction
• Do you need a clamp?
  • Buttonhole – Maybe no
  • Screw – yes
• You can overcompress
  • Haynes J. et. Al. FAI 2016 – 163N

Is the position of the foot important?
• Evidence for –
  • Cherney SM, et. Al. JOT 2015
• Evidence against –
  • Tornetta P 3rd. et. Al. JBJS AM 2001
• Clamp Position is also important –
  • Phisitkul P. et. Al. JBJS 2012 (clamp - neutral anatomical axis)
  • JOT 2017 Cosgrove CT, et. Al. – medial tine in the anterior third
Get as Many Data Points as Possible

- Marmor M, et al. Foot Ankle Int. 2011 (ER malreduction)
- Gardner MJ, et al. FAI 2006 (52%) - internal rotation or anterior translation
- Sagi HC, et al. JOT 2012 (39%) were malreduced significantly worse functional outcome scores
- Lucas DE, et al. Foot Ankle Spec. 2016: Not perfect, but another data point
- Cherney JM, et al. JOT 2018: 1 or 2 quadricortical screws
- CT post op
- No significant difference in functional outcomes

Case Study JS – 23y.o. Football player

Arthroscopic syndesmosis Evaluation
Stabilization

Screw loosens with time
Allows motion
Potentially better function
It is not osteopenia enough

Hybrid 1 is not always enough

Stabilization

Osteopaenia
Length Unstable
Maisonneuve
Severe injury

Should We Remove Screws and When?

- No good evidence to suggest better outcome
  - Dingemans SA, et. al. Bone Joint J. 2016 - systematic review
- Maybe
  - Allows for reduction of any malalignment being maintained by the screw

- Baek JH, et. al. , FAI 2017
  - 3 cortex screws removed at 12 weeks
  - Syndesmosis - malreduced on CT scans (24.1%)
  - 71.4% showed spontaneous reduction after screw removal
What is an endobutton?

- A dynamic fixation device
- Better reductions
- Less need for second surgeries
- Better functional outcome ???

Technical Tricks

- Medial Incision:
  - Button is down on bone
  - Avoid irritation
Deltoid repair? Weber B Jones CR Nunley JA 2015 JOT 23(5) MCS>5mm Weber C
Summary

- Syndesmosis injuries need to be identified
- You must image the normal ankle
- We need to do better at reducing them
  - Open is better
  - Stabilization is still dealer’s choice
    - Endobuttons may be better
      - But still not perfect (poor sagittal plane stability)
      - Literature to be reviewed
    - Deltoid/posterior malleolar fixation have a role

Thank You

Case Studies

Case 1 – Pre-op
- 25 y.o woman s/p slip and fall
  - Lisfranc injury
  - Ankle painful and swollen

Ext Rot Stress
Case 1 - Post-op

- No fibula fracture
- Stable on stress test after fixation
- Knot led to significant irritation laterally and had to be removed at 6 months

Case 2 – Pre-op

- 52 y.o. laborer s/p fall

What is the Ideal Treatment?

- 1. Closed reduction and "perc screws" of syndesmosis only
- 2. ORIF of the posterior malleolus and ignore the syndesmosis
- 3. ORIF of the syndesmosis with screws
- 4. ORIF of the syndesmosis with an endobutton
Case 2 – Post-op

- ORIF of posterior mal
- Syndesmosis still unstable
- My bias for rigid fixation in an axial unstable situation
- There are proponents for an endobutton in this setting

Case 3 – Missed syndesmotic injury

- 30 y.o. woman s/p slip and fall
- Wide syndesmosis discovered at first post-op visit

Case 3

- Still had syndesmotic widening after 1 endobutton
- Options:
  - Second endobutton?
  - $5555
  - A three cortex screw
  - $ but will it lead to malreduction
Case 4 – Pre-op

- 35 y/o, woman s/p trip and fall at work

Case 4 – post-op

- Able to return to work full duty

Options:
- Second endobutton $$$
- Repair deltoid
- Hybrid fixation
The overall quality of the studies was poor. The number or placement of syndesmotic screws or the breakage of trans-syndesmotic screws postoperatively had no adverse effect on outcomes (both with moderate strength of evidence). The use of alternative fixation devices (bioabsorbable and endobutton) had poor strength of evidence, as did the opinion that nondisplaced, unstable by stress test, syndesmotic injuries required fixation. There are insufficient data that link subtle rotational syndesmotic malreduction to clinical outcomes.

A systematic review of suture-button versus syndesmotic screw in the treatment of distal tibiofibular syndesmosis injury. Based on our research, though the suture-button fixation group had similar functional outcome (measured on the AOFAS score) and post-operative complication rate compared with the syndesmotic screw fixation group, the suture-button device could lead to better objective range of motion (ROM) measurements and earlier return to work. Besides, the suture-button fixation group had lower rate of implant removal, implant failure, and malreduction. However, high-quality randomized controlled trials with more uniformity in outcome reporting are desirable to determine the long-term effects and cost-effectiveness of the suture-button device.
Medial Clamp Tine Positioning Affects Ankle Syndesmosis Malreduction.

Cosgrove CT1, Putnam SM, Cherney SM, Ricci WM, Spraggs-Hughes A, McAndrew CM, Gardner MJ.

We recommend placing the medial clamp tine in the anterior third of the tibial line on the lateral view to minimize malreduction risk.

Current fixation methods for syndesmotic disruption maintain coronal plane fibular stability. However, respectively resulted in greater or insufficient constraint to fibular motion in the sagittal plane as compared to the intact syndesmotic ligament. These findings suggest that neither traditional screw nor suture button fixations optimally stabilize the syndesmosis, which may have implications for postoperative care and clinical outcomes.


The effect of ankle distraction on arthroscopic evaluation of syndesmotic instability: A cadaveric study.

Tibiofibular diastasis in the coronal plane, as measured at both the anterior and posterior third of the incisure, was found to be significantly less when ankle distraction was applied, as compared to arthroscopic evaluation in the absence of distraction. In contrast, measurement of sagittal plane tibiofibular translation was not affected by ankle distraction.
Massri-Pugin J, et al. FAI 2017
Effect of Sequential Sectioning of Ligaments on Syndesmatic Instability in the Coronal Plane Evaluated Arthroscopically.
Under arthroscopic evaluation, the syndesmosis becomes unstable in the coronal plane only when all syndesmotic ligaments are transected, which should preferentially be measured at the posterior margin of the incisura. Anteriorly, diastasis becomes apparent only with addition of DL disruption, although this added finding may aid in diagnosis of occult deltoid injury.

LaMothe J, et al. FAI 2017
Effect of Complete Syndesmotic Disruption and Deltoid Injuries and Different Reduction Methods on Ankle Joint Contact Mechanics.
Syndesmotic disruption decreased joint contact area and force. Although the thumb technique performed significantly better than the reduction clamp and suture-button construct, syndesmotic reduction did not restore contact mechanics to intact levels.

Lower complication rate and faster return to sports in patients with acute syndesmotic injuries treated with a new knotless suture button.

Colcuc C1,2, Blank M3, Stein T4,5, Raimann F6, Weber-Spickschen S7, Fischer S8, Hoffmann R3.
The screw fixation and knotless suture button groups comprised 26 and 28 patients, respectively. The complication rate was significantly lower (p = 0.03) and time to return to sports was significantly shorter in the knotless suture button than screw fixation group (average, 14 versus 19 weeks, respectively p = 0.006). No significant differences were identified in clinical outcomes or visual analog scale scores for pain and function between the groups.
Arthroscopic Quantification of Syndesmotic Instability in a Cadaveric Model.

Stress radiography did not distinguish between intact and single-ligament disruption and was unreliable in distinguishing between sequential transection models. Arthroscopy significantly predicted isolated disruption of the AITFL or deltoid ligaments. Also, probing was able to differentiate between most patterns of ligament injury, including sequential transections.

CLINICAL RELEVANCE:

These data can aid surgeons during arthroscopy of the ankle when attempting to correlate intraoperative syndesmotic evaluation findings with the extent of ligament injury.


Should syndesmotic screws be removed after surgical fixation of unstable ankle fractures? a systematic review.

Dingemans SA1, Rammelt S2, White TO3, Goslings JC1, Schepers T1.

The currently available literature does not support routine elective removal of syndesmotic screws. However, the literature is of insufficient quality to be able to draw definitive conclusions. Secondary procedures incur a provider and institutional cost and expose the patient to the risk of complications. Therefore, in the absence of high quality evidence there appears to be little justification for routine removal of syndesmotic screws. Cite this article: Bone Joint J 2016;98-B:1497-1504.

Foot Ankle Int. 2017 Dec 1;1071100717744332. doi: 10.1177/1071100717744332. [Epub ahead of print]

Correlation of Incisura Anatomy With Syndesmotic Malreduction.

Boszczyk A1, Kwapisz S1, Krümmel M2, Grass R3, Rammelt S3.

Clinically relevant malreduction in the coronal plane, sagittal plane, and rotation affected 8.3%, 27.8%, and 19.4% of syndesmoses, respectively. The syndesmoses with a deep incisura and the fibula not engaged into the tibial incisura were at risk of overcompression, anteverted incisuras at risk of anterior fibular translation, and retroverted incisuras at risk of posterior fibular translation.

CONCLUSIONS:

Certain morphologic configurations of the tibial incisura increased the risk of specific syndesmotic malreduction patterns.
LaMothe JM, et al. Foot Ankle Int. 2016. Three-Dimensional Analysis of Fibular Motion After Fixation of Syndesmotic Injuries With a Screw or Suture-Button Construct. The suture-button construct allowed significantly more sagittal plane motion than the syndesmotic screw. Measurements acquired with mortise imaging did not detect differences between the intact, lateral injury, and 2 repair conditions. External rotation of the fibula was significantly increased in both injury conditions and was not restored to intact levels with the screw or the suture-button construct.

Lucas DE, et al. Foot Ankle Spec. 2016. Arthroscopic Evaluation of Syndesmotic Instability and Malreduction. Two groups of surgeons were able to identify syndesmotic instability a combined 75% of the time. Malreduction diagnosis was mixed with a 100% accurate diagnosis of sagittal plane displacement but only 30% accuracy for rotation and 17% for an anatomic reduction.

Cherney SM, et al. JOT 2018. Trans-syndesmotic stabilization with either 1 or 2 quadrilateral position screws. CT post op. Minimum 1 yr. f/u. No significant difference in functional outcomes between reduced and malreduced groups at the 1.5-2.5-mm thresholds for linear measurement. Similarly, there was no functional difference between the reduced and malreduced groups for rotational malreductions of a 10 or 15 degrees threshold. Patients with state-sponsored insurance (Medicaid) had significantly worse functional scores and pain scores when compared with the groups with private insurance, Medicare, or no insurance.
Increased Reduction Clamp Force Associated With Syndesmotic Overcompression.

Syndesmotic overcompression (fibular medialization greater than 1.0 mm when compared with noninjured ankle) was seen in 11 of 21 patients (52%). Increased clamp forces 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 forces used for syndesmotic reduction.

Arthroscopically Assisted Open Reduction-Internal Fixation of Ankle Fractures: Significance of the Arthroscopic Ankle Drive-Through Sign.

The arthroscopic ankle drive-through sign is characterized by the ability to pass a 2.9-mm shaver (Smith & Nephew, Andover, MA) easily through the medial ankle gutter during arthroscopy, which is not usually possible with both an intact deltoid ligament and syndesmosis.

Radiographic Change of the Distal Tibiofibular Joint Following Removal of Transfixing Screw Fixation.

On plain radiographs, syndesmosis diastasis was not observed before or after the removal of transfixing screws. 3 cortex screws removed at 12 weeks, mWt for 12 wks.

However, the syndesmosis was found malreduced on CT scans in 7 cases (24.1%). Of the cases with a malreduced syndesmosis, 71.4% showed spontaneous reduction after screw removal. Therefore, we believe the removal of transfixing screws is recommended after confirming malreduction on CT scans, although plain radiographs demonstrate anatomic reduction.
Andersen MR, et al. JBJS 2018
Randomized Trial Comparing Suture Button with Single Syndesmotic Screw for Syndesmosis Injury.

Both groups were allowed partial weight-bearing at 2 weeks and full weight-bearing at 6 weeks. The mean time for SS removal was 85.9 days (range, 39 to 132 days) after surgery.

Twenty of 40 patients in the SS group had a difference in the tibiofibular distance of ≥2 mm between the injured and uninjured ankles at 2 years, compared with 8 of 40 patients in the SB group (p = 0.009). Seven patients in the SS group had symptomatic recurrent syndesmosis diastasis during the treatment period compared with none in the SB group (p = 0.005).

The patients treated with an SB had higher AOFAS scores, OMA scores, and EQ-5D Index scores as well as lower VAS scores for pain during walking and pain during rest. Also, the SB group had less widening seen radiographically at 2 years than the SS group (p = 0.012). No differences in the scores for pain at night or during daily activities were identified.

Suture-Button Fixation and Mini-Open Anterior Inferior Tibiofibular Ligament Augmentation Using Suture Tape for Tibiofibular Syndesmosis Injuries.