

Current Status of Syndesmotic Injuries: Our Understanding Today

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ABSTRACT

Syndesmotic injuries are common after ankle fractures. Despite the growing number of manuscripts on the fluoroscopic images performing the topic, there is still debate surrounding key aspects of syndesmotic injuries. This review aims to present current concepts about the diagnosis and treatment of these injuries.

Keywords: Ankle fractures, Ankle joint, Malleolar fracture, Syndesmosis, Syndesmotic injury.

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BACKGROUND/INTRODUCTION

Our understanding of the ankle complex, syndesmosis injuries, and significance of syndesmotic instability has evolved in the last 50 years shifting from no treatment at all to fixing all the fractures. In recent years, it has been recognized that not all syndesmotic injuries require stabilization. Still, there are no definitive answers regarding the best treatment option (i.e., operative vs nonoperative, and tight rope vs screw), and hardware removal. Recently, a survey of the Orthopaedic Trauma Association (OTA) members showed a high grade of variability and controversy in the treatment of ankle fractures.¹ In this review, we aim to present what is currently known about the diagnosis, treatment, and postoperative management of syndesmotic injuries.

REVIEW

Syndesmotic injuries usually occur after ankle pronation external rotation injuries and can be associated with malleolar fractures.² A better understanding of the ankle and syndesmotic anatomy has allowed the orthopedic surgeon to treat syndesmotic injuries. The medial, lateral, and posterior malleoli are important for ankle stability. Like the pelvis, the ankle can be conceived as a ring and altering its bony or ligament structures in at least two places can lead to instability.³

Diagnosis

Physical exam and clinical signs have not shown to be reliable in diagnosing syndesmotic injuries.^{3–5} Therefore, standard radiographs [anterior–posterior (AP), lateral, and oblique view] should be obtained to evaluate patients with a suspected ankle injury. Well-known X-ray parameters that suggest a syndesmotic injury are tibiofibular (TF) overlap (>6 mm in the AP view and >1 mm from the tibial plafond in the mortise view), TF clear space (<6 mm, 1 cm above the tibial plafond in the AP and mortise views), and medial clear space. Croft et al. also suggested using the anterior tibiofibular ratio (ATFR) measured on the lateral view as an additional measure that can aid in the diagnosis of a syndesmotic lesion.⁶

Dynamic stability of the ankle should be assessed using either external rotation stress, gravity stress, or weight-bearing (WB) radiographs. It is important to bear in mind that each of these methods has pros and cons, for example, manual stress and WB

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radiographs are dependent on patient's pain tolerance, which can affect its technique.⁷ Obtaining ankle stress radiographs in dorsiflexion and external rotation has shown to predict deltoid ligament disruption.^{8,9} Although reliable, this technique has the potential drawback of increased radiation for the medical personnel and limited reliability due to the patient's pain tolerance.^{7,10} Gravity stress images have shown to be equivalent to manual stress radiographs while being more comfortable for the patient, additionally, it has been reported to have nearly perfect sensitivity and specificity for deltoid ligament disruption.^{11–14} On the contrary, literature has shown that it can overestimate the need for surgical treatment as it increases medial clear space secondary to plantar flexion of the ankle.^{3,15,16} Weight-bearing radiographs allow evaluation of stability and congruence of the ankle joint while reducing the need for surgery.^{3,17,18} A recent study concluded that WB radiographs fail to demonstrate rotational instability and deltoid ligament lesion.¹⁹ Weber et al. evaluated the use of WB radiographs taken 3–10 days post-injury founding that this approach allows for a pain-free evaluation while being reliable in distinguishing those injuries that require surgery without affecting functional results.¹⁷

In cases in which a syndesmotic lesion is suspected but no definitive diagnosis can be made based on X-rays and clinical history alone, a magnetic resonance imaging (MRI) can be warranted. Literature has shown conflicting results, some studies have shown suboptimal interobserver agreement, although more recent studies

Table 1: Senior author's preferred method of treatment

Preoperative evaluation	X-rays/CT scan
Intraoperative evaluation	X-rays/3D intraoperative imaging if available
Reduction technique	Open
Fixation technique	Trans-syndesmotic screw
Postoperative protocol	WB as tolerated
Hardware removal	Not recommended

have reported that the MRI has high sensitivity and specificity while reducing the rate of false-positive injuries that require surgery.^{20–25} Despite having lower soft-tissue resolution when compared to the MRI, computed tomography (CT) allows the surgeon to evaluate the presence of a diastasis, evaluate the incisura fibularis, and when fractures are present, the articular extension, impaction, and presence of a posterior fragment (Table 1).

In the setting of an ankle fracture, diagnosis of syndesmotic instability can be made intraoperatively under fluoroscopic guidance using either the hook test or external rotation stress test.²⁶

Treatment

Once an ankle fracture or syndesmotic injury is deemed to require surgical fixation, the surgeon must consider the different options to obtain and maintain reduction.

How Do I Obtain an Adequate Reduction?

It is critical to obtain an adequate reduction of the syndesmosis, this can either be performed via indirect or direct methods. It is important to consider the anatomic variabilities of the incisura fibularis. Boszczyk et al. performed bilateral postreduction CT scans and found that over-compression was common in patients with a deep and disengaged incisura, while version of the incisura may lead to anterior or posterior displacement of the fibula.²⁷

A reduction clamp is the simplest method that can be used to reduce the syndesmosis, but adequate positioning is crucial, as a too anteriorly positioned tine can malreduce the syndesmosis translating the fibula and narrowing the incisura anteriorly and vice versa which results in malreduction. Efforts have been made to identify the most accurate clamp position. Clamp placement along the axis of the ankle joint (i.e., tines should be positioned lateral to the malleolar ridge at the fibula and in the central part of the medial cortex in the tibia) has historically been used.^{28,29} To evaluate if clamps were anatomically placed, Phisitkul et al. recommended that no overlap of the clamp tines should be seen in a fluoroscopic mortise view.²⁸ Cosgrove et al. described medial tine placement in the anterior third of the tibial line.³⁰ In a subsequent study, the trans-syndesmotic axis (TSA) measured in a preoperative CT scan was used as a reference for clamp placement, lower malreduction rates were obtained while positioning the clamp along the TSA axis or 10° posterior to it.³¹ The use of the TSA has proven to help guide adequate clamp positioning.³² In a recently published cadaveric study, Vetter et al. compared reduction with collinear clamps, reduction forceps, and crossing K-wires concluding that reduction could be successfully achieved with either method.³³ Comparison of these methods to digital reduction revealed the absence of over-compression, although clinical outcomes do not differ when compared to clamp reduction.^{33,34}

It is important to keep in mind that malreduction and over-compression are common with these techniques.^{35–37} Therefore,

Sagi et al. recommended a “direct, open visualization of the syndesmosis during reduction maneuver”.³⁵ Miller et al. reported on 149 patients treated with direct visualization and concluded that even though the reduction was suboptimal in some cases, there was a significant decrease in the rate of malreductions.³⁶ Recently, Tornetta et al. proposed using the articular surface as a visual landmark during open reduction aligning it with the anteromedial fibular articular surface, by doing so, alignment is further improved when compared to relying on the incisura alone.³⁸

Bringing back the “ring concept”, it is important to evaluate if a posterior malleolus fracture is present. The posterior malleolus is the attachment site for the posterior inferior tibiofibular ligament (PITFL). Thus, disruption of the posterior complex can lead to syndesmotic instability. Literature has shown that fragments as small as 10% can affect stability and, reduction and stabilization of this fragment, could be enough to restore syndesmotic stability.^{39–41} Even after fixation of this fragment has been achieved, it is important to rule out persistent syndesmotic instability.

Irrespective of the technique used, it is important to assess the adequacy of reduction, as it will be mentioned in the following sections.

How Should I Fix It?

Once reduction has been obtained, the surgeon faces the question of whether to use a static (screw) or dynamic fixation. And, while considering a screw fixation, many questions arise. Several biomechanical and clinical studies have addressed many of the questions and there seems to be no difference in screw size (i.e., 3.5 or 4.5 mm screws), although resistance to shear stress is better tolerated with 4.5 mm screws,^{42–44} material (stainless steel or titanium),⁴⁵ the use of one or two screws,⁴⁶ three or four for cortical,^{43,45–49} and location (trans- or supra-syndesmotic).^{46,50}

Advocates of suture-button devices argue that, since the syndesmosis is a mobile joint, a dynamic stabilization should be biomechanically more favorable as it allows movement while preserving reduction. A recently published in a meta-analysis including 11 cadaveric studies, concluded that suture-button fixation is less rigid when compared to screw fixation.⁵¹ There seems to be no difference among the different configurations (i.e., single, parallel, or divergent).⁵² A randomized control study by the Canadian Orthopaedic Trauma Society compared screw fixation (two, 3.5-mm, tricortical screws) vs TightRope; malreduction rates were lower with TightRope without finding differences in functional outcomes over time; as expected, reoperation rates were higher in the screw fixation group.⁵³ Fan et al. published a systematic review and meta-analysis aiming to compare screw fixation with suture-button devices, 420 patients (10 studies) were included in the analysis.⁵⁴ In their study, there were no statistically significant differences in functional outcomes, malreduction (although higher rates were found with screw fixation), and postoperative complications. A higher rate of secondary procedures, related to screw removal, was found. Literature has shown that postoperative outcomes, malreduction, and complication rates are similar between the two methods.^{54–56}

How Do I Assess My Reduction?

Irrespective of the method used, it is important to achieve an adequate reduction of the syndesmosis as it affects fixation stability, ankle biomechanics, functional outcomes, and increases the risk of posttraumatic arthritis secondary to an increase in joint reactive forces.^{35,36,57–62} Malreduction has been identified in up

to 50% of the cases and “small” differences (2-mm) in the anterior TR distance when compared to the uninjured side showed to correlate with poorer outcomes.^{35,60,63,64} Persistent diastasis is often overlooked in plain radiographs, therefore the surgeon must be aware of the methods to evaluate diastasis intraoperatively and postoperatively.⁶⁰

To evaluate instability intraoperatively, a hook test can be performed and can be complemented with an external rotation stress examination with fluoroscopic imaging.⁶⁵ Even though these tests have a high interobserver agreement (99%), it lacks sensitivity (25% and 58%, respectively) to detect instability.⁶⁶ Stress test can be complemented with a mortise and talar dome lateral fluoroscopic images of the uninjured side as a template for reduction and obtained an adequate reduction in 17/18 patients.^{67,68} Three-dimensional (3D) imaging has shown promising results and its use has been proposed as an alternative to identify subtle malreductions that are not identified in conventional fluoroscopy and/or postoperative radiographs.⁶⁹ Franke et al. used intraoperative 3D scans to verify the reduction of 251 patients, almost a third of them required an improvement of the reduction.⁶⁴ Despite this, literature has shown conflicting results while comparing 3D imaging to standard fluoroscopic images.^{70,71} It is important to remember that this method is not available in all hospital settings.

Postoperative CT scans have been used to evaluate reduction, Prior et al. published a protocol in which the anteroposterior translation and fibular length were measured and compared to the uninjured side.⁷² Abdelaziz et al. evaluated intraobserver and interobserver reliability of nine previously published methods used to evaluate reduction. Syndesmotic area calculation and fibular rotation proved to have the highest interobserver reliability.⁷³

Should I Remove My Implant?

There seems to be an agreement regarding implant removal. Literature has shown that there is no additional benefit to screw removal as there is no difference in functional, clinical, or radiographic outcomes.^{74–76} It is important to have an early conversation with patients and explain that screw breakage is a possibility, more importantly, it is crucial to emphasize that this does not affect recovery nor outcomes, and hardware removal is not advisable. There are circumstances in which implant removal should be considered (e.g., persistent pain or syndesmosis malreduction). Early removal (i.e., 6–8 weeks) has been associated with syndesmotic diastasis.^{74,77} It is advisable to wait at least 12 weeks to guarantee adequate healing.

CONCLUSION

Despite controversy and lack of consensus in some aspects of the diagnosis and treatment of syndesmotic lesions, irrespective of the reduction and fixation method used, to obtain good results it is essential to achieve an adequate reduction.

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