Technical Note

Arthroscopically Assisted Reduction of Sagittal-Plane Disruption of Distal Tibiofibular Syndesmosis

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Abstract: Injuries to the distal tibiofibular syndesmosis can occur in conjunction with ankle fractures. Sagittal instability of the syndesmosis is more critical than coronal instability and must be taken into account when considering reduction and fixation of the syndesmosis. The purpose of this Technical Note is to report the technique of arthroscopically assisted reduction of sagittal-plane disruption of the distal tibiofibular syndesmosis. This ensures a comprehensive assessment of the pattern of syndesmotic disruption, which can aid anatomic reduction of the syndesmosis.

S\textsuperscript{tability of the distal tibiofibular syndesmosis relies on the ligamentous structures and the bony architecture.\textsuperscript{1,3} Injuries to the syndesmosis can occur in conjunction with ankle fractures 13\% to 50\% of the time.\textsuperscript{4,5} Some of the injuries can lead to instability of the syndesmosis, which can be either latent or frank instability.\textsuperscript{6} If the unstable syndesmosis is missed or not properly reduced and stabilized, chronic syndesmosis instability and early degeneration of the ankle joint can result.\textsuperscript{7} During open reduction and internal fixation of ankle fractures, surgeons should assess the integrity of the syndesmosis. It should be noted that coronal, sagittal, rotational, or longitudinal instability of the syndesmosis can occur.\textsuperscript{8,9} A combination of frank and latent instability of the syndesmosis in different planes can occur.\textsuperscript{8,9} The fibula shows maximal motion in the sagittal plane with disruption of the syndesmosis.\textsuperscript{10} Intraoperative assessment of frank sagittal instability under fluoroscopy is unreliable because measurements on lateral images to assess the syndesmosis have not been well defined.\textsuperscript{10} Moreover, the anteroposterior view is not sensitive to detect sagittal instability because there is no increase in tibiofibular clear space.\textsuperscript{11} An intraoperative stress test under fluoroscopy for latent sagittal instability is also unreliable. Translation of the lateral malleolus in the sagittal plane cannot be measured reliably with conventional radiology because of the external rotation of the ankle itself during stress examination.\textsuperscript{12} Advanced intraoperative imaging techniques, such as 3-dimensional fluoroscopic imaging, are useful for assessment of the integrity of the syndesmosis. However, they are not always available. Ankle arthroscopy allows assessment of frank or latent instability of the syndesmosis in the coronal, sagittal, and transverse planes.\textsuperscript{8,9} It can also detect any associated chondral lesions.\textsuperscript{13} The purpose of this Technical Note is to report the technique of arthroscopic assessment and reduction of sagittal-plane disruption of the distal tibiofibular syndesmosis. This is important because sagittal instability seen during anterior and posterior stress testing of the fibula is far more accurate than isolated coronal-plane stress testing for accurately diagnosing syndesmotic instability.\textsuperscript{14} This is especially true if ankle distraction is applied because the syndesmosis diastasis in the coronal plane will be significantly less compared with arthroscopic evaluation in the

| Table 1. Indications and Contraindications of Arthroscopically Assisted Reduction of Sagittal-Plane Disruption of Distal Tibiofibular Syndesmosis |
|---------------------------------------------------------------|
| **Indications** | **Contraindications** |
| All ankle fractures undergoing open reduction and internal fixation | No contraindication |

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absence of distraction. In contrast, measurement of sagittal-plane disruption of the syndesmosis is not affected by ankle distraction. This procedure is indicated in all ankle fractures undergoing open reduction and internal fixation. There is no absolute contraindication to this arthroscopic procedure (Table 1).

Technique

Preoperative Planning and Patient Positioning

Computed tomography (CT) is a useful preoperative investigation to study frank disruption of the syndesmosis. There is significant variance in the bony anatomy of the syndesmosis between individuals, but there is minimal difference between the ankles of the same patient. The uninjured ankle provides a precise definition of normal tibiofibular relations, and therefore, CT of both ankles should be performed. Syndesmosis assessment using an axial CT scan at the joint level best correlates with the arthroscopic examination. However, latent instability of the syndesmosis cannot be detected by this static investigation. Moreover, the pattern of syndesmosis disruption as shown on preoperative CT may not be the same after reduction and fixation of the ankle fractures.

The patient is placed in the supine position. The hip and knee are flexed with a triangular supporting frame (Innomed, Savannah, GA) under the knee. This can relax the triceps surae. No continuous ankle traction is used. A thigh tourniquet is applied to provide a bloodless surgical field. Fluid inflow is by gravity, and no arthro-pump is used. A 2.7-mm 30° arthroscope (Henke Sass Wolf, Tuttlingen, Germany) is used for this procedure.

Fig 1. Arthroscopically assisted reduction of sagittal-plane disruption of distal tibiofibular syndesmosis of the left ankle. The patient is in the supine position with the hip and knee flexed. Ankle arthroscopy is performed using the anteromedial portal (AMP) and anterolateral portal (ALP).

Fig 2. Arthroscopically assisted reduction of sagittal-plane disruption of distal tibiofibular syndesmosis of the left ankle. The patient is in the supine position with the hip and knee flexed. The anteromedial portal is the viewing portal, and the anterolateral portal is the working portal. The integrity of the posterior inferior tibiofibular ligament (PITFL) is assessed. In the illustrated case, the ligament is ruptured in its tibial insertion. (LM, lateral malleolus; Ta, talar dome; Ti, tibia.)

Fig 3. Arthroscopically assisted reduction of sagittal-plane disruption of distal tibiofibular syndesmosis of the left ankle. The patient is in the supine position with the hip and knee flexed. The anteromedial portal is the viewing portal, and the anterolateral portal is the working portal. The integrity of the anterior inferior tibiofibular ligament (AITFL) is assessed. In the illustrated case, the AITFL is torn at its fibular insertion. (LM, lateral malleolus; P, arthroscopic probe; Ta, talar dome; Ti, tibia.)
Portal Placement
The standard anterolateral and anteromedial ankle arthroscopy portals are used (Fig 1). The anterolateral portal is just lateral to the peroneus tertius tendon, and the anteromedial portal is just medial to the tibialis anterior tendon. Three- to four-millimeter skin incisions are made at the portal sites. The subcutaneous tissue is bluntly dissected down to the anterior ankle capsule with a hemostat. The capsule is pierced by the hemostat.

Assessment of Integrity of Posterior Inferior Tibiofibular Ligament
The anteromedial portal is the viewing portal, and the anterolateral portal is the working portal. The inflamed synovium is resected with an arthroscopic shaver (Dyonics; Smith & Nephew, Andover, MA). The integrity of the posterior inferior tibiofibular ligament is assessed in its whole span from the fibular to tibial side. Any substance tear or the presence of a posterior malleolar fracture is noted. In the illustrated case, the posterior inferior tibiofibular ligament is torn at its tibial insertion (Fig 2).

Assessment of Integrity of Anterior Inferior Tibiofibular Ligament
The anteromedial portal is the viewing portal, and the anterolateral portal is the working portal. The arthroscope is placed in the joint proper as well as in the anterior ankle recess to obtain a complete assessment of the anterior inferior tibiofibular ligament. The ligament is examined for any tear. In the illustrated case, the anterior inferior tibiofibular ligament is torn at its fibular insertion (Fig 3).

Assessment of Sagittal-Plane Stability of Distal Tibiofibular Syndesmosis
The anteromedial portal is the viewing portal, and the anterolateral portal is the working portal. The interosseous
ligament is a few millimeters above the ankle joint line and usually cannot be visualized by ankle arthroscopy. Diastasis of the syndesmosis can be shown by passage of the arthroscopic shaver through the syndesmosis. Sagittal-plane instability of the syndesmosis can be shown by pushing the lateral malleolus anteriorly and posteriorly (Fig 4).

Assessment of Integrity of Deep Deltoid Ligament

The anterolateral portal is the viewing portal, and the anteromedial portal is the working portal. The anterior part of the deep deltoid ligament (deep anterior tibiotalar ligament) can be traced from the medial malleolus down to the medial talus. In the illustrated case, the deep anterior tibiotalar ligament is intact (Fig 5).

Arthroscopically Assisted Reduction of Syndesmosis

The anteromedial portal is the viewing portal. The syndesmosis is reduced by pushing the lateral malleolus anteriorly until the gap between the tibia and lateral malleolus is closed (Fig 6). The gaps in the torn anterior and posterior inferior tibiofibular ligaments are also closed.

Screw Fixation of Syndesmosis

The reduced syndesmosis is temporarily transfixed with a 1.6-mm K-wire. A syndesmotic screw measuring 3.5 or 4.5 mm (depending on the size of the distal fibula) is inserted 2 to 2.5 cm above the ankle joint (Fig 7, Video 1, Table 2).

Discussion

Sagittal instability of the distal tibiofibular syndesmosis is more critical than coronal instability and must be taken into account when considering reduction and fixation of the syndesmosis. If sagittal-plane disruption of the syndesmosis is misinterpreted as coronal-plane disruption, an inappropriate strategy of reduction of the syndesmosis may be adopted and may lead

Table 2. Pearls and Pitfalls of Arthroscopically Assisted Reduction of Sagittal-Plane Disruption of Distal Tibiofibular Syndesmosis

| Pearls                                      | Pitfalls                                      |
|---------------------------------------------|-----------------------------------------------|
| 1. Arthroscopic synovectomy is useful to aid visualization of the syndesmotic and collateral ligaments. | 1. The fibular fracture should be properly reduced and fixed to provide a length-stable fibula before the arthroscopic procedure. |
| 2. Besides closing the syndesmosis, anatomic reduction of the syndesmosis can be confirmed by closing the gaps at the torn anterior and posterior inferior tibiofibular ligaments. | 2. The reduction of the fibular fracture should be assessed fluoroscopically to avoid shortening or rotational malreduction. |
Reduction of Sagittal-Plane Disruption of Distal Tibiofibular Syndesmosis

1. Comprehensive assessment of injuries to syndesmotic and collateral ligaments
2. Complete picture of syndesmosis disruption can be obtained
3. Assessment and treatment of associated chondral lesions
4. Injury to articular cartilage
5. Malreduction of syndesmosis

Table 3. Advantages and Risks of Arthroscopically Assisted Reduction of Sagittal-Plane Disruption of Distal Tibiofibular Syndesmosis

| Advantages | Risks |
|------------|-------|
| 1. Injury to superficial peroneal nerve | 1. Injury to superficial peroneal nerve |
| 2. Injury to saphenous nerve and vein | 2. Injury to saphenous nerve and vein |
| 3. Injury to syndesmotic ligaments and collateral ligaments | 3. Injury to syndesmotic ligaments and collateral ligaments |
| 4. Injury to articular cartilage | 4. Injury to articular cartilage |
| 5. Malreduction of syndesmosis | 5. Malreduction of syndesmosis |

to malreduction of the syndesmosis and chronic syndesmosis disruption.

Intraoperative stress radiography fails to detect approximately half of the cases of instability confirmed at arthroscopy. In the presence of associated injuries requiring surgery, arthroscopic viewing with stress examination is the diagnostic benchmark when available. Besides assessment of the pattern of disruption of the syndesmosis and integrity of the syndesmotic ligaments, the surgeon should pay attention to the integrity of the deltoid ligament because disruption of the deltoid ligament appears to destabilize the syndesmosis in the coronal and sagittal planes when associated with partial disruption of the syndesmosis. In the case of latent instability of the syndesmosis, we still prefer fixation and stabilization of the syndesmosis because the complication rate of syndesmotic stabilization is low and unaddressed syndesmotic instability may lead to chronic instability with a poorer prognosis.

The advantages of this arthroscopic technique include performing a comprehensive assessment of the injuries to the syndesmotic and collateral ligaments, obtaining a complete picture of the syndesmosis disruption, and performing an assessment and treatment of associated chondral lesions. The potential risks include malreduction of the syndesmosis and injuries to the superficial peroneal nerve, the saphenous nerve and vein, the syndesmotic ligaments, the collateral ligaments, and the articular cartilage (Table 3). Extravasation is common but usually not a problem because no arthro-pump is used and the irrigation fluid will leak out through the lateral incision for reduction and fixation of the fibular fracture. Arthroscopically assisted reduction of sagittal-plane disruption of the distal tibiofibular syndesmosis is not a technically demanding procedure and can be attempted by average foot and ankle arthroscopists.

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