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Treatment of chronic isolated distal tibiofibular syndesmosis injury. Literature update and case report using autologous semitendinous graft reconstruction

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Summary

Isolated distal tibiofibular syndesmosis lesions are rare and can be easily missed. Diagnosis and treatment of chronic disruption is not easy, with limited published data. Surgical treatment of chronic syndesmosis injury is challenging as there is no international consensus on the optimal management. Diagnosis and treatment are still controversial and poorly discussed in literature.

PubMed/Medline, Cochrane Database of Systematic Reviews, Cochrane Clinical Trial Register, Current Controlled Trials and Embase were searched from 1990 to December 2020 to identify studies relating to treatment of isolated chronic syndesmosis injury and 17 articles were identified. We found 5 studies reporting on the results of autologous semitendinosus tendon graft in chronic syndesmosis reconstruction.

We describe the case of a 47-year-old man who sustained an isolated distal tibiofibular syndesmotic injury of his right ankle that was initially missed. The patient was diagnosed at 6 months after a motocross accident and underwent reconstruction of syndesmosis with semitendinous autologous tendon associated with debridement of the fibrosous scar tissue in the anterior tibial fibular area (with preservation of the anterior sleeve) and subsequent reinsertion with transosseous stitches in the fibular bone. We used a quadricortical screw to stabilize syndesmosis definitively. After 1 month, the reduction failed because of transyndesmosic screw breakage and the patient underwent another surgery. We removed the broken screw and then used a suture button to stabilize syndesmosis permanently.

The literature review and clinical case seem to suggest that reconstruction of the distal tibiofibular syndesmosis with autogenous tendon for chronic syndesmosis injury determines a good therapeutic effect in terms of both subjective symptoms and objective evaluation scores. The autologous semitendinosus tendon graft may be an appropriate and promising reconstruction target in the treatment of chronic syndesmosis injury.

Key words: syndesmosis, isolated, case report, autologous semitendinosus graft

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Objective

The syndesmosis complex consists of 4 ligaments. The AITLF (anterior inferior tibiofibular ligament) (35%) and deep posterior inferior tibiofibular ligament (PIT-

FL) (33%) contribute the most to ankle stability, followed by the interosseous ligament (IOL) (22%) and superficial posterior tibiofibular ligament (9%) [1]. The syndesmosis is commonly injured with the AITFL first [1]. The AITFL is important in providing resistance to external rotation and posterior translation of the fibula. In contrast, the PITFL is an important structure involved in controlling internal rotation [1].

The incidence of isolated distal tibiofibular syndesmotic ruptures in acute ankle sprains lies between 1 and 11% (most of these syndesmosis ruptures are associated with bony avulsions or malleolar fractures). These injuries are frequently overseen or misdiagnosed as anterolateral rotational instability of the ankle and often become apparent through protracted courses. Although the pathomechanics and extent of syndesmotic injuries have been systematically described by Lauge-Hansen and Weber, no generally accepted guidelines exist as to when these complex injuries are to be treated surgically to ensure sufficient and stable healing of the syndesmosis besides correct alignment of the distal fibula [2].

Case presentation

A 47-year-old male presented to our clinic five months after a right ankle sprain. At the injury date (31 July 2017), he was seen for a motocross accident at the Emergency Department of another hospital, and plain radiographs of his ankle were obtained (Fig. 1). The treatment involved a zinc glue bandage for six days and the prescription of an orthopedic checkup as needed.

After 10 days the patient was evaluated for persistent pain and swelling of right ankle by an orthopedic surgeon of the same hospital and an MRI of the right ankle was prescribed (Fig. 2).

After 20 days the patient was re-evaluated by the same physician who prescribed physical therapy rehabilitation.

The patient underwent examination after 20 days and was prescribed proprioceptive gymnastics and a brace for 30 days.

After the rehabilitation program, the right ankle evolved with persisting pain, swelling, and inability to perform physical activities.

The patient also underwent a Doppler examination for persistent ankle edema.

Six months after the trauma, the patient searched for a specialized evaluation at our Institution. The physical examination revealed ankle swelling, anterolateral tenderness, limitation in the range of movement (ROM), and pain on palpation of the medial side of the ankle and tibiofibular syndesmosis, positive external rotation test and lidocaine test for distal tibiofibular syndesmosis. A comparative load x-ray was performed (Fig. 3) and it was decided to have the patient undergo surgery after a diagnostic ankle arthroscopy (in the same operating session).

After obtaining informed consent and after anesthetic evaluation the patient underwent surgery eight days after the visit at our hospital.

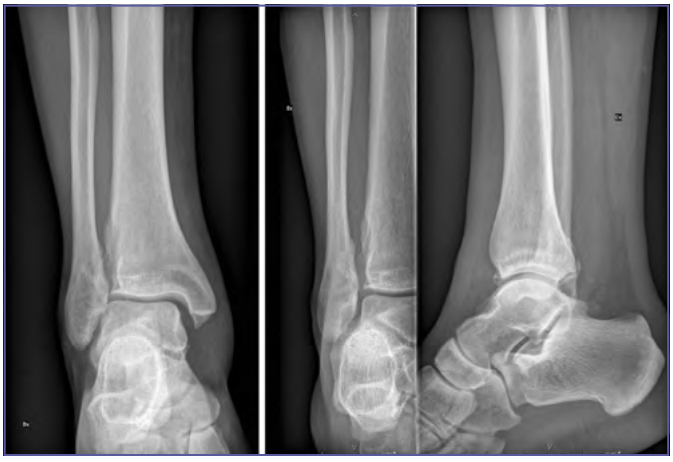

Figure 1. Right ankle x-ray after motocross accident.

The patient was placed in a supine position under spinal anesthesia with the affected limb on a thigh holder allowing for free movement of the ankle. A thigh tourniquet was applied. No soft-tissue distraction device was used. A 4-mm 30° scope for ankle arthroscopy was used, as well as 3.5- or 4.0-mm synoviotomes. Joint distension was achieved using an irrigation pump at 35 to 40 mmHg.

Access was gained to the joint using standard anteromedial (medial to the tibialis anterior tendon) and anterolateral (lateral to the extensor digitorum comunis tendon) portals. The intermediate cutaneous branch of the superficial peroneal nerve was identified through flexion and inversion of the ankle or by plantar flexion of the fourth toe. The ankle was examined. We found extensive synovitis and a third-degree chondral lesion of the lateral aspect of the talus dome, and performed debridment of the synovitis and microperforations of the cartilage lesion.

The distal tibiofibular syndesmosis was then assessed: a significant widening of the syndesmosis was found, which allowed for insertion of a 2-mm palpation hook.

Through a direct anteromedial approach at the proximal tibia, the semitendinosus tendon was harvested using a stripper. At the ankle, we initially performed an anteromedial approach to debride the scar and fibrosis of the medial gutter, with preservation of the anterior sleeve.

Once the congruence between the fibular notch of the tibia and the medial surface of the fibula was restored, we used a large reduction clamp to maintain syndesmosis reduction during the tunnel drilling. The semitendinosus tendon was used to reconstruct the AITFL (anterior inferior tibiofibular ligament) and IOL. This reconstruction was finished with two tunnels drilled 2 cm above the tibial plafond, in which one passed from the posterolateral fibula to the anterior tibia and the other was drilled below the first one, through the anterior tibia in the same direction. Next, the tendon was threaded through t tunnels from the medial to lateral aspects and with appropriate tension it was fixed with two interference screws. At the end the preserved

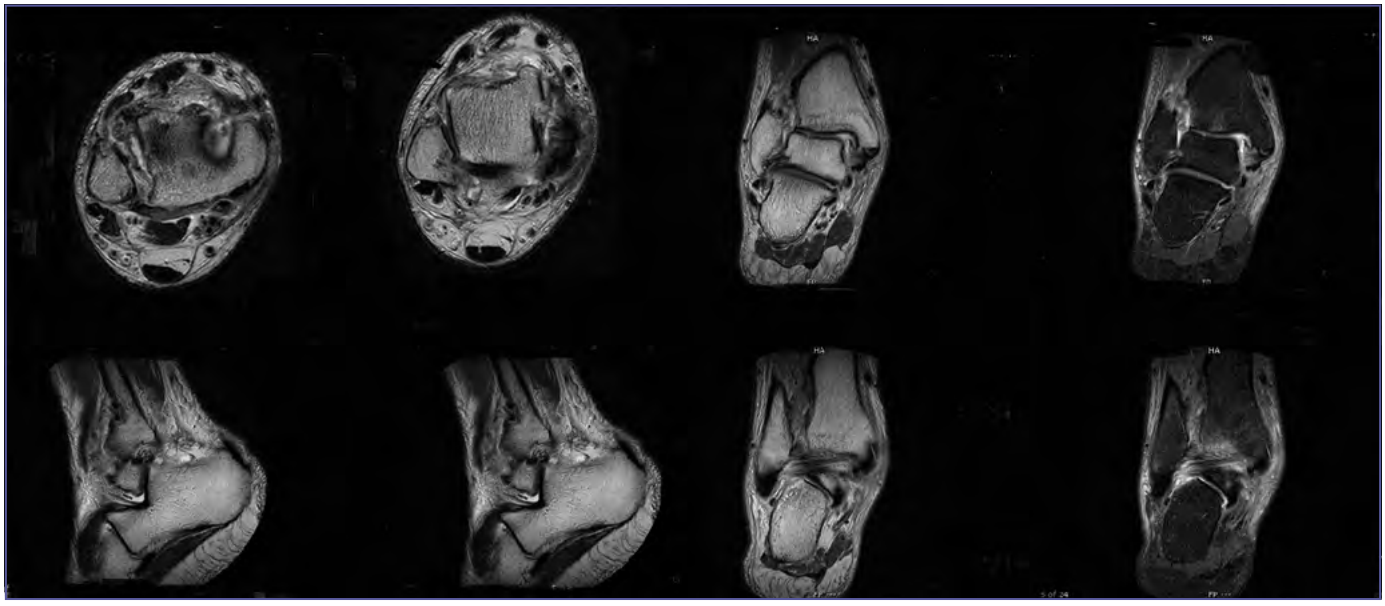

Figure 2. MRI of the right ankle 1 month after accident.

Figure 3. Comparative load x-ray.

anterior sleeve was reinserted with transosseous stitches in the fibular bone. A postoperative x-ray was performed (Fig. 4). The total procedure lasted approximately 100 minutes.

The patient was discharged after 24 hours. Mobilization of the ankle was immediately prescribed without cast, but it was prescribed not weight-bearing up to six weeks following the surgery until screw removal.

At one-month clinical checkup the patient complained of no symptoms and had a good range of motion, but the x-ray showed transyndesmosic screw breakage (Fig. 5). The patient underwent further surgery at our hospital after a few days. We removed the broken screw through two mini medial and lateral accesses and due to the good intraoperative syndesmosis reduction with reduction clamp we used a suture button to stabilize syndesmosis permanently. The reduction was maintained after taking the clamp off. The total procedure lasted approximately 20 minutes. Postoperative x-rays were performed (Fig. 6). In this case the use of only one quadricortical screw did not protect the syndesmosis reconstruction of the first surgery, but the second surgery allowed us to treat the lesion as an acute lesion instead of as a chronic lesion.

The patient was discharged after 24 hours. Partial load discharge was recommended for the next six days and then full weight bearing with crutches was allowed for the first month. Physical therapy was initiated immediately to recover the range of motion.

After 2 months the patient returned for re-evaluation. AP and lateral weight-bearing ankle views showed joint congruence with reduction of the distal tibiofibular space (Fig. 7). The patient presented with a good range of motion, minimal swelling, no significant complaint of pain, and possible mono-podalic standing position.

Figure 4. Postoperative x-ray (after the first surgery).

Figure 5. X-ray 1 month after first surgery (transyndesmosic screw breakage).

At the latest follow up at four years (20 September 2021), the patient presented with a wide range of motion (50° plantar flexion, 10° dorsiflexion) (Fig. 8), no significant complaint of pain, good ankle function (American Orthopedic Foot and Ankle Society Ankle-Hindfoot Scale (AOFAS) 92 points), and had resumed sports activities. AP and lateral weight-bearing ankle views showed joint congruence with persistent reduction of the distal tibiofibular space and only modest sign of osteoarthritis (Fig. 9).

Methods

PubMed/Medline, Cochrane Database of Systematic Reviews, Cochrane Clinical Trial Register, Current Controlled Trials, and Embase were searched from 1990 to December 2020 to identify studies relating isolated chronic syndesmosis injury treatment and 17 articles were identified. Chronic syndesmosis injuries are defined as injuries that have been present for >6 months after trauma [3,4].

Figure 6. Postoperative x-ray (after the second surgery).

Figure 7. X-ray control 2 months after the second surgery.

Misdiagnosis of syndesmosis instability may cause residual pain and, in the long term, ankle osteoarthritis [5,6].

Despite a large number of radiographic studies published that focus on this disorder, radiographic diagnostic criteria and classification criteria remain under debate. In addition, it is difficult to decide whether a patient with chronic syndesmosis injury should undergo nonoperative management or proceed to

Figure 8. Clinical control at the latest follow up at four years.

Figure 9. X-ray at the latest follow up at four years.

surgery, as there is still a lack of conclusive evidence [7].
We found only 5 studies reporting the results of autologous semitendinosus tendon graft in chronic syndesmosis reconstruction as in our case [3,8-11].

Results

The incidence of isolated distal tibiofibular syndesmotic ruptures in acute ankle sprains lies between 1 and 11%. These injuries are frequently overseen or misdiagnosed as anterolateral rotational instability of the ankle and often become apparent through protracted courses. Although the pathomechanics and extent of syndesmotic injuries have been systematically described by Lauge-Hansen and Weber, no generally accepted guidelines exist as to when these complex injuries are to be treated surgically to ensure sufficient and stable healing of the syndesmosis besides correct alignment of the distal fibula. So far, systematic follow-up regarding syndesmotic injuries in ankle fractures is lacking, although it has long been recognized that tibiofibular diastasis secondary to chronic syndesmotic instability leads to external rotation of the talus. In combination

with a valgus position of the talus, this instability leads to a decrease in the contact area which results in posttraumatic arthritic changes [2].
We divided our literature review into three main key points.

Clinical examination and imaging

If physical examination is suggestive of syndesmotic injury (pain upon palpation, positive squeeze and external rotation test), standing x-rays of both ankles are ordered, where the tibiofibular overlap, tibiofibular clear space, and medial clear space can be evaluated [7].
To date, several special tests on physical examination help to diagnose syndesmosis injury: squeeze test; palpation test; fibular translation test; Cotton test; external rotation test; and dorsiflexion compression test. Sman et al. [12] reviewed 8 clinical diagnostic tests and found that only the squeeze test had clinically relevant results, while other clinical tests showed low diagnostic accuracy and reliability. Therefore, the signs and symptoms of chronic syndesmosis injury are nonspecific. Additional diagnostic tests, such as MRI and arthroscopy, should be considered before making a final diagnosis and formulating a treatment strategy for chronic syndesmosis injury.
Chun et al. [13] systematically reviewed and concluded that MRI should be considered in diagnosing syndesmosis injury as a standard method for comparing arthroscopic findings.
MRI combined with the other imaging modalities (weightbearing MRI and CT) may have the possibility of diagnosing instability less invasively compared with arthroscopy.
However, Randell et al. [14] found that MRI was positive for detecting a syndesmosis injury in chronic injuries after 12 weeks in 83.3% of patients, compared with 100% if done within 6 weeks, which demonstrated that the detection of the injured syndesmotic ligaments on MRI may become less reliable with time.
In chronic cases, arthroscopy is emerging as the gold standard to evaluate painful, unstable ankles. Previous researchers have emphasized the importance of arthroscopy in the diagnosis and differentiation of syndesmosis instability [15,16]. Under arthroscopy, torn parts of the syndesmotic ligament can be directly seen. On the other hand, to evaluate the degree of instability, an arthroscopic probe can be inserted between the tibia and fibula and rotated to measure the widening and movement between the individual joint sections. The cutoff for the diagnosis of syndesmosis instability is recommended as 3.0 mm of the length of the opening in the dissector. The diagnosis criteria and grading of arthroscopic assessment of syndesmosis injury are areas still under discussion [3,17].

Classification

The classification system of chronic syndesmosis injury plays important roles in the treatment strategy. Classically, Edward and DeLee [18] divided syndesmotic sprains into stable ankle sprain and unstable ankle sprain on the basis of radiography, with the latter further divided into latent diastasis and frank diastasis. According to this classification system, stable ankle sprains were recommended to undergo conservative treatment, However, this system was based on the observation of only 6 cases, and MRI and arthroscopy were not applied in this system, which limited the accuracy of injury assessment [1]. Gerber et al. [19] proposed the West Point Ankle Grading System based on clinical examinations. Sikka et al. [20] classified syndesmotic ankle sprains into 4 grades on the basis of MRI examination. However, current classifications remain insufficient to differentiate between injury and instability to guide the treatment strategy, and this thus represents an area in need of further scientific investigation [4].

Treatment

Regarding surgical indications, classifications such as the West Point Ankle Grading System have attempted to categorize the degree of injury. According to this classification, grade 1 injuries with stable syndesmosis are treated conservatively, and grade 3 injuries with complete disruption of the syndesmosis and instability require surgical stabilization. However, intermediate grade 2 injuries have been poorly defined because of the difficulty in diagnosis, leading to more time spent deciding on surgical indications [3,18,21].
Most surgical techniques are performed using arthroscopy. Syndesmosis adhesions or scar tissue has been implicated as a source of chronic pain in syndesmosis injury; this was because of the lack of congruency of the syndesmosis or along the medial gutter of the ankle [22,23]. The non-physiological tissue limits ankle motion and results in impingement of the hypertrophied tissue against the lateral talar dome in dorsiflexion [24]. Clanton et al. [25] found that prominent synovial recess scarring and synovitis were readily apparent on preoperative MRI in patients with chronic syndesmotic injury.
Studies have reported better syndesmosis reduction after debridement [26]. The technique of syndesmosis debridement can be performed as follows: first, the medial gutter is debrided. Second, the syndesmosis is debrided from the syndesmosis and down to the ankle joint until the articular cartilage of the talar dome is visible. There is no consistent conclusion for the debridement technique. One can choose either arthroscopic or open debridement during the operation [22,27].
Debridement of injured syndesmosis was first performed with or without arthroscopy in accordance with the surgical techniques for chronic syndesmosis injury. The syndesmosis was then stabilized with a suture button or screw. Regarding the selection of screw size for the surgical fixation of syndesmotic diastasis, both 3.5-mm and 4.5-mm cortical screws exhibit similar biomechanical characteristics and there does not seem to be any superiority of the 4.5-mm over the 3.5-mm cortical screw in fixation of the syndesmosis. The decision appears to depend on the surgeons' experience and preference. Suture buttons generally provide less rigid fixation compared with

screw fixation, especially in sagittal motion, unless a double divergent pattern is utilized. However, clinical translation of this biomechanical finding is equivocal. Suture buttons theoretically negate the need for routine implant removal, but there have been reports of its causing skin impingement [28-31].

Reconstructive options for chronic syndesmosis disruption include arthroscopic debridement and screw fixation, arthrodesis of the syndesmosis, advancement of the anterior tibiofibular ligament, reconstruction of the interosseous and anterior inferior tibiofibular ligament, or tri-ligamentous reconstruction of the syndesmosis.

On the basis of the literature in combination with experience in clinical practice, some guidelines have been formulated even if no consensus on the optimal method has been established [32,33]. If inadequate remnants of the anterior inferior tibiofibular ligament (AITFL) are present, a tendon graft can be used. The insertion of the AITFL on the tibia can be medialized with a bone block and fixed with a screw. For treatment of persistent widening and late instability, these reconstruction techniques have to be combined with debridement and placement of a syndesmotic screw to protect the reconstruction. The most adequate treatment for chronic syndesmotic instability (> 6 months) is the creation of a synostosis to stabilize the distal tibiofibular joint. Late repairs give satisfactory but less favorable outcomes compared to properly treated acute injuries. It is not easy to regain complete stability by means of these secondary procedures [34].

Discussion

People sustain ankle syndesmosis injuries far less frequently than they do lateral ankle sprains; however, syndesmosis injuries are more challenging to detect and treat. Grade II injuries, which are occultly unstable, may be overlooked or treated too conservatively (not surgically), leading to latent diastasis, chronic instability, further injury, arthritic changes, chronic pain, osteochondral lesions, and other sequelae. Early arthroscopic assessment with or without syndesmosis stabilization has therefore been advocated, especially for athletes with severe syndesmosis injury when dynamic instability is suspected to avoid later symptoms and a delayed return to play [21].

Various approaches have been used for acute syndesmosis injury, including debridement, arthrodesis, screw fixation, suture-button repair, and graft reconstruction. However, not all these strategies can be applied to chronic syndesmosis instability, and the treatment of chronic injuries is more challenging than that of acute injuries [35,36].

Indeed, although there are various surgical treatment methods for the treatment of chronic isolated distal tibiofibular syndesmosis injury, include debridement, arthrodesis, screw fixation, suture button repair, and graft reconstruction, no consensus has been reached. On the other hand, there seems to be agreement on the need to conduct a meticulous debridement of the inferior tibiofibular joint to allow complete reduction of articulation.

Surgical intervention for chronic syndesmosis injuries produces mixed results and creates an uncertain future for athletes who desire to return to their sport.

Conclusions

The pooled results of the 5 studies in the use of autologous semitendinous tendon graft for the reconstruction of chronic lesions of syndesmosis show satisfactory outcomes even in the long term.

The position and direction of ligament reconstruction are also intensely debated [35].

The distal tibiofibular syndesmosis has been considered a physiological micromotion joint [35,36]. Anatomical ligamentous reconstruction for chronic syndesmosis injuries is key to maintaining articulation stability and avoiding alterations of physiologic biomechanics [37,38].

The literature review and the illustrated clinical case seem to suggest that reconstruction of the distal tibiofibular syndesmosis with an autogenous tendon for chronic syndesmosis injury determines a good therapeutic effect in terms of both subjective symptoms and objective evaluation scores. The autologous semitendinosus tendon graft may be an appropriate and promising reconstruction target in the treatment of chronic syndesmosis injury.

Ethical consideration

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). The study was approved by the institutional review board of our hospital. Written informed consent was obtained from the patient. The Authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Author contributions

MP made substantial contributions to all the following five point: Conceived and designed the analysis; Collected the data; Contributed data or analysis tools; Performed the analysis; Wrote the paper. PG have been involved in drafting the manuscript and revising it critically for important intellectual content. LR, CRM and AC have made contributions to analysis and interpretation of data. MM have been involved in revising it critically and have given final approval of the version to be published.

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Conflict of interest

The Authors have no conflicts of interest to declare.

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