

TRAUMATIC PERONEAL TENDON DISLOCATIONS IN ROCK CLIMBERS “THE CLIMBERS PULLEY LESION OF THE FOOT” - A CASE PRESENTATION

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Abstract

Pulley injuries at the upper extremity are commonly described in literature. Especially annular ligaments of the finger or biceps-pulley lesions can be found in injuries to pulley complexes. Likewise, transfer ligaments to retain tendons can be found at the human foot. These ligaments must functionally be addressed as pulley complexes. Due to extreme positions of the internal rotated and flexed foot with maximal contraction of the peroneal tendons while using small footholds during climbing extreme forces are applied to these tendons and their pulleys. Therefore closed pulley lesions at the foot are quite common injuries in sports climbers. Many different treatment options are discussed in literature.

For active patients surgery is commonly preferred. Active sports climbers are usually treated surgically in consideration of the high demands to the pulley complexes of the foot while climbing. This will be demonstrated in a case study of a 29 year old female national team climber.

Key words: peroneal tendon, annular ligament injury, tendon lesion, tendon dislocation, peroneal tendon dislocation

Introduction

More than 25% of all emergency admitted patients present with injuries of the hand [1]. About a third of these hand injuries are tendon lesions [1]. Annular ligament (pulley) injuries to the hand are common findings in rock climbers [2,3]. These can be degenerative or traumatic lesions. Annular ligaments are found in anatomical exposed locations. They allow tendons to run around corners without dislocation while muscle contraction and allow ideal power traction to the bone distal of the joint because “muscle excursion” is held to a minimum [1]. Besides the well known annular ligaments of the fingers [1], some other functional annular ligaments are described in medical literature, e.g. the biceps pulley. To keep the long biceps tendon in place the biceps pulley forms a bridge across the sulcus bicipitalis. A rupture of the biceps pulley leads to a dislocation of the long biceps tendon out of the original groove, the sulcus bicipitalis [4].

The function of the superior retinaculum at the ankle is similar to the known annular ligaments in the human body. Thus a rupture of the superior peroneal retinaculum can be considered as an annular ligament or pulley lesion. Over the last years we saw an increasing number of ruptures of the retinaculum extensorum with peroneal tendon dislocations in rock climbers. These can be described as the “climbers pulley lesion of the foot”.

The *mm. peronei longus et brevis* originate in the articular capsule of the tibiofibular joint and the proximal part of the fibula. Their tendons run in common around the lateral malleolus beneath the. At the lateral calcaneus the inferior peroneal retinaculum covers both tendons. On the tendon of the *m. peroneus longus* inserts at the base of the first metatarsal bone and the *os cuneiforme mediale*. This muscle mounts the plantar diagonal arch. On the other hand the *m. peroneus brevis* inserts at the base of the fifth metatarsal bone. Together these muscles pronate the foot and support the plantar flexion. The muscles are innervated by the *n. peroneus superficialis*.

At the lateral malleolus both tendons run in a common retrofibular groove. This groove is not formed by the fibula itself but a fibrocartilagenous cushion. Dorsal of this groove both peroneal tendons run distally and are covered by the superior peroneal retinaculum which holds the tendons in place to reduce tendon excursions and prevent the tendons to dislocate [5].

A rupture of the superior peroneal retinaculum causes the tendons to dislocate out of the anatomical retrofibular groove over the fibrocartilagenous cushion ventrally. Usually a peroneal tendon dislocation occurs with an inverted supinated position of the foot with an acute contraction of the peroneal muscles. In climbers this position of the foot appears while using the big toe to keep a stand on a small rock part especially using the

challenging boulder technique. In climbers we do find strong *mm. peronei* as a sign of stress adaptation. Full body weight is applied to the big toe and the peroneal muscles contract to a maximum to keep a stand on a small hold. In this position the tendons are under a strong tension. If a rupture of the superior peroneal retinaculum occurs the tendons are dislocated out of the small retromalleolar groove around the tip of the lateral malleolus.

We also find this foot position in many other sports activities, e.g. ballet, soccer, tennis, american football, basketball, ice-skating and running [6].

The peroneal tendons are stabilizer of the ankle joint as well. Chronic ruptures of the peroneal retinaculum or insufficiency cause a chronic instability of the ankle joint [7].

Even though the most important diagnostic feature is the clinical examination almost always imaging modality is performed to confirm the diagnosis. Ultrasound examination is now considered as first line imaging modality due to high resolution, cost-effectiveness, non-invasiveness and dynamism [8]. Radiographic imaging should be used to exclude acute avulsion fractures of the lateral malleolus which is pathognomonic for acute dislocations of the peroneal tendons [6].

For surgical treatment a CT scan should be performed to show pathologies of the retromalleolar groove and to decide whether deepening procedures of the groove are necessary [5].

MRI can be performed even though in acute injuries the superior peroneal retinaculum may be invisible due to soft tissue oedema. As the MRI imaging is performed in neutral ankle position the peroneal tendons may show up without spontaneous reposition [5,6,9].

Case presentation

Medical history

A diagnosis can be concluded only in knowing the detailed history and pathomechanism of the injury. In

our case, a 29 year old female nationalteam climber used a typical inverted supinated foot position with strong contraction of the peroneal muscles while bouldering (Fig. 1), causing immediate pain symptoms similar to an ankle sprain. Emergency treatment was carried out at a nearby hospital which recommended conservative treatment. Subsequently the young athlete showed up at our clinic for further medical examination carried out by the nationalteam physician

Clinical findings

Clinical findings are often similar to an acute ankle sprain even though a peroneal tendon luxation is existent. With dorsiflexion and eversion of the foot a luxation of the tendons can be reproduced. Due to pain this manoeuvre should not be attempted in acute injuries, whereas in chronic instability this examination can be performed easily [9].

The young female patient showed up with a doughy and painful swelling around the right lateral malleolus without haematoma. In plantarflexion a considerably dislocation tendency of the peroneal tendons was obvious. The peripheral circulation, function and sensibility was intact.

Apparative diagnostics

During emergency treatment an x-ray of the injured ankle was performed, a fracture was excluded, an examination with ultrasound confirmed the assumed diagnosis. The peroneal tendons were located in their originate position in the retromalleolar groove with a liquid surrounding without any signs of the retinaculum (Fig. 2).

An MRI was performed prior to showing up at our clinic, which shows the anatomic position of the ankle joint without any intraarticular pathological findings.



Fig. 1. Typical foot position for the injury-pattern

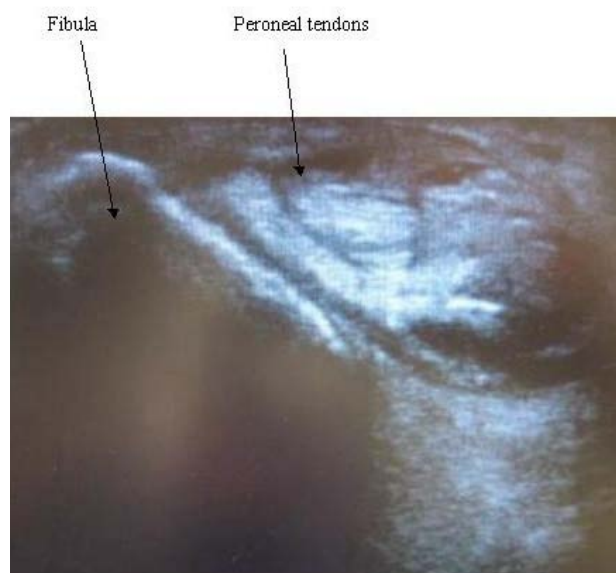


Fig. 2. Ultrasound of the retromalleolar groove with the peroneal tendons and surrounding liquid

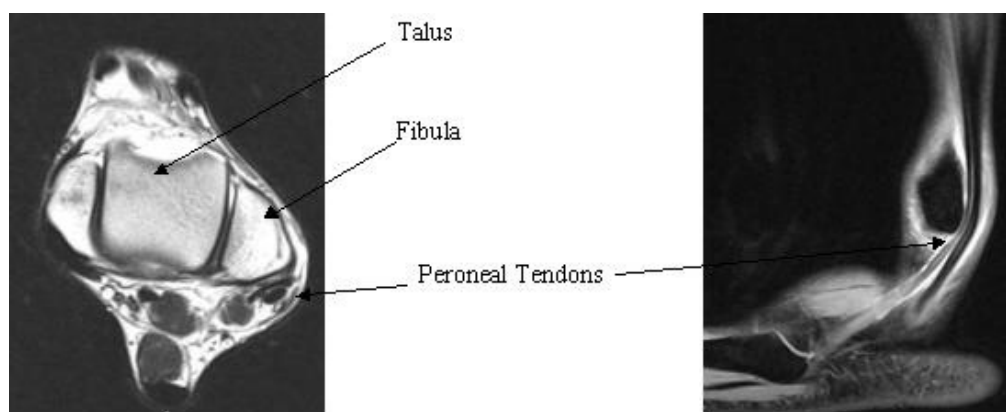


Fig. 3. MRI of the ankle (coronar and sagittal): signal alteration along the peroneal tendons without dislocation or rupture



Fig. 4. intraoperative situation: the peroneal tendons are dislocated over the distal end of the fibula (left), primary suture of the ruptured retinaculum (right)

Signal alterations dorsal of the lateral malleolus along the peroneal tendons without luxation or rupture of the tendons are apparent. The MRI was performed in neutral position of the foot (Fig. 3).

Therapy

For athletes and especially professional athletes we recommend a surgical reconstruction of the superior peroneal retinaculum, as we did in this case. The surgical approach was through a hockystick similar incision along the posterior part of the lateral malleolus. After the preparation through the subcutis and fascie both peroneal tendons appeared dislocated over the distal end of the fibula (Fig. 4).

The groove on the posterior side of the lateral malleolus seemed in normal shape in the presented patient and deep enough to keep the tendons in place. Just short from the posterior edge of the lateral malleolus the ruptured retinaculum could be produced. About 5mm of the retinaculum was still fixed on the bone whereas the remaining part of the retinaculum showed up not retracted and strong shaped. We therefore decided to perform a primary suture of the two parts of the ruptured retinaculum without transosseus fixation. First, both tendons were relocated into the groove, the retinaculum was doubled in terms of a Mayo technique and primary sutured. The groove did not need plastic modification. The patient was redressed

in a non-walking cast for 6 weeks, followed by pain adopted weight-bearing with an ancle orthotics (Mal-leoloc®) for 6 more weeks. Three months after surgery the patient showed full range of motion in the affected ankle with no limitaion in stress. Twelve months after surgery the patient was back to her full level of activity even in terms of athletic climbing.

Discussion

In our professional athlete patient primary repair of the superior peroneal retinaculum showed an excellent result three month after surgery. 12 month after surgery our patient describes no limitation in sports activity, competing in World-Cup events. In consideration of the anatomical function we must see the injury of the superior peroneal retinaculum as an annular ligament lesion, similar to the climbers pulley ruptures in the hand. The biomechanical pathomechanism is similar, transferring a high force in an extreme angle of the joint onto the pulley, which is deflecting the course of the tendon. This can lead to a pulley injury, clinical visible in "bowstringing" of the flexor tendons in the finger or peroneal tendon luxation in the foot. As the pathomechnaism is quite similar in these pulles injuries in the hand and foot we consider the rupture of the retinaculum extensorum superius the "climbers pulley injury of the foot". Over the last 3 years we saw an increasing number of rock climbers with this injury

type (4 patients) and performed a surgical repair in all of them. All outcomes were good. For acute trauma we thus recommend a primary repair to prevent a chronic lateral ankle instability.

Injuries to the finger pulleys and biceps pulley are commonly accepted as injuries of annular ligament complexes [10]. The rarely seen dislocation of peroneal tendons must be seen likewise as the anatomical function is similar to the other annular ligaments. The groove for the peroneal tendons is formed by a fibrocartilaginous cushion, which deepens the osseous depression on the posterior side of the lateral malleolus. The superior peroneal retinaculum prevents the peroneal tendons to dislocate out of this groove and therefor allows perfect power transmission from the *mm. peronei* to the first and fifth metatarsal and os cuneiforme. The function of the superior peroneal retinaculum is similar to the annular ligament complexes found in finger pulleys and the biceps pulley. A rupture of the retinaculum produces similar clinical findings as a severe sprain of the ankle [11].

The ventrofibular dislocation of the tendons can be reproduced but is not performed due to severe pain for the patient [6]. Most important to get to the right diagnosis thorough clinical examination is necessary. To confirm the diagnosis imaging procedures should be performed. Due to high resolution, cost-effectiveness, non-invasiveness and dynamism ultrasound is now considered first line imaging modality [8].

Depending on the level of activity conservative and surgical treatment can be used. Under conservative treatment about 50% of the injuries can be cured, however active patients should be treated surgically [5]. Many different types of surgery are described in the literature which all lead to the goal of repairing the retinaculum. The rarity of this injury prevents to conduct a general recommendation [5]. Clinical research could reproduce only evidence level 4. Even though the results recommend a surgical approach and retinaculoplasty for active patients and athletes. Follow up studies showed a low rate of complications and a high rate of return to full activity after surgical repair [12,13].

Conservative treatment of acute peroneal tendon dislocation lead to a low success rate and chronic instability of the ankle joint as Roth et al. proofed.

Excellent results with a short time of loss of activity are achieved by all known surgical approaches [14].

In 1993 Geppert et al. [7] proved the stabilizing function of the peroneal retinaculum to the ankle joint in a cadaver study. Due to the parallel run to the *calcaneofibular ligament* the retinaculum operates as a stabilizer to the ankle joint, especially while inversion of the foot. After a rupture of the retinaculum stress on the lateral collateral ligaments increases which can lead to a chronic instability of the ankle joint.

Cerrato and Myerson [6] showed a higher rate of the distinguished rare peroneal tendon dislocations as supposed. This pattern of injury is seen in sport activities with a high rate of sprains of the ankle joint such as ballet, skiing, soccer, american football, running, basketball, tennis and ice-skating. The rupture of the retinaculum occurs in a dorsiflexed and inverted position of the foot with an acute strong contraction of the peroneal muscles. An isolated dislocation of the peroneus brevis tendon is seen usually, even though the additional peroneus longus tendon dislocation is seen sometimes. Even tendon ruptures are seen, especially in patients with chronic ankle instability though a precise incidence of tendon ruptures is not known.

A detailed medical history, clinical findings and knowledge about the injury is essential not to oversee a dislocation of the peroneal tendons in acute dislocations of the ankle and to prevent a chronic lateral instability of the ankle joint [15].

In acute injuries conservative as well as surgical treatment is possible although surgical treatment is recommended [5]. Only contraindication for surgery or rejection of patient to surgery justifies non-operative treatment [9].

Declaration of interest

The authors report no conflict of interest.

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