Tears of the peroneus brevis tendon may cause ankle pain, swelling, and instability. Supportive therapy with ankle bracing and analgesics is the mainstay of therapy but surgical repair is often required in patients with ongoing symptoms. Surgical options include debridement, tubularization, or in severe cases, resection of the damaged tendon and tenodesis. We describe a 64-year-old woman with split peroneus brevis tendon presenting with lateral ankle pain, swelling, and instability, and we review the literature regarding presentation, diagnostic testing, pathophysiology, predisposing factors, and treatment recommendations. Primary care physicians should consider peroneal tendon injuries in patients with chronic lateral ankle pain and instability.

Keywords: ankle instability, split peroneus brevis tendon, management and treatment

Case report
A 64-year-old Caucasian woman presented to our family medicine clinic with complaints of right lateral ankle pain with dorsiflexion and inability to bear weight for the last 4 weeks. Her inability to bear weight was related to the sensation of instability. She
denied any recent trauma or injury to her ankle or associated symptoms including swelling, bruising, numbness, weakness, or tingling. She reported a “severe” ankle sprain 20 years ago while running, which required casting for 6 weeks. After the cast was removed, she continued to have pain and required multiple corticosteroid injections. She continued to have pain for about 5 years after her injury until she reports the pain resolved until 4 weeks prior to her office visit when her pain returned. She denied using tobacco, alcohol, or illicit drugs. Her family history was negative for cancers or orthopedic problems. Her medications included aspirin, calcium, cholestryramine, diclofenac topical, hydralazine, losartan/hydrochlorothiazide, spironolactone, metformin, metoprolol succinate, minocycline, multivitamin, omega-3 fatty acids, oxycodone/acetaminophen, sulindac, and vitamin B-12.

During her examination, her height was 61 inches, weight was 173 lb, and body mass index was 32.8 kg/m². She appeared well nourished and in no distress. There was extensive lateral ankle swelling but no bruising. She was unable to completely bear her weight on her right foot secondary to pain, and she had tenderness on the lateral malleolus. Drawer test and talar tilt were not performed secondary to pain. An x-ray was obtained and showed widening of the lateral talotibial joint, suggesting some lateral ligamentous instability (see Figure 1). She was prescribed crutches and an air splint. Sulindac was discontinued and she was started on naproxen.

She returned 2 weeks later with persistent lateral ankle pain and the sensation that the ankle was going to “give out”. Magnetic resonance imaging (MRI) of the right ankle was obtained and showed that the peroneal brevis tendon was flattened and borders both the medial and lateral aspects of the peroneal longus, consistent with a
split tendon (see figure 2). An ankle joint effusion was also present. We chose MRI after x-ray instead of computed tomography (CT) because we did not suspect an occult fracture with no recent history of trauma or injury. She was referred for physical therapy but complained of persistent ankle pain and no improvement of her symptoms after physical therapy. She was advised to wear heel pads and ankle support with a lace up ankle brace. She was referred to podiatry who recommended surgical repair or prolonged immobilization with conservative management. At this time, our patient has declined surgery.

Discussion

Background

Ankle sprains are the most common musculoskeletal injury, occurring in 1 in 10,000 people daily and symptoms are chronic in 40% of patients (1, 2). Ankle sprains account for 16-21% of all exercise-related injuries (1). Young adults and teenagers have a higher incidence of ankle sprains because they are often more active (3). One in five of all sports injuries are ankle sprains, with basketball being the number one sport for causing this injury (1, 3, 4). Ankle instability is a complication of ankle sprains and is caused by ligamentous injury. It is associated with recurrent injuries and repetitive sprains (5, 6). Ankle injuries can affect medial and lateral ligaments, but lateral ligament injuries are more common and 85% of ankle injuries involve the lateral ligaments (1). Problems associated with lateral ligament injuries include: peroneal tendon injuries, hindfoot varus alignment abnormalities, retinacular pathology, and anterolateral impingement lesions (7, 8). Ligamentous injuries may lead to chronic ankle instability, which increases risk of recurrent sprains and additional injury (6). The duration of ankle
instability and pain are related to the increased likelihood of having a split or tear of the ligament (9).

A cause of lateral ankle pain and instability is a split or tear of the peroneus brevis tendon (PBT) or peroneus longus tendon (PLT); however, PBT tears are more common. Split lesions of the PBT were thought to be relatively rare; however, a study of 112 cadaveric ankles found a prevalence of 37.5% based on thinning or longitudinal splitting of PBT. (10, 11). The peroneus can split due to the stress of stretching that occurs from the inversion of the lateral ankle injury. The PLT overlies and presses on the PBT, possibly resulting in a split. Other causes of PBT or PLT splits or tears include chronic instability or external compression from anatomical variants causing repetitive friction of the tendon over the posterolateral fibula resulting in the tear.

Literature Search
We searched PubMed and Ovid using the search term split peroneus brevis tendon. We found no randomized controlled trials, but found 1 systematic reviews, 3 clinical reviews, 2 retrospective studies, 2 longitudinal studies, and 1 case series. In addition, we searched ankle injuries, peroneal tendonopathies, peroneal brevis tears, peroneus longus tears, Ottawa ankle rules, talar tilt test and anterior drawer test.

Mechanism of Injury
PBT tears are often associated with a forced dorsiflexion injury and are most commonly longitudinal rather than transverse (10). With repetitive trauma or contraction of the peroneal muscles, the PBT may split. Splitting of the PBT can be caused by misalignment of the fibula following an ankle injury (12). A tear in the lateral PBT may occur after the superior peroneal retinaculum is torn during trauma when the ankle is
everted. As the split progresses, the tendon is compressed between the lateral ridge of the malleolus and the peroneus longus tendon. See Table 1 for a grading scale for split PBT.

Diagnostic Testing

Physical examination

A complete history and physical examination is the key to the diagnosis of the etiology of ankle pain and instability. A history includes asking about the onset of pain, mechanism of injury, duration and location of pain, clicking, sensation of the ankle “giving out”, persistent or shooting pain, numbness and tingling. The history is helpful to differentiate neuropathic, musculoskeletal, or vascular pain. An important question to also include is whether the patient could bear weight immediately following the injury and during the evaluation (see Figure 3). Physical examination consists of inspection, palpation for tenderness, swelling, crepitus, ankle and subtalar range of motion, talar tilt and anterior drawer signs (4, 5, 13). It is important to compare the injured ankle to the uninjured ankle. While uncommon, the physician should rule out sensory abnormalities and muscle atrophy. The anterior talofibular ligament is the most commonly injured ligament with inversion sprains (4, 6, 13). A positive anterior drawer test is elicited when gentle traction of the heel causes pain and laxity. It is the most appropriate clinical test for evaluation of lateral ankle ligament laxity (1). A positive talar tilt test occurs when the calcaneus is abducted and everted into the valgus position resulting in laxity and pain and indicates there has been concomitant injury to the calcaneofibular ligament along with the anterior talofibular ligament (1).

Imaging
Common imaging modalities for ankle injuries include plain film radiography, ultrasound, CT, and MRI; however, in the acute setting, to rule out a fracture, the Ottawa ankle rules should be used to assist in the clinical decision to obtain plain films (1, 4) (see Figure 4). A systematic review of 27 studies involving 15,581 patients reported the pooled negative likelihood ratios for ankle fractures was 0.08 (95% confidence interval 0.03-0.18) (14). The Ottawa ankle rules have excellent sensitivity, of almost 100%, and are an accurate instrument for excluding fractures requiring immediate operative management of the ankle while reducing the number of unnecessary radiographs by 30-40% (see figure 4) (14). A fifth metatarsal fracture is associated with a PBT injury as the PBT inserts on the proximal fifth metatarsal. The first line imaging modality is ultrasound since it is less expensive than MRI and has comparable (sensitivity 100% and specificity 85%, positive likelihood ratio 6.7, negative likelihood ratio 0) (2, 15). Ultrasound is dynamic which allows for visualization of subluxation and it may also be used for guided cortisone injections (2). When an occult fracture is suspected, CT is the preferred diagnostic test after negative plain film radiographs and persistent ankle pain. MRI is the preferred “gold standard” for ankle pain and instability when CT scan and x-ray are negative (sensitivity 92% and specificity 83%, positive likelihood ratio 5.4, negative likelihood ratio 0.1) (1). MRI may visualize the contrast between tendon, subcutaneous tissue, and bone; however, MRI is costly, not easily available, and should be limited to patients with chronic ankle instability after previous diagnostic evaluations have failed to determine the etiology of symptoms (1, 10).

**Treatment**
Initial supportive therapy is important and may enhance the healing process and avoid chronic ligamentous laxity and surgery. This includes nonsteroidal antiinflammatory drugs (NSAIDs), rest, ice, compression, elevation, and early mobilization (6). Topical NSAIDs may provide effective symptom relief with less side effects compared to oral NSAIDs (3). The combination of NSAIDs with cryotherapy (icing) is more effective than either therapy alone for acute ankle injuries (1). Inadequate supportive therapy of ankle sprains in the acute setting is associated with poor outcomes and chronic symptoms (6). Other treatment options include Medrol dose pack or corticosteroid injection; however, there is no high quality evidence to support these measures in peroneal injuries.

Physical therapy is a good option for many patients as exercise maintains range of motion, assists with lymphatic drainage, and improves proprioception. Stretching is important to recover full function and enhance the healing process (3, 4). Immobilization with braces and casting is a noninvasive option to stabilize the ankle and for added protection from further injury. Most sprains usually resolve within 2-6 weeks with supportive therapy; however, if symptoms do not resolve, then additional diagnostic evaluation and surgical options should be considered.

Surgical options include debridement, tubularization, or, in severe cases, resection of the damaged tendon and tenodesis. However, surgical therapy is only recommended after all other non-surgical methods have failed to control symptoms. Twelve weeks after surgery, patients can be released to limited physical activity with bracing (13). After 6 months, patients can potentially be released without any restrictions if their instability has significantly improved. However, some patient may still
experience instability following surgery (9, 13). Common complications of surgery include numbness, hyperesthesia, crepitus, pain, and instability (5, 9, 13). A Cochrane review of 20 randomized controlled trials involving 2262 patients found insufficient evidence to determine the relative effectiveness of surgery versus conservative therapy for lateral ankle injuries (16). We found no evidence regarding the relative effectiveness of surgery versus conservative therapy for peroneal injuries.

**Conclusion**

In our patient, a running injury 20 years prior caused her ankle pain and instability. Subsequently, she re-injured her ankle and complained of lateral ankle pain, swelling, and instability resulting in a Grade II split. Despite supportive therapy with NSAIDs, physical therapy, and bracing, her symptoms persisted. Primary care physicians should consider peroneal tendon injuries in patients with chronic lateral ankle pain and instability.
Figure 1. Radiographs showing widening of the lateral talotibial joint suggesting some lateral ligamentous instability.
Figure 2. Magnetic resonance image showing peroneal brevis tendon was flattened and borders both the medial and lateral aspects of the peroneal longus consistent with a split tendon.

A. Proton density weighted axial image demonstrating one of the appearances of a split peroneus brevis tendons splayed over the normal appearing peroneus longus tendon.
Figure 3. Algorithm for management and treatment of suspected split peroneal brevis tendon
The Ottawa ankle rules are used in the acute setting to assess if x-rays are warranted. If pain is in mid foot zone and any one of the following: bony tenderness at base of the 5th metatarsal, or bony tenderness at navicular bone or inability to bear weight in emergency department for 4 steps. The Ottawa ankle rules also used to assess if x-rays are needed if pain is in the malleolar zone and any one of the following: bony tenderness along distal 6 cm of posterior edge of tibia or tip of medial malleolus or bony tenderness along distal 6 cm of posterior edge of fibular or tip of lateral malleolus or an inability to bear weight in the emergency department for 4 steps.

Source:

ORIGINAL DRAWING
Figure 5. The Anterior drawer test and talar tilt test to assess injury to the anterior talofibular ligament.

A. With the patient in Sitting position and the knee flexed, the examiner stabilizes the distal leg with one hand while cupping the other hand around the ankle and applying force moving the talus anteriorly. If ligament laxity is noted, the test is positive consistent with rupture of anterior talofibular ligament. The examiner must compare both ankles.

B. With the patient in sitting position, and the ankle in plantar flexion, the examiner stabilizes the distal leg with one hand while applying force to the hindfoot with the other hand slowly inverting the foot. If ligament laxity and pain is noted, the test is positive consistent with anterior talofibular ligament tear.

Source: ORIGINAL DRAWINGS
Table 1. A grading system for split peroneus brevis tendon

<table>
<thead>
<tr>
<th>Grade of Split</th>
<th>Description</th>
<th>MRI finding</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Splayed out tendon</td>
<td>Peroneus brevis tendon flattened between peroneus longus tendon and lateral malleolus</td>
<td>Conservative treatment</td>
</tr>
<tr>
<td>II</td>
<td>Partial thickness split</td>
<td>Tendon flattened and also showed central thinning and some degeneration of tendon structure.</td>
<td>Conservative treatment</td>
</tr>
<tr>
<td>III</td>
<td>Full thickness Split</td>
<td>Tendon had a central “fenestration” and appeared to be separated into two fragments on a variable of section</td>
<td>Surgical evaluation and repair</td>
</tr>
<tr>
<td>IV</td>
<td>Split extending more than 2 cm</td>
<td>Tendon had a central “fenestration” and appeared to be separated into two fragments on a variable of section</td>
<td>Surgical evaluation and repair</td>
</tr>
</tbody>
</table>

Source: (10)
Acknowledgements:

Jammie Edwards, D.O.
Lindsay Blake, MLIS, AHIP
Lynsey Steinberg MSMI
References


Dear Editor:

Thank you for the opportunity to revise and resubmit our manuscript, "Split peroneus brevis tendon: a case report of an unusual cause of ankle pain and instability" (JABFM-13-0099 Version 1). We have responded to your comments and the comments of the reviewers in detail below. This process has strengthened and improved our manuscript.

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REVIEWER 1:
Comments:
Review – JABFM – “Split peroneus brevis tendon”

1. Case report
   a. there is a line that states “she continued to have pain for about 5 years after her injury until she reports the pain resolved” – if it resolved, then why is she at your office? When did this new pain start? New injury? Mechanism? Associated symptoms? – swelling/bruising/ numbness/tingling/ weakness/ instability/ snapping ,etc - need to write a complete HPI before you jump to physical exam!

   We agree with this reviewer and have revised the 1st paragraph of the case report as follows:
   A 64-year-old Caucasian woman presented to our family medicine clinic with complaints of right lateral ankle pain with dorsiflexion and inability to bear weight for the last 4 weeks. Her inability to bear weight was related to the sensation of instability. She denied any recent trauma or injury to her ankle or associated symptoms including swelling, bruising, numbness, weakness, or tingling. She reported a “severe” ankle sprain 20 years ago while running, which required casting for 6 weeks. After the cast was removed, she continued to have pain and required multiple corticosteroid injections. She continued to have pain for about 5 years after her injury until she reports the pain resolved until 4 weeks prior to her office visit when her pain returned.

   b. Exam/ eval – statement “widening of the lateral talotibial joint, suggesting some lateral ligamentous instability” may be incorrect. My understanding is that the concern if you have widening of your tibiotalar joint on xray is that of a syndesmotic injury as this would affect your mortise. Lateral ligamentous laxity is often shown with stress views performing an anterior drawer or talar tilt

   We disagree with this reviewer’s statement. While reviewer is correct that lateral ligamentous laxity is often demonstrated with stress views; in our case a musculoskeletal radiologist suspected some lateral ligamentous instability based on the history and appearance of the plain films.

2. Discussion:
a. Background
i. First line – delete “are common and” – should just say “ankle sprains are the most common…”

Agree. Sentence changed as suggested by reviewer.

ii. What is the incidence of ankle instability or chronic ankle pain after a sprain? – Review article by Philbin, et al in J Am Acad Orth Surg in 2009 sites 40%

We agree and have revised our 1st sentence of the background section. Ankle sprains are the most common musculoskeletal injury, occurring in 1 in 10,000 people daily and symptoms are chronic in 40% of patients

iii. How much more common are lateral ankle sprains?

We have added this statement: but lateral ligament injuries are more common and 85% of ankle injuries involve the lateral ligaments.

iv. What are the associated injuries with a lateral sprain?

We have added this statement: Problems associated with lateral ligament injuries include: peroneal tendon injuries, hindfoot varus alignment abnormalities, retinacular pathology, and anterolateral impingement lesions poor transition to split peroneus.

We agree and have added a new paragraph for split PBT and PLT.

Why would a lateral sprain/ ankle instability predispose to peroneus split?

We have added a sentence: The peroneus can split due to the stress of stretching that occurs from the inversion of the lateral ankle injury.

b. Mechanism of injury listed may be incorrect. My understanding is that the peroneus splits due to stress/stretching that occurs from the inversion injury itself. The peroneus longus overlies and presses on the brevis, leading to the split. Other causes – chronic instability or external compression from anatomical variants causes repetitive friction of the tendon over the posterolateral fibula, leading to the tear; or a tear of the retinaculum allows for subluxation of the tendon outside the fibular groove, leading to chronic instability and split tears

We agree and we have rewritten this paragraph as follows: The peroneus can split due to the stress of stretching that occurs from the inversion of the lateral ankle injury. The PLT overlies and presses on the PBT, possibly resulting in a split. Other causes of PBT or PLT splits or tears include chronic instability or external compression from anatomical variants causing repetitive friction of the tendon over the posterolateral fibula resulting in the tear.

c. Grading table is good

Comment only.

d. The hx taking described in the physical exam section is well written – it is the info you should be including in your actual case presentation!

We agree, we have written the first few sentences of the case to include more details of her presentation.

e. In the physical exam, you should point out that the talar tilt test is to determine whether there has been concomitant injury to the CFL along with the ATFL
Good point we have revised our sentence to include: A positive talar tilt test occurs when the calcaneus is abducted and everted into the valgus position resulting in laxity and pain and indicates there has been concomitant injury to the calcaneo fibular ligament along with the anterior talofibular ligament (1).

f. Imaging: may want to mention that 5th met fx/ avulsion is associated with peroneal injury as proximal 5th met is the insertion of the peroneus brevis

Agree. We have added this sentence to page 6: A fifth metatarsal fracture is associated with a PBT injury as the PBT inserts on the proximal fifth metatarsal.

g. Imaging: you neglected to mention the use of musculoskeletal ultrasound in evaluating peroneal tendon injuries. Msk U/S is less expensive than MRI and is dynamic, so will allow for visualization of subluxation; you can also use this modality for guided cortisone injections

Excellent point. We have added the following sentences and modified our treatment algorithm. The first line imaging modality is ultrasound since it is less expensive than MRI and has comparable (sensitivity 100% and specificity 85%, positive likelihood ratio 6.7, negative likelihood ratio 0) PMID: 16085620 PMID: 19411642. Ultrasound is dynamic which allows for visualization of subluxation and it may also be used for guided cortisone injections PMID: 19411642.

h. Treatment – one of the primary functions of physical therapy is restoration of proprioception, not just ROM and stretching

Added this statement to our sentence regarding PT: Physical therapy is a good option for many patients as exercise maintains range of motion, assists with lymphatic drainage, and improves proprioception.

i. Treatment – limited discussion of casting and/ or cortisone

We have added this statement: Other treatment options include Medrol dose pack or corticosteroid injection; however, there is no high quality evidence to support these measures in peroneal injuries.

j. Treatment - What is the success rate of non-operative tx for ankle sprains? For split peroneus?

We added these 2 sentences: A Cochrane review of 20 randomized controlled trials involving 2262 patients found insufficient evidence to determine the relative effectiveness of surgery versus conservative therapy for lateral ankle injuries PMID: 17443501. We found no evidence regarding the relative effectiveness of surgery versus conservative therapy for peroneal injuries.

k. Conclusion – your conclusion should be something to the affect that primary care physicians should consider peroneal tendon injuries in patients with chronic lateral ankle pain and instability...

We agree. We have added this sentence to our abstract and conclusion.

REVIEWER 2:

1. Although the abstract describes a relatively rare cause of persistent instability after an inversion ankle sprain, the body of the manuscript mainly describes the diagnosis and management of ankle sprains in general, with some detail on evaluation and management of patients with persistent symptoms after appropriate initial management.

Comment only.
2. In this patient's case, the persistent symptoms are felt to be due to a split peroneus brevis tendon, which could be the case, but the authors should expand the discussion to include other causes of chronic ankle pain after a sprain.

We have revised the 1st paragraph under BACKGROUND to include a discussion of associated injuries and other causes of chronic ankle symptoms.

3. The authors assume that the patient had persistent symptoms due to "inadequate initial management" of the patient's sprain 20 years ago. This inference is not supported by the case as presented, since most patients who have persistent ankle pain after a sprain have had adequate initial management.

We agree and we have deleted the sentence that said, "inadequate initial management"

4. I would suggest that the authors rewrite the manuscript within the context of chronic ankle pain after sprain and broaden the discussion to include causes other than a split peroneus brevis tendon, which would make the article more applicable to the broader family medicine readership.

We disagree. The point of this case was to highlight the rare condition of split PBT lesions in the evaluation of a patient with chronic ankle pain and instability.