



Delayed intra-articular pseudoaneurysm of the dorsalis pedis artery following arthroscopic Broström results in an unusual clinical presentation

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Abstract

Pseudoaneurysms of the dorsalis pedis artery are rare complications following arthroscopic surgery. This manuscript reports a case of an intra-articular pseudoaneurysm presenting nearly 5 months following an arthroscopic Broström procedure. The rarity of this complication and the patient's unusual clinical presentation prompted the use of imaging to diagnose the problem and guide management. Although imaging artifacts are often a nuisance, recognition of clinically relevant artifacts can help make a diagnosis. This case illustrates such a situation.

Keywords Pseudoaneurysm · Dorsalis pedis artery · Imaging artifacts · Arthroscopic Broström procedure

Introduction

The role of arthroscopy in the management of ankle injuries has increased over the past decade [1]. Although less invasive than open surgery, complication rates for arthroscopic ankle procedures can range from 9 to 17% [2]. Most of the complications are neurological and often involve injury to the superficial peroneal nerve or its branches [3], but vascular damage can also occur [4–9]. Iatrogenic pseudoaneurysms of the ankle are a rare surgical complication, with an estimated incidence of 0.008% [4]. Pseudoaneurysms, or contained vessel ruptures, result when all three layers of the vascular wall are

destroyed, but the bleeding through the defect is contained by the surrounding tissue [5]. They are often eccentric and may result in a focal dilation of an artery [4]. The most commonly injured vessels after ankle surgery are the anterior tibial artery (ATA)/dorsalis pedis artery (DPA) and the lateral plantar artery (LPA) [4]. Though uncommon, untreated pseudoaneurysms may result in hemarthrosis (and resultant cartilage injury), arterial thrombosis, compartment syndrome, and decreased flow to distal tissues due to distal embolization [4]. In the event of a pseudoaneurysm rupture, hemorrhage may occur and when severe enough, hemodynamic instability may ensue [5].

This manuscript reports a case of a pseudoaneurysm that developed several months after surgery, which resulted in a peculiar clinical presentation. The multimodality imaging appearance of this complication is presented with an emphasis on an imaging artifact that helped to make the correct diagnosis.

Case report

A 15-year-old girl with a history of chronic right ankle instability, presented with acute onset of intermittent stabbing pain along the medial ankle and foot 4.5 months following an arthroscopic Broström procedure (a modified arthroscopic procedure to achieve anatomical stabilization of the lateral ankle

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ligaments [10–13]). She described her pain as waxing and waning, with episodes lasting from 5 to 15 min, associated with a transient erythematous and purpuric skin rash along the medial and dorsal aspect of her foot (Fig. 1). The patient described gradual resolution of the rash within a few hours after each attack. Clinical examination revealed paresthesia in the same distribution of the rash and fullness in the anterior ankle and bounding DPA pulse. An MRI of her ankle (3 T SKYRA; Siemens Healthcare, Berlin, Germany) was requested to determine the etiology of her pain. While the patient was in the magnet, she developed severe pain with the accompanying rash. She was in so much pain that she could not complete the examination. Upon review of the images, there was a large ankle joint effusion with an intra-articular mass. There was also marked distention of the flexor hallucis longus (FHL) tendon sheath with T1 iso- to hyperintense material and a rim of low T1 and T2 signal (Figs. 2, 3). Additionally, in the phase encoding direction, pulsation artifact was noted along the plane of the mass. At this point, the referring surgeon was told that a vascular lesion was suspected and that an ultrasound examination would help to confirm the diagnosis. Within less than an hour, the patient presented for the ultrasound and her rash and severe pain had completely resolved. The ultrasound confirmed the presence of an intra-articular vascular mass with turbulent high velocity blood flow that resembled a yin-yang with color Doppler imaging (Fig. 4). The joint effusion was hyperechoic and similar material was present in the FHL tendon sheath. The patient had reproducible pain with probe pressure over her FHL tendon sheath and reported that there was chronic pain in this region even when the rash was not present. The imaging findings were reported as consistent

with a pseudoaneurysm arising from the dorsalis pedis artery or one of its branches with intra-articular hemarthrosis decompressing into the FHL sheath (presumably irritating the tendon and the sheath owing to the reproducible pain with probe pressure on the sheath).

Surgical management was elected. After the dorsalis pedis artery was exposed, the pseudoaneurysm was identified and entered. Following thrombus evacuation, a defect in the posterior wall of the dorsalis pedis artery was identified, but was too large to attempt primary repair. Therefore, the artery was clamped proximally and distally and the pseudoaneurysm was resected. Intraoperative doppler ultrasound of the dorsalis pedis artery documented good signal proximal and distal to the ligation. At 6 weeks post-procedure, the patient's symptoms had resolved.

Discussion

During an arthroscopic procedure, the ankle joint is normally visualized using the anterolateral and anteromedial portals with the anterolateral portal positioned lateral to the peroneus tertius tendon and the anteromedial portal medial to the tibialis anterior tendon [6]. The antero-central portal is avoided owing to the increased risk of injury to the anterior tibial/dorsalis pedis artery [4, 7, 8], but aggressive shaving through the anterolateral portal under traction may cause direct injury to the posterior wall of the DPA [9]. The anatomy of the DPA, including its variable anatomical positioning and branching patterns in addition to its inherent proximity to the anterior ankle joint (mean distance of 2.3 ± 1.1 mm), increases its



Fig. 1 A 15-year-old female patient with repeated episodes of transient dorsal and medial purpuric rash. Sample images taken by the patient during these episodes. The picture on the right shows near normalization

of the skin color following such an episode. The patient described gradual resolution of the rash within a few hours of each attack

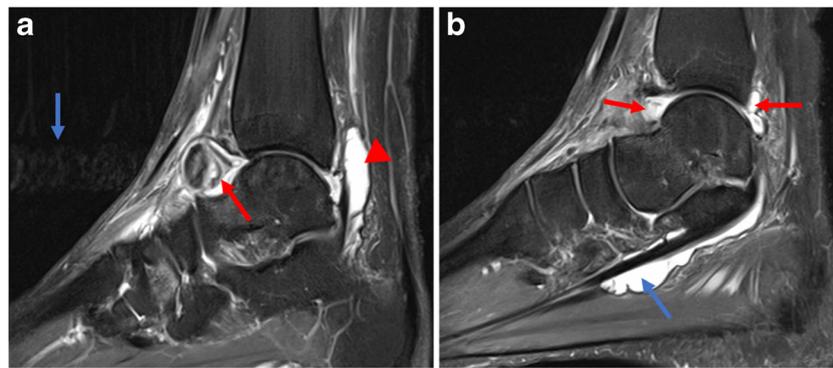


Fig. 2 MRI from a 15-year-old girl with transient rash and pain nearly 5 months after an arthroscopic Broström procedure. **a** Sagittal proton density fat-suppressed (PDFS, TE: 48 TR: 3,270) shows a round, heterogeneous intra-articular mass within the anterior ankle joint (*red arrow*). Pulsation artifact is noted emanating from the mass in the phase encoding direction, suggesting high velocity blood flow within the structure (*blue*

arrows). There is fluid signal intensity material within the ankle joint around the mass and within the flexor hallucis tendon sheath (*red arrowhead*). **b** Sagittal PDFS (TE: 48 TR: 3,270) image demonstrates extensive fluid signal intensity material distending the flexor hallucis longus tendon sheath (*blue arrow*). Similar materials are also seen in the ankle joint (*red arrows*)

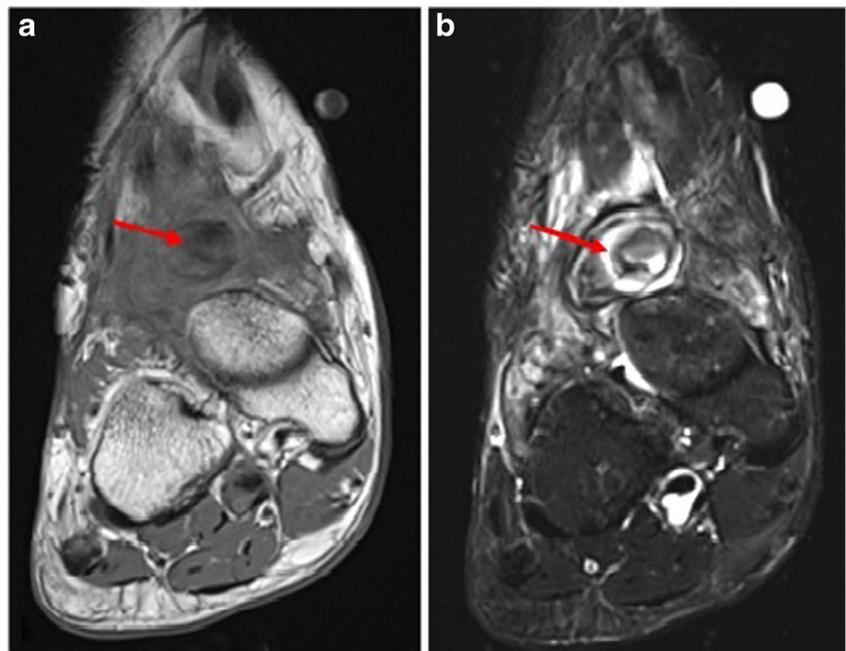
susceptibly to damage [4, 5, 7–9, 14]. Moreover, intraoperative joint manipulation (such as distraction and plantarflexion) further decreases the distance between the DPA and the anterior capsule, rendering it even more vulnerable to injury [9]. Patient-related factors may also contribute to the risk of pseudoaneurysm development including early weight-bearing, anticoagulation, and the presence of comorbid diseases such as collagen diseases, fibromuscular dysplasia, and osteogenesis imperfecta [4]. The development of a pseudoaneurysm typically occurs within the first few weeks of the procedure [4], although development has been reported up to months following surgery [5, 15].

Patients usually present with pain and swelling and may have a clinically apparent pulsatile mass [4, 6, 16]. This mass

may be associated with audible bruits, palpable thrills or clinical signs of arterial insufficiency [4, 14]. Although the exact etiology of our patient's unusual transient and painful skin is not entirely clear, possibilities include embolic showers in the distal circulation, transient vasospasm, or venous edema [17].

The diagnosis of a pseudoaneurysm can be confirmed via an ultrasound or conventional MR or CT angiography, the latter being more accurate in defining the exact origin of the pseudoaneurysm [4]. Unenhanced CT may reveal a low-attenuation mass with a neck arising from the parent artery. Conventional or CT angiograms demonstrate filling of the pseudoaneurysm with contrast material. Unenhanced MRI may depict a pseudoaneurysm as a round heterogeneous mass

Fig. 3 MRI from a 15-year-old girl with transient rash and pain nearly 5 months after an arthroscopic Broström procedure. **a:** T1 (TE: 11 TR: 721) and **b** coronal short tau inversion recovery (STIR, TE: 77 TR: 5,870) images show heterogeneous signal (*red arrows*) within the sac relating to the swirling blood and degrading blood products



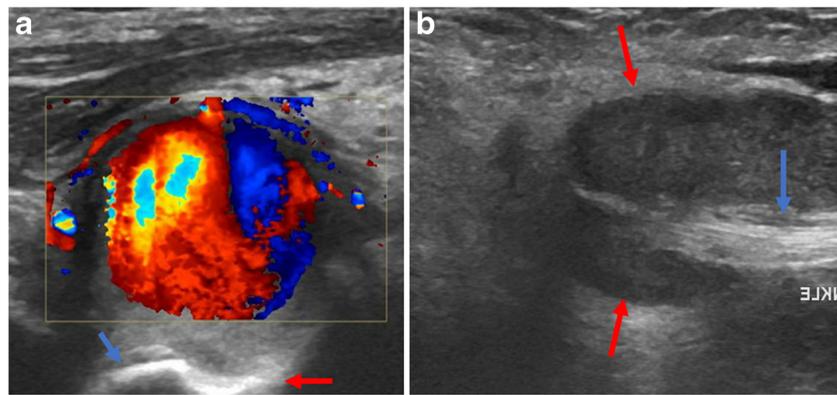


Fig. 4 Targeted ultrasound of the mass following termination of the MRI. **a** Long axis ultrasound image at the level of the anterior ankle joint shows a corresponding round hypervascular mass within the anterior recess of the ankle joint. Color Doppler imaging demonstrates the “ying yang sign” with aliasing noted indicative of the high-velocity flow within the mass. Around the mass, hyperechoic material corresponding to the hyperintense material seen on the MRI images is noted. This material does not have the

usual anechoic appearance typical of simple joint fluid because the fluid is blood. For reference, the dorsal talar head and neck are indicated with a *blue and red arrow*, respectively. **b** Long-axis ultrasound image over the area of tenderness to palpation shows distension of the flexor hallucis longus sheath filled with hyperechoic material consistent with blood. The sheath is flanked with *red arrows*, and the tendon is indicated with a *blue arrow*

near a vessel [18]. One key MRI finding is the presence of pulsation artifact. Pulsation artifact is caused by periodic k-space modulation due to vascular diameter changes resulting from the inflow and outflow of arterial blood flow [19]. Although pulsation artifact is usually an imaging nuisance, in this case, recognition of pulsation artifact along the phase encoding direction emanating from the mass suggests a high-flow vascular lesion. An additional clue to the presence of a vascular lesion is the visualization of blood products or thrombus, which may appear as hyperintense on T1-weighted images owing to the presence of methemoglobin depending on how long the blood has been present [19]. Color Doppler ultrasound demonstrates turbulent high flow within the mass with the specific “yin-yang sign,” a mixing of red and blue color appearing owing to the swirling of blood as it rushes in and out of the pseudoaneurysm [20]. Moreover, pulsed wave Doppler, when placed along the pseudoaneurysm’s neck, provides a classic biphasic to-and-fro waveform, indicating antegrade blood flow during systole and retrograde blood flow during diastole within the non-thrombosed portion of the aneurysmal cavity [21, 22].

Various methods have been described for the treatment of pseudoaneurysms arising from the ATA/DPA. The chosen treatment method is based on the pseudoaneurysm’s location, size, and shape, in addition to the patient’s age and medical comorbidities, particularly local arterial patency [4]. In a more typical extra-articular location, such as the groin, treatments include prolonged ultrasound-guided compression, ultrasound-guided thrombin injection, resection of the pseudoaneurysm with interposition vein grafting, or endovascular stenting [2, 5, 9]. Intra-articular pseudoaneurysms are usually not amenable to compression and thrombin would be unlikely to be used owing to the potential communication with the joint (as seen in this case).

Surgical methods are warranted if nonsurgical methods fail or if a pseudoaneurysm is rapidly expanding and/or causing neurovascular compromise [4].

In conclusion, although rare, pseudoaneurysms may occur following arthroscopic ankle surgery. The interpreting physician should keep this diagnosis in mind when confronting a vascular mass following surgery and the presence of emanating pulsation artifact is highly suggestive. A limited ultrasound examination can be performed to confirm the diagnosis if necessary.

Compliance with ethical standards

Disclosures The authors have no relevant conflicts to disclose.

References

- Battisti D, Oliva F, Tarantino U, Nicola M. Pseudoaneurysm of peroneal artery after ankle arthroscopy. *Muscles Ligaments Tendons J*. 2014;4:269–72.
- Brimmo OA, Parekh SG. Pseudoaneurysm as a complication of ankle arthroscopy. *Indian J Orthop*. 2010;44:108–11. <https://doi.org/10.4103/0019-5413.58614>.
- Suzangar M, Rosenfeld P. Ankle arthroscopy: is preoperative marking of the superficial peroneal nerve important? *J Foot Ankle Surg*. 2012;51:179–81. <https://doi.org/10.1053/j.jfas.2011.11.003>.
- Yu JL, Ho E, Wines AP. Pseudoaneurysms around the foot and ankle: case report and literature review. *Foot Ankle Surg*. 2013;19:194–8. <https://doi.org/10.1016/j.fas.2012.08.003>.
- Jacobs E, Groot D, Das M, Hermus JP. Pseudoaneurysm of the anterior tibial artery after ankle arthroscopy. *J Foot Ankle Surg*. 2011;50:361–3. <https://doi.org/10.1053/j.jfas.2011.01.004>.
- Schaarschmidt BM, Heuser LJ. Diagnostics and treatment of pseudoaneurysms of the distal anterior tibial artery after upper tibiotalar joint arthroscopy: a case report and a review of literature. *Rofo*. 2013;185:169–71. <https://doi.org/10.1055/s-0032-1325442>.

7. Mariani PP, Mancini L, Giorgini TL. Pseudoaneurysm as a complication of ankle arthroscopy. *Arthroscopy*. 2001;17:400–2.
8. Salgado CJ, Mukherjee D, Quist MA, Cero S. Anterior tibial artery pseudoaneurysm after ankle arthroscopy. *Cardiovasc Surg*. 1998;6:604–6.
9. Jang EC, Kwak BK, Song KS, Jung HJ, Lee JS, Yang JJ. Pseudoaneurysm of the anterior tibial artery after ankle arthroscopy treated with ultrasound-guided compression therapy. A case report. *J Bone Joint Surg Am*. 2008;90:2235–9. <https://doi.org/10.2106/jbjs.g.01409>.
10. Hua Y, Chen S, Li Y, Chen J, Li H. Combination of modified Bröstrom procedure with ankle arthroscopy for chronic ankle instability accompanied by intra-articular symptoms. *Arthroscopy*. 2010;26:524–8. <https://doi.org/10.1016/j.arthro.2010.02.002>.
11. Lui TH. Modified arthroscopic Brostrom procedure with bone tunnels. *Arthrosc Tech*. 2016;5:e775–80. <https://doi.org/10.1016/j.eats.2016.03.003>.
12. Lui TH. Modified arthroscopic Brostrom procedure. *Foot Ankle Surg*. 2015;21:216–9. <https://doi.org/10.1016/j.fas.2015.01.008>.
13. Yeo ED, Lee KT, Sung IH, Lee SG, Lee YK. Comparison of all-inside arthroscopic and open techniques for the modified Broström procedure for ankle instability. *Foot Ankle Int*. 2016;37:1037–45. <https://doi.org/10.1177/1071100716666508>.
14. Jeffery CA, Quinn SJ, Quinn JM. Pseudoaneurysm of the anterior tibial artery after ankle arthroscopy. *ANZ J Surg*. 2014;84:391–3. <https://doi.org/10.1111/ans.12280>.
15. Davis M, Brooks D, Bryceson W. Pseudo-aneurysm: a rare complication of ankle arthroscopy. *J Orthop Sports Phys Ther*. 2017;47:42. <https://doi.org/10.2519/jospt.2017.5544>.
16. Verbrugghe P, Vandekerckhof J, Baeyens I. Pseudoaneurysm of the anterior tibial artery: a complication of ankle arthroscopy. *Acta Chir Belg*. 2011;111:410–1.
17. Naqvi S, Khalid S, Beg M, Haseen M, Ali E. Long-standing pseudoaneurysm of proximal brachial artery mimicking soft tissue neoplasm. *Ind J Vasc Endovasc Surg*. 2017;4:66–8. https://doi.org/10.4103/ijves.ijves_59_16.
18. Shah A, Botchu R, Dunlop D, Davies AM, James SL. Metal-on-metal total hip arthroplasty associated with adverse local tissue reaction and pseudoaneurysm of the superior gluteal artery: a case report and literature review. *Surg J (New York, NY)*. 2016;2:e113–8. <https://doi.org/10.1055/s-0036-1593855>.
19. Samim M, Mandell J, Smith S, Kapoor N, Czuczman G. Arterial pseudoaneurysms of the shoulder mimicking other entities: utilization of pulsation artifact on musculoskeletal MR for accurate diagnosis in 2 cases. *Skeletal Radiol*. 2017;46:1119–24. <https://doi.org/10.1007/s00256-017-2622-9>.
20. Arshad FH, Sutijono D, Moore CL. Emergency ultrasound diagnosis of a pseudoaneurysm associated with an arteriovenous fistula. *Acad Emerg Med*. 2010;17:e43–5. <https://doi.org/10.1111/j.1553-2712.2010.00758.x>.
21. Hall HA, Minc S, Babrowski T. Peripheral artery aneurysm. *Surg Clin North Am*. 2013;93:911–23, ix. <https://doi.org/10.1016/j.suc.2013.04.008>.
22. Lupattelli T. The yin-yang sign. *Radiology*. 2006;238:1070–1. <https://doi.org/10.1148/radiol.2383031884>.