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MUSCULOSKELETAL IMAGING

Dynamic musculoskeletal ultrasound: slipping rib, muscle hernia, snapping hip, and peroneal tendon pathology

Antonia S. Caldwell[1] · Stacey M. Elangovan[1,2] · Jon A. Jacobson[3,4]

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Abstract
Dynamic musculoskeletal ultrasound is an important diagnostic tool that allows the practitioner to observe soft tissue structures over a range of motion and identify pathology not diagnosed on other modalities. Familiarity with this modality allows health care practitioners to appropriately refer patients for this type of examination. This article will review several indications for dynamic ultrasound imaging, including slipping rib, muscle hernia, snapping hip, and peroneal tendon pathology. The examination technique and expected findings for common pathology in each location are discussed.

Keywords Ankle · Musculoskeletal disease · Ribs · Tendons · Thoracic wall · Ultrasonography

Introduction

Ultrasound offers multiple advantages as a diagnostic modality, particularly in the pediatric population. In addition to providing diagnostic information without the use of ionizing radiation, the examinations can typically be performed without the use of sedation and may even be performed at the patient's bedside or while the patient is being held by a caregiver. For musculoskeletal applications, ultrasound also allows the practitioner to conduct a dynamic examination, observing soft tissue structures over a range of motion and confirming whether the motion reproduces the patient's symptoms. Despite these advantages, many health providers remain unfamiliar with the use of dynamic ultrasound for musculoskeletal imaging. By becoming more familiar with the indications and techniques for dynamic ultrasound, patients can be referred for this type of examination to identify pathology not diagnosed with other imaging modalities. This article reviews several indications for dynamic ultrasound imaging, including slipping rib, muscle hernia, snapping hip, and peroneal tendon pathology, and discusses the examination technique as well as the expected findings for common pathology in these locations.

✉ Stacey M. Elangovan
stacey.elangovan@cchmc.org

1 Department of Radiology, University of Cincinnati College of Medicine, Cincinnati, OH, USA

2 Department of Radiology, MLC 5031, Cincinnati Children's Hospital Medical Center, 3333 Burnet Ave., Cincinnati, OH 45229, USA

3 Lenox Hill Radiology, New York, NY, USA

4 Department of Radiology, University of California, San Diego, San Diego, CA, USA

Chest wall pathology: slipping rib

Background/indication

A slipping rib, first described by Cyriax in 1919, is an infrequently diagnosed cause of lower chest or upper abdominal pain that is caused by abnormal motion between the costal cartilage of the ribs [1]. Because the intercostal nerves course along the inferior margin of the costal cartilage, abnormal motion in this location can impinge on the nerve, producing pain that is exacerbated by activity and relieved by rest [1].

The abnormal motion that causes the symptoms of a slipping rib most often occurs in the false ribs. The ribs can be categorized as true, false, or floating based on their cartilaginous attachments to the sternum. The true ribs, the 1st through 7th ribs, exhibit direct cartilaginous attachments to the sternum. The false ribs, the 8th through 10th ribs, each attach to the cartilage of the rib above, but do not themselves directly attach to the sternum. The floating ribs, the 11th and 12th ribs, do not have any cartilaginous attachment to the sternum (Fig. 1). The false ribs, the 8th through 10th ribs, are therefore most commonly implicated in the diagnosis of a slipping rib. Slipping occurs when the cartilaginous attachment to the rib above is deficient, leading to increased motion at the medial head of the costal cartilage that impinges on the nerve and causes pain. [2]. Uncommonly, a slipping rib may occur in a true rib affected by an anatomic variant resulting in a deficient cartilaginous attachment to the sternum.

Slipping rib affects both children and adults. [3] However, female patients, particularly female athletes, are most frequently affected [3, 4]. Due to the location of the pain, which some patients perceive as intraabdominal, the differential diagnosis is often broad, and patients may undergo extensive testing to evaluate for other causes of pain before a diagnosis of slipping rib is suggested.

For many years, a diagnosis of slipping rib was made on the basis of a corresponding history and physical examination, which classically included the hook maneuver in which the fingers of the examiner are slid below the costal margin and moved anteriorly and superiorly, reproducing the patient's pain [3]. In recent years, the role of dynamic ultrasound in both diagnosing slipping rib and defining the level(s) of involvement for surgical planning has been increasingly recognized [5].

Examination technique

The sonographic evaluation of slipping rib is performed with the patient in the supine position. A high-frequency linear transducer is preferred. The examination begins by using anatomic landmarks to localize the site of the patient's pain. In the majority of patients, the 7th rib costal cartilage bears the most inferior direct attachment to the sternum. The medial attachment of the 8th rib cartilage can be identified arising from the 7th rib, and so on [5]. Localization of the patient's pain both contributes to the confirmation or refutation of a diagnosis of slipping rib and allows for image-guided surgical site marking if surgical intervention is required.

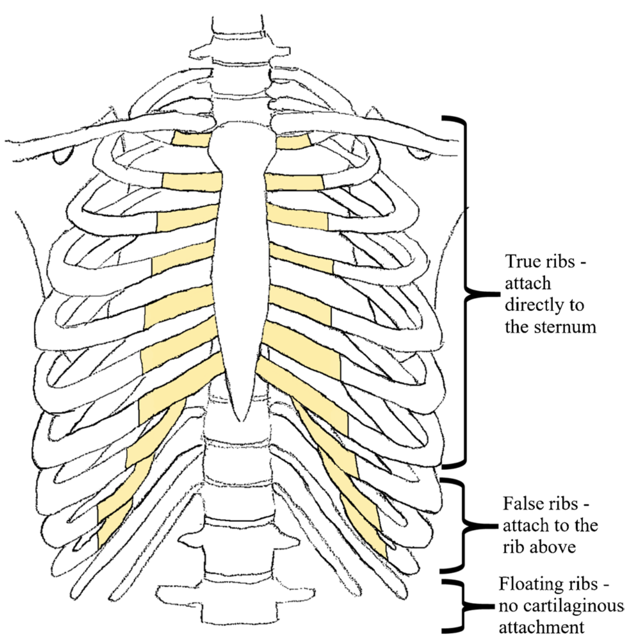

Fig. 1 Diagram of normal rib anatomy showing the true, false, and floating ribs

Once the patient's pain is localized, dynamic maneuvers can demonstrate the presence or absence of abnormal motion of the costal cartilage at the site of pain. Dynamic maneuvers for the diagnosis of a slipping rib include Valsalva, abdominal crunch, and manual push [5].

Because the Valsalva maneuver, forced expiration against a closed glottis resulting in increased intrathoracic pressure, infrequently demonstrates a slipping rib in positive cases, this technique can reasonably be omitted from the examination. However, its low diagnostic yield means that the maneuver is frequently painless, and its use can be employed to practice dynamic maneuvers with the patient before moving on to other actions that may provoke pain.

An abdominal crunch, contraction of the abdominal muscles accompanied by slight elevation of the shoulders from the examination table, may demonstrate abnormal costal motion. For this technique, it is important that the patient avoid very large movements as it is difficult to maintain transducer contact during a complete sit-up.

Positive slipping rib cases are often identified by a manual push, using the fingers of one hand to exert pressure in the cephalad direction on the costal cartilage while the other hand holds the transducer in place (Fig. 2). A second person or a foot pedal may be needed for image capture using this technique if prospective cine clip acquisition is not available. In addition to the above techniques, any movement identified by the patient that reproduces their pain and that can be reasonably performed with the transducer in good contact with the skin should be attempted.

Findings

At rest, the medial head of the costal cartilage of a false rib is located in the same plane as the cartilage of the level above. With dynamic maneuvers, this relationship normally remains unchanged. In patients with a slipping rib, however, the medial head of the costal cartilage moves deep to, or, less commonly, superficial to the cartilage above, reproducing the patient's pain (Fig. 3 and Online Resource 1). Because slipping may occur but be asymptomatic, it is only by reproducing the patient's pain that the diagnosis of a slipping rib can be confirmed or disproven.

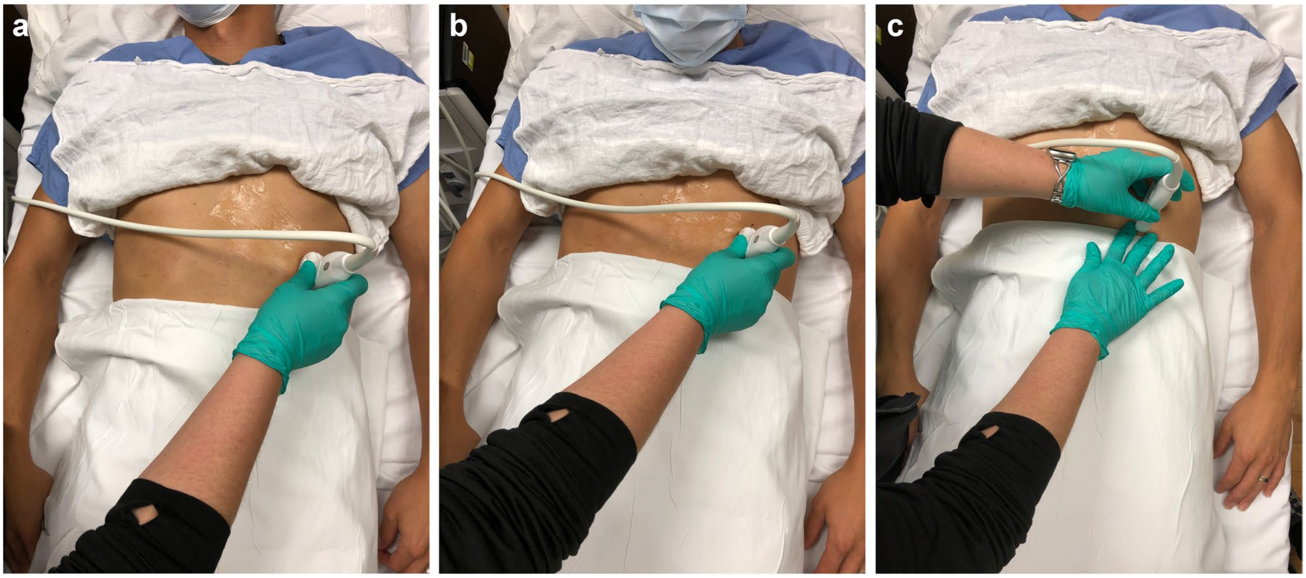

Fig. 2 Transducer position (**a**) with the patient in neutral position, (**b**) during an abdominal crunch maneuver, and (**c**) during the push maneuver

Treatment

After a diagnosis is made, both nonoperative and surgical treatment options may be considered. For some patients, it may be feasible to avoid activities that exacerbate the pain and treat the symptoms with rest, ice, and analgesia when it occurs. Other nonoperative strategies for management include anesthetic and steroid rib blocks, topical analgesia, acupuncture, and manipulative techniques [3]. Operative treatment involves the resection of the slipping costal cartilage. Recently, the addition of vertical rib plating with bioabsorbable plates at the time of surgery has been shown to reduce the risk of recurrent symptoms [6].

Extremity pathology: muscle hernia

Background/indication

Muscle hernias, protrusion of muscle tissue through congenital or acquired fascial defects, are most commonly encountered in the lower extremities of male athletes [7]; however, this entity has also been identified in the pediatric population [7, 8], in which neither a male predominance nor an exclusive association with athletic activities is seen [8]. Patients with muscle hernias that come to medical attention typically describe a palpable nodule that may wax and wane with activity or position. The nodule may be painless or associated with pain and/or focal swelling [9].

The diagnosis of muscle hernia may be suspected on the basis of a detailed clinical history and physical examination, particularly if a palpable change is observed with muscle contraction. Dynamic ultrasound can help confirm the diagnosis, rule out other possible etiologies, and evaluate for additional features such as nerve entrapment that may be associated with the hernia [9].

Examination technique

Prior to sonography, a physical examination of the affected area should be performed to identify the area of involvement and to identify maneuvers that may increase its visibility. Because these lesions may reduce with the patient in the recumbent position, the examination should be performed with the patient in a position that enables visualization of the lesion. In the lower extremities, plantar flexion and dorsiflexion of the foot may change the size and shape of the lesion [7]. Imaging after repeated exercise may increase the size and echogenicity of the lesion. In addition, any maneuver identified by the patient that changes the characteristics of the lesion and can reasonably be performed with the transducer in good contact with the skin should be attempted. Compression of the lesion with the ultrasound transducer may reduce the lesion, which can aid in the diagnosis, but, if applied throughout the examination, can inadvertently reduce the lesion, resulting in a missed diagnosis [8]. Therefore, care should be taken to apply the transducer lightly. A standoff pad is not needed.

Findings

The normal deep fascia is seen as a linear band of hyperechogenicity immediately superficial to the muscle. In the case of a muscle hernia, a defect in the fascia appears as an

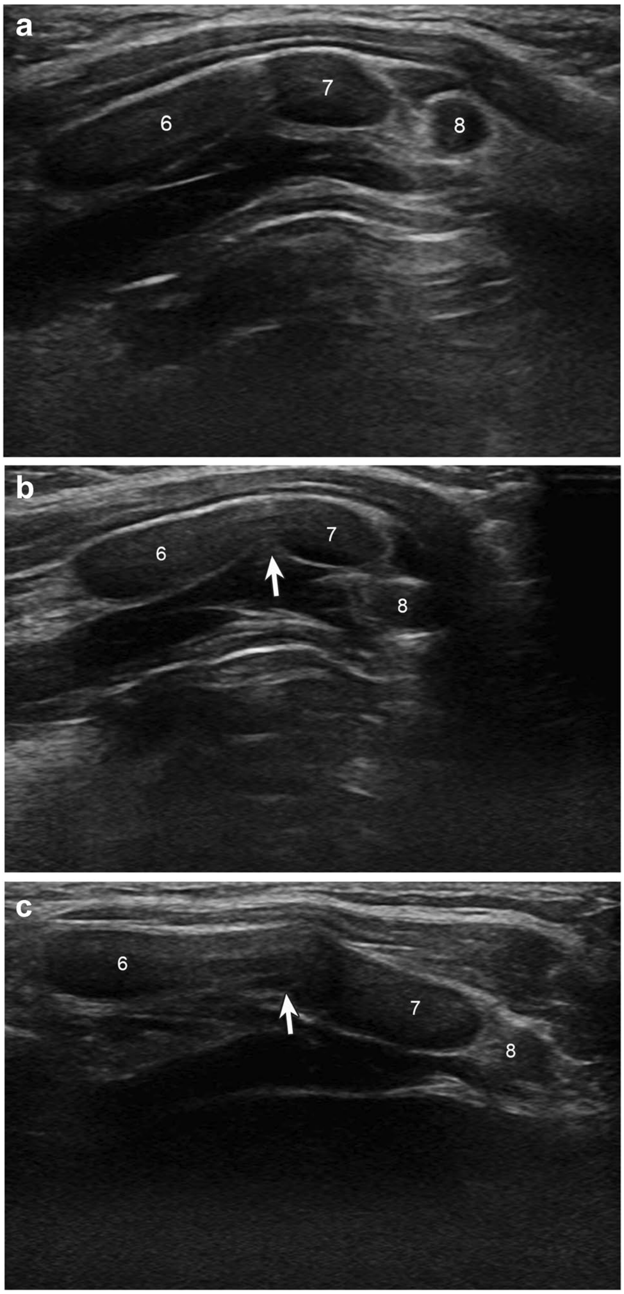

Fig. 3 Slipping rib syndrome. Twelve-year-old female patient with chest wall pain with activity. (**a**) Sonographic images obtained perpendicular to the long axis of the ribs of the costal cartilage of the 6th, 7th, and 8th ribs on the symptomatic side, indicated by their respective numerals, demonstrate the 8th rib cartilage adjacent to but not in contact with the 7th rib cartilage at rest. (**b**) Additional image at the same location demonstrating that with manual pressure, the 8th rib cartilage slips deep to the 7th rib cartilage. (**c**) Similar pressure applied to the asymptomatic side does not result in abnormal motion of the 8th rib cartilage. Note the fusion anomaly between the cartilage of the 6th and 7th ribs on both the symptomatic and asymptomatic sides (straight arrows). This has been observed to occasionally be associated with abnormal mobility of the cartilage at the level below but is present bilaterally in this patient with unilateral symptoms

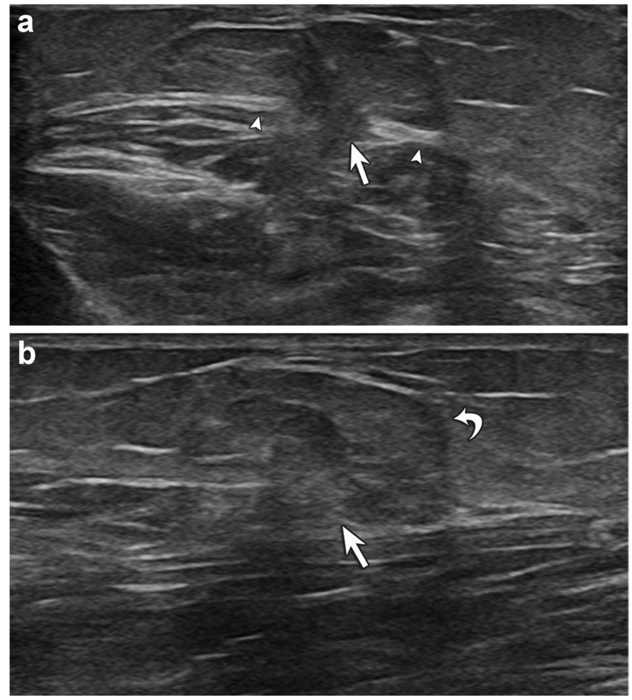

Fig. 4 Muscle hernia. Twelve-year-old female patient with a palpable mass in the anterior right lower leg that had slowly increased in size over time. (**a**) Transverse image of the palpable mass shows hypoechoic muscle fibers (straight arrow) protruding through a defect in the linear, echogenic fascia (arrowheads). (**b**) Longitudinal image of the same mass shows protruding muscle fibers (straight arrow) in a mushroom shape (curved arrow), but the fascial defect is less conspicuous in this plane. Compression partially reduced the mass, while imaging during plantar flexion and dorsiflexion showed muscle fibers moving through the fascial defect

interruption of this hyperechoic band (Fig. 4). The muscle fibers protruding through this defect, which may only be visible with dynamic maneuvers, are often slightly hypoechoic to the surrounding muscle. A mushroom-like shape of the herniated muscle tissue may be seen where the tissue overhangs the edges of the fascia [9]. There may be increased vascularity within the herniated muscle [10], which has been proposed to represent either vascular congestion or vessels perforating the fascia at a site of congenital weakness [9]. Compression, dynamic maneuvers, and imaging after exercise can change the size and shape of the lesion as shown in the supplemental cine clip (Online Resource 2).

Treatment

For patients whose muscle hernias are not associated with pain or swelling, no further treatment may be indicated. If the lesion is painful or associated with an unacceptable cosmetic defect, however, patients may choose to undergo treatment. Nonoperative treatment may include rest, activity modification, compression sleeves applied to the affected area, physical therapy, and acupuncture [8]. If conservative management fails, a fasciotomy of the entire involved muscle may be performed [9]. Repair of the fascia may be performed with a mesh or autologous fascial graft; however, primary repair is not generally recommended due to potential weakness of the tissue at the site of the defect as well as the reported risk of compartment syndrome following such a repair [8].

Hip pathology: snapping hip

Background/indication

Snapping syndromes of the hip are common in the general population, but most prevalent in young populations and athletes, particularly ballet dancers, who regularly perform movements requiring hip abduction and external rotation. The snapping sensation can occur with or without pain or an audible snap and may be described when getting out of a car or walking up steps. While snapping hip, also termed *coxa saltans*, has been classically described as intra-articular or extra-articular, the former relates to mechanical symptoms in the setting of intra-articular bodies, labral tears, etc., and will not be discussed further as these causes are best assessed with cross sectional imaging modalities. The snapping phase of extra-articular causes can be directly visualized with dynamic ultrasound, making it the diagnostic imaging method of choice.

Extra-articular snapping hip can be further subdivided into internal and external causes. Internal or anterior snapping hip involves the iliopsoas complex and the relationship of the psoas major tendon and the medial fascicle of the iliacus muscle. With dynamic maneuvers, the iliacus muscle can become entrapped between the psoas major tendon and underlying bone, with subsequent snapping of the psoas major tendon against the bone as the muscle is released. Other less common causes include snapping of the two heads of a bifid iliopsoas tendon on themselves, and snapping of the psoas major tendon over a paralabral cyst or hip prosthesis, which occur with the same movement pattern. Internal snapping hip was originally thought to be due to impingement of the iliopsoas tendon by the iliopectineal eminence; however, dynamic ultrasound studies have now demonstrated the true cause and shown the iliopectineal eminence to remain medial to the psoas major tendon throughout movement without altering the tendon's course [11]. External or lateral snapping hip involves the iliotibial tract and/or anterior fibers of the gluteus maximus muscle snapping over the greater trochanter. Structures of the anterior and lateral hip are well seen with sonography, allowing for accurate diagnosis of snapping hip syndromes with dynamic maneuvers [11].

Examination technique

The sonographic evaluation of internal snapping hip is performed with the patient supine. A high-frequency linear transducer is preferred; however, with larger body habitus or muscular patients, a lower frequency may be necessary for adequate penetration. The exam begins with the transducer placed in a transverse oblique orientation over the anterior hip in the plane of the inguinal ligament. With this transducer placement, the psoas major tendon and medial and lateral fascicles of the iliacus muscle are identified overlying the superior pubic ramus and ilium. The iliopsoas bursa lies deep to the psoas major tendon and is normally collapsed and not visible. The patient is then asked to assume a frog-leg position by flexing, abducting, and externally rotating the affected hip. Maintaining these structures in view in the transverse oblique plane over the anterior hip, the patient slowly returns the hip to neutral position, which is the point at which snapping may occur.

To evaluate external snapping hip, the patient is placed in the lateral decubitus position with the affected hip up. With the transducer in the transverse plane over the greater trochanter, the characteristic contour of the trochanteric facets and associated gluteal tendon attachments are identified as the starting landmarks. The more superficial iliotibial tract and its muscular expansions are identified, the tensor fascia lata anteriorly and gluteus maximus muscle posteriorly. Dynamic ultrasound of the lateral hip is performed with the patient flexing and extending the affected hip. This can also be performed in the standing position utilizing contraction of the gluteus maximus muscle, which may be necessary to elicit symptoms [12–14].

Findings

Internal snapping hip involves the relationship of the iliopsoas complex. At rest, the psoas major tendon lies against the superior pubic ramus along the medial margin of the iliacus muscle adjacent to the ilium, which demonstrates separate medial and lateral fascicles (Fig. 5). With flexion, abduction, and external rotation of the hip, the psoas major tendon normally rotates laterally with some movement of the iliacus muscle. In the abnormal situation, the psoas major tendon moves further away from the ilium/superior pubic ramus and the medial fascicle of the iliacus muscle becomes interposed or entrapped between the psoas major tendon and underlying bone (Fig. 5) [11]. On return to neutral leg position, the psoas major normally glides smoothly to its original position [11]. In snapping condition, the medial iliacus

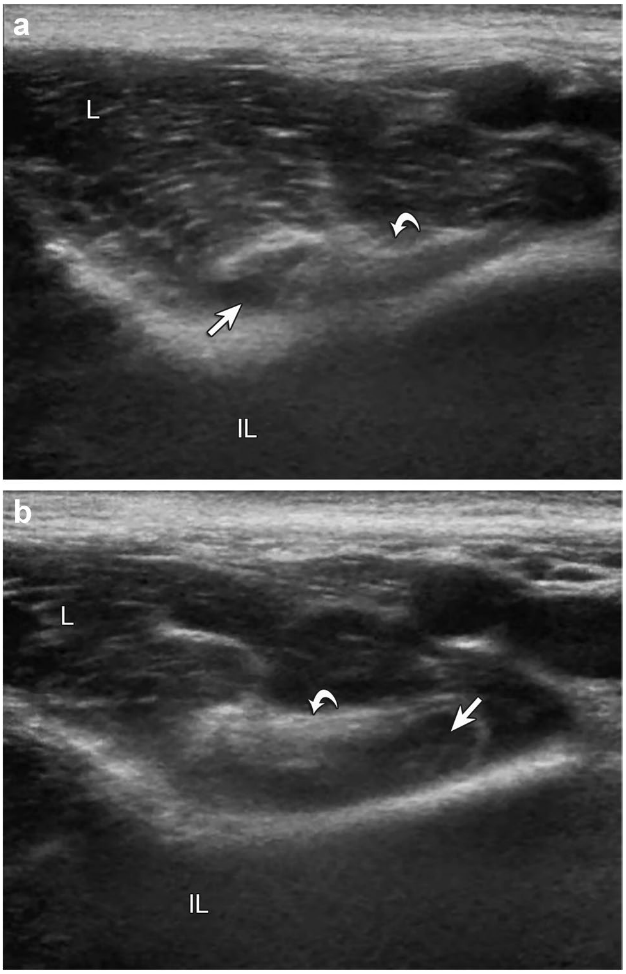

Fig. 5 Internal snapping hip: Snapping iliopsoas complex. Male patient in his mid-30 s with hip pain. (**a**) Ultrasound image in the transverse oblique plane over the anterior hip in the plane of the inguinal ligament with the patient supine, hip in neutral position (left side of image is lateral) shows lateral (L) and medial (straight arrow) fibers of iliacus, and psoas major tendon (curved arrow). IL, ilium. (**b**) With hip in frog-leg position (flexion, abduction, and external rotation), the psoas major tendon (curved arrow) moved anterior from the ilium (IL) with medial fibers of the iliacus muscle (straight arrow) interposed between the psoas major tendon and the underlying ilium. When patient extended the leg back to neutral position, the medial iliacus fibers moved back to normal position and the iliopsoas tendon abruptly snapped as it made contact with the ilium

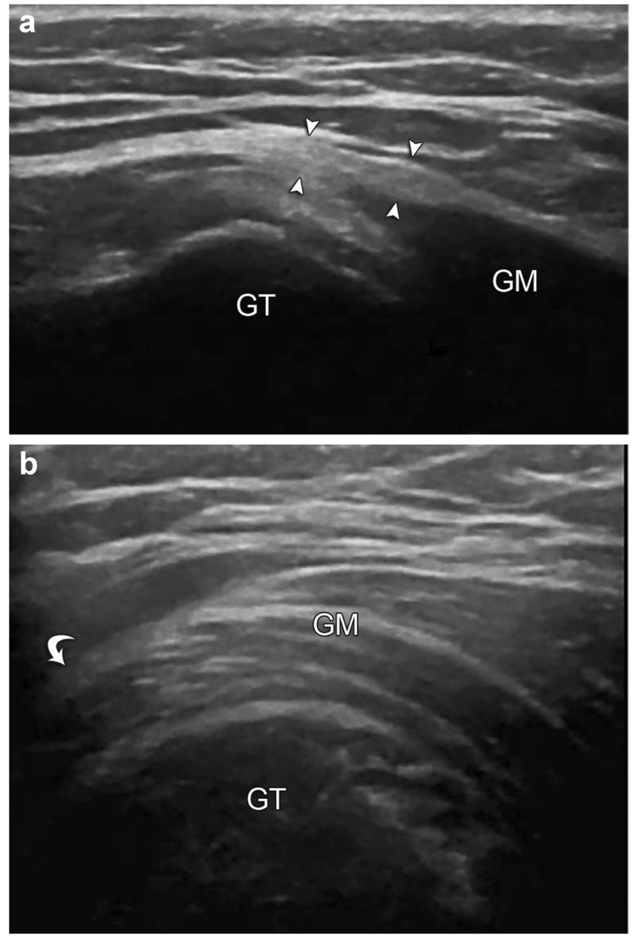

Fig. 6 External snapping hip: snapping gluteus maximus/iliotibial tract. Female patient in her late 20 s with hip pain. (**a**) Ultrasound in the transverse plane over the lateral hip at the level of the greater trochanter with hip in neutral position (left side of image is anterior) shows focal thickening of the iliotibial tract (arrowheads) over greater trochanter (GT) and gluteus maximum muscle (GM). (**b**) With hip in flexion, the iliotibial tract (curved arrow) and gluteus maximus (GM) abruptly snap anteriorly over greater trochanter (GT)

abruptly rotates back to its normal position (clockwise for the right hip, counterclockwise for the left) allowing the psoas major tendon to abruptly move toward the ilium/superior pubic ramus, which can be heard as an audible snap and also felt through the ultrasound transducer. The anatomic variant bifid iliopsoas tendon can also produce snapping when its medial and lateral heads snap around each other, which can be assessed with the same dynamic maneuver [15, 16]. Rarely, iliopsoas tendinosis, tear, or bursal distension may be seen [15, 17].

External snapping hip is typically a clinical diagnosis [13, 15]. However, in the setting of an equivocal clinical exam or question of other causes of snapping such as over a distended trochanteric bursa or impingement by orthopedic hardware, dynamic imaging may be useful to delineate the exact cause. On dynamic ultrasound, the iliotibial tract and anterior gluteus maximus muscle can be seen to glide over the lateral facet of the greater trochanter. With external snapping hip, the iliotibial tract and/or anterior gluteus maximus muscle may be thickened and can be seen to abruptly snap over the greater trochanter on return to extension from a flexed position (Fig. 6) [13–15]. Other contributing factors to external snapping hip include leg length discrepancy and coxa vara [15].

Treatment

The initial treatment of internal snapping hip is conservative, consisting of rest, physical therapy, and analgesics, with corticosteroid injection into the iliopsoas bursa used as a diagnostic and therapeutic measure in patients that fail conservative management or if immediate relief is needed to return to activity or physical therapy [12, 13, 15]. In refractory cases, surgical intervention may be warranted [12, 13, 15].

Ankle pathology: peroneal tendon subluxation and dislocation

Background/indication

Common peroneal tendon pathology includes tenosynovitis, tendinosis, peroneal tendon tears, most often partial or full-thickness longitudinal split tears, and traumatic or atraumatic tendon subluxation/dislocation [18]. While the former can be adequately assessed with static magnetic resonance imaging, peroneal tendon subluxation and dislocation occurs intermittently, with frank dislocation typically not seen at rest [19]. Peroneal tendon subluxation is not uncommon, estimated to occur in 0.3–0.5% of traumatic ankle injuries with atraumatic instability occurring in 20% of the general population [19, 20]. While peroneal tendon subluxation was originally described in ballet dancers, it is also seen in athletic injuries, including skiing, ice skating, basketball, soccer, and American football [18–23]. Patients often give a history of ankle instability, snapping and popping, or the ankle giving way, which may be misdiagnosed, especially as concomitant lateral ankle injury is often present [24]. Ultrasound allows for dynamic evaluation of the peroneal tendons with the use of provocative maneuvers to reproduce episodic subluxation and dislocation.

Peroneal tendon instability can be differentiated into traumatic or atraumatic subluxation. Traumatic subluxation involves injury of the superior peroneal retinaculum and may be acute, following severe inversion injury or forceful dorsiflexion with reflexive contraction of the peroneal muscles, or chronic, related to recurrent inversion ankle sprain. With superior peroneal retinaculum injury, the peroneal tendons are no longer stabilized in the retromalleolar groove and one or both may be anteriorly displaced over the lateral malleolus with dorsiflexion and eversion of the foot. This displacement of the tendon over the fibula may be palpable at physical exam. In contrast, in atraumatic or intrasheath subluxation, the tendons remain in the retromalleolar groove with an intact superior peroneal retinaculum but demonstrate abnormal motion relative to each other within their common synovial sheath. Without anterior displacement of the tendon(s), intrasheath subluxation may be missed on physical exam, making dynamic ultrasound a useful diagnostic tool. Intrasheath subluxation may occur with or without longitudinal split tear of peroneus brevis tendon and may be predisposed by anatomical variants, including a hypoplastic or convex fibular groove, low lying peroneus brevis muscle belly, and accessory peroneus quartus muscle [19, 21, 25, 26].

Examination technique

For dynamic ultrasound evaluation of the peroneal tendons, the patient is placed in the lateral decubitus position with the affected ankle internally rotated, exposing the lateral ankle. Alternatively, prone positioning with the feet extended beyond the end of the stretcher can be used for ease of contralateral comparison in the case of equivocal findings. Using a high-frequency transducer preferably with a small footprint, the peroneal tendons are assessed in the transverse plane, posterior to the distal fibula. Examination begins with evaluation of the length of the peroneus longus and brevis tendons to evaluate tendon integrity and the presence of concomitant injury or predisposing anatomical factors. Dynamic assessment is performed at the level of the lateral malleolus, and the patient is asked to reproduce symptoms and/or actively dorsiflex and evert the ankle with and without light resistance to elicit symptoms. The use of a gel stand-off is helpful both in maintaining contact with the contours of the posterolateral ankle and in avoiding restriction of the abnormal peroneal tendon movement under transducer pressure.

Findings

At the level of the lateral malleolus, the peroneus brevis tendon lies anterior and medial to the peroneus longus tendon, directly abutting the fibular groove. The tendons appear as hyperechoic, fibrillar structures, with variable tapering of the peroneus brevis musculotendinous junction. Presence of the peroneus brevis muscle distal to the fibular tip represents a "low-lying" peroneus brevis muscle [19]. Superficially, the peroneal tendons are stabilized by the normally thin, echogenic superior peroneal retinaculum, which spans the posterolateral distal fibula to the aponeurosis of the Achilles tendon. A hyperechoic triangular fibrocartilage can be seen at the peroneal retinaculum fibular attachment, which serves to deepen the retromalleolar groove.

With traumatic anterior peroneal subluxation, the superior peroneal retinaculum may appear thickened and hypoechoic, with variable injury or frank disruption. Based on the Oden classification, this ranges from stripping of the periosteum at the fibular attachment with an intact but lax retinaculum (type I), superior peroneal retinaculum disruption without (type II) or with (type III) osseous avulsion of the fibular attachment, to superior peroneal retinaculum disruption at the posterior attachment (type IV) [22]. With forced ankle dorsiflexion and eversion, one or both peroneal tendons can transiently displace anteriorly over the fibula into the type I retinacular pouch or through the detached retinaculum (Fig. 7). Chronic peroneal tendon instability can lead to concurrent findings of tenosynovitis, tendinosis, or partial or complete tear.

Atraumatic intrasheath peroneal subluxation is characterized by transient retromalleolar subluxation. With forced ankle dorsiflexion and eversion, the peroneus longus tendon may transiently subluxate anterior to peroneus brevis, reversing their anatomic relationship (Fig. 8). With concurrent longitudinal split tear of the peroneus brevis tendon, there may be subluxation of peroneus longus through the split bundles of peroneus brevis. Sonographically, a longitudinal split tear will appear as a hypoechoic cleft along the long axis of the peroneus brevis tendon. The superior peroneal retinaculum remains intact with no history of trauma or discrete injury.

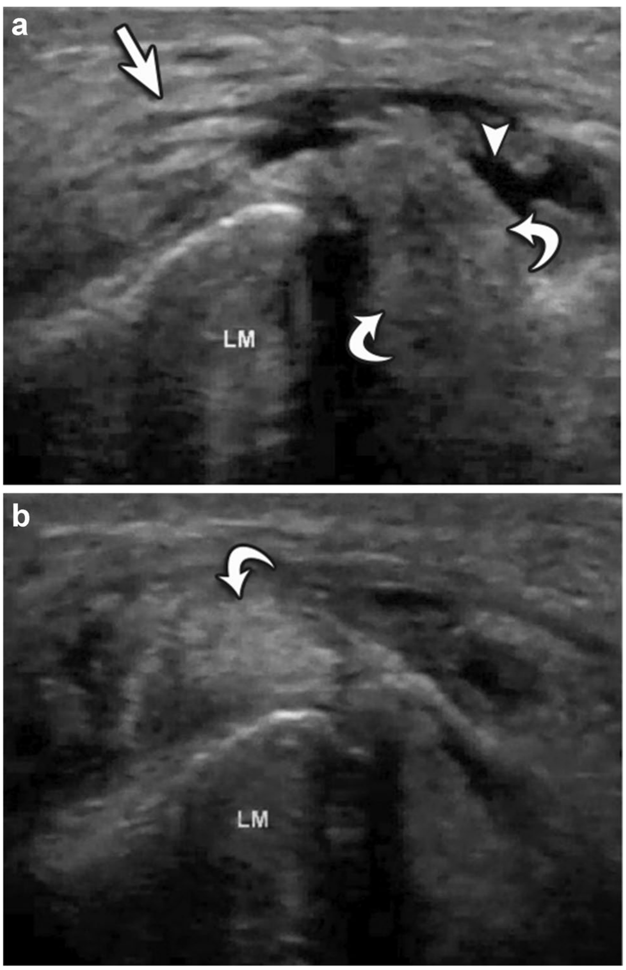

Fig. 7 Peroneal tendon dislocation. Female patient in her mid-50 s with ankle pain. (**a**) Ultrasound over the lateral ankle posterior to the lateral malleolus (LM) in the transverse plane with ankle in neutral position (left side of image is anterior) shows peroneal tendons normally located posterior to the fibula (curved arrows). Note the diffusely abnormal heterogeneously hypoechoic appearance of tendinosis within the peroneal tendons, adjacent tenosynovitis (arrowhead), and superior peroneal retinaculum (straight arrow) that has been torn away from the fibula. (**b**) With foot in dorsiflexion and eversion, there is abnormal dislocation of the peroneal tendons anteriorly (curved arrow)

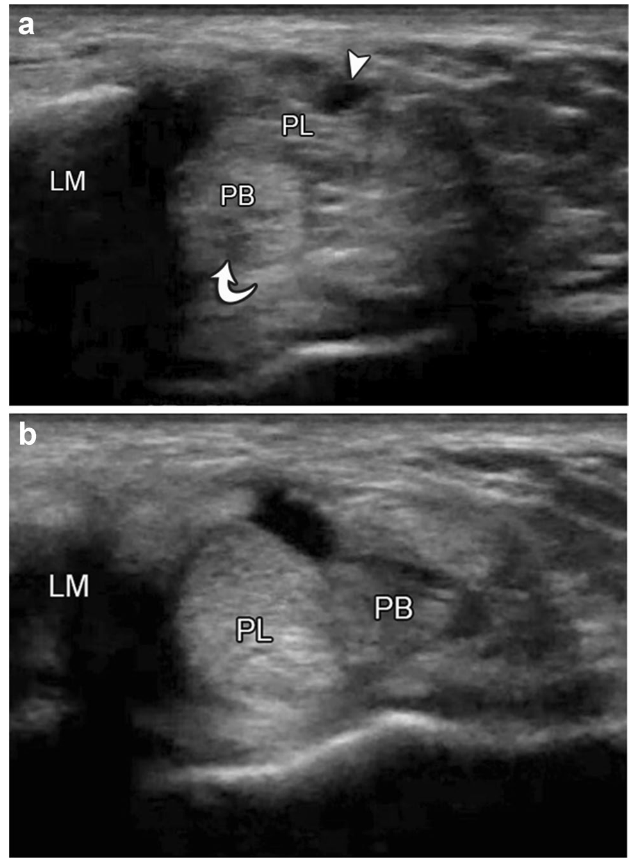

Fig. 8 Intrasheath peroneal tendon subluxation. Female patient in her 20 s with ankle pain. (**a**) Ultrasound over the lateral ankle posterior to the lateral malleolus (LM) in the transverse plane with ankle in neutral position (left side of image is anterior) shows normal location of peroneus brevis (PB) and peroneus longus (PL) tendons. Note abnormal hypoechoic tendinosis (curved arrow) and tenosynovitis (arrowhead). (**b**) With ankle rotation, the peroneal tendons have changed position relative to each other producing an abrupt snap

Treatment

In the general population, both traumatic and atraumatic peroneal tendon subluxation can be treated conservatively, with bracing and/or splinting, heel lifts, or non-weightbearing; however, this is controversial as patients can progress to chronic ankle instability and early onset osteoarthrosis [25, 26]. Therefore, operative repair has become the treatment method of choice, particularly in elite athletes, aiming to repair the superior peroneal retinaculum and/or deepen the retromalleolar groove [19, 20, 25, 26].

Conclusion

Dynamic musculoskeletal ultrasound of the chest wall, extremities, hip, and ankle provides important diagnostic information that often cannot be obtained with static modalities. For patients with chest wall pain due to a slipping rib, dynamic ultrasound can both confirm the diagnosis and aid in surgical planning. In cases of muscle hernia, correctly diagnosing this entity, which is often visible only with dynamic maneuvers, may reassure patients and prevent additional, unnecessary testing. Dynamic ultrasound performed for snapping hip confirms the diagnosis and appropriateness of conservative management. In the ankle, visualization of peroneal tendon subluxation can guide surgical management. Familiarity with these important diagnoses will ensure that a patient is directed to appropriate imaging with dynamic ultrasound, where subsequent assessment can provide an accurate diagnosis.

Supplementary information The online version contains supplementary material available at https://doi.org/10.1007/s00247-023-05700-y.

Author contribution All authors contributed to the drafting of the manuscript and reviewed and approved the final manuscript.

Declarations

Conflicts of interest None

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