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Sonographic evaluation of gluteus medius and minimus tendinopathy

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Abstract Our objective was to describe the sonographic appearance of the gluteus medius and minimus tendons in normal subjects, and to illustrate the spectrum of sonographic findings in gluteus tendinopathies. Sonography was performed in 20 asymptomatic volunteers. Seventy-five consecutive patients (59 women, 16 men; mean age 57.1 years) presented with pain and point tenderness over the greater trochanter. There were 43 right hips and 32 left hips. Ten patients provided a history of a traumatic incident with subsequent symptoms (mean duration 3.2 months). All patients underwent sonography to assess the site and severity of injury, and to discriminate tendinosis from partial and complete tear. Calcific foci, bony change, and fluid in the trochanteric bursae were noted. Twenty-two patients subsequently underwent surgery. Fifty-three (53 of 75) patients showed sonographic evidence of gluteus medius tendinopathy. Twenty-eight patients were thought to have tendinopathy without discrete tear. Sixteen patients had partial tears and 9 full-thickness tears. Gluteus minimus tendinopathy was detected in 10 of 75 patients. Foci of tendinopathy and partial tears were more common in the deep and anterior portions of the gluteus medius tendon attachment. Eight patients had fluid pooling in the trochanteric bursae. Findings were confirmed in 22 patients at surgery. Sonography can identify gluteus medius and minimus tendinopathy and provides information about the severity of the disease.

Keywords Gluteus medius · Minimus · Tendinopathy · Tears · Sonography

Introduction

Lateral hip pain is a common clinical dilemma that may be due to either intra-articular or periarticular pathology. Causes of lateral hip pain include trauma, infection, avascular necrosis, stress fractures of the femoral neck and referred pain from the spine [1]. Arthritis, tumours and entrapment neuropathies have been reported [2]. There is also a group of patients whose lateral hip pain is thought to be related to tendinopathy of the gluteus medius and minimus muscles.

Schein and Lehmann first speculated that calcification around the greater trochanter seen on radiographs was due to either injury or degeneration in the gluteus medius tendon [3]. In 1961, Gordon reported that trochanteric bursitis commenced at the attachments of the gluteus tendons, but thought that the adjacent bursae were involved secondarily in a fashion analogous to the rotator cuff and subacromial–subdeltoid bursitis [4]. Gluteus tendinopathy or the greater trochanteric pain syndrome are the preferable terms for this disease entity rather than trochanteric bursitis, because there is often no evidence of the latter [5, 6]. This pathology is typically unilateral and occurs in middle-aged women [1, 4, 6, 7]. Patients complain of a dull ache and tenderness over the lateral aspect of the hip which is exacerbated with weight bearing, and an inability to sleep on that side. These symptoms may be relieved with injection of local anaesthetic.

To our knowledge, no one has reported the sonographic findings of gluteus tendinopathy.

Sonography is a simple, inexpensive and radiation-free test that has been used to demonstrate tendinopathy. High-frequency probes in combination with software advances have resulted in a marked improvement in image resolution of the deep extra-articular soft tissues. Sonography offers an alternative to MR imaging in assessing patients with intractable hip pain some of whom may be contemplating surgery.

We set up the study to describe the sonographic anatomy of the gluteus medius and minimus tendons in a group of asymptomatic volunteers and the findings in patients with clinical evidence of gluteus tendinopathy. We attempted to characterize the location and degree of injury, discriminating tendinosis from partial tears and full-thickness tears.

Materials and methods

From October 1999 to September 2001, 75 consecutive patients with unilateral pain and point tenderness over the greater trochanter were referred for sonographic assessment at two institutions. There were 59 women and 16 men with a mean age of 57.1 years (age range 37–79 years). There were 43 left hips and 32 right hips.

In addition, both hips in 20 asymptomatic volunteers (10 women, 10 men; mean age 35.4 years) were studied following informed consent in order to describe the normal sonographic anatomy.

Most patients (60 of 75) in the study cohort provided a history of insidious onset of lateral hip pain and tenderness with no precipitating event. Ten patients recalled an event followed by symptoms developing soon afterwards. Ten patients from this group reported falls, 2 were involved in motor vehicle accidents and 1 patient was thrown from a horse. Two patients reported direct blows to the hip joint (hockey stick, slamming door). The initial diagnosis was made following clinical assessment and referred for evaluation on sonography. The interval from symptom onset to sonography ranged from 6 weeks to 3 years (mean 5.4 months).

Patients were examined in the lateral decubitus position with the hip slightly flexed and the symptomatic side facing upwards. The patients were asked to identify the site of pain and point tenderness was confirmed with sono-palpation. Patients were examined with either a 5- to 12-MHz linear probe (HDI 5000, ATL, Bothell, Wash.), or an 8- to 15-MHz linear probe (Sequoia, Acuson, Mountainview, Calif.). One focal zone was routinely used to optimise spatial and temporal resolution at the point of gluteal insertion and optimise temporal contrast. Compound scanning was used to exclude anisotropy. Colour and power Doppler sonography were routinely employed with the power and gain increased to noise threshold. Exclusion criteria for this study were previous surgery including hip replacement and previous injection of steroid. Approval for the study was granted by our institutional Review Board.

The gluteus medius and minimus muscles and tendons were examined with respect to morphology and echo texture in both longitudinal and transverse planes. The examination included comprehensive assessment of both muscles, the bony greater trochanter, the origin of the tensor fascia lata, the iliopsoas muscle, the iliopsoas bursa and the hip joint for an effusion. Fluid in the greater trochanteric bursae was noted and the relationship of the iliotibial band to the gluteus was observed. The examination time approximated 15 min. Correlation was made with the opposite asymptomatic side in all cases.

The thickness of the tendon was measured in millimetres and compared with the opposite side. Tendon echo texture was considered to be normal if a uniform fibrillar pattern could be followed from the muscle belly to the greater trochanter. Tendinosis was present if there was hypoechoic change but preservation of the fibrillar pattern. This was graded as mild when less than 30% of the fibres were injured, moderate when 30–70% of fibres were affected or severe when greater than 70% of fibres were involved. A partial tear was defined as a focal anechoic area with no fibres intact or a discrete irregular hypoechoic band traversing either longitudinally or horizontally within the tendon [8]. A full-thickness tear was defined as a distinct interval extending through the full width of either the gluteus medius or minimus tendon with or without tendon retraction. Any abnormality was confirmed in at least two imaging planes.

The size of any abnormality was measured in millimetres. The site of focal pathology was evaluated in two planes and assigned as predominantly affecting the superficial or deep fibres and also the anterior, mid and posterior fibres. Focal areas of calcification were recorded. Bony changes in the greater trochanter were noted, as was fluid pooling in the trochanteric bursae.

Sonography was performed independently by both a trained musculoskeletal sonographer and musculoskeletal radiologist with an information collection sheet consequently filled out in collaboration. The interpretation represented the original report. Twenty-two patients subsequently underwent surgery. Fifty-three patients were treated conservatively including rest, physiotherapy and anti-inflammatories; of these, 18 patients subsequently returned for sonographic guided injection of Bupivacaine and corticosteroid. Five patients returned for repeat imaging when symptoms failed to resolve with conservative treatment.

Results

In normal volunteers, the gluteus medius muscle is a fan-shaped structure composed of hypoechoic striated fascicles with bright, linear bands running within the muscle. The muscle tapers into a strong echogenic fibrillar tendon (Fig. 1). The tendon attaches to the anterosuperior portion of the greater trochanter over a broad U-shaped area. The posterior fibres of the tendon form a thick band which becomes thinner further anteriorly. The distal attachment is well defined and averaged 9.8 mm in asymptomatic male volunteers and 9.7 mm in asymptomatic female volunteers at the mid-trochanteric point in size (Table 1).

The anterior third of the gluteus minimus muscle lies directly under the gluteus medius muscle. A distinct echogenic covering separates minimus from medius, and in cadavers this has been shown to represent fascia and a fatty layer [9]. Muscle fibrils of gluteus minimus converge to form a tendinous insertion into the capsule of the joint. The fascia increases in thickness and forms the tendon of gluteus minimus to insert on a bony ridge of variable shape of the anterolateral surface of the greater trochanter [10].

Of 75 patients, 53 showed sonographic signs of gluteus medius and minimus tendinopathy (Table 2). Two patients had sonographic findings suggestive of ten-

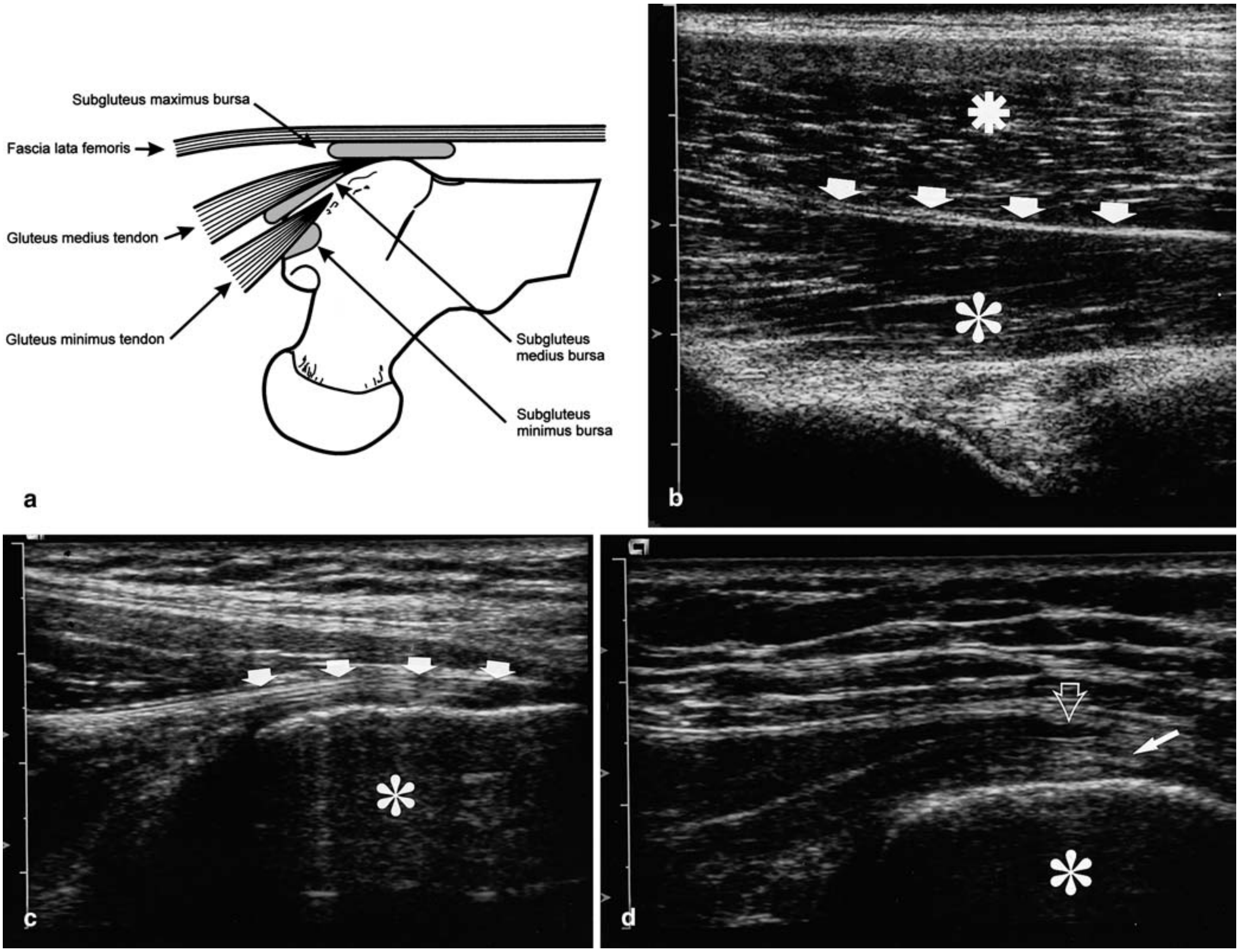


Fig. 1a–d Normal sonographic anatomy of the gluteus medius and minimus tendons. a The insertion of gluteus medius and minimus tendons. b Longitudinal sonogram shows gluteus medius muscle (*spoked wheel*) overlying gluteus minimus (*asterisk*) with a linear band of echogenic fascia separating the two muscles (*short arrows*). c Longitudinal sonogram showing gluteus medius (*straight arrow*) inserting into the greater trochanter (*asterisk*) with a tiny amount of fluid in the trochanteric bursa (*open arrow*). d Longitudinal sonogram showing gluteus medius (*straight arrow*) inserting into the greater trochanter (*asterisk*) with a tiny amount of fluid in the trochanteric bursa (*open arrow*)

Table 1 Size of gluteus medius and gluteus minimus tendons in 20 controls

Control group	Mean size of gluteui (mm)		Difference (%)	Mean age (years)	Age range (years)
	Left	Right			
Gluteus medius					
Men (n=10)	9.8	9.9	1	33	18–53
Women (n=10)	9.7	9.7	0	38	20–58
Gluteus minimus					
Men (n=10)	8.9	8.7	2	33	18–53
Women (n=10)	9.7	8.6	1	38	20–58

Table 2 Features of gluteus medius and gluteus minimus tendinopathy in patient group

Patient no.	Age (years)	Gender	Duration of symptoms	Size of gluteus medius (mm)		Difference (%)	Echo texture	G. trochanter	Other
				Abnormal	Normal				
1	53	F	3 months	15.1	9.8	54	Partial tear	+	
2	49	F	2 months	14.2	9.9	43	Severe tendinosis	++	Ca2+
3	38	F	6 weeks	12.3	9.9	24	Partial tear		Bursal fluid
4	37	F	11 weeks	10.9	10.0	9	Mild tendinosis		
5	37	M	6 months	13.2	9.4	40	Partial tear	+	
6	68	F	1 year	10.9	10.2	7	Moderate tendinosis		Bursal fluid
7	69	M	7 months	10.2	10.3	–1	Full-thickness tear		
8	42	F	6 months	17.2	9.7	77	Severe tendinosis	++	Ca2+
9	42	M	14 weeks	13.4	9.8	37	Full-thickness tear		
10	44	F	2 years	15.6	11.0	42	Severe tendinosis		Tendinosis G. minimus
11	59	F	14 months	7.2	9.2	–22	Full-thickness tear	++	
12	47	F	15 weeks	11.1	10.8	3	Partial tear		
13	71	F	3 years	12.2	8.7	40	Severe tendinosis	++	Tendinosis G. minimus
14	54	M	12 months	13.4	11.1	21	Partial tear		Bursal fluid
15	51	F	10 weeks	9.6	9.4	2	Partial tear		
16	48	M	7 weeks	13.2	9.1	45	Severe tendinosis	+	
17	61	M	9 weeks	11.1	9.8	13	Mod tendinosis		Ca2+
18	75	F	7 months	10.4	9.4	11	Moderate tendinosis	+	
19	79	F	3 months	5.7	9.3	–39	Full-thickness tear	+	Bursal fluid
20	65	M	6 weeks	14.1	10.1	40	Partial tear	+	
21	63	M	9 weeks	9.9	9.9	0	Mild tendinosis		
22	53	F	4 months	9.8	9.8	0	Mild tendinosis	+	
23	50	F	5 months	3.7	10.2	–64	Full-thickness tear	++	Tendinosis G. minimus
24	57	F	7 weeks	11.1	9.8	13	Moderate tendinosis		Bursal fluid
25	60	F	9 months	12.2	10.2	20	Moderate tendinosis	+	
26	62	F	8 months	13.1	10.1	30	Moderate tendinosis		Ca2+
27	42	F	9 weeks	12.8	10.6	21	Partial tear	++	
28	78	M	12 months	10.1	10.1	0	Mild tendinosis		
29	47	F	2 years	0	10.2	–100	Full-thickness tear		Tendinosis G. minimus
30	57	F	13 months	15.9	10.9	59	Severe tendinosis	++	
31	63	F	14 weeks	7.2	10.1	29	Full-thickness tear		Partial tear G. minimus
32	54	F	15 months	10.2	10.3	–1	Full-thickness tear	+	Tendinosis G. minimus
33	49	F	7 months	11.2	11.8	–5	Severe tendinosis		
34	59	M	7 weeks	13.7	11.7	17	Moderate tendinosis		
35	60	M	8 weeks	14.8	12.2	21	Severe tendinosis	+	
36	69	F	9 months	12.1	12.0	1	Partial tear		Bursal fluid
37	75	M	7 weeks	9.7	9.7	0	Moderate tendinosis		
38	70	F	6 months	8.7	9.9	–22	Partial tear	+	
39	71	F	3 months	11.8	10.0	18	Partial tear	++	
40	64	F	3 months	10.2	10.2	0	Mild tendinosis		Tendinosis G. minimus
41	52	F	8 weeks	14.2	11.0	29	Moderate tendinosis		
42	49	F	9 weeks	13.8	10.1	37	Partial tear	+	Tendinosis G. minimus
43	54	F	5 months	14.8	10.0	48	Severe tendinosis	++	
44	61	M	4 months	12.7	9.7	31	Moderate tendinosis	++	Ca2+
45	45	F	8 months	12.7	10.4	22	Partial tear		
46	47	F	12 weeks	0	8.9	–100	Full-thickness tear		Bursal fluid
47	67	M	7 months	14.2	9.8	45	Partial tear	+	
48	61	F	11 weeks	13.8	9.6	44	Severe tendinosis		Bursal fluid
49	77	F	8 months	14.9	10.3	45	Partial tear		Partial tear G. minimus
50	55	F	10 weeks	11.8	10.8	9	Partial tear	++	
51	44	M	18 months	22.7	9.8	132	Severe tendinosis	++	Tendinosis G. minimus
52	51	M	3 months	18.6	10.2	82	Moderate tendinosis		
53	72	F	6 months	12.1	11.1	9	Moderate tendinosis		
			Mean:	11.8 mm	10.1 mm				

sor fascia lata tendinopathy, another with iliopsoas bursitis. Twelve of the 22 patients with normal sonography of the glutei subsequently underwent MR imaging of the hip. Seven of these patients showed degenerative change within the joint, 3 had acetabular labral lesions and 1 patient had avascular necrosis.

Thirty-seven of 53 patients (69.8%) had an enlarged gluteus medius tendon, 10 of 53 (18.9%) had a thin at-

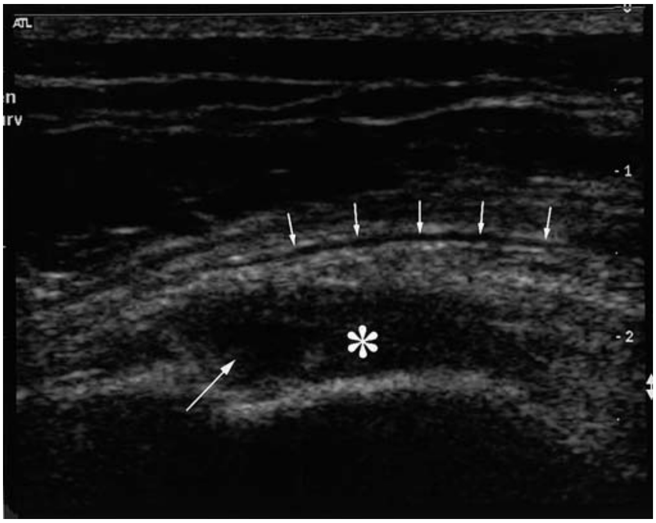


Fig. 2 Gluteus medius tendinopathy in a 58-year-old woman. Transverse sonogram shows enlargement of the gluteus medius tendon (*asterisk*) with a focal area of hypoechoic change anteriorly (*long arrow*). Increased fluid is noted in the trochanteric bursa (*short arrows*)

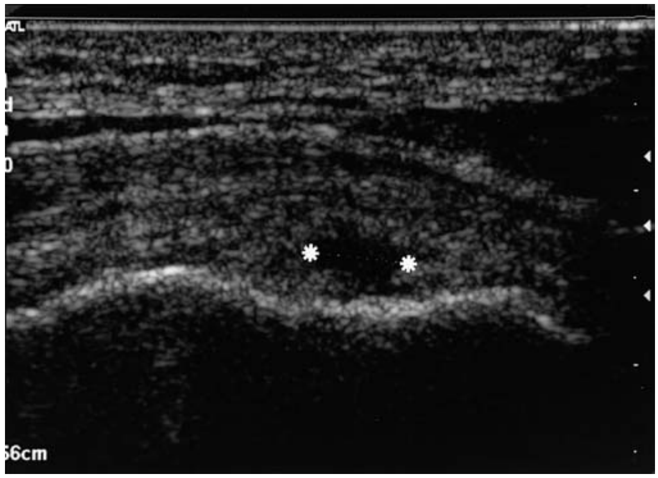


Fig. 3 Partial tear of the gluteus medius tendon in a 68-year-old man. Longitudinal sonogram shows a small anechoic focus (*between asterisks*) in the deep fibres of gluteus medius

tenuated or torn tendon, and 5 of 53 (9.4%) were considered to be normal in size when compared with the opposite side. The most common sonographic appearance was a hypoechogenicity with some preservation of the fibril pattern (Fig. 2). This was felt to represent tendinosis and felt to be present in 28 patients without discrete tear. This was by consensus mild in 5 of 28, moderate in 12 of 28 and severe 11 of 28 cases.

In addition, 25 patients from the study cohort had either partial or full-thickness tears of the gluteus medius. Partial tears were felt to be present in 16 of 53 (30.2%) patients. There were 10 of 53 patients with discrete anechoic foci with no fibres intact (Fig. 3) and 6 of 53 with discrete intrasubstance cleavage planes (Fig. 4). Full-thickness tears with or without retraction of the tendon were shown in 9 of 53 (17%) patients (Fig. 5). The anterior fibres of the gluteus medius tendon were the most common site of injury seen in 12 of 16 partial tears and 7 of 9 full-thickness tears with tendon retraction. The mid fibres were partially torn in 3 of 16 and posterior fibres 1 of 16. Thirteen of the 16 patients with partial tears were by consensus involving the deep fibres with 3 of 16 predominantly affecting the superficial fibres.

Two of 9 patients had full-thickness tears of the posterior fibres, although both of these patients were involved in motor vehicle accidents. Of the 53 patients with sonographic confirmation of gluteus medius tendon pathology, 10 patients also showed features of gluteus minimus disease (Fig. 6). Seven patients showed features of tendinosis, 2 patients had partial tears and 1 patient had a full-thickness tear including both gluteus medius and minimus (Fig. 7).

Other findings included foci of calcification in the gluteus medius tendon in 5 patients (Fig. 8) with gluteus medius tendinosis. Cortical irregularity of the greater trochanter was noted in 25 of 53 patients and was present at all levels of disease. Fluid pooling in the trochanteric bursae was found in 8 of 53 patients. Colour and power Doppler sonography were used routinely and showed increased vascularisation of the tendon in 9 of 53 cases.

Twenty-two hips from the 53 patients underwent surgery. At surgery the patient was positioned on their side and a longitudinal incision made over the greater trochanter, measuring approximately 15 cm in length. The iliotibial band was split longitudinally in line with its fibres. The trochanteric bursa findings were variable at surgery. The bursa was often enlarged, thickened or inflamed, and contained fluid. In all cases the bursa was excised in order to remove it as a potential cause for further symptoms and also to gain adequate access to the gluteus medius tendon.

Full-thickness tears were evident immediately after resection of the trochanteric bursa. This was transverse in orientation. On elevating the proximal segment, a large defect was readily identified extending into the tendon tissue (Fig. 5). Patients with partial-thickness tears had an apparently intact superficial surface; however, on palpating the tendon it became evident that there was an underlying defect present in the anterior fibres. A longitudinal incision, in line with the fibres of the tendon, was made in the centre of the palpable defect. This revealed a large underlying tear. Another type of tendon pathology did not have a discrete large tear but rather diffuse tendon injury with an irregular surface and small surface and deeper tears being identified.

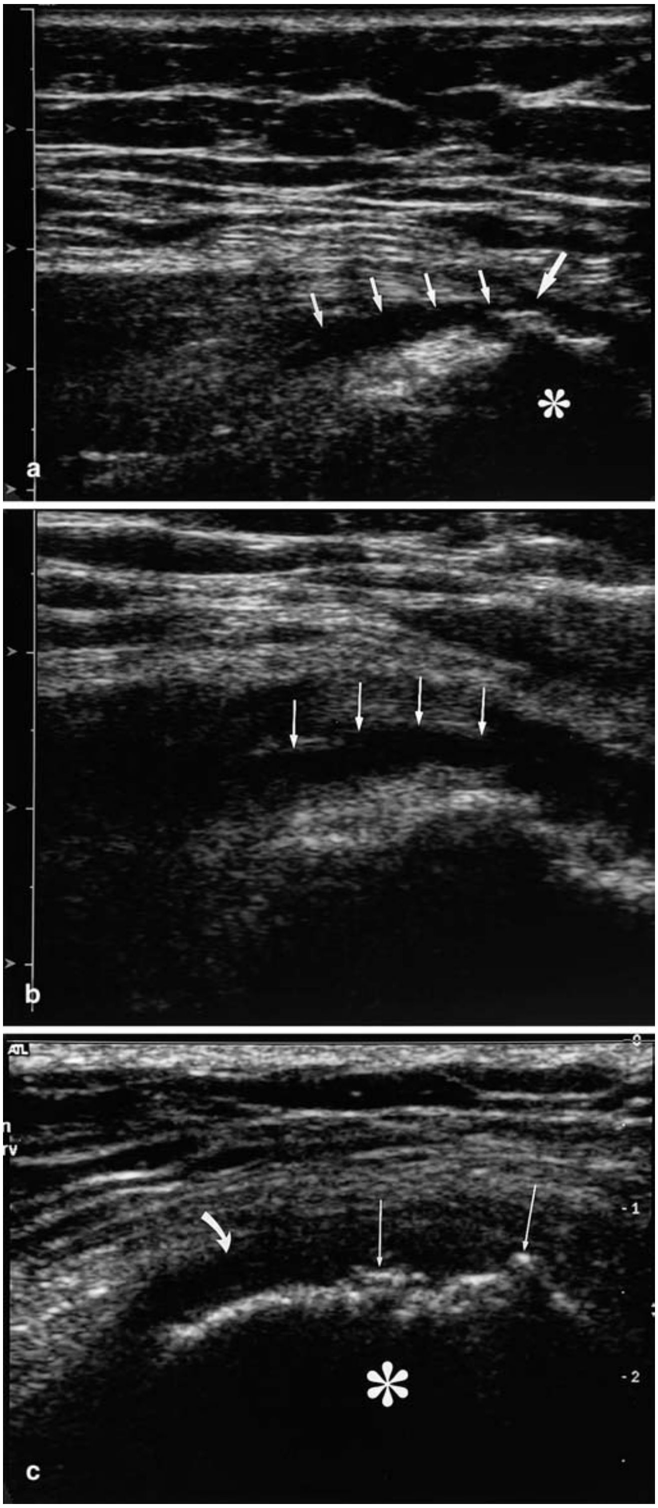


Fig. 4a–c Partial cleavage tear in a 67-year-old woman. a Longitudinal sonogram shows a discrete linear plane (*short arrows*) involving the insertional fibres of gluteus medius tendon. The tear breaks through to the bursal surface (*long arrow*) and fluid pools in the bursa. The greater trochanter is indicated (*asterisk*). b Transverse sonogram shows the discrete cleavage plane traversing through the tendon (*arrows*). c Transverse sonogram further distal shows cortical irregularity (*small arrows*) where gluteus medius (*curved arrow*) inserts onto the greater trochanter (*asterisk*)

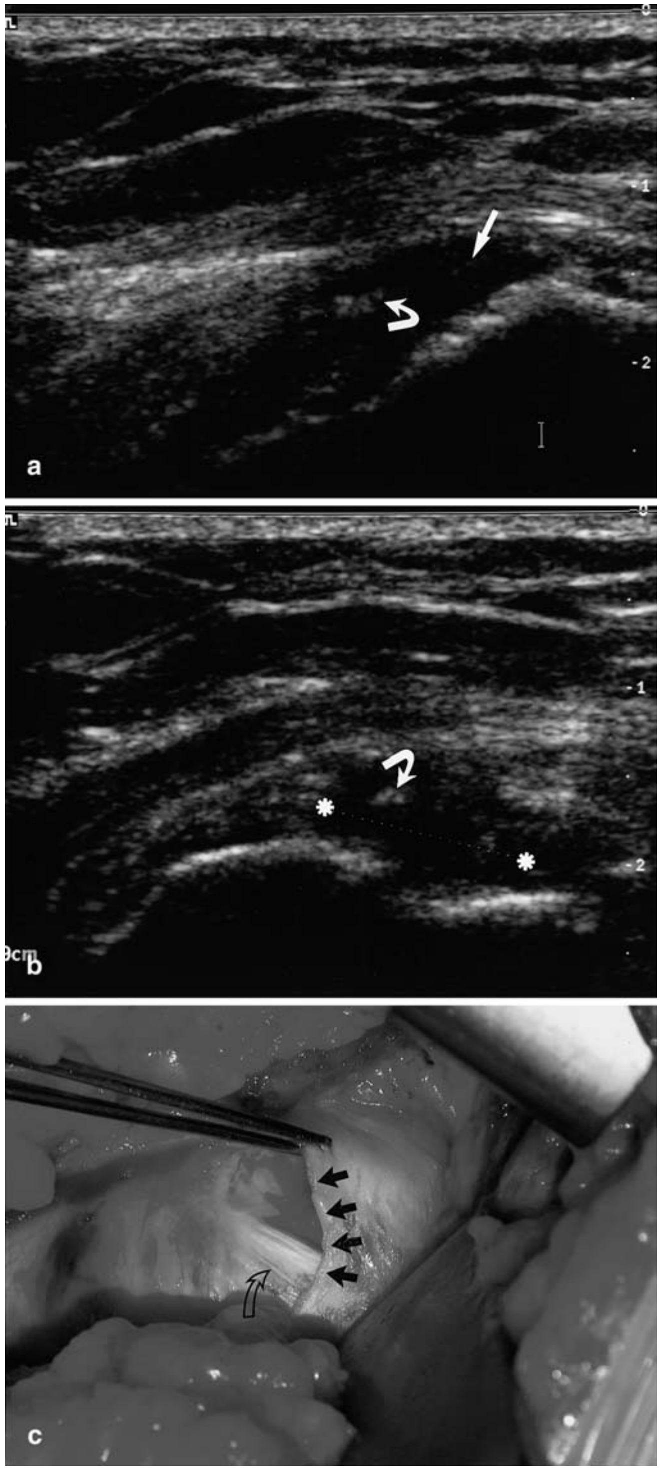


Fig. 5a–c Full-thickness tear of gluteus medius in a 71-year-old woman. a Longitudinal sonogram shows fluid (*straight arrow*) pooling around the retracted tendon edge (*curved arrow*) of the torn gluteus medius tendon. b Transverse sonogram shows the transverse extent of the gluteus medius tear (*between asterisks*) and the retracted tendon slip is shown (*arrow*). c Full-thickness defect in the gluteus medius tendon (*short arrows*) at surgery. Note the underlying intact gluteus minimus tendon (*open arrow*)

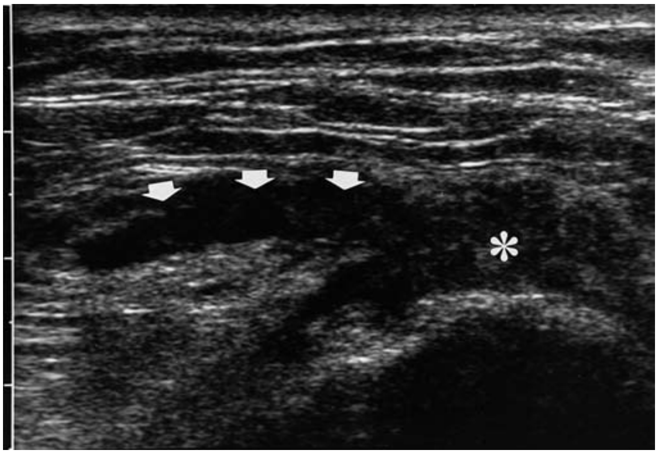
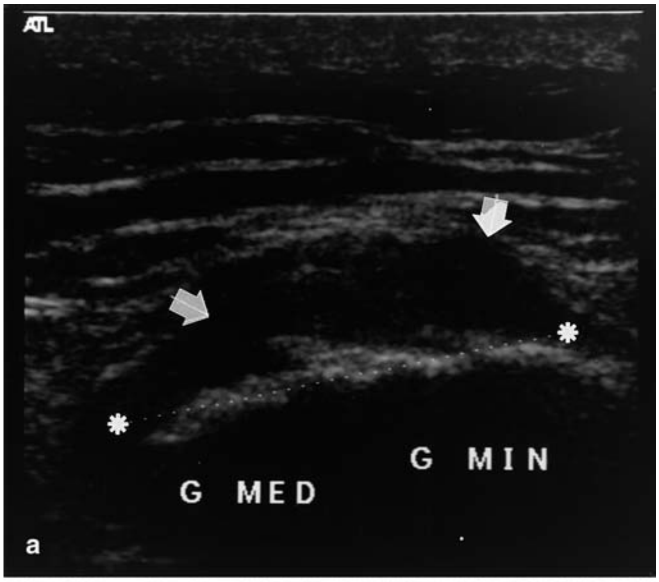


Fig. 6 Gluteus minimus tendinopathy in a 63-year-old woman. Transverse sonogram shows enlargement and diffuse hypoechoic change in the gluteus minimus tendon (*asterisk*) in keeping with severe tendinopathy. The adjacent bursa is thickened and distended with fluid (*arrows*)



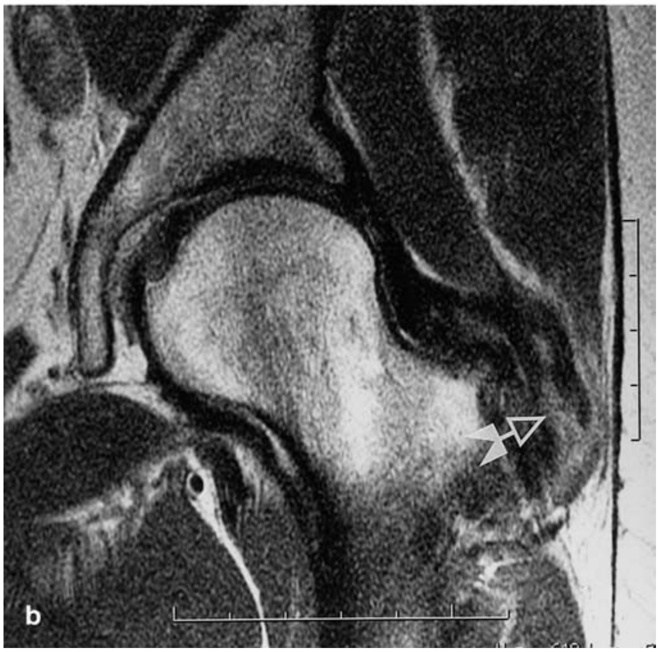


Fig. 7a, b Full-thickness tears of gluteus medius and minimus in a 54-year-old woman. a Transverse sonogram shows a large defect (*between asterisks*) where gluteus medius and minimus normally insert (*arrows*) corresponding to a large tear involving both tendons. b Coronal MR image (TR 3500 ms, TE 436 ms) shows tearing and retraction of the gluteus tendon (*arrow*) from the greater tuberosity

The sonographic findings of gluteus tendinopathy were confirmed in all cases. Seven full-thickness tears were confirmed as were 12 partial tears. On sonographically two patients thought to have moderate and severe tendinosis, respectively, were also shown to have partial tears. One patient with a partial tear on sonography was found to only have mild tendinosis at surgery.

Full- and partial-thickness tears were repaired by excision of the degenerative tendon tissue, curettage of the bone surface where attachment belonged and then reattachment using a bone anchor system, combined with direct side-to-side repair of the tendon. Diffuse tendon degeneration was managed with multiple insubstance longitudinal tenotomies and subsequent repair. All cases underwent an iliotibial band cruciate tenotomy over the prominence of the greater trochanter. Post-operative management included 6 weeks of minimal weight bearing and a graduated exercise program commencing at 6 weeks.

Five patients had tendon samples sent for histopathological analysis. Findings included collagen degeneration with fibre rupture, eosinophilic exudate, fibroblastic proliferation and prominent small blood vessels. Dystrophic calcification was also seen. There was no evidence of acute inflammation.

Discussion

The most common finding in our study cohort who presented with lateral hip pain was mild enlargement of the gluteus medius tendon with diffuse hypoechoic change. This was thought to represent tendinosis and ranged in severity from mild to severe. The deep and anterior fibres of the gluteus medius tendon were the most common sites for partial tearing. It is likely that further tearing leads to full-thickness tears and as this extends posteriorly, tendon avulsion occurs. The posterior fibres of gluteus medius were rarely involved. Tendinopathy was seen less in the gluteus minimus tendon and when present was less severe. The torn tendon margins were fre-

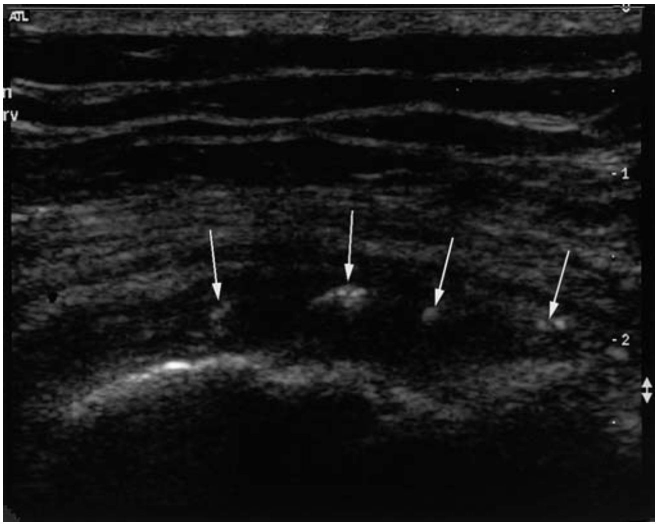


Fig. 8 Foci of dystrophic calcification in 49-year-old woman. Transverse sonogram shows numerous echogenic foci (*long arrows*) in a mildly enlarged and hypoechoic gluteus medius tendon

quently surrounded by fluid, aiding in their identification.

Calcification in the tendons of patients with trochanteric bursitis has been reported ranging from 12 to 40% [11, 12]. In our study, we found calcification in 5 of 53 patients. Bony abnormality was frequently seen but not related to disease severity. Fluid pooling in the trochanteric bursae was uncommon in keeping with previous reports [4, 5, 6]. Increased vascularity on colour and power Doppler imaging was seen in 9 of 53 patients, probably reflecting neovascularisation as a part of the healing response.

The pathogenesis of gluteus tendinopathy is uncertain and probably multifactorial. The predisposition for middle to elderly aged women is worth noting. We postulate that the wider female pelvis may subject additional stress upon degenerating collagen fibres. It is likely that sustained microtrauma results in rupture of individual collagen fibres with further microtrauma leading to partial tearing and eventual tendon avulsion. Findings of low-grade tendinopathy in the contralateral asymptomatic hip lend support that the pathology is degenerative in nature. The reason why tendinopathy on one side is symptomatic and not the other remains a mystery. The greater trochanter pain syndrome has more recently been described in recreational runners and in step aerobics [13, 14]. Macrotrauma through direct blows to the hip played a role in the pathogenesis of 2 of the patients from our cohort.

Bunker et al. studied 50 consecutive patients with fractures of the neck of femur and incidentally found gluteus medius tears in 11 patients at surgery [7]. They found that the tears appeared to start at the insertion of gluteus minimus near the digital fossa in front of the greater trochanter and would involve the anterior third of the insertion of gluteus medius. Kagan reported partial tearing of the anterior fibres of the gluteus medius tendon in 6 of 7 patients at surgery [1]. Both authors refer to this condition as the rotator cuff tear of the hip.

The histological changes observed in the gluteal tendons are similar to those observed in other tendons prone to degeneration, such as lateral epicondylitis [8], supraspinatus [15] and patellar tendons [16]. It is not surprising that the clinical and sonographic findings are analogous to tendinosis and tears of the rotator cuff with associated subacromial bursitis. Tension within the iliotibial band may result in frictional trauma to the gluteus medius and minimus tendons and their associated bursae, similar to the effect of the acromion process on the rotator cuff. Although not a part of our study, the dynamic nature of sonography could allow these phenomena to be studied.

A spectrum of tendinosis as well as partial and full-thickness tears of both gluteus medius and minimus tendons has been identified on MR imaging [17, 18]. The advantage of MR imaging is the ability to concomitantly assess for intra-articular and bony causes of hip pain. Given that gluteus tendinopathy occurs in an age group vulnerable to degenerative joint disease, avascular necrosis and other hip pathology, the ability to exclude an intra-articular cause for the pain represents a considerable bonus; however, sonography has superior spatial resolution and therefore may be more sensitive for identifying focal areas of degeneration, macroscopic partial tears, foci of calcification and bony irregularity. Sonography also allows for guided injection of corticosteroid.

Sonography is an operator-dependent modality that requires knowledge of normal sonographic anatomy and understanding of tendon pathology. Continued clinical and surgical feedback is essential for reliable reporting and disease definition. The glutei often lie under a thick coverage of subcutaneous tissues and so the depth of sonographic penetration required is greater than that associated with the tendons of the shoulder, elbow, knee or ankle. This can be problematic when scanning obese patients; however, advances in ultrasound technology have allowed for a marked improvement in sonographic assessment of the deep soft tissues. We found that a 5- to 12-MHz or 15L8 linear probe with a frequency in the 8–12 MHz range offered the best tradeoff between depth and resolution.

When performing sonography of the hip, radiologists should consider certain technical aspects. Anisotropy may occur when trying to image a curved tendon with a linear probe where there is a dropout of echoes where the tendon fibres fan out onto the greater trochanter. This is particularly prevalent in the longitudinal plane. This artefact may be misinterpreted as foci of tendinopathy or partial tears. Confirmation of the pathology in both the longitudinal and transverse planes, increasing gain and repositioning the probe can be helpful. Compound scanning can also be used to minimise this artefact.

Correlation with the opposite side can be useful, particularly if the operator is not familiar with the sonographic anatomy of the glutei or has limited experience. Identifying the muscle and following this down to the tendon while scanning longitudinally we found useful for discriminating between gluteus medius and minimus tendon attachments. One or more focal zones should be centred at the level of the tendon for optimal resolution. Sonopalpation can be used to confirm the site of pathology.

A limitation of the study is that all observations were made by consensus rather than independent analysis. There is no assessment of either intra- or interobserver variability. The surgeons had access to the sonographic findings prior to operation. There is little surgical correlation with low grades of tendinosis as most patients that underwent surgery had severe tendinosis, partial or full-thickness tears. Furthermore, the gluteus minimus tendon was not routinely or comprehensively evaluated at surgery.

An inherent bias of the study is that this was a highly selective group of patients many of whom had not responded to conservative treatment prior to sonography. We do not know the prevalence of the disease in the asymptomatic population, although we did occasionally observe pathology on the asymptomatic side. Furthermore, we do not know if there is concomitant intra-articular hip pathology which may be the true cause of the patients' complaints, and if the sonographic findings were merely incidental.

Treatment options for patients with gluteus tendinopathy range from rest, physiotherapy and corticosteroid injections to surgical debridement and tendon reattachment (19, 20). Patients with severe tendinosis may not respond to conservative treatment, and the identification of partial or full-thickness tears may encourage a surgical option.

In conclusion, sonography can identify gluteus tendinopathy in patients with lateral hip pain. Sonography can be used to localise and characterise the severity of disease, discriminating tendinosis from partial tears and complete avulsions.

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