Pain in the groins more often results from a tendinous or muscular lesion. It is good to remember, however, that groin pain may also result from a lesion of the lumbar spine, the hip joint or, uncommonly, the sacroiliac joint. Also, a number of intra-abdominal pathological conditions, such as appendicitis, gynaecological disorders and inguinal or femoral hernia, may cause groin pain (see online chapter Groin pain).¹

**Resisted flexion**

This test primarily examines the psoas muscle. However, a strain or weakness may be obscured because of active contraction of other synergistic muscles such as the rectus femoris, sartorius, tensor fasciae latae and some of the adductors.

**Pain**

If resisted flexion is strongly opposed and is painful, the following conditions should be considered:

- Tendinitis of the:
  - Psoas
  - Rectus femoris
  - Sartorius
- Obturator hernia.

**Tendinitis of the psoas**

Tendinitis of the psoas is rare. It may result from an acute hyperextension of the hip or from an overuse injury.²⁻⁶ Iliopsoas impingement is also an uncommon cause of pain after total hip replacement.⁷ The lesion is always located in the femoral triangle and thus accessible to the palpatory finger. It can be identified just below the inguinal ligament between the pulsating femoral artery medially and the sartorius muscle laterally.
Treatment
Deep transverse friction is very effective. Sonography-guided iliopsoas peritendinous injections with steroid have also been proposed as a safe and effective method of treatment.

Deep friction
The patient sits upright on the couch with the hip joint in 90° of flexion and the knees extended – with the hip extended in the supine position, it is not possible for the finger to penetrate deeply enough because of the taut overlying tissues. The therapist sits at the patient’s side facing the thigh, with the index and middle fingers placed at the painful tendon in the femoral triangle, just lateral to the femoral artery and medial to the sartorius muscle. The thumb is placed at the outer part of the hip and used as a fulcrum (Fig. 48.1). The transverse movement of friction is imparted by alternating flexion and extension of the wrist and elbow, together with some adduction–abduction movement at the shoulder. In acute cases, treatment can be started the day after onset. However, really deep friction should not last more than 1 minute and is repeated daily, with a gradual increase in the treatment time. In the second week, treatment is performed on alternate days. It is then carried out deeply throughout and for about 15 minutes. A good result is to be expected in 2 weeks. Chronic strain requires 15 minutes of friction, two or three times weekly, depending on the result of each session. A lesion that has persisted for years will respond to 6–8 sessions of deep transverse friction. Treatment is very painful but, in our opinion, there is no alternative. Finding the exact point is not easy and requires a good understanding of local topographical anatomy.

Tendinitis of the rectus femoris
Resisted flexion is painful, especially if the test is executed with an extended knee (active straight leg raising). Resisted extension of the knee in prone lying position is also painful. The lesion is discussed in ‘Pain on resisted extension of the knee’ (see Ch. 54).

Lesions of the sartorius
Lesions of the sartorius muscle are rare and typically occur in soccer players. Resisted flexion of the hip is painful, especially if some external rotation with a flexed knee is added to the movement. Palpation reveals the localization of the lesion, which is either at the tenoperiosteal insertion or 1 or 2 cm more distal in the tendon. Treatment consists either of deep transverse friction or, if the lesion is tenoperiosteal, of one or two infiltrations with triamcinolone.

In young athletes (aged 15–18) who are skeletally immature, an avulsion fracture of the anterior superior spine of the ilium is more common than a muscle strain or tendinitis (see ‘Pain and weakness’).

Obturator hernia
This lesion is principally found in thin, elderly women, often with a history of recent weight loss, obstipation or chronic respiratory disease. The patient complains of numbness or pins and needles, which may eventually culminate in intense pain at the anterior and medial side of the thigh down to the knee. These symptoms result from compression of the obturator nerve at the obturator foramen by a prolapsed fold of peritoneum. Absence of the adductor reflex test is a sign of involvement of motor conduction of the same nerve. Pain on resisted hip flexion is explained by pressure exerted by the psoas on the hernia. The differential diagnosis can be made when resisted flexion becomes negative after the patient has been in the Trendelenburg position for upwards of 2 minutes; the effect of gravity is to reduce the prolapse, which is no longer painfully squeezed during active contraction of the psoas.

Pain and weakness

Pain and weakness on resisted flexion can be present in the following conditions.
Avulsion fracture of the anterior superior iliac spine

Avulsion fractures occur more commonly in skeletally immature athletes than in adults because young patients’ tendons are stronger than their cartilaginous growth centres. The same stress that causes a sartorius tendinitis in an adult can cause an avulsion fracture of the anterior superior iliac spine in an adolescent. The fracture does not become widely displaced because of the surrounding thick periosteum.

The lesion is well known in young sprinters, soccer players and jumpers.12 While running, the subject feels a sudden painful click in the groin and upper part of the thigh. From that moment further activity is impossible and the athlete leaves the track with a limp; even walking is painful.13,14 On examination, resisted flexion and resisted lateral rotation of the hip and resisted flexion of the knee are all painful. Palpation reveals ecchymosis and palpable tenderness at the anterior superior iliac spine where the sartorius muscle is attached. Radiography shows slight separation of the iliac spine. Spontaneous recovery is the rule and takes 2–3 weeks. During this period, however, total bed rest is not necessary. Movement should be permitted to the limits of pain but return to sports activity should be allowed only from the time that clinical examination becomes fully negative.

Avulsion fracture at the apophysis of the lesser trochanter

This may be seen in schoolboys and young athletes. There is no history of sudden onset because the lesion appears to be caused by overuse.15 The complaint is of groin pain during walking. Clinical examination shows a normal range of passive movement but resisted flexion is weak and provokes pain. This should be reason enough to obtain a radiograph, which shows separation at the lesser trochanter. In most instances 2 or 3 weeks’ bed rest in a half-sitting position will be enough for recovery to take place. Once the patient can walk without pain, standing is allowed.

It is important to remember that avulsion fractures of the lesser trochanter in adults are almost always the result of metastatic bone disease.16

Abdominal neoplasm

Infiltration of an abdominal neoplasm into the psoas muscle, although rare, is another cause of considerable weakness of hip flexion and pain in the iliac fossa.

Metastasis in the upper femur

Weakness and pain in the thigh will be accompanied by marked articular signs in the hip joint and probably a ‘buttock sign’ (see p. 637).

Painless weakness

Lumbar root palsy

Painless weakness is a major sign in the rare condition of a second lumbar root palsy in a second lumbar disc protrusion. In a third lumbar root palsy, it is less obvious and is also accompanied by weakness of the quadriceps.

Psychoneurosis

Weakness of hip flexion is also a common finding in psychoneurotic patients complaining of pain in the lower back or thigh. The diagnosis can only be made if this sign is accompanied by other inconsistencies in the history and clinical examination (see online chapter Psychogenic pain).

Serious non-specific disorder

Because discoradicular conflicts at the second lumbar level almost never occur, painless weakness of hip flexion should always arouse suspicion of a serious non-specific disorder (see p. 534), such as inflammatory disease or neoplasm.

Resisted extension

Pain

Pain on resisted extension hardly ever has anything to do with the gluteus maximus, in which a lesion occurs only after a direct blow and recovers spontaneously within a few days. However, a contracting gluteus maximus may compress an inflamed gluteal bursa and thus indirectly provoke pain in an inert structure (transmitted stress). Pain after prolonged contraction of the gluteal muscles indicates a particular form of intermittent claudication.

If there is hamstring tendinitis or sprain of the sacrotuberous ligament, resisted flexion of the knee is then also painful (see ‘Resisted flexion of the knee’, p. 658).

Inflamed gluteal bursa

An inflamed gluteal bursa is a much more frequent cause of pain on resisted extension, especially if one or more passive movements also elicit the pain (see ‘Gluteal bursitis’, p. 646).

Buttock claudication

Claudication is the symptomatic expression of peripheral artery disease in the leg. It is confined as pain (aching, heaviness, cramping or burning) that is produced with a similar level of walking, disappears after several minutes of standing and occurs at the same distance once walking has resumed.17 Classically, it appears in the calf and/or thigh, but sometimes is confined to the buttock region only and is then caused by a proximal arterial stenosis (bifurcation of the aorta, common iliac, internal iliac and gluteal arteries).18 The essential history is that of a buttock pain that forces the patient to stop walking, improves in a minute or two and reappears when the patient starts walking again. The routine clinical examination is completely negative. An additional test – active extension of the hip in prone-lying position – may reproduce the buttock pain (see p. 625). The usual reduction in femoral pulse may be absent if the stenosis is located on the hypogastric or gluteal artery and there is no substantial damage to the aorta–iliac
The Hip and Buttock

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muscle fibres. Imaging procedures are usually unnecessary. However, ultrasound, although operator-dependent, can confirm the diagnosis.

There are three possible locations of the lesion:

- tenoperiosteal
- musculotendinous
- proximal extent of the muscle belly.

The exact site of the lesion is found on palpation and is more often musculotendinous, a few centimetres below the pubic bone, than tenoperiosteal. Exceptionally, the uppermost part of the muscle belly itself is at fault.

Differential diagnosis

Although pain in the groin during resisted adduction usually indicates a lesion of the adductor longus, this is not always so. Strong adduction indirectly pulls on bones and ligaments of the pelvic ring and, if a pathological condition is present in this region, the transmitted stress causes pain. A detailed discussion of pubic lesions can be found in the online chapter, Groin pain. The following three lesions are the most important.

Fracture or neoplasm in the pubic bone

Palpation of the adductor muscles reveals nothing, whereas a radiograph establishes the presence of a lesion.

Osteitis pubis (periostitis at the pubic symphysis)

This occurs in soccer players and race walkers as the result of repeated shearing of the pubic bones at the symphysis. Palpation of the adductor muscles reveals nothing but the pubic symphysis is very tender (see online chapter Groin pain).

Lesions of the sacroiliac joint

Sacroilitis or sacroiliac strain may also be responsible for painful resisted adduction in the hip, caused by distraction of the ilium from the sacrum. Usually, the pain is felt in the buttock and attention is immediately directed to the sacroiliac joint. However, in some instances, pain is felt in the groin or inguinal region and diagnosis can then be more troublesome.

Treatment

Deep transverse friction is usually effective in tendinous or musculotendinous lesions, whereas tenoperiosteal lesions can be treated by friction or infiltration with triamcinolone. Muscular lesions react well to infiltration with local anaesthetics or to deep friction.

Treatment should always be associated with relative rest to avoid further strain on the involved structure. In persistent cases, surgery is indicated. The procedure used includes division of the adductor longus tendon close to its origin from the pubis. The results seem to be good and most athletes can return to sports after 8 weeks.

Technique: deep friction

The patient adopts a half-lying position on the couch, with the affected thigh in slight abduction and lateral rotation. The therapist sits level with the patient’s knees and facing the body. In musculotendinous lesions, the affected area is grasped between the thumb and index and middle fingers (Fig. 48.3). Friction is imparted by a drawing movement of the hand....
syringe is filled with triamcinolone and fitted with a 4 cm needle. The needle is inserted just distal from the palpating finger on the periosteum and directed upwards until it hits bone (Fig. 48.5). Using a series of small withdrawals and reinsertions at slightly different points, the whole area is infiltrated. Meanwhile, the palpating finger is kept on the spot, to detect where the tiny bulges of drug appear.

Another infiltration may be required when the patient is seen 2 weeks afterwards, if the resisted adduction test remains positive.

Resisted abduction

Pain

Lesions of the hip abductors are rare. The diagnosis is often difficult because pain on resisted abduction of the hip is often caused by transmitted stress on inflamed bursae (trochanter and gluteal) or strained sacroiliac ligaments.

Glutei medius and minimus muscles

Muscular lesions seem not to occur. Local pain during resisted abduction is far more likely caused by compression of an underlying inflamed bursa, which takes place during contraction of the gluteal muscles.37 If passive abduction is also painful, bursitis is almost a certainty and results from compression of the bursa between the greater trochanter and the ilium (p. 646).

Lesion of the tensor fasciae latae

This muscular overuse lesion may occur in dancers and athletes. It is often caused by repetitive increased tension on the iliotibial band, which results from pelvic tilt or certain activities such as habitual running on the sides of the road (‘downside leg’). Localized pain is felt between pelvic crest and trochanter. The signs are characteristic: lumbar examination reveals pain...
on side flexion of the trunk towards the painless side, although
the other lumbar movements are free. Passive and resisted
movements of the hip are normal. Resisted abduction may also
be painless, especially in the prone-lying position with the hip
extended. When a sprain of the tensor is suspected, resisted
abduction should be performed in the side-lying position, with
the uppermost hip (test limb) flexed to 45°. Alternatively, an
accessory test is performed: in a standing position, the patient
crosses the painful leg behind the other and bends sideways
towards the painless side, taking all the body weight on the
affected limb. Pain – sometimes severe – indicates a lesion of
the tensor fasciae latae. Palpation then reveals a painful spot
between the iliac crest and the greater trochanter.

**Treatment**

Treatment of a local lesion of the tensor fasciae latae is by deep
transverse friction.

**Technique**

The patient lies on the painless side. The upper leg rests on
the couch in an extended and slightly adducted position to
stretch the iliotibial tract. The lower leg is flexed to about 45°
to stabilize the pelvis. The therapist stands level with the hip
dorsal to the patient. The thumbs are placed on top of
each other at the affected area, with the fingers opposite the
thumbs for counterpressure. Friction is imparted by moving
the thumbs forwards over the iliotibial tract in a transverse
direction (Fig. 48.6).

At the same time, the elbows are slightly extended together
with a flexion movement at the shoulders. Friction is continued
for 20 minutes and is repeated twice a week. Even in long-
standing and neglected cases, it will take no more than 6–8
sessions to achieve a satisfactory result.

**Sprain of the iliotibial tract**

This lesion is often described as the ‘lateral snapping hip syn-
drome’. It is caused by slipping of the iliotibial band over the
posterior part of the greater trochanter and is frequent in
runners, dancers and basketball players. 38,39

In addition to the audible snapping phenomenon, the syn-
drome is characterized by pain in the region of the greater
trochanter which radiates to the buttocks or thighs. The painful
snapping can be observed by placing the palm of the hand on
the trochanteric area during walking. Signs on examination of
the hip may be identical to those of an inflamed bursa underly-
ing the iliotibial tract (see p. 647).

The non-operative treatment of choice is infiltration with
triamcinolone. In refractory circumstances, surgical treatment
is indicated. The procedure usually consists of excising an
ellipsoid-shaped portion of the band overlying the greater
trochanter.40

**Sacroiliac joint**

MacNab41 also points to the sacroiliac joint as a possible source
of pain. When the gluteus medius contracts to abduct the hip,
it pulls the ilium away from the sacrum. In the absence of hip
joint disease, pain experienced over the sacroiliac joint on
resisted abduction of the leg is then highly suggestive of a lesion
of the sacroiliac joint (see p. 600).

**Pain and weakness**

In adolescents, painful weakness of abduction is indicative of
an avulsion fracture of the greater trochanter but iliac apo-
physitis can be another possibility. It develops in young long-
distance runners as the result of repeated contractions of the
gluteus medius and tensor fasciae latae on an immature iliac
apophysis (see online chapter *Hip disorders in children*).42

**Painless weakness**

Painless weakness usually has a neurological cause – weakness
of the gluteus medius in a fifth lumbar root palsy. It is also a
common finding in disorders of the hip joint and femoral neck,
and leads to a raised greater trochanter – protrusion of the
acetabulum, epiphysiodesis, congenital dysplasia and malunion
after a fracture of the femoral neck. In these instances, resisted
abduction is weak and the pelvic–trochanteric muscles are
ineffective in stabilizing the pelvis on the leg during walking.
In placing the centre of gravity over the hip joint, the patient
forces a lurch towards the involved side. Such a movement is
called an ‘abductor’ or a ‘gluteus medius’ lurch. In mild cases,
only a Trendelenburg gait is found – characteristic dipping of
the pelvis towards the leg that is off the ground.
**Resisted medial rotation**

### Pain

Pain produced during this resisted movement is rare and usually attributable to an inflamed gluteal bursa. The muscles (the gluteus medius, the anterior fibres of minimus and the tensor fasciae latae) are involved only following a direct blow that causes bruising.

**Resisted lateral rotation**

### Pain

When pain is produced, the quadratus femoris, gemelli and piriformis are initially suspected of being the site of the lesion but, except in a direct injury, they are seldom affected. Pain during resisted lateral rotation of the hip is most often the result of transmitted stress of the contracting muscles acting on an inflamed gluteal or trochanteric bursa (see ‘Gluteal bursitis’, p. 646).

**Resisted extension of the knee**

### Pain

Tendinitis of the rectus femoris presents as pain felt in the groin. It has been found in 12% of all groin injuries. It is usually an overuse phenomenon that occurs as a result of prolonged, repetitive strengthening exercise or intensive goal-shooting training in soccer. Pain is provoked more on resisted extension of the knee than on resisted flexion of the hip, particularly when the patient lies prone with the hip extended. This finding has already been mentioned and is the result of the constant-length phenomenon. Pain is also felt on full passive flexion of the hip and even more so in a combined movement of flexion and adduction, when the tender part is pinched between the upper femur and the anterior spine of the ilium. Additionally, full passive rotation of the hip, done with the hip and knee held in 90° of flexion, can sometimes cause enough localized stretch to be painful.

The lesion is located just below the inferior iliac spine (in the body of the tendon). Alternatively, the tender point lies at the proximal part of the muscle belly. Treatment is deep transverse friction or infiltration with triamcinolone.

The same stress that causes a muscle strain in an adult can cause an avulsion fracture in an adolescent. The fracture occurs at the apophysis, which becomes separated from the underlying bone. The fracture is never widely displaced because of the surrounding thick periosteum. Most patients can be treated non-operatively with 6–10 weeks of relative rest.

Lesions of the muscle bellies of the quadriceps are discussed in the chapter on the knee (Ch. 54).

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**Differential diagnosis**

Tendinitis of the rectus femoris should be differentiated from lesions of the second and third lumbar roots, usually the result of a disc lesion. Pain is reported over the anterior aspect of the thigh. Knee flexion with the patient in a prone-lying position may provoke the pain. However, testing the muscle for strength is painless, although there may be some weakness. When there is any doubt, an epidural local anaesthetic can be given and confirms the diagnosis.

**Treatment**

Deep transverse friction of the tendon or infiltration with triamcinolone is effective.

**Technique: deep friction**

The patient sits on the couch, with the hip joint in flexion, in order to make it possible for the therapist’s palpat ing fingers to reach the overlying tissues. The therapist sits at the patient’s side facing the thigh. The painful tendon is found about 8 cm below the anterior superior iliac spine and in line with it, bordered by the sartorius muscle medially and the tensor fasciae latae laterally. Two or three fingers are placed just medial to the tendon, using the thumb at the outer side of the thigh for counterpressure (Fig. 48.7).

Friction is imparted by repetitively pulling the fingers over the tendon in a transverse direction. During this movement, the wrist is extended and the shoulder adducted. In acute cases, treatment is started the day after onset. At this point, deep friction should not last more than 1 minute and is repeated daily, with a slow increase in duration. During the second week, treatment is undertaken on alternate days. In chronic cases, treatment takes about 20 minutes, twice a week. Recovery is achieved in 6–8 sessions. During this period, all activities that are likely to worsen the condition should be avoided.

**Technique: infiltration**

The patient adopts a half-lying position on a high couch. The affected spot is identified at the tenoperiosteal junction in the triangle between the muscle bellies of sartorius and tensor fasciae latae. A 2 mL syringe is filled with triamcinolone and then injected at the affected site.
fitted with a 4 cm needle. The needle is inserted just distal to the palpating finger on the periosteum and directed upwards until it hits bone. Using a series of small withdrawals and reininsertions at slightly different points, the whole area is infiltrated. Meanwhile, the palpating finger is kept on the spot, to ascertain where the tiny bulges of drug appear. Another injection may be required if the resisted adduction test remains positive when the patient is seen 2 weeks afterwards.

**Pain and weakness**

This characterizes a partial muscle rupture.

**Painless weakness**

Painless weakness of the quadriceps is present in third lumbar nerve root compression (see p. 517). If weakness is bilateral, myopathy or myositis should be suspected.

**Resisted flexion of the knee**

**Pain**

Painful resisted flexion of the knee implicates the hamstrings (biceps femoris, semitendinosus and semimembranosus). Lesions of the muscle bellies of the hamstrings are discussed in the chapter on the knee (Ch. 54). Tendinous and tenoperiosteal lesions also occur, cause pain in the gluteal area and posterior aspect of the thigh, and are generally referred to as the ‘hamstrings syndrome’.48,49

**Hamstrings syndrome**

This lesion is common in hurdlers and ballet dancers and is also found in all athletes who engage in rapid acceleration and short intense sprinting, such as baseball, tennis and soccer players.80 The cause of a hamstring strain is not fully understood but most authors today agree that the basic causative reason for its development is the muscle strength imbalance between the hamstrings muscle group and the quadriceps femoris muscle.31 Clinical features of the hamstrings syndrome include pain in the lower gluteal area which radiates down the posterior thigh to the popliteal area. The pain typically increases during performances that stress the hamstring muscles (sprinting or hurdling). Another characteristic complaint is pain felt while sitting. Driving a car typically provokes the pain because of local pressure on the lesion and the increased tension of the hamstring muscles in that position.

Clinical examination shows painful resisted flexion of the knee and resisted extension of the hip. Straight leg raising is of full range but quite painful at the extreme of range. One common clinical test that may induce the pain is the ‘shoe wiping test’ of Pecina32: it consists of having the patient imitate movements typically used when wiping shoes on a doormat; the hamstrings are stretched and at the same time are contracting, which causes the typical pain.

Palpation reveals tenderness either in the tendon or at the tenoperiosteal insertion. The tendons are usually affected at the upper 5 cm of their extent. In tenoperiosteal lesions, the sprain lies at the tuberosity of the ischium.

**Differential diagnosis**

**First and second sacral root lesions**

Tendinitis should be differentiated from these lesions, which are usually the result of disc protrusion at the fifth lumbar level. Pain may be reported in the thigh and there is probably also pain at the end of lumbar flexion or straight leg raising, but testing the muscle for strength is painless. Local tenderness is also absent. In case of doubt, epidural local anaesthetic is given.

**Ischial bursitis**

Resisted movements are also painless in ischial bursitis or ‘weaver’s bottom’. Local tenderness is then the only clinical finding and points to involvement of the bursa (see p. 648).

**Treatment**

In tendinous lesions, the patient is treated with deep transverse friction or infiltration with triamcinolone.48 Persistent lesions can be treated surgically.

**Technique: deep friction**

The patient adopts a side-lying position or a supine one with hip and knee flexed to 90° and a chair supporting the lower leg. This position is necessary to move the gluteus maximus upwards, bringing the tuberosity of the ischium directly within reach. It also keeps the tendon fairly stretched; otherwise it lies too lax and deep to be properly subject to friction. The therapist stands on the ipsilateral side, level with the patient’s hip. Friction is imparted by applying two or three fingers at the medial aspect of the affected area and moving across the tendon by alternating adduction–abduction at the shoulder and a slight flexion–extension movement at the wrist. The thumb supplies counterpressure and acts as a fulcrum at the outer aspect of the thigh (Fig. 48.8). Treatment is given for 20 minutes, two or three times a week. Recent-onset cases respond sufficiently in about 2 weeks. In chronic cases, 2 months may

**Fig 48.8** • Deep transverse friction to the hamstring tendons.
be required for a response; therefore infiltration with steroid suspension is the preferred treatment.

**Technique: infiltration**

Unless the hip is slightly flexed, the origin of the hamstrings at the ischium remains covered by the gluteus maximus. In order to render the insertion palpable, the patient must adopt a prone position, the pelvis well supported on a high cushion. The origin of the hamstrings is then palpable just distal to the lower gluteal border.

The physician stands next to the patient’s hip and palpates for the tender spot. A 2 mL syringe is filled with triamcinolone and fitted with a 5 cm needle. The needle is inserted well distally and the tip is moved upwards until it strikes bone. Using a series of small withdrawals and reinsertions at slightly different points, the whole area is infiltrated. Another injection may be required if the resisted flexion test remains positive when the patient is seen 2 weeks afterwards.

**Painless weakness**

Painless weakness of knee flexion is typical of a full root syndrome at S1 and/or S2. Disorders of the contractile structures of the hip and buttock are summarized in Table 48.1.

Access the complete reference list online at www.orthopaedicmedicineonline.com
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