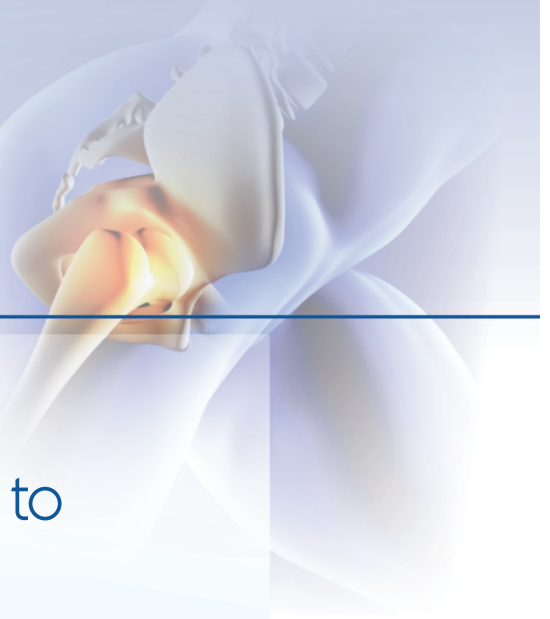

CHAPTER

1

A Systematic Approach to Hip Examination

Pathologies of the hip are common and disabling, affecting patients of all ages. The differential diagnosis of hip affections is broad and presents a diagnostic challenge. The hip is kept as a long case because of the complexity it offers, in terms of:

- Variety of etiologies
- The spectrum of age group it affects
- Bilateral affections in some conditions
- Relationship to alteration in gait and weight bearing
- Concealment of deformities and compensation
- How patients tolerate these compensations and altered biomechanics.

In this chapter, we will try to learn the standard format of hip examination along with various clinical tests and the reasoning behind them.

Disclaimer

The examination methods and the instructions provided here are based on authors' experience as teaching faculty and examiner at various universities. These guidelines are acceptable by most examiners on a routine basis. However, there may be variations based on a particular examiner's personal preference for some clinical methods. The candidate should be able to rectify/modify/agree politely or disagree with strong evidence and demonstrate the clinical signs without being dogmatic or aggressive in an exam situation if there is a difference of opinion.

Examiners can easily recognize how well versed you are in the hip examination techniques by watching you or asking you to demonstrate certain parts of the examination. Remember, there are no shortcuts to success and only practice makes you perfect. So read and practice thoroughly the art of performing various tests several times in the ward before going to the exam. Follow a definite pattern of examination and adhere to it. It is equally important that you understand the clinical significance of what you are doing.

Introduce yourself to the patients and ask their permission to examine them. Take them into confidence that you will do your best not to hurt them. Make sure that you watch their face throughout the examination and avoid sudden movements. At all times be careful to maintain the patient's modesty. Stay calm and focused. Listen to what the examiner says and modify your approach, if

required. As already mentioned, we will follow a sequence for hip examination and emphasize on areas where examiners generally test the students' knowledge and skill.

The general format of hip examination and case sheet writing in an exam includes:

- History
- Provisional diagnosis/differential diagnosis based on history
- General and systemic examination
- Local examination:
  - Gait: Some examiners expect the candidate to mention the type of gait and also demonstrate it in the beginning of the examination. Whereas, others may want this at the end. Please go by what the examiners indicate.
  - Inspection
  - Palpation
  - Assessment of deformities
  - Movements
  - Measurements
  - Special tests
  - Neurovascular examination
  - Examination of the contralateral hip, ipsilateral knee and spine
  - Clinical diagnosis
  - Brief plan of management

Take time to write the case sheet in a neat and legible manner. All examiners read the case sheet and hence, it helps in providing a good impression if the case sheet is written well.

History

Well, 'history matters'.

- It is important to know the age, occupation, and region from where patient comes from, as some diseases are commonly seen in certain age groups, related to the work they do and have regional prevalence.
- It is also equally important to gather as much information regarding the treatment history, past history, personal habits, recreational activities and co-morbidities.
- Pain is the most common presenting symptom. Others include limp, stiffness, deformity and limb length discrepancy.

Pain: We need to know more about the pain including

- Mode of onset, duration and type of pain.
- Patients often localize their pain to—(1) anterior hip and groin area (most likely to be an intra-articular hip pathology), (2) posterior hip and buttocks (could be from the hip, sacroiliac joint, lumbar spine or muscles) or (3) lateral aspect (from the trochanter).
  a. **The 'C' sign:** Patients place their hand with the thumb on the lateral aspect and fingers over anterior aspect of hip to show the painful area around the hip. It is more classical for femoroacetabular impingement.

b. **The triangulation sign:** Patient points with fingers of both hands over the borders of Scarpa's triangle.
c. **Deep penetrator sign:** Patient complains of deep pain in the Scarpa's triangle area or inner groin.

- The main nerves innervating the hip joint originate in the lumbosacral region, which can make it difficult to distinguish between primary hip pain and radicular lumbar pain.
- Radiation: Usually to anterior thigh along femoral nerve, to medial thigh along obturator nerve and to posterior thigh along sciatic nerve.
- Referred pain: From knee (via obturator nerve), intrapelvic (via ilioinguinal and genitofemoral nerves) or lumbosacral area (via gluteal nerves).
- Aggravating and relieving factors: Usually hip pain is aggravated by weight bearing on the affected side, sitting cross legged or on squatting.
- Remissions, exacerbations, diurnal variation and rest pain.
- **Night cry:** This is very typical of osteoarticular tuberculosis in children. When the child is awake, the muscles around the hip joint remain in spasm and limit movements of the joint and hence, there is less pain. However, when the child is asleep, these muscles relax permitting movement in the inflamed joint and the child wakes up from sleep with excruciating pain. Do not mention this symptom when presenting an adult case as adults generally tolerate pain better and do not wake up crying at night.
- **Night pain:** This description explains pain at rest and even disturbing the sleep. It denotes that the condition has progressed to a great extent.
- Restriction of activities of daily living due to pain.

Limp

- Painful limp may be due to infection, inflammation, trauma, tumorous or degenerative causes.
- Painless limp may be due to congenital or paralytic etiologies or as a result of fixed deformities or limb length discrepancy.

Stiffness: It is mostly due to inflammation and muscle spasm

- Early morning stiffness lasting more than one hour: Inflammatory arthritis
- Morning stiffness lasting less than 30 minutes or stiffness on initial walking after a period of rest: Degenerative arthritis
- Stiffness which is maximum in the morning and decreases towards evening: Ankylosing spondylitis

Deformity: Can be extra-articular or intra-articular and can occur due to:

- Joint effusion
- Soft tissue and capsular contractures
- Asphericity of the femoral head and incongruity of the joint
- Fractures/subluxation/dislocation/instability of the hip joint
- Limb length discrepancy
- Muscle imbalance
- Ankylosis of the joint
- Secondary to pathologies in the spine or pelvis

Past/personal/treatment/family history: Gathering information about the past, personal and family history is very important in achieving a probable diagnosis. Birth history including neonatal sepsis, ICU admission and surgery during childhood, developmental milestones and immunization status (if symptomatic from childhood), childhood infections, trauma, bleeding diathesis (like hemophilia, other inherited coagulation factor deficiency disorders, advanced liver or renal disease, vitamin K deficiency, disseminated intravascular coagulation, or use of anticoagulation medications), multiple joint pains, infections like tuberculosis, intake of medications (steroids for bronchial asthma or skin lesions, anti-tubercular drugs, antiepileptic drugs, DMARDs), smoking and alcoholism can give us important clues for diagnosis.

At the end of history taking, the candidate should quantify the disability of the patient in terms of limitation of activities of daily living, work and extra-curricular activities. They should be able to tell if the problem is acute or chronic, progressive, static or regressive, mono-articular or poly-articular with probable etiology and patient's expectations.

At the end of history taking, the candidate should give a diagnosis/differential diagnosis preferably based on etiology such as congenital, post-traumatic, developmental, infective, inflammatory, metabolic, degenerative, neoplastic or idiopathic condition.

The provisional or differential diagnosis should reasonably correlate with the history elicited from the patient.

Before starting your clinical examination, it is important that both lower limbs are exposed properly from at least thoracolumbar junction to toes (at the same time taking care of patient's modesty) and in the presence of a chaperone or a nurse.

Relevant general examination

- Built and nutritional status, cachexia, dwarfism upper–lower segment ratio, arm span, BMI.
- Vital parameters: Pulse, BP, body temperature
- Pallor, icterus, cyanosis, clubbing, edema
- Skin and nail changes, neurocutaneous markers
- Significant lymphadenopathy: Lymphatics from the anterior aspect of the hip joint drain into the deep inguinal nodes. They also receive drainage from the entire lower limb and drains into the external iliac nodes. Lymphatics from the medial and posterior aspects of the hip joint travel along obturator and gluteal vessels respectively and reach the internal iliac nodes.

  The deep inguinal lymph nodes are palpated just medial and distal to the femoral artery pulsation in the Scarpa's triangle.
- Generalized ligamentous laxity
- Hepatosplenomegaly
- Chest expansion

- Multiple swellings
- Evidence of systemic illness in other parts of the body

(If significant abnormal findings are absent, you can tell that the general examination is normal. Do not use terms like PICCLE)

LOCAL EXAMINATION

Gait

Some examiners expect this to be demonstrated in the beginning of the local examination and some do not mind this being shown at the end. Always ask the examiners and do according to what they expect.

Make the patient walk at least four to five times back and forth (around 10 meters). Mention if the patient is using any walking aid or not. Comment if the stance is symmetrical and if on both sides the shoulders/pelvis are at level or not. Note the progression of the foot and see if it is plantigrade, inverted, everted or in equinus while bearing weight (abnormality can be due to pain, weakness or limb length discrepancy).

The various abnormal gait patterns that we come across due to a hip pathology includes:

- Antalgic gait
- Trendelenburg gait (lurching or waddling)
- Short limb gait
- Gluteus maximus gait
- Stiff hip gait
- Circumduction gait
- Spastic gait

Antalgic gait: Seen in painful conditions of the hip joint. Patient walks with shortened stance phase with leaning of trunk to the affected side. The painless limb is brought forward more quickly than normal. In doing so, the patient tries to shift the center of gravity of the upper body to a position closer to the femoral head which reduces the counter-balancing force required in the abductor muscles, thus dramatically reducing the compressive forces across the painful hip joint. During the swing phase, the distance covered by the painful limb is short (short stride length). If the body leans to the normal side, it could be due to pain in the knee or ankle.

Trendelenburg gait: Before we discuss about this gait pattern we need to understand about the normal hip abductor mechanism. The hip abductor muscles (gluteus medius and minimus) originate from the outer aspect of the iliac wing and inserts onto the tip of greater trochanter. When the muscles contract, the insertion of abductors is fixed and pull is exerted on their origin. When a person stands on one leg, the hip abductor muscles on that side pulls the ipsilateral pelvis downwards. This is better appreciated as the opposite hemi pelvis (ASIS/PSIS) moving upwards.

The hip abductor mechanism consists of (a) the fulcrum (hip joint), (b) the lever arm (head, neck and greater trochanter of femur) and (c) the powerhouse (gluteus medius and minimus muscles). Dysfunction of any of the components will lead to Trendelenburg gait.

The drop in opposite side pelvis characterizes the gait during stance phase of the affected limb. There is also a shift in the body's center of gravity to the non-weight bearing side that has dropped down. Patients usually compensate and avoid falling over by shifting the upper body towards the weight bearing leg. This decreases the counter balancing force that needs to be exerted by the weak abductor muscles. **The student should appreciate the drop of the pelvis on opposite side along with swaying or lurching of the trunk to the involved side, during stance phase.** When there is a unilateral hip pathology, swaying is only to one side and is called lurching gait. In bilateral conditions, swaying occurs to both sides and is called **waddling** (walking like a duck) **gait**. The stride length and duration of stance phase remains normal.

Short limb gait: This gait is apparent if the limb is shorter than two centimeters. The patient tries to bring the foot to the ground by tilting the affected half of the body down. This involves excessive shift of the center of gravity towards the short side and hence, the shoulder and the pelvis on the shorter side dips down in stance phase. It differs from the antalgic gait in that, the stance phase is equal. **A few compensatory trick movements by which the patient tries to equalize the limb length include, walking with an equinus/inversion of foot on the shorter side, or, flexing the hip and knee on the longer side.**

Gluteus maximus gait: The gluteus maximus muscle is the main extensor of the hip. The hip joint during heel strike and foot flat phase is in flexion and during mid-stance to toe off-phase goes into extension. If there is paralysis of the gluteus maximus muscle (inferior gluteal nerve palsy), locking of hip in extension does not occur and due to inertia, the upper trunk and thereby center of gravity tends to move forwards and the patient has a tendency to fall. In order to bring the center of gravity back to neutral position, the patient arches his upper trunk backwards which is observed as a forward pelvic thrust and backward lurch of trunk with increased lordosis during mid-stance to toe off-phase. This action brings the center of gravity posterior to the hip and locks it in extension.

Stiff hip gait: The patient lifts the pelvis and swings it forwards with the leg as one piece. The patient walks without flexing the hip.

Circumduction gait: The classical circumduction is seen in hemiplegia, because the hip and knee are spastic and cannot be flexed during gait, hence the individual walks with circumduction gait. However, when the hip is in fixed abduction and with associated knee stiffness if any, there occurs an apparent lengthening of the limb. In order to clear the ground, the patient has to take the affected "long leg" in a roundabout fashion to take the forward step (circumduction).

Spastic gait: The most common type of spastic gait is the scissoring gait seen in cerebral palsy. The child's legs cross over to the opposite side in the swing phase due to extreme spasm of the hip adductor muscles.

Inspection

Examine the patient from the front, side and back with the patient standing, sitting and lying down. Look from proximal to distal and from front to back.

Examination in standing position

- From front, observe the head and neck, level of shoulders, trunk, pelvis, anterior superior iliac spine (ASIS), iliac fossa, inguinal region, wasting of thigh muscles, patella, knees, ankle and limb length.
- From the side, look at the curvature of the spine, especially for exaggerated lumbar lordosis and kyphosis and the trochanteric area. In the presence of normal spinal curvature, when the patient stands close to a wall, the patient's heel, buttocks and occiput normally touches the wall. When there is excessive thoracic kyphosis as in a case of ankylosing spondylitis, the occiput of the patient cannot touch the wall (wall test).
- From the back, look at the alignment of spine for scoliosis, level of the shoulders and scapula, step in the spine and presence of rib hump, posterior superior iliac spine (PSIS), gluteal folds, gluteal muscle wasting and perineal widening.
- If scoliosis is noted, ask the patient to bend forward and see if the scoliosis disappears or rib hump is getting prominent (Adam's forward bending test). It is a postural scoliosis if the deformity disappears. However, it is structural, if it persists.
- Normally, both shoulders are at the same level. However, if there is limb length discrepancy or spinal deformity, they will be at different levels.

When the patient is made to sit, if there is asymmetry of the shoulder or spinal deformity like scoliosis and lordosis, which is related to the hip joint, it is corrected. A deformity in the hip (abduction/adduction) also disappears on sitting as now the patient is sitting on the ischial tuberosity (Fig. 1.1). Changes seen during change of posture needs to be highlighted.

Fig. 1.1: The scoliosis present on standing (A) disappeared when the patient sat down (B)

Examination in supine position

The patient should lie on a firm flat couch for the entire period of examination which will facilitate many examination techniques and tests. A soft bed may mask many findings including lumbar lordosis and deformities.

Attitude: Normal attitude of the lower limb in supine position is:

- Hip in extension
- Knee in extension
- Ankle in gravity assisted plantar flexion and
- The lower limb is in 15° of external rotation (patella facing outwards) due to the hip external rotators being relatively more powerful than internal rotators. If the patella faces the ceiling directly, it means that the hip is in neutral position and in case of excess anteversion of the hip, the limb goes into more internal rotation.

From the front (Fig. 1.2)

- The attitude of the lower limb: The change in attitude at the hip in chronic conditions like osteoarthritis or sequelae of trauma like dislocation, non-union or malunion exhibit specific patterns (each of these is described in respective chapters). The common change in attitudes are flexion/rotational malalignment at hip, flexion at knee and plantar flexion at ankle. The abnormal attitudes should be correlated with deformities in the latter part of the examination.
- Level of anterior superior iliac spine (ASIS). Normally they appear to be at the same level. However, in obese patients the ASIS may not be clearly visible.
- If ASIS of the affected hip is at a **higher level**, that hip may be having **a fixed adduction deformity**. If the patient has a fixed adduction deformity, there will

Fig. 1.2: Left lower limb is in external rotation and limb shortening noted. Right lower limb shows normal attitude

not be free abduction and in order to bring both the lower limbs parallel, the patient has to raise the pelvis on the adducted side. This causes the ASIS to go higher and this will become a fixed deformity in chronic cases.

- If ASIS of the affected hip is at a **lower level**, that hip may be having **a fixed abduction deformity.** If the patient has a fixed abduction deformity, there will not be free adduction and the patient brings his both lower limbs parallel by lowering the pelvis on the abducted side. This causes the ASIS to be at a lower level.
- ***However, if the patient has a limb shortening, the ASIS will appear lower in standing, but on lying down, the ASIS can go back to the same level if there is no fixed abduction deformity.***
- Fullness in Scarpa's triangle. The **Scarpa's triangle (femoral triangle)** is an inverted triangle, which overlies the hip joint. It is bordered superiorly by the inguinal ligament, laterally by the medial border of Sartorius muscle and medially by the medial border of adductor longus muscle. Candidates should know about the contents of this triangle and their relationship to one another. The femoral vein, femoral artery and femoral nerve is arranged from medial to lateral. In addition, the deep inguinal lymph nodes, the femoral branch of the genito-femoral nerve, the nerve to Pectineus and the lateral cutaneous nerve of thigh also cross the femoral triangle. **Fullness may be noted when there is significant inguinal lymphadenopathy, cold abscess, aneurysm of the femoral vessel or an anterior dislocation of the hip joint** (Fig. 1.3).
- Scar, sinuses or swellings: May point to old history of childhood infection (which may have been drained), trauma, previous surgery or an underlying cold abscess.
- Dilated veins
- Wasting of quadriceps muscle: Even though maximal wasting of quadriceps muscle occurs in knee pathology, it may also be seen in conditions affecting the hip joint as well (in hip pathology, gluteal muscles get wasted which should be appreciated from behind).
- Limb length discrepancy: Comment if the limbs appear equal in length, or if one is short or long.

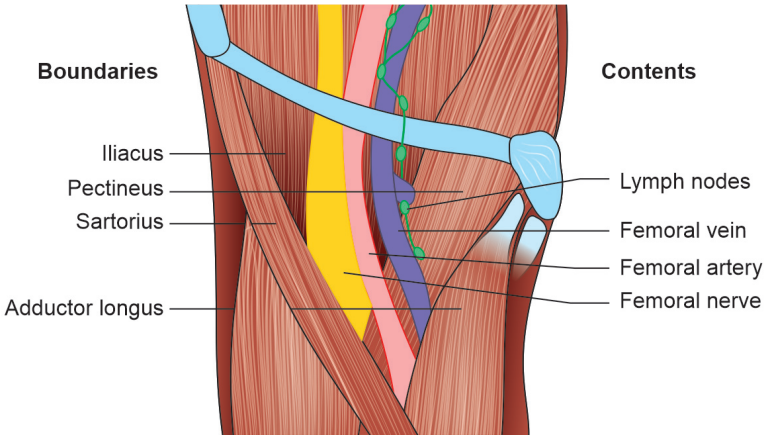

Fig. 1.3: Femoral triangle with its contents

- Distal trophic changes: Look for the status of skin, nails, sweating, edema and hair growth in distal limb including foot. This is relevant in neurological deficits proximally.

From the side

- Exaggerated lumbar lordosis. **(The complete details of examination methodology is described in the section on fixed flexion deformity.)**
- In the lying down position, the lumbar spine area of the patient just touches the couch. In exaggerated lumbar lordosis, the spine is arched up and also light from the opposite side will be visible (Fig. 1.4). **Appreciate the light by squatting down to the level of the spine and inspecting the spine.**

Fig. 1.4: Exaggerated lumbar lordosis with light visible from the opposite side

- Level and position of trochanter: Normally the trochanters on both sides will be at the same level. If the limb is more externally rotated, the greater trochanter will be more posterior. The trochanter may not be visible on inspection in patients who are muscular or obese.
- Scar, sinus, swelling: Cold abscess and trochanteric bursitis can present with swelling over the greater trochanter.

From the back: The patient has to be turned to the lateral or prone in a gentle manner especially in a painful condition and the following should be quickly examined. Look at the

- Level of posterior superior iliac spine (PSIS).
- Asymmetric gluteal folds: Usually noted when there is dislocation of the hip (developmental or traumatic).
- Wasting of gluteal muscles: In hip pathologies maximal muscle wasting occurs in the gluteal muscles. Students should never forget to comment about gluteal muscles while presenting a hip case.
- Scar, sinuses, swellings, dilated veins.
- **Mass in gluteal region: Dislocated femoral head, myositis ossificans, tumor, cold abscess are common examples.**
- A common reason for swelling around the hip joint is a cold abscess which can localize in the femoral triangle, medial aspect of thigh, trochanteric region, gluteal region or over the inferior lumbar area (Petit's triangle). The Petit's triangle is bordered by iliac crest inferiorly, margin of latissimus dorsi posteriorly and

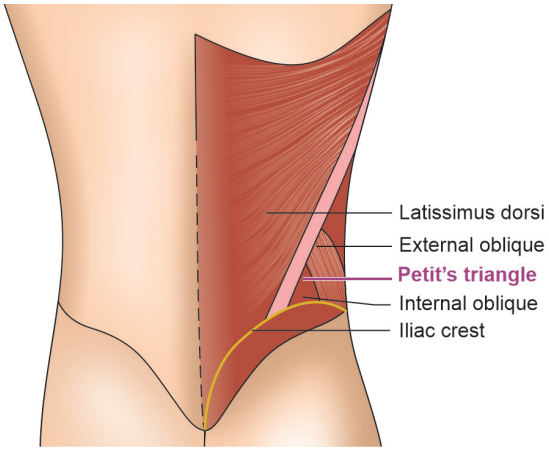

Fig. 1.5: Boundaries of Petit's triangle

external abdominal oblique anteriorly. The floor of the triangle is formed by the internal abdominal oblique muscle (Fig. 1.5).

Palpation

From the front: Local rise of temperature, inguinal region, ASIS, anterior joint line, Scarpa's triangle, inguinal nodes and femoral pulse.

- **Local rise of temperature:** Since the hip is a deep seated joint, local warmth due to inflammation in the hip joint may not be well appreciated unlike in other superficial joints.
- **Tenderness:** Hip, as already mentioned, is a deep seated joint. Unlike in the knee or ankle we cannot palpate the joint margin. Hence, we select points on the anterior and posterior aspects which normally represent the hip joint and feel for tenderness there. Also, inward push applied on the greater trochanter gets transmitted to the hip joint and is used to elicit tenderness. Palpate Scarpa's triangle too.
- **Anterior joint line tenderness:** It is checked two centimetres below and lateral to the mid-inguinal point (not midpoint of inguinal ligament). The portion of the femoral head which is not covered by the acetabulum is being palpated by this method (Fig. 1.6).

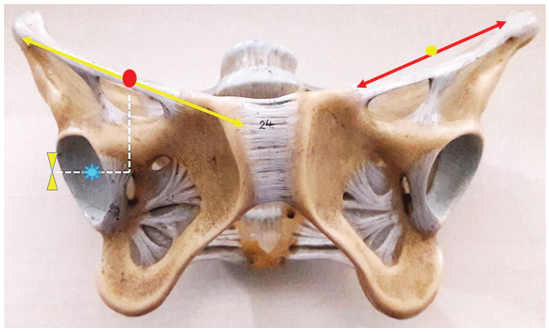

Fig. 1.6: Landmark for palpating anterior joint line on the right side and identification of the midpoint of the inguinal ligament on the left side

- **Vascular sign of Narath:** Femoral artery pulsation is felt one centimeter distal and lateral to the mid-inguinal point. The vessel is palpated against the head of the femur. In normal circumstances, a good volume pulse can be appreciated. When the head of the femur is destroyed or lysed or is dislocated posteriorly, the femoral pulse appears feeble or absent when compared to opposite side and this is called "Positive vascular sign of Narath". In an anterior dislocation, the pulsations will be more prominent. **So in a normal joint, the vascular sign of Narath is negative** (Fig. 1.7).

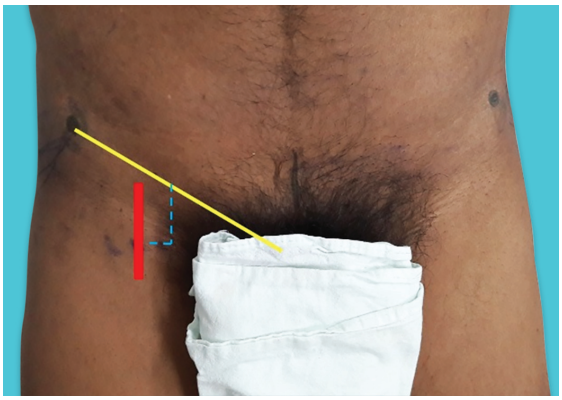

Fig. 1.7: Femoral artery location

- **Level of anterior superior iliac spine:** In normal circumstances, the ASIS on both sides are at the same level. Almost all examiners ask the candidate to demonstrate this finding and, therefore, it is very important that the candidate knows the correct method of palpating the ASIS.

  To palpate the ASIS, it is recommended to identify the pubic tubercle near the symphysis pubis and go laterally along the inguinal ligament till the first bony landmark, which is the ASIS is felt (Fig. 1.8).

Fig. 1.8: Palpation of ASIS

It would be a good idea to mark the symphysis pubis, pubic tubercle and the ASIS with a marking pen as these points will be needed in later stages of examination as well. It is important not to stretch the skin too much while marking the ASIS as the marking can go wrong. It is also important that you mark out the mid-inguinal point (midpoint of the line from symphysis pubis to ASIS). **Please understand that the mid-inguinal point is different from midpoint of inguinal ligament (which is midpoint of a line from pubic tubercle to ASIS).**

The level of ASIS can be confirmed by placing a measuring tape across both ASIS after marking them (Fig. 1.9).

Fig. 1.9: Confirming ASIS level by placing a measuring tape

The method to stabilise both ASIS during assessment of deformities and movements is explained in the next section: "Assessment of deformities".

- A difference in the level of ASIS can occur due to coronal plane deformity in the hip joint, pelvic tilt or scoliosis. In standing/supine position, if one of the ASIS is at a lower level, there could be an abduction deformity on that side if the hip is symptomatic. If it is at a higher level, then it is an adduction deformity. **Other reasons for pelvic tilt include scoliosis (suprapelvic cause), hypoplasia of pelvis or partial agenesis of sacrum and ilium (pelvic cause) and limb length discrepancy (LLD). In LLD, the pelvis is tilted when standing but not while lying down.**
- **Level of greater trochanter:** The level can be checked in an accurate manner by standing in front of the patient. As greater trochanter is part of femur, it is better to start palpating the lateral aspect of the upper third of the femoral shaft and go cranially. At one point you feel the sudden dip or change in the feel from bony

resistance to firm/soft feel of muscles. The dip represents the tip of the greater trochanter (Fig. 1.10). Do not forget to mark out that point. Compare the level of tip of greater trochanter on both sides. Normally, they are at the same level. If there is supratrochanteric shortening, the greater trochanter on that side may be at a higher level. If there is an external rotation deformity, the greater trochanter on the affected side will be more posterior than the unaffected limb.

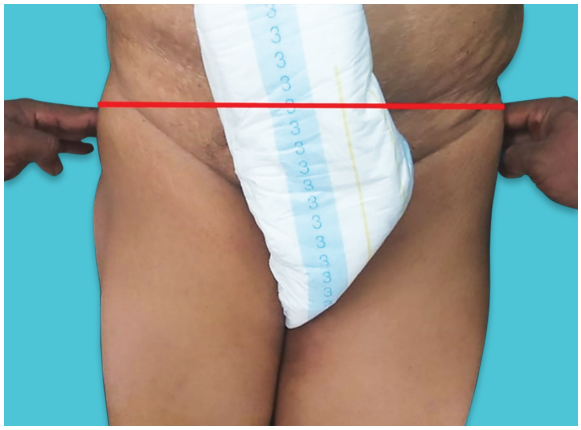

Fig. 1.10: Palpating the level of greater trochanters

From the side

- **Lumbar lordosis:** Confirm the exaggerated lumbar lordosis, if any. If you place your hand under the spine, you will be able to pass it across the midline to the other side if there is exaggeration of the lordosis. The knuckles should pass beyond the midline if your palm was kept facing down (Fig. 1.11).

Fig. 1.11: Insinuating the back of the hand to check for exaggeration of lumbar lordosis

- **Trochanteric tenderness:** Three types of tenderness are elicited over the trochanter. First is by light touch for superficial tenderness which could be due to pain from skin and subcutaneous tissue. The next is deep palpation which signifies tenderness over the trochanter and overlying bursa (extra-articular). The third is trochanteric thrust tenderness wherein compressive force is applied inwards on the greater trochanter. This force gets transmitted along the neck and head of femur to the hip joint and is positive in intra-articular pathology (Fig. 1.12).

Fig. 1.12: Trochanteric thrust tenderness

- **Broadening:** The anteroposterior distance of the greater trochanter in the middle third will be increased compared to the normal side.
- **Thickening:** The greater trochanter appears more prominent and superficial to palpation compared to normal side. The ideal way to feel the thickening is to hold the trochanter by insinuating the fingers at the tip and appreciating the thickness. However, this may not be possible in all patients.
- **Irregularity:** The surface of the greater trochanter feels irregular compared to the smooth contour on the normal side.
- **Broadening, thickening and irregularity are generally seen in malunited intertrochanteric fracture, old infection of the proximal femur and thickened trochanteric bursa.**

From the back

Palpate the posterior superior iliac spine (PSIS), sacroiliac (SI) joint, posterior joint line, ischial tuberosity, proximal femur and for any mass in the gluteal region.

- **Posterior joint line tenderness:** A line connecting PSIS (dimple of Venus) and the tip of the greater trochanter is drawn. This line is divided into three equal portions. The junction of medial two-thirds and lateral one-third represents the posterior hip joint line. The junction of medial one-third and middle one-third on the same line represents the sciatic nerve marking.

- **Tenderness over the sacroiliac joint:** Palpate along the posterior aspect of the iliac wing and feel for the PSIS. The sacroiliac joint lies just medial to the PSIS.
- **Any globular mass in the gluteal region:** In posterior dislocation of the hip joint, there will be a bony hard globular mass in the gluteal area. Mention that a globular mass (not globular swelling) is palpable in the gluteal region which moves with movement of the thigh. A mass which is noted here but which does not move with movement of the thigh could be a myositis mass or a tumor. However, this mass will not be globular and can be irregular and of variable consistency at times.

Assessment of deformities

Deformities in the hip can occur in any plane and multiplanar deformities are common. Here, we try to find out if a deformity really exists or not and if present, quantify it in degrees and see if it has become a fixed deformity.

- **Fixed deformity:** A deformity is said to be fixed in a particular plane **when the opposite movement is not possible when tested passively and the joint cannot be brought to the neutral position.** For example, a fixed flexion deformity is when the extension is not possible. During passive testing, any attempt to do so will result in the movement of the pelvis. However, further free flexion can be possible to varying degrees or no flexion may happen from the point of fixed deformity. Most of the deformities, except rotational deformities, are masked by compensatory movements in the pelvis and spine, and in order to assess the deformity we need to reveal the concealed deformity.
- **Non-fixed deformity:** Non-fixed deformities are usually due to transient effusion, muscle spasm or intra-articular mechanical block due to loose bodies or torn labrum. When movements are done slowly, the muscles relax or the mechanical block clears and the deformity disappears.

Fixed flexion deformity (FFD): Flexion deformity occurs due to spasm of hip flexor muscles or as a posture assumed to avoid pain. It can also occur due to the destructive changes in the joint or fibrotic contracture in periarticular soft tissues. Later the same deformity becomes fixed in nature. When the patient has a fixed flexion deformity, extension is not possible and the patient cannot bring his feet to the ground. In order to do that, the pelvis tilts forwards which shifts the center of gravity anteriorly and patient may fall forward. To restore the center of gravity back to the normal position, the patient arches the spine backwards by increasing the lumbar lordosis. Hence, in order to reveal the flexion deformity, we have to reverse the compensatory pelvic tilt and the exaggerated lumbar lordosis.

- Assessed by doing the **Sir Hugh Owen Thomas well leg flexion test**.
- Explain to the patient what you are going to do and take them into confidence. Tell that you will do the test without causing much pain.
- Make the patient lie supine on a firm couch. Remove the mattress if there is one.
- Look for exaggerated lumbar lordosis. To do this test, squat to the level of the patient and see tangentially for the lordosis. If there is exaggerated lordosis, light from the opposite side is seen and you will be able to insinuate your hand

Fig. 1.13: Exaggerated lumbar lordosis with light seen from opposite side

under the lumbar spine till the knuckles cross the midline if you have inserted your hand with palm facing down (Fig. 1.13).

- Some examiners may expect you to place your hand with palm facing up. The original photo in Hamilton Bailey's textbook shows palm facing up.

The explanation for palm facing up is that the palm is flat in this position and the finger pulps are more sensitive to touch. The explanation for palm facing down is that the dorsum of the hand is sensitive to touch and the knuckles act as a guide for quantifying the exaggerated lordosis and the knuckles should at least cross the midline if the lordosis is exaggerated (Figs 1.14 and 1.15).

Remember that both these methods will give you the information about exaggerated lumbar lordosis and it is preferable to alter the method based on the examiner's preference. The important thing is to find out if the lordosis is exaggerated or not.

Fig. 1.14: Checking the lordosis with palm facing up

Fig. 1.15: Checking the lordosis with palm facing down

The most important component of the Thomas' test is to keep the palm under the lumbar spine throughout the entire period of the test to appreciate the appearance and disappearance of lumbar lordosis.

- Flex the hip and knee of the unaffected side with the other hand. At the end of normal flexion, the upper end of femur hitches the anterior acetabulum and further flexion using the femur as a lever will tilt the pelvis backwards. The tilting back of the pelvis will bring the lumbar lordosis to its normal position which is appreciated by the patients back touching the examiner's palm. If the patient is having FFD in the affected hip, it is revealed by now. A common mistake at this point is being too gentle during flexion. This may not obliterate the lumbar lordosis completely. On the contrary, too much vigorous flexion may move the pelvis so much that even the affected hip is taken into flexion.

  Ask the patient to hold the flexed normal hip with his clasped hands and passively extend the affected hip gently till the pelvis starts tilting forward (appreciated by the lumbar spine moving away from the palm kept under the patient's back). This is to neutralize any excessive flexion done forcibly resulting in pelvic tilt.

  Stop at this position and remove the hand kept under the lumbar spine. With a goniometer, measure the angle between the couch and the affected thigh on the lateral side (Fig. 1.16).
- In bilateral hip involvement, the deformity can be assessed in supine or prone position. In supine position, flex both hips together till obliteration of lordosis is noted. Then extend one hip at a time and check FFD. The hip which is affected more is checked first followed by the less severe side. In prone position, bring the patient to the edge of the table and slowly extend the hip keeping one hand over the sacrum to detect movement of pelvis. This method is easy to perform in children and not so easy in adults (Staheli's method) (*refer* to Chapter 13: 'Developmental Dysplasia of the Hip').

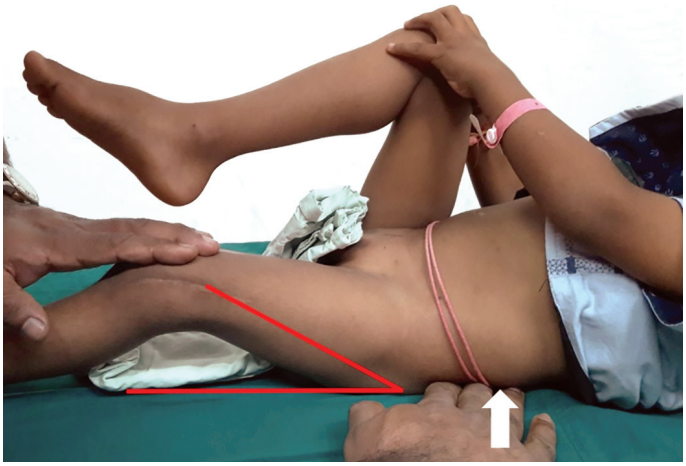

Fig. 1.16: Position of the hip before measuring the angle of fixed flexion deformity at hip

- When there is associated FFD of the knee as well, bring the patient to the edge of the bed in supine position and perform the Thomas' test or make the patient lie prone and slowly extend the hip one at a time (*refer* to Chapter 13: 'Developmental Dysplasia of the Hip').
- Severity of the flexion contracture will not be appreciated if the hip is allowed to abduct whilst performing the test. Also, if there is a fixed lordosis, then FFD cannot be checked.
- This test is difficult to perform in the presence of a knee which is ankylosed in extension, in obese or heavy built individuals and in bilateral involvement with painful restriction of hip flexion.
- The proof of FFD is that no extension is possible.

Fixed extension deformity: It is very rare, but if it occurs, the patient will not be able to flex the hip joint.

Fixed coronal plane deformity: Fixed abduction or adduction deformity is usually evaluated using Perkin's/Kothari's method. Perkin's method can be used when pelvis can be squared. Hence, it can be done in both unilateral and bilateral cases. In Kothari's method, the limbs need to be in parallel and the pelvis need not be squared. Hence it is useful only in unilateral case.

Fixed abduction deformity (Perkins method): Usually seen when there is an inflammatory or infectious pathology along with fixed flexion and external rotation deformity. In this position, the hip joint has a maximum capacity to accommodate the effusion in the joint.

If the patient has an abduction deformity, he/she cannot adduct to bring the limb to the ground. So the pelvis on that side has to tilt/dip downwards so that both limbs are parallel. Therefore, the ASIS/PSIS appears to be at a lower level than the opposite side and the limb appears lengthened. In addition, to keep shoulders at the same level, the spine will develop a scoliosis with convexity to the affected side.

To reveal the deformity, we need to restore the drooped pelvis upwards so that both ASIS come to the same level and this is called **'Squaring of the pelvis'**. Squaring can be done only in a patient with mobile spine. In a fixed lumbar scoliosis, the compensatory tilt of the pelvis cannot happen.

- Patient is supine
- If the patient is thin, keep thumb of one hand on one ASIS and span your hand across the pelvis to keep the index finger on the opposite ASIS. However, if the patient is muscular or obese or you are unable to span out your fingers, span the hand and forearm across the pelvis over both the ASIS and stabilize it to detect movement of pelvis (Fig. 1.17A and B).

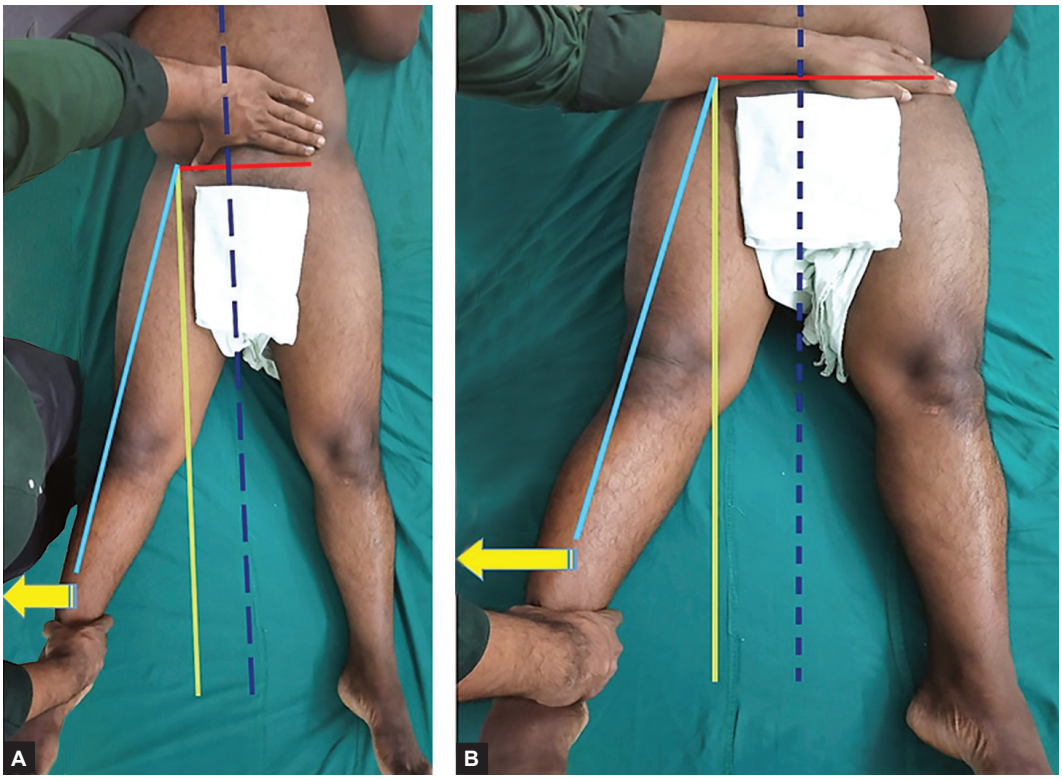

Fig. 1.17A and B: Stabilising the pelvis by holding the ASIS throughout the process of assessing the deformity and range of motion. (A) In patient where your thumb and index can be spanned. (B) When patient is muscular or obese, you span your forearm and hand to palpate the ASIS

- **Abduct** the affected hip so that the ASIS on that side rises up and comes to the same level as opposite hip and the pelvis gets squared. Stop at that point.
- However, if there is possible free abduction, you may have taken the limb into more abduction which could change the angle. Therefore, the safer method will be to over abduct the limb (even after squaring) and then bring the affected hip towards the midline. The minute the hip reaches the extent of abduction deformity, the pelvis starts tilting downwards.

- Stop there and measure the angle subtended by the limb with the midline.
- One limb of the goniometer is kept parallel to the midline and the other limb is kept over the thigh. The center point is kept over the ASIS (Fig. 1.18).

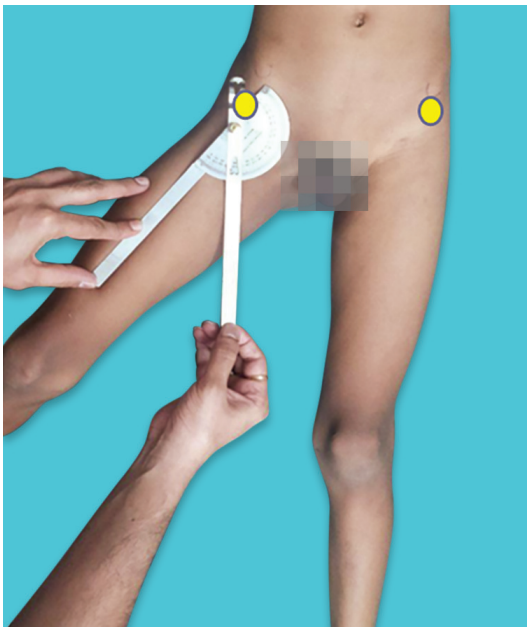

Fig. 1.18: Measuring abduction deformity with goniometer

Fixed adduction deformity (Perkin's method): Adduction deformity is more common than abduction deformities and is seen in arthritic phase of many diseases due to adductor muscle and capsular contracture. If the patient has an adduction deformity, in order to keep both limbs parallel, the pelvis on the affected side has to tilt/move upwards. Therefore, the ASIS/PSIS appears to be at a higher level than the normal side and the limb appears shortened. In addition, to keep shoulders at the same level the spine will develop a scoliosis with convexity towards the unaffected/normal side. Hence to assess the deformity we need to bring the tilted pelvis downwards so that both ASIS come to the same level **(squaring of the pelvis)** and the adduction deformity gets revealed.

To quantify the adduction deformity:

- Patient is supine
- Keep the thumb and index finger over each ASIS or one hand over the opposite ASIS across the pelvis (Fig. 1.19).
- **ADDUCT** the affected limb further to lower the ASIS till both are at the same level. Or, as mentioned earlier, the limb can be over adducted and then brought back towards the neutral/midline. When the extent of adduction deformity is reached, the pelvis starts tilting.
- Stop there and measure the angle.
- One limb of the goniometer is kept parallel to the midline and the other limb is kept over the thigh. The center point is kept over the ASIS.

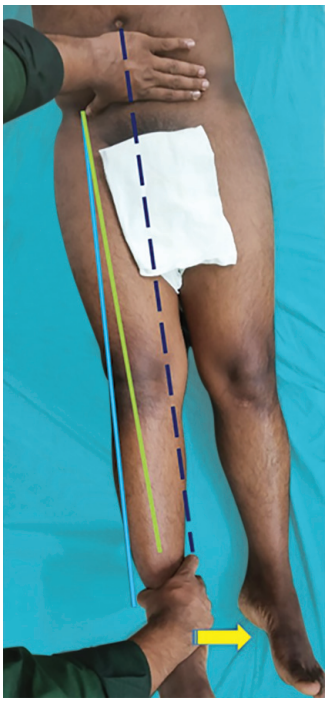

Fig. 1.19: Revealing the adduction deformity

Kothari's method: Coronal plane deformities can also be quantified using the **Kothari's method**. This method was described by Dr Manu Liladhar Kothari (1935–2014). Dr Kothari was a registrar in the Department of Anatomy in Grant Medical College, Mumbai, when he wrote about his observations to Dr Graham Apley.

This method can be used only in unilateral hip disease and when the limbs can be kept parallel. Therefore, there is no need to square the pelvis. The deformity becomes maximum when the limbs are kept parallel.

First draw a midline from suprasternal notch to symphysis pubis (broken yellow line) and then a line connecting both ASIS (yellow line). Thirdly, draw perpendicular line from midline to ASIS on each side (red and blue lines).

The angle subtended by red or blue line with the yellow line connecting both ASIS forms the Kothari's angle. If the angle is above the interspinous line, it represents adduction deformity and if the angle is below the interspinous line, it represents abduction deformity (Fig. 1.20).

In bilateral hip disease, you cannot bring the legs parallel to each other. So Kothari's method cannot be done and only Perkin's method has to be followed.

If the patient has abduction deformity in one hip and an adduction deformity in the other, the pelvis can be squared by moving both the limbs together towards each side of the deformity in sequence (Fig. 1.21). In bilateral abduction or adduction deformities, it is not possible to square the pelvis.

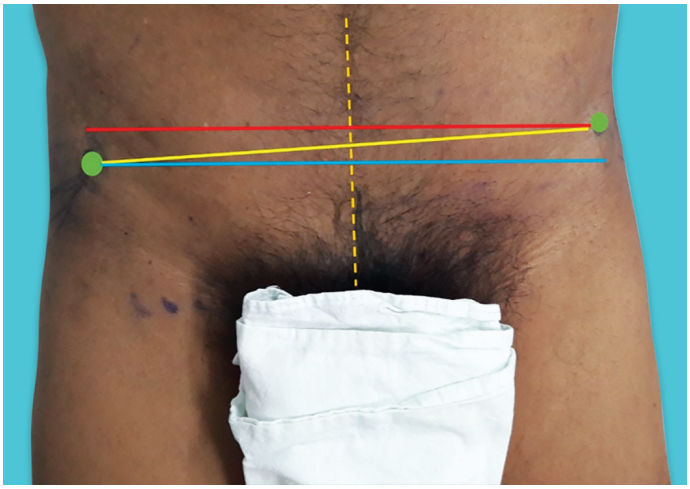

Fig. 1.20: Kothari's angle in unilateral hip disease to measure coronal plane deformities

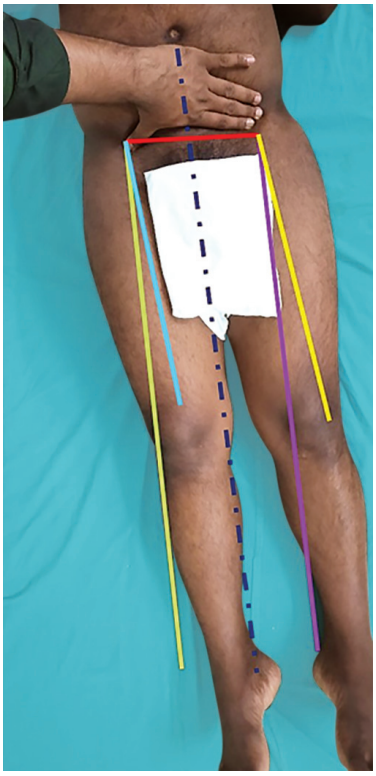

Fig. 1.21: Revealing deformities in bilateral hip pathology

Rotational deformities: Normally, the lower limb lies in 15° of external rotation due to the femoral anteversion. In supine position with the hip and knee extended, rolling of the legs give an initial impression about rotational deformities by noting the restriction in internal or external rotation. Look at the patella and the feet to note the limb alignment.

External rotation deformity: External rotation deformity is seen along with flexion and abduction deformities in early phase of inflammatory or infectious etiology when there is joint effusion and synovitis. External rotation deformity can be assessed with the patient in supine, prone or sitting position.

Supine position: In this position, flex the hip and knee to 90° each. Once the hip and knee are stabilized in this position, one hand is kept over both the ASIS to stabilize the pelvis and the other hand holds the leg. Thereafter, the leg is rotated inwards with knee pointing outwards to check for external rotation at the hip till you appreciate any movement at the ASIS which is the limit of external rotation in that hip. There is no fixed deformity if the hip can be moved back to neutral again and towards internal rotation (Fig. 1.22).

Fig. 1.22: Examination of external rotation deformity at the hip

If the hip rotation is restricted at neutral position, then there is internal rotation restriction only and if the hip does not even reach the neutral, then there is fixed external rotation deformity as internal rotation is not possible. The angle between the axis of the leg and midline of the body is the amount of external rotation deformity.

In the prone position, flex the knee to 90° and turn the leg inwards (hip goes to external rotation) keeping the other hand over the sacral area to appreciate the movement of pelvis once the limit of deformity is reached. Bring the leg back towards the vertical position. Once the limit of external rotation deformity is reached the pelvis moves. Measure the angle subtended by the leg and an imaginary line drawn vertically along the midline of body.

Internal rotation deformity: Commonly seen in posterior dislocation of hip joint and stage of arthritis in tuberculosis of hip joint.

Supine position: In this position, flex the hip and knee to 90° each. Once the hip and knee are stabilized in this position, one hand is kept over both the ASIS to stabilize the pelvis and the other hand holds the leg. Thereafter, the leg is rotated outwards with knee pointing inwards to check for internal rotation at the hip till you appreciate any movement at the ASIS which is the limit of internal rotation in that hip. There is no fixed deformity if the hip can be moved back to neutral again and towards external rotation.

If the hip rotation is restricted at neutral position, then there is external rotation restriction only and if the hip does not even reach the neutral, then there is fixed internal rotation deformity as external rotation is not possible. The angle between the axis of the leg and midline of the body is the amount of internal rotation deformity (Fig. 1.23).

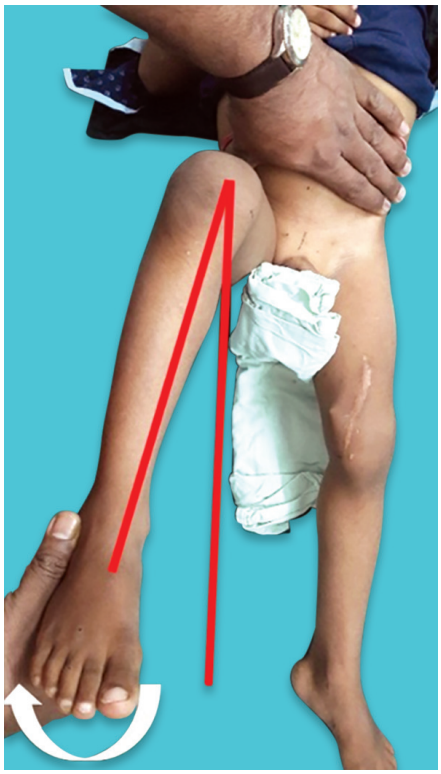

Fig. 1.23: Examination for internal rotation deformity at hip

In the prone position, flex the knee to 90° and turn the leg outwards (hip goes to internal rotation) keeping the other hand over the sacral area to appreciate the movement of pelvis once the limit of deformity is reached. Bring the leg back towards the vertical position. Once the limit of internal rotation deformity is reached the pelvis moves. Measure the angle subtended by the leg and an imaginary line drawn vertically along the midline of body.

Assessment of range of movement

- First check active movements as it helps to differentiate painful and painless range.
- In a normal joint, range of both active and passive movements are nearly the same.
- In an arthritic joint, passive movements are little more than active movements.
- In a paralytic condition, active movements are absent. Check for passive movements to rule out joint stiffness.
- In a joint with bony ankylosis/arthrodesis, there will not be any movement
- In a joint with fibrous ankylosis, a small degree of movement (jog of movement) may be noted.

The following are to be mentioned while describing movements: Range of movements, painful or not, which range is painful (initial, mid-range, terminal or throughout), associated with muscle spasm or not, crepitus while moving and any associated abnormal mobility or instability.

- Range (quantify in degrees): To be measured with a goniometer and conveyed in degrees (*refer* to Chapter 82 on 'Goniometry'). If there is fixed deformity, mention the degree of deformity and further free movement in that plane if present. There is no need to tell about absence of opposite movement.
- Associated with pain or not: Check if the movement is painful or not. If painful, note during which range of motion it is painful.
  - Pain throughout the range: Infective, acute trauma
  - Pain only in terminal range: Inflammatory (synovitis), degenerative arthritis
  - Pain in certain arc of movement: Inflammatory or impingement
  - Painless: Normal, congenital (DDH), post-septic dislocation
- Associated with muscle spasm: Tubercular, inflammatory arthritis
- Associated with crepitus: Degenerative arthritis, synovial chondromatosis
- Abnormal mobility: Dislocation, fracture non-union, post-septic sequelae with instability.

The movements which are checked include flexion, extension, abduction, adduction and rotations (Table 1.1). Rotations are checked in three positions, supine with the hip and knee in extension, supine with hip and knee flexed to 90° and prone with hip in extension and knee flexed to 90°.

- **Differential rotation:** Occurs due to focal deformity in the head of femur (superolateral or anterior head collapse and flattening). Check rotations with hip and knee flexed to 90° (supine) and also with hip extended and knee flexed (prone position). A difference of more than 20° in rotations between hip in flexion and extension is considered significant. This difference is produced as the surfaces of the head of femur which articulates with the acetabulum is different in the two positions (differential rotation).

Table 1.1: Hip movements

Movement	*Normal range*	*Muscles*	*Points to note*
Flexion	0–130°	Iliopsoas	Keep your hand under lumbar spine to appreciate pelvic tilt once normal range is exceeded
Extension	0–20°	Gluteus maximus	Patient in prone position and keep hand over lumbosacral junction
Abduction	0–60°	Gluteus medius and minimus	Keep fingers on both ASIS
Adduction	0–40°	Adductor longus, brevis and magnus	Keep fingers on both ASIS
Internal rotation	0–40°	Tensor fascia latae, gluteus medius and minimus, adductors and pectineus	Watch for cranial tilt of ASIS
External rotation	0–70°	Pyriformis, quadratus femoris, Gemelli	Watch for caudal tilt of ASIS

- **Axis deviation:** Normally when the hip is flexed in supine position, the knee has a tendency to point towards the opposite shoulder and also can be easily pushed towards the opposite shoulder. When the head of femur becomes aspherical (sectoral sign) the hip develops an external rotation deformity and the knee points away from the ipsilateral shoulder (axis deviation) and cannot be pushed towards the opposite side. This is typically seen in AVN.

  Some examiners insist 90° of available hip flexion to call it axis deviation. However, if the hip flexion is limited, it can be mentioned that as soon as the hip flexes, the limb goes into external rotation and there is marked external rotation to the same side. In conditions like congenital gluteus maximus contracture and post-injection external rotation deformity, the hip can show axis deviation without sectoral defect in femoral head.

Altered arc of movements may be seen in certain situations

- Increased adduction and decreased abduction in coxa vara.
- Increased extension and external rotation and decreased flexion and internal rotation in slipped capital femoral epiphysis.
- Increased internal rotation with decreased external rotation in excessive anteversion of femur.
- Increased external and decreased internal rotation in extreme retroversion of femur.

Measurements

Apparent limb length measurement

- Apparent length is the compensation which the patient has developed to conceal any fixed deformity.
- No attempt is made to reveal the deformity before taking the measurement.
- Both lower limbs are kept parallel and measurement is taken from a midline reference point (xiphisternum) to the tip of medial malleolus on each side.

- By rule of thumb, every 10° of fixed abduction deformity corresponds to one centimeter of apparent lengthening.
- Every 10° of fixed adduction deformity corresponds to one centimeter of apparent shortening.
- Amount of apparent shortening is the sum of the true shortening plus the shortening due to fixed deformity (each 10° of adduction deformity corresponds to 1 cm of shortening).

True limb length measurement

- There are two pre-requisites before taking true measurements, (a) The concealed deformities should be revealed and pelvis should be squared, (b) The unaffected limb should be kept in identical deformity as the affected hip. It is advisable to take the measurement first on the unaffected side. Hence, in a bilateral hip case it is difficult to measure the true length as mostly it may not be possible to position both lower limbs in identical deformity.

- True length is measured from the ASIS on one side to the medial joint line of ipsilateral knee. This corresponds to thigh length which further has a supratrochanteric and an infratrochanteric component. Further, the measurement from the medial joint line of knee to the tip of medial malleolus is taken which corresponds to the leg length.
- At the hip, the metal end of tape should be placed immediately distal to ASIS and pushed up against it. At the lower end, the tip of the index finger should be placed immediately distal to the medial malleolus and pushed up against it (Fig. 1.24).

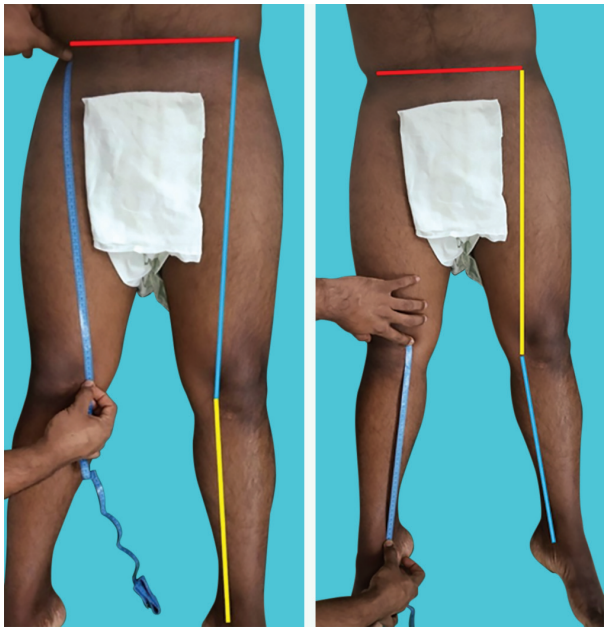

Fig. 1.24: Measuring true length (thigh and leg components)

- In situations where the pelvis cannot be squared, you will not be able to take true measurement.
- Also, if there is unilateral genu valgum deformity, it will be difficult to comment on the true measurement as the normal limb cannot be placed in identical position.

- In hips with abduction deformity, True length = Apparent length – measurement corresponding to the degree of deformity.
- In adduction deformity, True length = Apparent length + measurement corresponding to the degree of deformity.

Correction of limb length and deformity in relation to various levels of pathologies

- Suprapelvic causes: If the deformity is at the spinal/lumbosacral junction (with pelvic obliquity), the patient may compensate by flexing the lower limb of the longer side or with placing the foot in equinus attitude on the shorter side. It will not correct with blocks nor with sitting or forward flexion.
- Pelvic causes: Intrapelvic deformity will apparently correct with blocks under shorter side (brings iliac crests to the same level), but not with sitting (ischial tuberosities at the same level).
- Infrapelvic causes: Compensatory infrapelvic deformity (due to hip pathology or limb length discrepancy) will correct with blocks and on sitting.

Bryant's triangle (supratrochanteric length): (Fig. 1.25)

- Described by Thomas Bryant (1828–1914) in 1876.
- This is a true measurement and hence pelvis should be squared and limbs should be kept in identical position. The measurement is reliable only if the opposite hip is normal as it is a comparative measurement. So it cannot be employed in a bilateral hip case.
- Two reference points are marked, namely ASIS and tip of the greater trochanter.

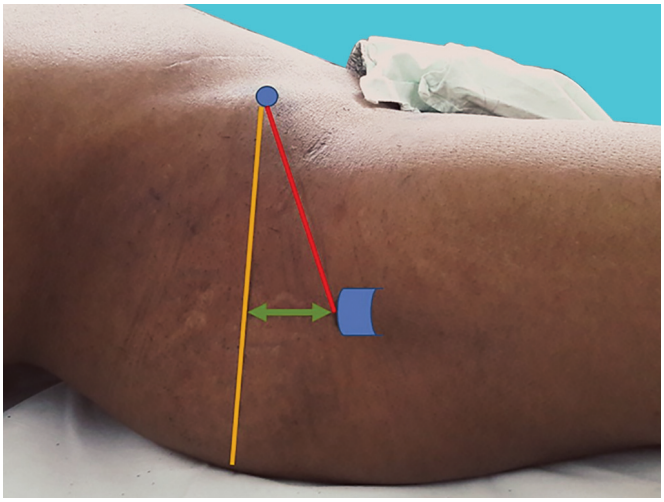

Fig. 1.25: Measurement of Bryant's triangle

- Three lines are now drawn to create a triangle, (a) connecting ASIS to tip of greater trochanter (hypotenuse, red line), (b) a line drawn vertically down from the ASIS to the couch (altitude, yellow line) and a third line from the tip of greater trochanter to the altitude (base of the triangle, green line) (Fig. 1.25).
- The base of the triangle represents the amount of supratrochanteric shortening (compared to the value on the unaffected side).
- When the trochanter is migrated up significantly, there is reversal of the triangle. The shortening is calculated by adding the base of the unaffected side plus the base of the reversed triangle.

Dimension of Bryant's triangle	*Possible etiology/Interpretation*
Shortening of base	Up riding of greater trochanter, coxa vara, coxa breva, Destruction of head of femur, neglected dislocation, Girdlestone's arthroplasty and Perthes' disease
Shortening of altitude alone	Suggest internal rotation of femur or central migration of head of femur
Shortening of hypotenuse	Is associated with shortening of base or altitude
Shortening of base and altitude	Central fracture dislocation, resorption of neck and Protrusio acetabuli
Shortening of base and lengthening of altitude	Anterior dislocation of hip, SCFE, nonunion neck of femur, Girdlestone arthroplasty
Lengthening of base, altitude and hypotenuse	Coxa magna and coxa valga

Allis method or Galeazzi's test

- This test is also used to assess limb length discrepancy especially in children and demonstrates whether the shortening is in the femur or tibia.
- Flex the both hips to 45° and knees to 90°. Place the malleoli and heel together at same level (the test is inaccurate if you are unable to do so) (Fig. 1.26).
- Comment on whether the knees are at same level or not, and on the parallelism of the femora and tibia. Normally both knees are at the same level.
- When one knee projects farther forward (distally) than the other, either that femur is longer or more usually the contralateral femur is shorter.

Fig. 1.26: Galeazzi test or Allis' method of assessing limb length discrepancy

- When one knee is higher and proximal than the other, either the tibia of that side is longer or the contralateral tibia is shorter.

Circumferential girth for muscle wasting at thigh

- In hip pathology, look specifically for gluteal muscle wasting.
- Circumferential measurement of the thigh is taken at a fixed distance from a reference point.
  Normally, it is measured at 15 cm proximal to the medial joint line of knee or at the most prominent bulk of the muscles (Fig. 1.27). **15 cm is taken as a landmark because the joint capsule normally extends 8–10 cm proximally from the joint line.** Therefore, a point well above the suprapatellar fossa is taken to determine muscle wasting as the fossa may be swollen with fluid or synovial hypertrophy. The vastus medialis obliquus is the first muscle which mainly becomes wasted.
- Identical places are measured on both thighs and values compared.

Fig. 1.27: Thigh circumference for muscle wasting

Lines

Roser-Nélaton's line (Wilhelm Roser and Auguste Nélaton): This is a very sensitive measurement in bilateral hip case as Bryant's triangle cannot be drawn in such cases. Hence, the proximal migration of trochanter is detected by this line in such situation (Fig. 1.28).

Patient is made to lie in lateral position and the hip and knee are flexed to 90°. This makes the ischial tuberosity prominent. Draw a line from ASIS to ischial tuberosity. Normally, the tip of greater trochanter lies at or below this line. If the greater trochanter tip passes above this line, it indicates proximal migration. If you are unable to flex the hip to 90°, flex it to the maximum possible flexion and keep the opposite limb in the same amount of flexion and draw the line. The flexion is required only to identify the ischial tuberosity.

Fig. 1.28: Nélaton's line useful in bilateral hip pathology

Schoemaker's line: With the patient lying supine, lines are drawn from tip of the greater trochanter to the ipsilateral ASIS on both sides. When these lines are extended to the anterior abdominal wall, the lines normally cross in the midline above the umbilicus (Fig. 1.29). If the greater trochanter on one side has migrated up, the line will cross below the umbilicus and on the opposite half of abdomen. If both greater trochanters have moved up, the lines will cross below the umbilicus (Fig. 1.30).

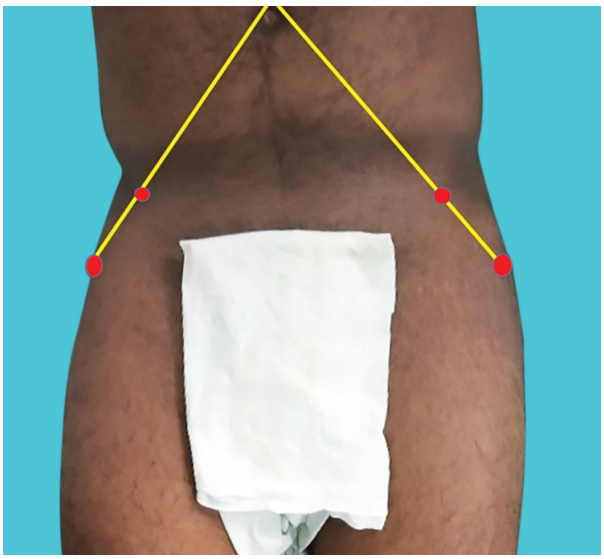

Fig. 1.29: Schoemaker's line in normal hips crossing above umbilicus in midline

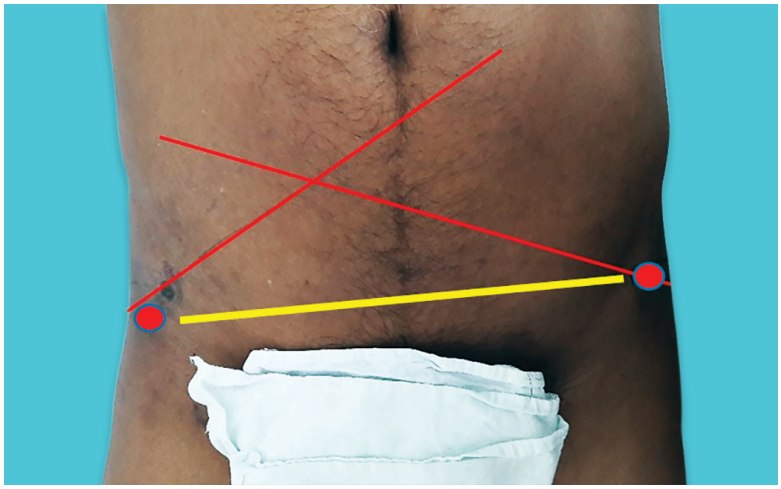

Fig. 1.30: Schoemaker's line indicates unilateral or bilateral hip pathology when line crosses below umbilicus away from midline

Chiene's line: With the patient in supine position, draw lines connecting both ASIS and also both the greater trochanters. Normally, these lines are parallel to each other. If there is migration of one greater trochanter, there will be convergence of lines to that side (Fig. 1.31).

Fig. 1.31: Chiene's line for trochanteric migration in unilateral hip pathology

Morris bi-trochanteric distance: Distance from the symphysis pubis to the tip of greater trochanter on either sides are measured using a caliper. You can also use two books on both sides and measure with a tape if calipers are not available (Fig. 1.32).

Normally, the distance is equal on both sides. If there is medial migration of the femoral head (examples being protrusio acetabuli, central fracture dislocation, femoral head destruction, short neck and coxa valga), the distance on the affected side is reduced. It increases in coxa vara.

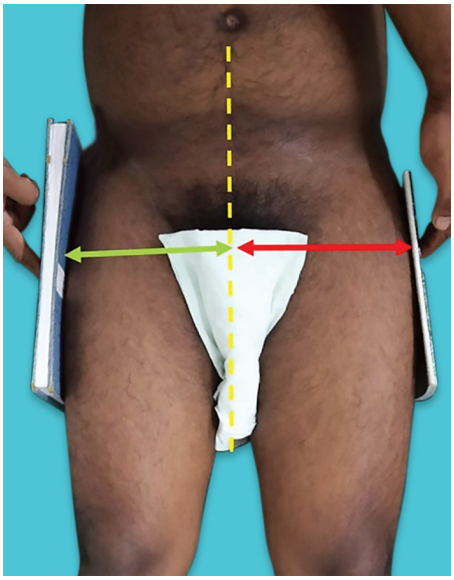

Fig. 1.32: Morris bitrochanteric line

Special tests

Friedrich Trendelenburg test: Trendelenburg test is done to assess the integrity of the abductor mechanism of the hip, which is formed by the fulcrum (joint), lever arm (head, neck and greater trochanter of femur) and power (abductor muscles).

The test can be performed either with the examiner standing in front or behind the patient. The original test was described with the examiner behind the patient. It is easier, if you first demonstrate the Trendelenburg test to the patient showing them what you want them to do. Patient should be advised to flex the hip only up to 30° and the knee to around 70°. Flexing the hip beyond 30° might lead to erroneous findings with respect to pelvic tilt as the iliopsoas muscle will prevent the pelvis from dipping down. Patient should be able to stand on one leg for at least 30 seconds. Classical description is to look for gluteal asymmetry. Balance the limb length discrepancy, if any, with wooden blocks.

The patient is asked to stand on normal side first and you are supposed to inspect from the back or front. Original description of doing the Trendelenburg test says the candidate has to stand behind the patient and observe the gluteal folds/PSIS. However, standing from the front and commenting about the change in level of ASIS is more practical and also accepted by many examiners. Hence, the candidate should alter the method of performing this test based on the preference of the examiners.

If the abductor mechanism is normal on the weight bearing side, the opposite side pelvis tilts up due to the contracting abductors on weight bearing side and the patient is able to maintain his balance. (This is the normal mechanism employed by us when we lift one leg to clear the ground during normal walking.)

On the contrary, when the patient stands on the affected hip and if the abductor mechanism on that side is not working, the opposite ASIS/PSIS drops down **(sound**

side sags) (Fig. 1.33). This will shift the center of gravity towards the non-weight bearing side and patient tends to lose balance. In order to regain balance (to bring the center of gravity towards the weight bearing hip), the patient sways his/her trunk in an exaggerated manner towards the weight bearing limb.

Fig. 1.33A and B: (A) Positive Trendelenburg sign on the affected side and (B) Negative test on the sound side

Assisted Trendelenburg test: Some patients may find it difficult to stand for 30 seconds. In them, we can employ the assisted Trendelenburg test.

The candidate stands in front of the patient and asks the patient to place their hands on the candidate's hands for balance by extending their elbows. Then, ask the patient to stand on their normal leg first and then on the affected side. The candidate can feel how much pressure the patient is applying on to his hands on the normal side in order to maintain balance (Fig. 1.34). The test is positive (abnormal) if the patient is unable to hold the pelvis level and maintain this for 30 seconds.

True positive test occurs with failures in

a. Fulcrum: In Perthes' disease, if there is femoral head incongruity or hinge abduction, the test may become positive. It may also be positive in osteoarthritis.
b. Power (weakness of abductors): Poliomyelitis, neuromuscular conditions, superior gluteal nerve injury, generalized neurological weakness, spinal cord lesions, myelomeningocele, post-THR exposure with failure of adequate repair and trochanteric osteotomy.
c. Lever (pivot): Nonunion fracture neck of femur, malunited intertrochanteric fracture, and short neck as in coxa vara or developmental dysplasia of the hip.

Fig. 1.34: Assisted Trendelenburg test

It should be understood that at least 15–20° of free adduction and abduction should be possible at the affected hip to perform this test correctly.

False positive test: Presence of pain, poor balance and either lack of co-operation or understanding by the patient can lead to false, positive tests as the test cannot be properly performed.

If the patient has fixed adduction deformity of one hip with normal abductor mechanism, free abduction is not available. Abduction is required at the weight bearing hip joint if the opposite pelvis has to raise up and, therefore, in this scenario the opposite pelvis will always remain at a lower level and will produce a false positive result.

False negative test: The reason for false negative tests is that the subject uses muscles above the pelvis to elevate the nonweight-bearing side of the pelvis, or shifts the torso well over the weight-bearing side.

It is also false negative, if the affected hip has a fixed abduction deformity. If the opposite pelvis has to drop down when patient stands on the affected limb, free adduction is required which is not seen in fixed abduction deformity. Therefore, the opposite pelvis will always remain at a higher level and will produce a false negative result.

Telescopy test (Fig. 1.35): Telescoping the femur on to the acetabular articulation tests the stability of the hip joint. If the patient has non-union of fracture neck of femur or persistent dislocation of the hip joint, telescopy sign will be appreciated.

The test is positive in Girdlestone's arthroplasty, old unreduced dislocation, DDH, pathological dislocation, Charcot's joint, sequelae of septic arthritis, non-union fracture neck of femur.

The patient is made to lie supine on the couch with the examiner standing on the affected side. One hand stabilizes the pelvis using the thenar eminence or thumb over the ASIS and the fingers on the greater trochanter. The knee and hip are flexed to about 90° and with the other hand and forearm underneath the popliteal fossa, the lower thigh and knee are held and stabilized (Fig. 1.35).

Thereafter a gentle push and pull force is applied along the long axis. The excessive proximal and distal translation of the femoral shaft can be appreciated by the fingers placed on the greater trochanter. This test basically confirms that the hip joint is not stable (femoral head is dislocated or destroyed) or there is discontinuity between the neck/head and remaining part of the shaft.

Fig. 1.35: Telescopy test in adult patient

Additional special tests done in hip examination

Impingement test (for labral tear/femoroacetabular impingement): With the patient lying supine the hip is gently flexed, internally rotated (FIR) and adducted. This elicits pain signifying an anterior labral tear. The pain which is felt when the hip is extended, abducted and externally rotated (HABER) may signify a posterior labral tear/impingement.

With the hip in FABER position (Figure of 4) move it towards the couch and measure the distance between lateral femoral condyle and the couch. Decreased distance indicates hip capsular contracture.

Ling's test (Stinchfield test): This is done to differentiate intra-articular hip pathology from spinal pathology. With the patient in supine position, he/she is asked to elevate the lower limb with the knee extended until pain prevents further movement. The examiner then places his/her hand under the distal third of leg and asks the patient to press down on the hand. If pathology is in the hip the pain is located in the groin, thigh or knee, while it is in the low back or SI joint area if the source is from the spine.

Neurovascular examination

- Do a systematic neurological examination. Check for bulk, tone and muscle wasting.
- The muscles to be checked in the lower limb include iliopsoas, gluteus maximus, gluteus medius and minimus, adductors, quadriceps, hamstrings, tibialis anterior, tibialis posterior, gastrocsoleus, peronei, flexor and extensor hallucis longus and flexor and extensor digitorum longus. Grade the muscle power according to MRC grading.
- Check sensation over specific dermatomes. L1-over inguinal crease, L2-over anterior aspect of mid-thigh, L3-over anterior aspect of knee, L4-along anteromedial aspect of leg, L5-along anterolateral aspect of leg and dorsum of foot, S1-over calf and sole, S2-over popliteal fossa and S3-S4 in perianal area.
- Check knee and ankle jerk.
- Palpate all pulses and compare for rate, rhythm and volume in lower limbs. Compare capillary refill time.

Tests for sacroiliac joint

- **Patrick's test (FABER/Jansen's test):** Flexion, abduction and external rotation at the hip produces pain at the sacroiliac joint.
- **Erichson's pelvic compression test:** Press both iliac crests together which produce pain over SI joint.
- **Gaenslen's test or maneuver:** Patient lies supine at the edge of the bed on affected side with the knee hanging out. The opposite side hip and knee is kept flexed. Now stabilise the opposite knee in one hand and hyperextend the affected side by pushing down the knee with other hand. Pain at the SI joint indicates its involvement due to the shear force applied. The test can be done by patient lying in lateral position too.
- **Pump handle test:** Ipsilateral hip and knees are fully flexed and force them towards the chest and opposite shoulders. Pain over SI joint is noted if the joint is affected.

Tests for lumbar radiculopathy

Perform straight leg raising test and other nerve root irritation tests to rule out sciatic nerve involvement (*See* Chapter 20: Examination of Spine).

Per abdominal and per rectal (PR) examination

Important when there is past history of pelviacetabular injury or suspected central fracture dislocation. In the exam, always ask the examiners whether you can perform the test. The examiners usually say it is not required. However, you should always make it a point to mention about per rectal examination during your case presentation.

Ipsilateral knee examination

To look for fixed deformities, contractures, swellings and osteoarthrosis changes.

Complete diagnosis and plan of management

At the end of your clinical examination examiners expect you to give your complete clinical diagnosis (anatomical, etiological, pathological and complication). If in doubt give differential diagnosis. The same should be recorded in your case sheet. Please also mention the basic investigations required and plan of management.

- Anatomical diagnosis: Structure and side involved: Bone/joint/cartilage/synovium/other soft tissues or extra-articular structures.
- Etiology: Whether the condition is congenital/traumatic/degenerative/metabolic/infective/inflammatory/tumour/idiopathic.
- Pathological diagnosis: Synovitis/arthritis/chondrolysis/ankylosis.
- Complications: Include nonunion, malunion, associated nerve injuries, shortening, instability or stiffness like ankyloses.