Chapter 2
Physical Examination of the Hip and Pelvis

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CLINICAL PEARLS

- Hip and pelvis injuries are common in both sports medicine and primary care practices.
- The hip and pelvis are often viewed as a “black box” because of the complex anatomy and overlapping pain referral patterns.
- Use of a systemic physical examination will assist the clinician in demystifying this region of the body and narrowing the differential diagnosis.
- A thorough lower extremity neurologic examination should be included in the evaluation of the hip and pelvis.
- Special tests are used in concert to gather a more complete picture of the patient’s biomechanical deficits.

CASE REPORT: PRESENTATION

Chief Complaint and History
T.R. is a 20-year-old male NCAA Division I cross-country runner who presents to the sports medicine clinic complaining of “right hip dislocation.” He has noticed lateral hip pain over the past 2 months which has been gradually increasing in severity. He states that it feels as though his hip is “going out of place.” Initially, the patient noticed the pain only at the end of a run. Now, he complains of a constant dull ache that sharpens during runs. He has no radiation of the pain and no complaints of paresthesias. His running shoes are only 2 months old, and he used his prior pair for only 4 months. A change to his training regimen – the addition
of hill workouts – corresponded to the onset of his pain. His first scheduled meet of the season is in 4 weeks.

He denies fevers, chills, night sweats, anorexia, and weight loss. He has no gastrointestinal symptoms or genitourinary symptoms. He denies a history of back pain.

He has no personal history of cancer. He had a left distal tibial stress fracture, and 2 years ago that healed without complication. There is no family history of cancer or rheumatologic disorders other than osteoarthritis in his grandparents.

T.R. takes ibuprofen prn. He is a non-smoker, uses alcohol socially, and does not use recreational drugs or dietary supplements.

**Physical Examination Results**

T.R.’s vital signs are within normal limits. He is a well developed, well nourished, Caucasian man. He is in no acute distress, alert, and oriented to person, place, and time with normal affect.

The abdomen is non-distended and non-tender, with normal active bowel sounds. There is no abdominal mass.

A back examination reveals no tenderness to palpation of the lumbar spinous or transverse processes. There is no sacroiliac (SI) joint tenderness and no tenderness of the lumbar musculature. The back demonstrates full range of motion in all planes and the Stork test is negative. No pelvic obliquity is present.

On neurological examination, T.R. demonstrates normal gait, mildly positive Trendelenburg on left and grossly positive Trendelenburg on right. The straight leg raise is negative, and hip abduction strength is 4+/5 right and 5/5 left. The remainder of lower extremity strength testing is 5/5 bilaterally, sensation is intact, and lower extremity reflexes are +2 and symmetrical.

Right hip examination reveals no obvious deformity. T.R. is able to reproduce an audible, palpable pop by flexing and abducting the hip. Log roll is negative. Hip range of motion tests’ results are as follows:

- Extension: 20° bilaterally
- Flexion: full bilaterally
- Abduction and adduction: equal and full bilaterally
- Internal rotation and external rotation full and equal bilaterally.

There is no tenderness at the anterior superior iliac spine (ASIS), anterior inferior iliac spine (AIIS), ischial spine, iliac crest, or lesser trochanter. There is tenderness just posterior to the greater trochanter. Ober’s test is positive; Stinchfield, piriformis, and Gaenslen’s tests are negative. Leg lengths are equal.
The FABER (Flexion, Abduction, External Rotation), modified Thomas, and Ely’s tests are all negative. The popliteal angles are equal at 30° bilaterally.

INTRODUCTION

Hip and pelvis injuries are seen commonly in sports medicine and primary care clinics. In fact, certain groups of athletes such as runners, dancers, and soccer players have been identified as being at particularly high risk of injuring these regions, likely secondary to the extremes of motion and high-level forces exerted on the hip during participation in these sports. Studies suggest that up to 10–24% of all pediatric patients as well as 5–6% of all adult patients presenting with musculoskeletal complaints have involvement of the hip. Yet despite the commonplace nature of hip and pelvis injuries, many still view the evaluation of this area as a proverbial “black box.” Such a view may result from the combination of complex anatomy and overlapping pain referral patterns that often present as hip complaints. As such, the clinician is required to maintain a broad differential diagnosis of both musculoskeletal and non-musculoskeletal etiologies. The following chapter strives to arm the reader with a systematic method for evaluation of this potentially intimidating area.

ANATOMY

The hip derives its stability from the fact that, unlike the shoulder, it is a true ball-and-socket joint, with the femoral head held snugly in place by the pelvic acetabulum. Yet despite its stable construction, the hip maintains a considerable deal of flexibility in the frontal, sagittal, and transverse planes of motion. Because of its unique design, the partially spherical articulation of the femoral head with the acetabulum is ideally designed to receive and distribute the forces of daily activity, which studies have shown can range from three to five times the patient’s bodyweight with simple tasks such as walking or running.

The bony joint of the hip is derived from the articulation of the head of the femur and the convergence of the ilium, ischium, and pubis bones of the pelvis to form the acetabulum. These bones, which are commonly referred to as innominate bones, collectively comprise the “hip bone.” Like the shoulder, the articular surface of the acetabular cartilage possesses a thickened rim, or labrum, at its periphery which serves to deepen the acetabulum and lend additional support without significantly sacrificing flexibility. When one considers the extra support provided by the three ligaments which surround and enmesh the joint capsule as well as the small
ligamentum teres which connects directly to the femoral head, it is easy to see why the hip is one of the most stable joints in the body. The innominate bones also articulate anteriorly at the symphysis pubis, while the posterior articulation of the pelvic girdle is completed by the sacrum and coccyx, providing the connection of the distal appendicular skeleton to the axial skeleton and torso.

The muscular anatomy of the hip is typically divided for simplicity into the medial adductor region, the anterior flexor region, the lateral abductor region, and the posterior extensor region. This breakdown oversimplifies the muscular anatomy insofar as such a strict classification does not take into account the ability of the hip to internally and externally rotate. However, it serves as a convenient way to conceptualize the cooperative muscle groups that mobilize the hip joint. When evaluating the individual muscles, it is important to remember that the musculature of the “hip” includes origins as proximal as the lumbar spine and insertions as far distal as the tibia. The major muscles from each of the cardinal groupings and their respective functions will be discussed in greater detail later in this chapter.

HISTORY
One of the primary difficulties in definitively diagnosing a patient who presents with hip pain is the sheer number of possible sources of this seemingly simple complaint. Aside from the articulation of the femur and acetabulum (i.e., hip joint proper), potential causes of pain include a variety of local bony and soft tissue sources, several potential peripheral nerve palsies, and radiculopathies referring pain from the lumbar spine. In light of the many potential etiologies of hip pain, it is important to consider a broad differential diagnosis before devising a treatment strategy.

Further complicating matters is the significant effect of age on the differential diagnosis of hip pain. Developmental dysplasia of the hip, Legg–Calve–Perthes disease, and slipped capital femoral epiphyses all have their own classical age ranges for presentation in the pediatric population (see Chap. 7). In addition, a mechanism of injury which likely would cause tendinopathy at the musculotendinous junction in a skeletally mature individual is far more likely to cause an apophysitis or apophyseal avulsion fracture in children or adolescents with open growth plates as their tendons are frequently stronger than the apophyses to which they attach. Fortunately, the incidence of all the previously cited pediatric hip disorders decreases as a patient reaches skeletal maturity. Because of these variables, accurate assessment of both the patient’s chronologic and physiologic age is an elementary yet essential part of any evaluation of the hip.
Systemic causes of intra-articular hip pathology, such as transient synovitis and septic arthritis, are also more common in pediatric populations. Such examples illustrate the importance of assessing constitutional symptoms as well as musculoskeletal complaints.\textsuperscript{6,7} Non-musculoskeletal diseases, particularly those involving the genitourinary and gastrointestinal systems (e.g., pelvic inflammatory disease, appendicitis), have also been known to masquerade as vague hip discomfort. A final yet critical point entails the possible diagnosis of cancer, as hematopoietic and metastatic tumors frequently invade the hip region,\textsuperscript{8} making the presence of a long-standing limp or recent weight loss an integral part of the patient history.

Despite the complex interplay of biomechanical, developmental, and systemic contributions to “hip pain,” the responsible healthcare practitioner should find that a detailed, thorough, and systematic history and physical examination can efficiently narrow an initially broad differential diagnosis.

As with any musculoskeletal complaint, the patient presenting with hip pathology should always be questioned regarding the onset, provoking and alleviating factors, quality, radiation, severity, and timing (duration) of symptoms (OPQRST). Characterization of the pain as sharp or dull, constant or intermittent, severe or mild can also be helpful. Other historical points of emphasis should include the presence or absence of neurological signs and symptoms and a clear description of any clicking or snapping of the joint.

One of the primary objectives of the history with any joint complaint should be to determine whether the injury is acute, chronic, or acute-on-chronic in nature. Detailed questions regarding athletic involvement, exercise habits, training regimen and modifications, equipment use, and nutritional practices often yield useful information to help elucidate the mechanism of injury. One must also inquire about any previous or concurrent injuries sustained to the back or lower extremities, as injury to either the ipsilateral or contralateral leg, knee, ankle, or foot can cause a compensatory alteration to gait pattern and potentially contribute to sustained hip pain (see Chap. 3).\textsuperscript{9} Once one determines the nature of the injury, considering the progression or regression of symptoms along with behavioral modifications preceding those changes may help unmask the precise biomechanical “culprit” of the disease process, which is an imperative step in healing the “victim” and preventing recurrence.

The presence of radiating symptoms can be helpful in accurately diagnosing hip pain as well. The hip serves as a conduit through which all the nerves innervating the lower extremity must pass;
as such, it is a frequent location of nerve injury. The surface area and skin distribution affected can vary widely with these complaints and should be definitively delineated to ensure an accurate diagnosis. Sciatica presents with its classic nerve impingement syndrome, but smaller nerves such as the ilioinguinal nerve may also be damaged and should also be included in the differential diagnosis. If neurological symptoms are present, the healthcare professional must differentiate between functionally-predominant and sensory-predominant symptomatology and pursue an immediate diagnosis more aggressively when functional decline is apparent (SOR-C).

Finally, the value of an accurate past medical history and medication list must never be underestimated, as a history of osteoporosis or recent steroid treatment, for example, can alter the differential diagnosis and treatment plan significantly.

**PHYSICAL EXAMINATION**

The evaluation of hip complaints should begin before the physician has even entered the room. An astute physician can gather vital information simply by observing the patient’s affect, posture, and gait pattern as he or she is escorted to an exam room. In doing so, the physician should be able to identify obvious muscular atrophy or weakness, pelvic obliquity, and abnormal scoliotic or lordotic curves resulting in gross postural abnormalities. Knowledge of normal gait biomechanics and frequently encountered compensatory reactions to traditional disturbances is essential for integrating this information into the clinical picture (see Chap. 4). For example, a patient with a Trendelenburg gait most likely has hip abductor weakness, but the cause may also be related to a tight iliotibial band or coxa externa saltans (snapping hip). Likewise, a hyperlordotic lumbar curve may indicate a compensatory reaction employed to preserve balance in a patient with flexion contractures of one or both hips.

**Range of Motion**

Range-of-motion testing can be very informative and, therefore, should constitute a distinct part of the standard hip exam. Normal parameters for range of motion have been well defined, giving the practitioner a reliable standard against which to compare collected data (Table 2.1). When performing this portion of the exam, it is important to pay special attention to abduction and internal rotation, as these are the most commonly compromised motions in many pathological conditions involving the hip (SOR-C).
The majority of the range-of-motion testing can easily be performed with the patient supine. One can assess internal and external rotation by having the patient lying with his or her legs slightly separated and passively rolling the entire lower extremity as if performing a log roll. An alternate method involves flexing the patient at the knee and rotating the leg around the vertical axis of the femur (Fig. 2.1 and Fig. 2.2). This method may make measurements easier, but it is important to remember that pivoting the ankle in one direction causes the hip to rotate in the opposite plane. For example, moving the ankle laterally, while using this method, causes internal rotation at the hip. Abduction (Fig. 2.3) and adduction (Fig. 2.4) are performed by anchoring the patient's pelvis with one hand while moving one leg at a time through the transverse plane with the other. When the hip begins to rotate (despite the

<table>
<thead>
<tr>
<th>Motion</th>
<th>Flexion</th>
<th>Extension</th>
<th>Abduction</th>
<th>Adduction</th>
<th>Internal Rotation</th>
<th>External Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range in degrees</td>
<td>110–120</td>
<td>0–15</td>
<td>30–50</td>
<td>30</td>
<td>30–40</td>
<td>40–60</td>
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**Figure 2.1.** Internal rotation.
Figure 2.2. External rotation.

Figure 2.3. Abduction.
added support provided by the examiner) the full range of motion in that plane has been reached. Hip flexion should be tested in the supine position by having the patient draw both knees to his or her chest, as flexion at the knee eliminates hamstring tightness as a potential limiting factor for this exam. Extension, on the other hand, is best performed with the patient in the prone position by raising the selected thigh from the exam table (Fig. 2.5).

**Palpation**

Palpation constitutes another significant portion of the exam. The musculature, tendinous origins and insertions, bony prominences (e.g., the greater trochanter), bony articulations (including the SI joint (Fig. 2.6) and pubic symphysis), bursae, and apophyses all must be palpated to the extent possible. The examiner must be attentive to any snapping or popping throughout the range of motion. While this usually indicates benign tendinous friction over a bony prominence, it can at times indicate an intra-articular lesion or free-floating loose body. This information may be obtained by palpating the portion of the joint being assessed with the free hand while performing the range of motion testing as detailed above.
Figure 2.5. Extension.

Figure 2.6. SI joint palpation.
Neurologic Testing
The hip and pelvis channel numerous nerves from the back to the groin and lower extremity. Accordingly, a thorough neurologic exam is essential even when neurological involvement is not suspected. Strength testing of the lower extremity must include each of the major muscle complexes that mobilize the hip and knee. As described previously, these muscle complexes can be divided into four cardinal muscle groups: the flexors (e.g., iliopsoas and rectus femoris), the extensors (e.g., gluteus maximus and hamstrings), the abductors (e.g., gluteus medius and gluteus minimus), and the adductors (e.g., adductor longus, adductor brevis, adductor magnus, pectineus, and gracilis.) Strength should then be graded on a scale from 1 to 5 (Table 2.2).

After palpating the muscle bellies and tendinous junctions of the individual muscles, the examiner may proceed to test the strength of each muscle grouping. In order to test the flexor group, the examiner places his or her hand over the seated patient's thigh and asks the patient to push upward against his or her hand while offering resistance. Similarly, to test the hip extensors, the patient is placed in a prone position and instructed to raise his or her thigh from the exam table as resistance is applied from behind the knee. Abduction and adduction may be assessed from the supine position with knees extended. The patient is instructed to separate the legs as the examiner offers resistance from the lateral malleoli and then to squeeze the legs together as resistance is applied to the medial malleoli. These latter tests may also be performed with the patient in the lateral decubitus position with the hips neutral. In this scenario, the patient is instructed to abduct the upper thigh to 30° and strength testing proceeds as above for the elevated leg (Fig. 2.7). The authors suggest that this technique may offer a greater degree of sensitivity to subtle deficits of strength (SOR-C).

<table>
<thead>
<tr>
<th>Strength test value</th>
<th>Meaning of the value</th>
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<tbody>
<tr>
<td>1/5</td>
<td>No signs of muscle firing</td>
</tr>
<tr>
<td>2/5</td>
<td>Visible twitching or fibrillations of the contracted muscle group without any movement</td>
</tr>
<tr>
<td>3/5</td>
<td>Active movement when gravity is eliminated</td>
</tr>
<tr>
<td>4/5</td>
<td>Active muscle activity against resistance with decreased strength</td>
</tr>
<tr>
<td>5/5</td>
<td>Indicating normal strength</td>
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</table>
Special Tests

One may employ a number of special tests to narrow the differential diagnosis after history, range-of-motion testing, neurologic testing, and palpation have been completed. Despite variability in sensitivity and specificity, as well as significant crossover, such tests can be helpful when employed within the context of the previously obtained information.

*Trendelenburg’s sign* is a test used to determine whether the patient has adequate hip abductor strength, particularly of the gluteus medius. To perform this test the patient is instructed to stand on both feet and slowly raise one foot off of the ground without additional support. If the patient has adequate abductor strength, then the iliac crest of the raised leg should remain parallel with or elevated slightly in relation to the contralateral side (Fig. 2.8). In addition, the patient should maintain an upright posture without significant tilt of the upper trunk, which would indicate a compensatory mechanism to help the patient maintain his or her balance (Fig. 2.9). A positive Trendelenburg sign is defined as either a compensatory tilt of the torso (vide supra) or a drop of the contralateral iliac crest (Fig. 2.10), indicating that the ipsilateral hip abductors are unable to contract with adequate force to maintain a level pelvis. Instability of the pelvis from other etiologies may also create a positive Trendelenburg’s sign resulting from increased tensile forces on the bony structures of
The FABER test, sometimes referred to as Jansen’s test or Patrick’s test, was designed to isolate hip joint, SI joint, or iliopsoas pathology. The most commonly used name of this test is an acronym for the positioning of the hip during the test (i.e. FABER). The patient lies supine and one leg is placed in a flexed, abducted, externally rotated position, as if creating the number 4, with the foot of the leg being tested resting on the contralateral knee (Fig. 2.11). From this position, the examiner places gentle downward traction on the ipsilateral knee. Pain or a decreased range of
motion indicates a positive test. A study by Broadhurst and Bond published in 1998 demonstrated a sensitivity of 0.77 and specificity of 1.0 when using the symptom of SI pain during the FABER test to indicate SI dysfunction. The examiner should note, however, that a restricted range of any of the individual planes of motion being tested in the FABER results in decreased specificity of the test, as any individual restriction would be expected to decrease range of motion in this composite motion exam as well, thereby leading to false positive results.

Ober’s test is useful for evaluating the iliotibial band, tensor fascia lata, and greater trochanteric bursa. The patient is placed in a lateral decubitus position with hips and knees each flexed to 90°. Initially, the examiner passively abducts and extends the upper leg until the thigh is in line with the torso, followed by passive adduction until the extremity returns to a natural position (Fig. 2.12). A positive test is indicated by a leg maintained in relative abduction, in contrast to a negative test in which the leg may rest on the table without causing significant discomfort. Inflexibility indicated by

Figure 2.9. Compensated Trendelenburg sign.
a positive test suggests excessive tightness of the iliotibial band, whereas focal pain overlying the trochanter points towards a possible trochanteric bursitis.

The Thomas test\textsuperscript{10} and modified Thomas test are used to assess hip flexor flexibility, particularly of the iliopsoas muscle. To perform the Thomas test, the patient is placed in a supine position and instructed to flex one leg and pull it to the chest. A flexion contracture would be indicated by passive flexion of the contralateral straight leg lifting off of the exam table (Figs. 2.13 and 2.14). A more informative version, the modified Thomas test, is performed by having the patient sit on the end of the exam table and pull a single leg to his or her chest. The patient is then instructed to lie back on the exam table while maintaining the knee against the chest wall, as the examiner watches carefully to insure that the patient does not fall. Once again, a flexion contracture of the iliopsoas is indicated by the contralateral thigh rising off of the table. In the modified Thomas, however, the patient may
also demonstrate a rectus femoris contracture via extension of the contralateral knee from its passively flexed position, making this a higher-yield test.\textsuperscript{10}

The \textit{piriformis} or \textit{FAIR} (flexion, adduction, internal rotation) test is performed with the patient in the lateral decubitus position, with the upper leg flexed to 60° and the lower leg maintained in full extension. The examiner places one hand on the patient's shoulder and, with the other hand, exerts mild pressure on the flexed leg at the knee. A positive test is defined as classical “shooting” pain elicited by direct impingement of the sciatic nerve by the tight piriformis muscle. In 1992, Fishman and Zybert showed that when used to demonstrate sciatic nerve impingement, these symptoms have a sensitivity of 0.88 and a specificity of 0.83 in comparison to electrodiagnostic studies as a gold standard.\textsuperscript{16} It is important to distinguish this classical description, however, from other sources of pain which may result from the added pressure placed on the hip joint during the exam.

\textbf{Figure 2.11. FABER test.}
The Log Roll test\textsuperscript{17} is a simple but useful test for demonstrating acetabular or femoral neck pathology. To perform the test, the practitioner passively internally and externally rotates both fully extended legs of the supine patient. Pain in the anterior hip or groin is considered positive. When significant bony injury is suspected, this test can be used to offer a preliminary assessment of

\begin{figure}
\centering
\includegraphics[width=\textwidth]{Ober_test.png}
\caption{Ober test. (A) Start (B) End.}
\end{figure}
bony integrity in order to guide subsequent exam maneuvers and minimize risk of further injury (SOR-C).

The Stinchfield test is performed with the patient in the supine position with the symptomatic hip flexed to $20^\circ$ and the knee maintained in full extension. A gentle downward pressure is then exerted
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on the distal end of the elevated leg (Fig. 2.15). Pain in the anterior hip or groin indicates a positive test and may suggest femoral fracture, acetabular injury, or osteoarthritis of the affected hip.\(^{18}\)

_Ely’s test_ is used to assess the flexibility of the rectus femoris. To perform this test, the patient is instructed to lie in the prone position with legs fully extended. The examiner then passively hyperflexes the knee to the extreme of its range of motion taking care to avoid rotation or extension of the hip joint, and observes the ipsilateral hip for vertical separation from the exam table (Fig. 2.16). If the hip is forced to lift off of the table, then the test is considered positive, suggesting a rectus femoris contracture. Again, the examiner must cautiously avoid any extension or rotation of the hip which can cause false positive results by eliciting pain from other areas.\(^{8}\)

The _straight leg raise_ test classically has been used in descriptions of patients suffering from lumbar herniated disk disease, but it can also be used to differentiate various types of hip pathology from those of gluteal etiology. To perform the exam, the patient is placed in a supine position, and the examiner passively flexes (raises) one leg at a time while maintaining full extension at the knee. If the patient experiences pain or is too inflexible to perform an adequate exam, then the knee may be slightly flexed and continued flexion of the hip attempted. If the examiner is unable to further flex the hip despite this modification, then a pathology of the buttock such as

**Figure 2.15.** Stinchfield test.
ischial bursitis or an abscess, rather than intra-articular hip pathology, is likely. Pain radiating distally in either leg represents a positive test and suggests some form of sciatic nerve irritability, either at the level of the piriformis or possibly at the site of a more proximal lumbar disk herniation. A meta-analysis by Vroomen and Knottnerus in 1999 suggested that the ipsilateral straight leg raise was the most sensitive physical exam maneuver used to rule out a herniated disk, with a pooled sensitivity of 0.85 compared to a specificity of just 0.52.\(^1\) The contralateral straight leg raise, on the other hand, was the most specific exam technique for identification of a herniated disk, with a specificity of 0.84 in contrast to its poor sensitivity of 0.30.\(^1\) For this reason, when used, the straight leg raise should always be evaluated bilaterally (SOR-B).

An accurate leg length assessment is critical in the evaluation of hip pain, as a significant discrepancy sometimes may represent a masked “culprit” masquerading as secondary pathology. These secondary problems, or “victims,” are destined to recur unless the primary etiology is addressed appropriately. While it may be difficult for the practitioner to definitively diagnose an anatomic leg length discrepancy,\(^2\) it is equally important to make the diagnosis of a functional leg length discrepancy due to its effects on the athlete’s kinetic chain. One proposed method for determining anatomical leg length requires the patient to stand fully erect with his or her feet 6–8 in. apart as the examiner measures the distance
from the ASIS to the medial malleolus of each lower extremity. Confounding factors such as the patient shifting weight to alleviate pain and the potential for asymmetrical soft tissue distribution, however, sometimes decrease the reliability of the obtained measurements. In addition, even in cases in which the measurements are reliable, this method offers no information as to where the discrepancy arises, thus limiting its clinical utility.

The Weber–Barstow maneuver was subsequently designed to address these limitations. In this technique, the patient is asked to lie supine with both knees and hips flexed to approximately 45°. The patient is then instructed to reset the pelvis by pushing off of the table and gently lowering himself or herself back down (Fig. 2.17). The examiner can then assess the length of the femur and tibia individually by aligning the medial malleoli and examining the profile of the knees from both the front and side. A vertical discrepancy between the level of the knee joints most visible from the front would indicate a discrepancy of the structures distal to the knee (i.e., tibia), while an anterior–posterior discrepancy more apparent from the lateral view indicates that the discrepancy lies proximally (i.e., femur). After making these observations, the examiner then passively extends the knees and uses the medial

![Figure 2.17](image)

**Figure 2.17.** (A) Start for resetting the pelvis for leg length evaluation.
malleoli as landmarks to indicate whether a discrepancy appears to be present (Fig. 2.18). Similarly, the examiner can compare the position of the patellas and ASISs to evaluate for proper and symmetrical body alignment.
The **prone knee flexion test** can be used as a confirmatory examination when the Weber–Barstow suggests that a discrepancy may exist. It is performed with the knees flexed to 90° and the patient in a prone position. The clinician’s thumbs are placed transversely across the soles of the feet distal to the calcaneus bilaterally, and the heights of the thumbs are compared. A discrepancy in thumb position would suggest a tibial length discrepancy. Unfortunately, the inter-examiner reliability of the prone knee flexion test has only been found to be 0.21–0.26.21,22

The **supine to sit test** or **long sitting test** is employed to differentiate functional versus anatomical leg length discrepancy. To perform this test, the patient is placed in the supine position with legs fully extended and the medial malleoli aligned. The patient is then instructed to rise to a sitting position without moving his or her legs. The examiner observes this motion, paying particular attention to the medial malleoli. If the patient is unable to rise without one leg shifting proximally to the other, then there is likely some degree of pelvic dysfunction or malrotation contributing to any discrepancy present (Fig. 2.19). Bemis and Caniel evaluated 51 asymptomatic individuals and found the test to have a sensitivity of 0.17 and specificity of 0.38.23 However, a limitation of this study was that all of the subjects were asymptomatic.

The **standing flexion test** is also used to assess for pelvic dysfunction. The posterior superior iliac spines are palpated while the patient stands vertically and then maximally flexes at the waist. A positive test is marked by migration of one side cephalad (cranially) and suggests SI joint hypomobility. Cohort studies have found inter-examiner reliability of the standing flexion test to range from 0.08 to 0.68.21,24–28

The **Gillet test** is another assessment of the SI joint. The patient stands with feet separated by about a foot, and the examiner’s thumbs are again placed on the posterior superior iliac spines. The patient is then instructed to balance himself or herself on a single leg while pulling the opposite leg toward his or her chest wall. The maneuver is performed bilaterally, and a positive finding is noted if the posterior superior iliac spine on the flexed side migrates vertically or remains still, indicating inadequate SI flexibility or hypomobility. Dreyfuss et al. determined the sensitivity and specificity of this particular test to be 0.43 and 0.68 respectively making it a poor screening tool if SI dysfunction is suspected.29

The **Gaenslen sign** is also used to elicit symptoms of SI disorders. This test is performed by positioning a supine patient on the edge of the table with both legs flexed to his or her chest. The patient is then instructed to allow the outside leg to hang off of
the side of the table as the examiner stabilizes the patient’s torso. Pain in the SI region with this maneuver indicates a positive test. Sensitivity and specificity of this test have varied widely in multiple studies, with ranges from 0.21 to 0.71 and 0.26 to 0.72 respectively.\textsuperscript{29,30}

Craig's test\textsuperscript{10} is used to test for femoral torsion. The normal range of femoral anteversion, or forward projection of the femoral
neck, changes throughout life from an average range of 30–40° in infants to 8–15° in adults. Excessive anteversion, or less commonly femoral retroversion, can be problematic and presents most frequently in the pediatric population. To perform the exam, the patient is instructed to lie prone on the exam table with the knee of the side being tested flexed to 90°. From this position the examiner palpates the greater trochanter of the flexed knee and internally and externally rotates the hip to find the position in which the greater trochanter is most lateral. The degree of femoral anteversion can then be estimated using a goniometer with the stationary arm perpendicular to the floor and the moving arm at the angle of the leg.

Passive abduction and resisted adduction are useful maneuvers for differentiating pubic symphysis pathology from other midline pelvic symptoms.31 The exam is performed with the patient in the lateral decubitus position and 90° flexion of the knees and hips. Pain at the pubic symphysis with either maneuver from this position is considered a positive test and may be indicative of osteitis pubis.

The lateral pelvic compression test is also performed from the lateral decubitus position with knees and hips flexed. To perform this test, the examiner places direct downward pressure to the greater trochanter. Once again, midline pain overlying the pubic symphysis is consistent with bony injury or osteitis pubis.17

The Scour test or Quadrant test is used for investigation of possible labral pathology. To perform this test the examiner axial loads, adducts, and flexes the hip to its end range of motion with the patient in a supine position. If performed correctly, the ipsilateral knee should point to the patient’s contralateral shoulder. From this position the leg is taken in an arc-like motion to the point of full abduction. Any positive exam, defined as pain, apprehension, or catching of the hip during the maneuver, is presumably caused by either labral pathology or a loose body within the hip joint.10 The authors suggest that this maneuver is analogous in technique to the McMurray test for the knee, lending a useful method for conceptualizing the exam.

The fulcrum test is performed with the patient seated on the exam table with legs hanging from the edge. The examiner’s forearm is positioned under the patient’s thigh for use as a fulcrum as pressure is applied to the ipsilateral knee by the examiner’s spare hand. In this manner, the examiner moves up and down the entire shaft of the femur attempting to elicit any point tenderness which may indicate a stress fracture of the overlying bone.10 Either sharp pain or apprehension indicates a positive test.
CASE REPORT: CONCLUSION

Assessment
- External snapping of the right hip secondary to inflexibility of
  the iliotibial band and tensor fascia lata which is secondary to
  core instability, specifically gluteus medius weakness.
- Poor hamstring flexibility bilaterally.

Plan
Physical therapy to address the above biomechanical deficits with
specific attention to the core instability. Cross train to maintain
cardiovascular fitness. Decrease weekly running mileage in half
and decrease running pace by 1 min/mile.

Follow-up
After 4 weeks of physical therapy, the patient’s pain had resolved.
Once the patient became completely pain free, his running mileage
and pace were gradually increased. When he was able to run on
level ground at his previous pace, hills were slowly re-introduced.
He was back competing at pre-injury levels by his second competi-
tion, which was 6 weeks after presentation.

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2. PHYSICAL EXAMINATION OF THE HIP AND PELVIS
