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Physical Examination and Special Test of the Pelvis: A Review Article

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ABSTRACT

The pelvis is a central biomechanical and structural unit that plays a vital role in locomotion, load transmission, and stability of the human body. Accurate physical examination and special tests are essential components in the clinical evaluation of pelvic dysfunctions, injuries, and pain syndromes. This review outlines the fundamental aspects of pelvic physical examination, including inspection, palpation, assessment of range of motion (ROM), and muscle strength testing. Special tests such as FABER (Flexion, Abduction, External Rotation), FADIR (Flexion, Adduction, Internal Rotation), Thomas Test, Trendelenburg Test, and Straight Leg Raise (SLR) are detailed, highlighting their diagnostic value in identifying conditions like femoroacetabular impingement (FAI), sacroiliac joint dysfunction, hip flexor contracture, gluteal weakness, and radicular pain, respectively. Additionally, key neurovascular structures relevant to the pelvis, including the femoral, obturator, sciatic, and gluteal nerves, as well as associated arterial branches, are discussed due to their clinical importance in diagnosis and intervention. Understanding and performing these examinations with precision is crucial for early diagnosis, appropriate management, and improved functional outcomes in patients presenting with pelvic complaints.

Keywords: pelvis, physical examination, special tests, FABER, FADIR, Trendelenburg, Thomas Test, sacroiliac joint, femoroacetabular impingement, neurovascular structures

INTRODUCTION

The pelvis is a central structure within the human musculoskeletal system, functioning as the primary connection between the vertebral column and the lower extremities. Anatomically, the pelvis consists of major bony components including the ilium, ischium, and pubis, as well as essential joints such as the sacroiliac joint and the hip joint, also known as the femoroacetabular articulation. It also provides attachment for several large muscle groups, including the gluteal muscles, the iliopsoas, and the adductor group, all of which play important roles in movement and stability of the lower body. [1] Pelvic disorders can originate from intraarticular structures, such as labral tears, femoroacetabular impingement, or osteoarthritis, as well as from extraarticular sources including tendinopathy, bursitis, piriformis syndrome, and muscular dysfunction. Pelvic pain may also arise from non-musculoskeletal causes such as hernias or gynaecological and urological conditions,

which may further complicate diagnostic evaluation. In orthopaedic practice, the assessment of patients with pelvic complaints should begin with a systematic history followed by a comprehensive physical examination. [2]

Physical examination plays a vital role because it allows clinicians to assess joint motion, muscle strength, and the presence of biomechanical abnormalities or deformities. In addition, physical examination helps determine whether the patient's symptoms originate from the hip joint itself or from other anatomical regions such as the lumbar spine or the posterior structures of the pelvis. [3] A variety of special clinical tests have been developed to assist in the evaluation of pelvic and hip pain. For example, the FABER test, which involves flexion combined with abduction and external rotation, can help identify sacroiliac joint pathology or anterior hip disorders. The FADIR test, which involves flexion with adduction and internal rotation, is widely used for detecting femoroacetabular impingement. The Trendelenburg test can reveal weakness of the gluteus medius muscle, a condition often seen in patients with hip dysplasia or injury to the superior gluteal nerve. [4]

Despite their usefulness, the diagnostic accuracy of these special tests remains a subject of ongoing discussion. Many of these tests are provocative in nature and may demonstrate limited sensitivity or specificity when used in isolation. Therefore, it is essential to interpret the results of special tests in the broader context of other clinical findings and, when necessary, confirm them with additional investigations such as plain radiographs, magnetic resonance imaging, or musculoskeletal ultrasonography. A strong understanding of pelvic anatomy, underlying pathophysiology, and correct performance of physical examination techniques and special tests is crucial for clinicians, especially those working in orthopaedics and rehabilitation medicine. Such knowledge supports the establishment of accurate diagnoses and assists in designing effective treatment strategies for patients. [4]

With the essential role of physical examination and special tests in assessing pelvic disorders, there is a need for a comprehensive and systematic literature review that discusses the available examination methods in detail. This review aims to provide clinicians with a deeper understanding of the principles, techniques, strengths, and limitations of various physical examination procedures and special tests commonly used in the orthopaedic evaluation of the pelvis and the hip.

PELVIC ANATOMY

The pelvis is a complex component of the musculoskeletal system, composed of bones, joints, muscles, ligaments, and neurovascular structures. It functions to support body weight during standing and walking, and serves as a conduit for the transmission of forces from the trunk to the lower extremities. In orthopaedic practice, a detailed understanding of pelvic anatomy is essential for evaluating pain, dysfunction, and mobility limitations through physical examination and special clinical tests. The pelvic ring consists of several major bony elements, namely two os coxae on the right and left sides, the sacrum, and the coccyx. [5]

The os coxae develops from the fusion of three primary bones during growth, specifically the ilium, the ischium, and the pubis, which converge at the acetabulum to form the hip joint. The ilium, located in the superior and lateral region, forms the lateral wall of the pelvic cavity and provides attachment for large muscles such as the gluteus maximus. The ischium is situated in the inferior posterior region, with the ischial tuberosity acting as a supporting point when sitting and serving as the attachment site for the hamstring muscles. The pubis occupies the anterior region of the os coxae, forming the anterior portion of the pelvic ring and articulating with the contralateral pubis at the pubic symphysis to provide stability to the pelvis. [5]

The acetabulum is a cup shaped articular cavity located on the lateral aspect of the os coxae. It articulates with the femoral head to form the hip joint. Surrounding the acetabulum are the acetabular rim and the acetabular labrum, both of which contribute to joint stability and enhance the congruence between the acetabulum and the femoral head. The sacrum, positioned at the posterior aspect of the pelvis, consists of five fused sacral vertebrae. It articulates with the ilium to form the sacroiliac joint, a structure that plays an important role in pelvic stability. The coccyx, or tailbone, is located at the most inferior portion of the vertebral column. It contributes to the stability of the pelvic floor and supports several functions including defecation and providing assistance during sitting. [5]

Table 1. Muscles of the Pelvis

Fuction	Primary Muscles	Clinical Notes
Flexion	Iliopsoas, Sartorius, Rectus femoris	The iliopsoas is the primary flexor of the hip.
Extension	Gluteus maximus, Hamstring	The gluteus maximus is highly active during the transition from sitting to standing.
Abduction	Gluteus medius, minimus	A lesion of the superior gluteal nerve may result in a Trendelenburg gait.
Adduction	Adductor longus, brevis, magnus; Gracilis	Pain frequently occurs due to overuse, especially in athletes.
Internal Rotation	Gluteus medius (anterior), tensor fasciae latae	Movement becomes limited when the gluteus medius is weak.
External Rotation	Piriformis, obturator internus, gemelli	Piriformis syndrome may occur when the piriformis muscle compresses the sciatic nerve.

BIOMECHANICAL STRUCTURE OF THE PELVIS

The pelvis is a highly important anatomical structure in the human body. It functions as the connecting region between the upper and lower body and serves as the central element for stability and movement. The pelvis is composed of the pelvic bones, which include the ilium, the ischium, and the pubis. These bones unite to form the acetabulum, a socket that articulates with the femoral head to create the hip joint. The hip joint is a ball and socket articulation that allows a wide range of movements including flexion, extension, abduction, adduction, and both internal and external rotation. In addition to the hip joint, the pelvis contains the sacroiliac joint, which connects the sacrum to the iliac bones. This joint plays an essential role in transferring forces from the upper body to the lower extremities and contributes to overall body stability. The biomechanics of the pelvis involves the interaction of forces acting on the pelvis, including gravitational forces, muscular forces, and joint reaction forces. [6]

Gravitational force passes vertically through the body's center of mass, which is located near the pelvis. Muscular forces generated by large muscles such as the gluteus maximus, the iliopsoas, and the adductor group contribute to movement and help maintain balance during physical activity. Smaller stabilising muscles, including the gluteus medius and the gluteus minimus, play an equally important role in maintaining pelvic stability during dynamic activities. In addition, ligaments surrounding the hip joint, such as the iliofemoral ligament, the pubofemoral ligament, and the ischiofemoral ligament, provide passive support to maintain joint stability and limit excessive motion.[7]

All of these elements work together to ensure that the pelvis remains stable yet sufficiently flexible to support a wide range of body movements. Proper posture and appropriate load distribution are essential for maintaining pelvic biomechanical integrity. Imbalance in posture or uneven load distribution can result in biomechanical dysfunction, which may lead to injury or pelvic disorders. Disturbances in pelvic

biomechanics, including hip joint osteoarthritis, sacroiliac joint dysfunction, or injury to the surrounding muscles and ligaments, may reduce mobility and cause pain. Therefore, a strong understanding of pelvic biomechanics is crucial for designing effective strategies for injury prevention, rehabilitation, and optimisation of physical performance. [8]

PHYSICAL EXAMINATION OF THE PELVIS

Inspection and palpation are essential initial components in the physical examination of the pelvis. These steps aim to evaluate the external condition of the pelvic region both visually and through touch, and to identify any structural abnormalities, inflammation, trauma, or anatomical asymmetry that may support a specific diagnosis. The examination begins with inspection, which is performed with the patient standing in an upright position and observed from the anterior, lateral, and posterior views. During this stage, the clinician assesses the symmetry of the pelvic bones, the contour of the gluteal muscles, the height of the iliac crests, and the position of the greater trochanter, all of which may indicate pelvic rotation or limb length discrepancy. Additional visible findings may include swelling, hematoma, muscle atrophy, erythema, or skin changes such as surgical scars, fistulas, or other lesions. [9]

Palpation follows inspection and is performed with the patient in a supine or lateral position depending on the region of interest. Palpation includes the identification of key anatomical landmarks such as the anterior superior iliac spine, the posterior superior iliac spine, the greater trochanter, the ischial tuberosity, and the pubic symphysis. Gentle pressure is applied to assess for tenderness, masses, crepitus, increased local temperature that may suggest inflammation or infection, and abnormal mobility of specific structures. Palpation also provides information regarding the tone of surrounding muscles and helps differentiate between muscular disorders and joint related abnormalities. Careful evaluation during inspection and palpation offers highly valuable initial data that guide subsequent assessment steps, including provocative tests, range of motion evaluation, and muscle strength testing. [10]

Table 2. Inspection and Palpation in Pelvic Examination

Examination Aspect	Clinical Objectives	Possible Findings
Inspection of Pelvic Symmetry	Assessing the position of the iliac crest and pelvic rotation	Asymmetry with anterior or posterior rotation
Inspection of Muscle Contour	Assessing gluteal muscle atrophy or hypertrophy	Atrophy of the gluteus medius for example in superior gluteal nerve lesion
Inspection of Skin and Soft Tissue	Identifying wounds, surgical scars, or signs of inflammation	Erythema, hematoma, fistula, or edema
Palpation of the SIAS and SIPS	Determining pelvic alignment and areas of tenderness	Tenderness in sacroiliac joint dysfunction
Palpation of the Greater Trochanter	Assessing bursitis or trochanteric fracture	Tenderness in trochanteric bursitis
Palpation of the Pubic Symphysis	Assessing instability or trauma of the pubic region	Tenderness in pubic symphysis dysfunction
Palpation for Local Temperature and Edema	Detecting local inflammation or infection	Increased temperature, local edema, or abscess

ASSESSMENT OF RANGE OF MOTION IN THE HIP JOINT

Assessment of range of motion is an essential component in evaluating the functional status of the hip joint. This examination aims to assess both the structural integrity and the functional capacity of the joint. The hip joint is a synovial ball and socket articulation that connects the femoral head with the acetabulum of the pelvic bone, and it plays a crucial role in activities such as walking,

standing, sitting, and dynamic movement. Therefore, disturbances in range of motion often reflect underlying musculoskeletal, neurological, or intraarticular disorders. [11] Range of motion can be assessed actively, in which the patient performs the movement independently, or passively, in which the examiner provides assistance. During assessment, the examiner evaluates normal movement limits, any restriction, pain, crepitus, or abnormal resistance. Active range of motion reflects muscle strength and the patient's willingness to move, while passive range of motion more specifically represents the condition of the joint capsule, ligaments, and articular surfaces. Both sides of the pelvis should be compared to detect functional asymmetry. [12]

The principal movements assessed during hip range of motion evaluation include:

- Flexion and extension: Flexion moves the limb forward and generally reaches approximately one hundred twenty degrees, while extension moves the limb backward and is usually around ten to twenty degrees. The assessment is performed with the patient in a supine or lateral position. Limitation of flexion may indicate capsular rigidity or intraarticular lesions such as osteoarthritis.
- Abduction and adduction: Abduction, which moves the limb away from the midline, typically reaches about forty-five degrees, while adduction, which brings the limb toward the midline, reaches approximately thirty degrees. Restrictions may occur in conditions such as femoroacetabular impingement or adductor muscle spasm.
- Internal and external rotation: Examination is performed with the hip and knee flexed at ninety degrees. Internal rotation, in which the foot moves outward, and external rotation, in which the foot moves inward, both usually range from forty to forty-five degrees. Pain during rotational movement may indicate pathology such as labral tear or synovitis. [6]

Beyond movement amplitude, it is also important to evaluate the quality of movement and the end feel, which refers to the mechanical sensation at the limit of motion. End feel may be elastic in normal conditions, firm or hard as seen with osteophyte formation, or painful in cases of inflammation or soft tissue injury. Range of motion assessment must be conducted in a systematic manner, beginning with active movements followed by passive movements, and should include quantitative documentation, using a goniometer when appropriate, to allow comparison over time. [13]

Table 3. Normal Range of Motion of the Hip Joint

Hip Joint Movements	Normal Range of Motion in Degrees	Examination Position	Structures Examined
Flexion	110°–120°	Supine position with the knee flexed	Iliopsoas, anterior capsule, femoroacetabular joint
Extension	10°–20°	Prone or lateral position	Gluteus maximus, posterior capsule
Abduction	40°–45°	Supine position	Gluteus medius and gluteus minimus, lateral capsule
Adduction	20°–30°	Supine position	Adductor muscles, medial capsule
Internal Rotation	30°–40°	Sitting or supine position with the knee flexed	Pelvitrochanteric muscles, labrum
External Rotation	40°–60°	Same as internal rotation	Piriformis, obturator muscles, ligaments

SPECIAL TESTS FOR THE PELVIS

Special examinations or provocative tests of the pelvis are essential components of the musculoskeletal clinical evaluation, particularly when history taking, inspection, palpation, and range of motion assessment do not clearly identify the source of pain or dysfunction. These tests are designed to

isolate specific anatomical structures and apply pressure or stretch to the hip joint, the sacroiliac joint, the peripelvic muscles, and the lumbosacral neural structures in order to reproduce characteristic symptoms or the patient's pain. The results of these tests assist in identifying specific pathology such as impingement syndrome, muscle contracture, neuromuscular weakness, or nerve irritation, thereby guiding a more accurate diagnosis and supporting appropriate therapeutic decision making. [7]

One of the most common and essential tests is the FABER Test, which represents flexion, abduction, and external rotation, and is also known as the Patrick Test. The test is performed by placing the patient's limb in a figure four position, with the ankle resting on the opposite thigh. The examiner stabilises the contralateral pelvis and applies gentle downward pressure on the knee of the examined side. Pain felt in the anterior pelvic region may indicate pathology of the hip joint such as osteoarthritis or synovitis. Conversely, pain in the posterior region suggests involvement of the sacroiliac joint such as sacroiliitis or sacroiliac joint dysfunction. [14]

Another important test is the FADIR Test, which represents flexion, adduction, and internal rotation, used to identify femoroacetabular impingement. This condition results from abnormal contact between the acetabulum and the femoral neck. During the test, the hip is placed in flexion, adduction, and internal rotation at the same time. Reproduction of pain, particularly in the anterior or anterolateral pelvic region, indicates a positive result suggesting the presence of CAM deformity or Pincer deformity, the two principal forms of femoroacetabular impingement. This test has high sensitivity and is commonly used in the pre operative evaluation of patients with chronic unexplained pelvic pain. [15]

The Thomas Test is used to assess contracture of the hip flexor muscles, especially the iliopsoas. The patient lies supine, then brings one knee toward the chest while the other limb is allowed to drop toward the table. If the contralateral thigh rises off the table, the result is positive, indicating tightness or shortening of the hip flexor muscles. The test may also reveal rectus femoris contracture if the dependent knee does not maintain normal flexion. [16]

The Trendelenburg Test evaluates the function of the gluteus medius and gluteus minimus muscles and the integrity of the superior gluteal nerve. The patient is asked to stand on one leg while the examiner observes for a drop of the unsupported side of the pelvis. If the contralateral side descends, the test is positive and indicates weakness of the abductor muscles on the supporting side. This may occur due to superior gluteal nerve lesion, gluteal myopathy, or chronic biomechanical dysfunction such as pelvic dysplasia.[15]

The Straight Leg Raise and the Lasegue Test are used to evaluate irritation of the sciatic nerve and possible compression of the lumbosacral nerve roots. Although these symptoms often originate from lumbar pathology such as disc herniation, they are still relevant in the evaluation of pelvic pain. In the Straight Leg Raise, the examiner lifts the patient's extended limb passively. Reproduction of low back pain or radiating pain along the limb suggests nerve root irritation. When pain appears during passive flexion from approximately thirty degrees to seventy degrees, the result is considered positive. The Lasegue Test is a modification of the Straight Leg Raise in which the examiner adds ankle dorsiflexion to increase tension on the sciatic nerve and reinforce diagnostic accuracy.

Table 4. Summary of Pelvic Special Tests

Test Name	Purpose	Examination Technique	Positive Result
FABER (Patrick's)	Assessing sacroiliac joint dysfunction or hip joint pathology	Flexion, abduction, and external rotation of the hip; apply downward pressure on the knee while stabilising the pelvis	Anterior pain indicates hip joint involvement; posterior pain indicates sacroiliac joint involvement
FADIR	Assessing femoroacetabular impingement	Flexion, adduction, and internal rotation of the hip	Pain in the anterior pelvic region
Thomas	Detecting hip flexor contracture	One knee is brought toward the chest while the opposite thigh is observed	Elevation of the opposite thigh from the table indicates iliopsoas or rectus femoris contracture
Trendelenburg	Assessing weakness of the gluteus medius or gluteus minimus	Patient stands on one leg; observe for pelvic drop on the contralateral side	Pelvic drop on the unsupported side indicates abductor weakness
Straight Leg Raise	Detecting sciatic nerve irritation or lumbosacral nerve root compression	Passive flexion of the straight limb, with optional addition of ankle dorsiflexion	Radiating pain along the limb from the lower back indicates nerve irritation
Lasegue's Test	A variant of the Straight Leg Raise with ankle dorsiflexion	Same as the Straight Leg Raise, with added dorsiflexion of the ankle	Pain that increases with dorsiflexion reinforces suspicion of sciatic nerve irritation

CONCLUSION

The pelvis is a complex anatomical structure that plays a vital role in supporting body weight, enabling movement of the lower extremities, and maintaining overall stability and mobility of the body. Pelvic biomechanics involves the interaction of bony structures, joints, muscles, ligaments, and mechanical forces that are generated during both static and dynamic activities. The physical examination of the pelvis aims to evaluate functional status and identify structural or functional abnormalities that may contribute to pain or movement disorders. The examination procedure includes inspection, palpation, assessment of range of motion, and a series of special tests that are designed to isolate and identify specific pathology involving the hip joint, muscles, ligaments, or neural structures.

Range of motion assessment allows evaluation of the functional capacity of the joint through both active and passive movement, whereas special tests such as FABER, FADIR, and the Trendelenburg test provide more specific diagnostic information. Correlation between physical examination findings and clinical presentation is essential for establishing an accurate diagnosis and determining an appropriate treatment plan. Therefore, a comprehensive understanding of pelvic anatomy, physiology, and biomechanics forms a critical foundation in the evaluation and management of musculoskeletal disorders in this region.

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