CQ HAND + UPPER LIMB
SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

Iliopsoas impingement and tendinopathy

Anatomy & Pathophysiology

BONY ANATOMY

- The hip is a multiaxial joint formed by the articulation between the pelvis and femur, connecting the axial skeleton and the lower extremity [8].
- The hemipelvis comprises three bones: the ilium, ischium, and pubis, which unite at the triradiate cartilage within the concave acetabulum [8].
- The shape and depth of the acetabulum are formed by the appearance of ossification centers around the end of the first decade of life, with complete fusion occurring around 18 to 19 years of age [8].
- The ilium is a large flat bone forming the majority of the coxal bone, with its superior margin terminating anteriorly at the anterior superior iliac spine (ASIS) and posteriorly at the posterior superior iliac spine (PSIS) [8].
- The anterior inferior iliac spine (AIIS) and posterior inferior iliac spine (PIIS) are located inferior to the ASIS and PSIS, serving as clinically important landmarks and muscle attachment points [8].
- The greater sciatic notch is located directly below the PIIS and serves as the passage for the large sciatic nerve exiting the pelvis into the thigh [8].
- The ischium is a small L-shaped bone forming the posteroinferior margin of the pelvis, with its thickened body portion known as the ischial tuberosity serving as a large attachment site for multiple muscle groups [8].
- The pubis consists of a body and two rami that connect superiorly to the ilium and inferiorly to the ischium to form the obturator foramen, which serves as a conduit for arteries and nerves [8].
- The acetabulum comprises an articular crescent-moon-shaped lunate surface and a nonarticular central fossa that serves as the attachment point for the ligamentum teres [8].
- The acetabulum is incomplete inferiorly, forming a notch through which vital blood vessels and nerves pass to supply the joint [8].
- The femoral head forms two-thirds of a sphere, with a small depression at its center from which the ligamentum teres extends to connect to the acetabular notch [8].

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- The femoral neck-shaft angle averages 125°, allowing for greater mobility by placing the head and neck more perpendicular to the acetabulum in a neutral position [8].
- Normal version, defined as the head-neck angle in the frontal plane, averages 15 to 20° [8].
- The angular projection of the femoral head and neck in relation to the obliquely placed acetabulum allows for rotary movements at the hip and prevents impingement [8].
- The iliopectineal eminence is an anterior pelvic rim prominence at the union of the ilium and pubis [14].
- The iliopsoas muscle/tendon traverses a groove between the iliopectineal eminence and the AIIS [14].
- The acetabulum is normally anteverted 15 degrees and obliquely oriented in the coronal plane 45 degrees caudally [14].
- The posterosuperior articular surface of the acetabulum is thickened to accommodate weight bearing [14].
- The inferior surface of the acetabulum contains the acetabular (cotyloid) notch, which is bound by the transverse acetabular ligament [14].
- The femoral neck is normally anteverted approximately 14 degrees in relation to the femoral condyles, with a range of 1 to 40 degrees [14].
- The femoral neck-shaft angle averages 127 degrees, beginning at 141 degrees in the fetus [14].

LIGAMENTS AND CAPSULE

- The hip is surrounded by a dense fibrous capsule extending from the periphery of the acetabulum to the intertrochanteric line of the femoral neck [8].
- The capsule enhances joint stability by preventing translation of the femoral head in the acetabulum [8].
- The iliofemoral ligament is Y-shaped, thickest, and strongest of the three main hip ligaments, with its medial portion connecting the AIIS to the anterior intertrochanteric line and its lateral portion attaching to the anterior greater trochanter [8].
- The iliofemoral ligament functions to limit external rotation, while its lateral arm in isolation limits extension of the joint [8].
- The ischiofemoral ligament extends from the ischial margin of the acetabulum to the greater trochanter of the femur, providing posterior support and restricting internal rotation motion [8].
- The pubofemoral ligament extends from the obturator crest of the pubic bone to the femoral neck and acts to limit abduction of the joint [8].
- Deep fibers from the iliofemoral, ischiofemoral, and pubofemoral ligaments merge to form the zona orbicularis, which circumvents the femoral neck [8].
- The hip capsule attaches anteriorly and posteriorly along the periphery of the acetabulum outside the labrum, and inferiorly to the acetabular labrum [9].
- The capsule attaches to the femur anteriorly along the intertrochanteric crest, while on the posterior side it attaches only partially, leaving the basicervical region of the femoral neck and intertrochanteric region extracapsular [9].
- The iliofemoral ligament becomes taut in full extension, preventing anterior dislocation and hyperextension of the hip [9].

- The twisted orientation of the hip ligaments provides a screw mechanism for the hip in full extension [9].
- The ligamentum teres originates in the cotyloid fossa and attaches on the fovea of the femoral head [9].
- The sacrospinous and sacrotuberous ligaments create the boundaries of the greater and lesser sciatic foramina [9].
- The piriformis muscle and the sciatic nerve exit from the greater sciatic foramen [9].
- The short external rotator muscles exit from the lesser sciatic foramen [9].

LABRUM

- The acetabular labrum is a fibrocartilaginous ring attached to the rim of the acetabulum that extends the articulating surface area and increases femoral head coverage [8].
- The labrum is triangular in cross section, which contributes to its ability to create a pressurized seal of the central compartment of the hip during loading [8].
- Only the external one-third of the labrum contains blood vessels, leaving the majority of the structure avascular and limiting its healing ability following injury [8].
- The labrum is highly innervated, with the presence of both mechanoreceptors and nociceptors [8].
- The labrum is absent in the area of the inferior acetabular notch, where the transverse acetabular ligament serves as the continuation of the labrum, connecting the anterior and posterior lunate surfaces of the acetabulum [8].
- The fibrocartilaginous labrum deepens the acetabulum, enhancing stability [5].
- Labral functions include load transmission, maintenance of vacuum seal, regulation of synovial fluid hydrodynamics, and joint lubrication [5].

MUSCLES

- The primary hip flexor muscles are the iliopsoas, rectus femoris, and sartorius muscles [16].
- The iliopsoas muscle has a large origin along the iliac crest, iliac fossa, sacra ala, iliolumbar ligaments, and sacroiliac ligaments [16].
- The iliopsoas muscle also has origins along the bodies of the T12 through L4 thoracic lumbar vertebra, the transverse process of the first through fifth lumbar vertebra, and the intervertebral disks [16].
- The rectus femoris crosses the hip and knee joints, with its straight head originating from the AIIS and its reflected head originating from the supra-acetabular tubercle [16].
- The sartorius muscle originates on the ASIS, crosses the hip and knee joints, and inserts on the medial aspect of the tibia and the pes anserine complex [16].
- The tensor fasciae latae muscle originates laterally on the anterolateral edge of the iliac crest, with its fibers combining with the fasciae latae to form the iliotibial band [16].
- The action of the tensor fasciae latae is to flex, abduct, and rotate the hip [16].
- Other flexors of the hip include the pectineus, adductor longus, adductor brevis, adductor magnus, and gracilis muscles [16].

- The gluteus maximus and hamstring muscles are the most important hip joint extensors [16].
- The abductors of the hip are predominantly the gluteus medius and minimus muscles [16].
- The gluteus medius has three different components: anterior, middle, and posterior [16].
- The external rotators of the hip include the obturator internus and externus, superior and inferior gemelli, quadratus femoris, and piriformis muscles [16].
- The piriformis forms the reference structure for the posterior part of the hip, with structures identified by whether they originate above or below it [16].
- The superior gluteal nerve and artery exit the pelvis above the piriformis muscle [16].
- The pudendal nerve, internal pudendal artery, nerve to the obturator internus, posterior femoral cutaneous nerve, sciatic nerve, inferior gluteal nerve, inferior gluteal artery, and nerve to the quadratus femoris exit the pelvis below the piriformis [16].
- In 10% of cases, the common peroneal component of the sciatic nerve can pass through the division in the piriformis [16].
- The most consistent internal rotators of the hip joint are the gluteus medius and tensor fascia latae muscles [16].
- The average range of motion of a normal hip is approximately 120° of flexion, 30° of extension, 45° of abduction, 20° to 30° of adduction, 35° of internal rotation, and 45° of external rotation [16].

NEUROVASCULAR ANATOMY

- The medial femoral circumflex artery is the main blood supply to the femoral head in adulthood [18].
- The lateral femoral circumflex artery gives rise to the anterior aspect of the extracapsular arterial ring [18].
- The superior and inferior gluteal arteries contribute branches to the extracapsular arterial ring [18].
- The ascending cervical arteries originate from the extracapsular arterial ring and are divided into lateral, medial, posterior, and anterior groups based on their relationship to the femoral neck [18].
- The lateral group of ascending branches is the main blood supply to the femoral head [18].
- The lateral epiphyseal artery penetrates the femoral head and is believed to be the dominant blood supply to the femoral head from this system [18].
- The artery of the ligamentum teres arises from either the obturator or medial femoral circumflex artery but does not provide sufficient blood supply to maintain the viability of the femoral head [18].
- The common femoral artery arises from the external iliac artery as it passes underneath the inguinal ligament [21].
- The common femoral artery passes anterior and medial to the hip capsule [21].
- The common femoral vessels are the most commonly reported extrapelvic vascular structures injured during total hip arthroplasty [21].
- The most common mechanism of injury to the common femoral vessels is errant retractor placement anterior to the acetabulum [21].

- The lateral circumflex artery arises from the lateral side of the proximal profundus femoris artery and has ascending and descending branches [21].
- The medial circumflex artery most commonly comes from the posteromedial profundus femoris artery and traverses between the pectineus and psoas muscles [21].
- The superior gluteal vessels are branches of the posterior division of the internal iliac artery and are closest to the hip as they exit from the sciatic notch [21].
- The inferior gluteal vessels and internal vessels are branches of the anterior division of the internal iliac artery and exit the pelvis between the piriformis and coccygeus muscles [21].

PATHOPHYSIOLOGY OF IMPINGEMENT

- Femoroacetabular impingement (FAI) is recognized as a common cause of hip dysfunction and secondary osteoarthritis [3].
- In FAI, distinct structural abnormalities produce repetitive impingement between the acetabulum and the femoral head-neck junction [3].
- Three types of FAI are recognized: cam, pincer, and combined cam/pincer [3].
- Cam impingement involves femoral-based abnormalities such as an aspherical femoral head, reduced head-neck offset, or femoral retroversion, resulting in repetitive abutment of the acetabular rim and femoral head-neck junction [3].
- Pincer impingement involves acetabular-based disorders such as acetabular retroversion, global overcoverage, and acetabular protrusio, creating abnormal abutment of the acetabular rim and femoral head-neck junction [3].
- Combined cam/pincer deformities are common [3].
- Impingement abnormalities can cause labral tears, degeneration, or ossification [3].
- Impingement abnormalities can cause acetabular cartilage delamination [3].
- Impingement abnormalities can cause secondary osteoarthritis [3].
- Patients with symptomatic FAI frequently present with activity-related groin pain exacerbated by hip flexion activities [3].
- Patients with symptomatic FAI may experience difficulty with prolonged sitting, walking, running, or pivoting [3].
- The onset of symptoms in FAI is often insidious or follows minor trauma [3].
- Mechanical symptoms secondary to labral and articular cartilage disease are present in patients with FAI [3].
- Patients with FAI exhibit restricted hip internal rotation in 90° of flexion [3].
- The impingement test (flexion, adduction, internal rotation) elicits pain in patients with FAI, though the test is not specific for FAI [3].
- The iliopsoas tendon can act as an obstacle to closed reduction in dislocated hips by stretching taut across the medial and anterior aspect of the hip capsule [13].

- The iliopsoas tendon contributes to the narrowing of the hip capsule through an hourglass shape, forming a capsular isthmus that reduces the diameter of the acetabular orifice [13].
- Chronic iliopsoas impingement is listed as a chronic soft tissue injury condition in the differential diagnosis of hip pain [20].
- Recalcitrant internal snapping hip secondary to chronic iliopsoas bursitis is a pathology of the peripheral compartment of the hip joint [19].

Investigations

RADIOGRAPHY

- Conventional radiographs remain critical in the initial imaging evaluation of the hip [2].
- A complete hip series usually consists of an anterior-posterior (AP) pelvis, a centered AP hip, a lateral view (frog-leg, cross-table, Dunn 45° or 90°), and a false-profile (Lequesne) view [2].
- The AP pelvis view is used to assess acetabular anatomy, including version, acetabular coverage, and femoral head sphericity [3].
- Various lateral views, most commonly the 45° Dunn view and frog-leg lateral, can be used to assess femoral head sphericity and head-neck offset [3].
- The Dunn 45° view may be more accurate for determining the alpha angle measurement than CT or MRI [2].
- Standard AP radiographs of the hip and pelvis are obtained to examine bony architecture, check for evidence of joint space narrowing or changes to bone quality, and quantify femoral head coverage [25].
- The Dunn view and frog leg view are appropriate to measure the α angle to determine the presence of impingement [25].
- Radiographs can be used to diagnose various conditions including fractures, developmental dysplasia of the hip (DDH), femoroacetabular impingement (FAI), and osteoarthritis [2].

MAGNETIC RESONANCE IMAGING

- MRI is the modality of choice for patients suspected of soft tissue or intra-articular pathology, given its superior sensitivity and specificity [25].
- Conventional MRI is effective at identifying osteochondral injuries, musculotendinous pathologies, and inflammation [25].
- Magnetic resonance arthrography (MRA) is more appropriate to determine injuries to the labrochondral structures and the ligamentum teres and identify the presence of loose bodies and synovial chondromatosis [25].
- The utility of MRA in the accurate detection and staging of articular cartilage lesions is reduced, with sensitivity reported to be less than 50% compared with arthroscopic findings [25].

- Recent advances in MRI imaging techniques, such as delayed gadolinium-enhanced MR imaging and T2* mapping, allow for a more in-depth analysis of the structure of articular cartilage [25].
- Delayed gadolinium-enhanced MR imaging and T2* mapping were effective at detecting early changes to the articular cartilage surfaces of patients with hip dysplasia and femoroacetabular impingement [25].
- MRI provides information regarding the integrity of the acetabular labrum and articular cartilage [3].
- The anatomy of the proximal femur as well as the version of the acetabulum and femur may be assessed using MRI [3].
- Sensitivity to acetabular rim chondral lesions is limited with MRI [3].
- Noncontrast MRI at 3T is generally adequate for diagnosing intra-articular pathology [28].
- If 3T imaging is unavailable, MRA can be considered at 1.5T for increased diagnostic accuracy [28].
- A prospective study found similar accuracies between noncontrast 3T MRI and 1.5T MRA in femoroacetabular impingement [26].
- In a retrospective study evaluating noncontrast 3T MRI versus hip arthroscopy, accuracy for labral tears was 98% and for acetabular cartilage lesions was 90% [26].

COMPUTED TOMOGRAPHY

- CT scans are effective for examining cortical and cancellous bone and can be used to create three-dimensional reconstructions of the hip for use in surgical planning [25].
- Measurements of femoral head coverage and acetabular and femoral impingement can also be performed reliably using CT images [25].
- Low-dose CT with three-dimensional reformats is particularly useful in surgical planning of complex or borderline deformities [3].
- CT overcomes the limitations of radiography by providing three-dimensional assessment of bony morphology and, to some degree, assessment of soft-tissue abnormalities [10].
- Combined with arthrography, CT can evaluate chondrolabral abnormalities, specifically in patients with contraindications to MRI [10].
- The multiplanar and 3D capabilities of CT make it an invaluable tool for assessing bone morphology, but at higher cost and radiation dose [28].
- 3D volume renderings are useful to aid in preoperative planning in FAI and subspine impingement [28].

ULTRASONOGRAPHY

- Ultrasonography provides real-time dynamic assessment of the hip and is useful in diagnosing soft-tissue abnormalities about the hip joint [10].
- Ultrasonography is particularly useful in providing real-time guidance during diagnostic and therapeutic procedures [10].
- Although ultrasonography is a valuable tool to examine pediatric hip conditions, its utility in evaluating the adult hip is limited [25].

- Ultrasonography can be an effective modality to identify musculotendinous disruptions, effusions associated with intra-articular pathology, or inflammatory conditions, such as bursitis [25].
- Ultrasonography is increasingly used for targeted injections into muscles, tendons, or intra-articularly around the hip [25].
- Ultrasonography allows bedside evaluation of the hip and can be used to guide interventions in the office setting [28].
- A higher frequency ultrasonographic beam can provide higher resolution images of superficial structures such as tendons and ligaments [29].
- Elastography is an ultrasonography technique that can assess the elasticity of soft tissues and identify pathology that changes the elasticity of soft-tissue structures, like tendinopathy [29].
- Elastography technology is used mostly in research studies but not for clinical use at this point [29].
- Ultrasonography cannot image inside bone because bone cortex reflects almost all sound waves [29].
- Internal joint structures are not well visualized unless they are in a superficial location [29].

GENERAL PRINCIPLES

- The complexity of the hip and pelvic region can make accurate diagnosis of painful conditions difficult [1].
- A thorough understanding of normal anatomy and biomechanics is necessary to identify pathology and determine the appropriate course of treatment [1].
- Because many hip conditions present with similar symptoms, a comprehensive clinical examination is required to determine a differential diagnosis [1].
- Findings from imaging studies should complement clinical examination findings to provide the most accurate diagnosis [1].
- A thorough history is essential to differentiating between common causes of hip pain [1].
- Clinical examination tests and imaging findings should be used to confirm a suspected clinical diagnosis [1].

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