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Research Article

Hip Pain: Relation to Anatomical Location and Underlying Pathology

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ARTICLE INFO

Article history:

Received: 27 May, 2021

Accepted: 14 June, 2021

Published: 28 June, 2021

Keywords:

Hip pain

anatomical location

intra-articular

periarticular

extra-articular

ABSTRACT

The purpose of this article is to provide a synopsis of the current medical understanding of hip pain highlighting its relation to anatomical location and underlying pathology. We describe the i) mechanism of the hip joint, ii) classification of hip pain, iii) prevalence of hip pain, iv) purported causes, v) associated risk factors, vi) clinical presentation, vii) diagnosis and classification, and viii) treatment options. A quiz serves to assist readers in their understanding of the presented material.

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The article begins with the following Advance Organizer Quiz to retrieve, use, and organize the materials presented in this paper.

Advance organizer – please answer true or false to the following questions:

- i. Hip pain can be classified as anterior, posterior, or lateral. TRUE
- ii. Hip osteoarthritis (OA) is a common cause of anterior hip pain in adults. TRUE
- iii. Lateral hip pain is generally localized to the region immediately superior to the greater trochanter. TRUE
- iv. Lateral hip pain is often caused by GTPS affecting bursa, tendons, and muscle. TRUE
- v. GTPS may originate from tightness in the muscle that travels over the hip and knee, resulting in compression and irritation to the hip area. TRUE
- vi. Patients with GTPS will have difficulty putting on their socks and shoes. FALSE; this is seen in patients with hip OA.
- vii. Diagnosis of hip OA includes physical examination findings, plain radiographs (to rule out fractures or calcifications). TRUE
- viii. Treatment of hip pain includes both non-surgical and surgical options dependent on underlying pathology. TRUE

Introduction

Hip pain is not an uncommon symptom in individuals of all ages and may be associated with numerous underlying causes or etiologies. Once present, hip pain can become persistent, problematic, and potentially debilitating compelling those who develop it to seek assistance from their health care practitioners. This article will identify various conditions that cause hip pain and highlight their clinical presentations. An approach to classify hip pain in the adult is presented with an emphasis on differentiating between the site of the hip pain and the likely underlying pathology related to its origin. In general, hip pain can be classified according to its location of the pain as anterior, posterior, and lateral. In addition, conditions that cause hip pain are classified according to their location within a joint (i.e., intra-articular), around a joint (i.e., periarticular) or outside a joint (i.e., extra-articular). Focused history-taking, physical examination (PE) techniques, laboratory testing and imaging studies are essential aids to evaluate the causes of hip pain and are reviewed. Non-surgical and surgical treatment options are presented to assist in the management of patients with hip pain.

Mechanism of the Hip Joint

The hip is the joint between the upper end of the thighbone (femur) and its socket in the pelvis. The hip joint is a stable, major weightbearing ball

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and socket synovial (fluid) joint with significant mobility, formed by an articulation (connection) between the pelvic acetabulum (the cup-shaped socket in the hip bone) and the head of the femur (the thigh bone) [1]. It forms a connection from the lower limb to the pelvic girdle (which are different in men and women related to function and size), and thus designed for stability and weightbearing. Comprised of bone, cartilage, ligaments, muscle, and a lubricating fluid, painful symptoms of a hip disorder will differ depending on the cause of the underlying disorder and the part of the hip joint causing problems [2].

Symptoms of Hip Pain

Commonly associated symptoms related to hip pain and disorder include antalgic gait (limping), reduced movement in the hip joint, referred pain (pain that may be felt in the buttock and leg), muscle stiffness, pain in the leg on weightbearing and swelling (Table 1) [3]. Without proper evaluation and treatment, hip pain can lead to significant functional impairment, disability, and interference with activities of daily living. When hip pain causes alterations in gait (or the way one walks) other parts of the body can be impacted as well. One example is the ability to ambulate (walk), which may potentially be limited to the point of debilitation (deterioration) if proper assessment and management are not undertaken in a timely manner.

Table 1: Common symptoms of a hip disorder.

- | | |
|----|---|
| 1. | Hip/groin pain |
| 2. | Limping |
| 3. | Reduced movement in the hip joint |
| 4. | Referred pain (may be felt in the leg or spine) |
| 5. | Muscle stiffness or swelling |
| 6. | Leg pain with weightbearing on that leg |

Classification of Hip Pain

While currently there is no consensus on how to classify hip-related pain in adults, one approach to classify hip pain is to consider the location of the pain as anterior, posterior, and lateral as it relates to the hip joint which is located in the groin (Table 2) [4]. Anterior hip pain is often due to hip joint pathology (consider osteoarthritis (OA), osteonecrosis (ON), or tumor), although the pain of acute onset may be due to labral injury, proximal hip flexor muscle strain or iliopsoas bursitis [5]. Femoroacetabular impingement (FAI) produces anterior hip pain that is often worse when the hip is moved to the extremes of its range of movement (ROM), especially internal rotation (IR) and external rotation (ER). Pain localized to the region of the adductor tendon origins may indicate adductor tendon pathology or referred pain from osteitis pubis [6].

Table 2: Classification of hip pain [5].

Location	Underlying pathology	Physical exam
Anterior hip	OA, ON, tumor, labral injury, muscle strain, FAI	Pain is worse at extremes of ROM (OA, ON, tumor, FAI), acute onset pain (labral injury), (localized pain at adductor tendon origins (adductor tendon pathology or referred pain from osteitis pubis).
Posterior hip and buttock	Labral tear, synovitis, chondral injury, proximal hamstring pathology, piriformis syndrome and SIJ pathology from L5-S1	Referred pain to buttock, lower back. Hip joint pathology may refer pain to leg or foot. Referred pain to leg or foot generally indicative of lumbar spine pathology.
Lateral hip	Tendinitis, tight muscles, GTPS, trochanteric bursitis and gluteus medius bursitis. Most often, i) bursitis, ii) hamstring strain, iii) ITB syndrome, iv) hip flexor strain, v) hip impingement syndrome, vi) groin strain, vii) snapping hip syndrome, viii) spine disorder	Referred pain down the lateral thigh to lateral knee along ITB associated with ITB tightness. Paresthesia and burning pain in lateral hip and thigh may indicate nerve entrapment. Pain in gluteal muscles may occur from muscle spasm or may be referred pain from hip joint. Bursitis pain presents when getting up from a chair, walking, climbing stairs and driving.

Posterior hip and buttock pain may indicate pathology within the hip joint (labral tears, synovitis, or chondral injuries) and can refer pain to the buttock or lower back, although proximal hamstring pathology, piriformis syndrome and sacroiliac joint (SIJ) pathology, and lumbar radiculopathy from the L5 to S1 levels should be considered [4]. Hip joint pathology may refer pain to the knee, while pain referred to the leg or foot generally indicates lumbar spine radiculopathy.

Lateral hip pain on the (lateral) side of your pelvis is more likely caused from tendinitis, tight muscles, or other conditions such as greater trochanteric pain syndrome (GTPS), trochanteric bursitis and gluteus medius bursitis [7]. Most often, this type of pain is caused by problems including i) bursitis, ii) hamstring strain, iii) iliotibial (IT) band syndrome, iv) hip flexor strain, v) hip impingement syndrome, vi) groin strain, vii) snapping hip syndrome, viii) spine disorder [5]. Bursitis pain most commonly presents with getting up from a chair, walking, climbing stairs and driving [5].

Common Conditions that Cause Hip Pain

In general, hip pain in adults may be caused by disorders occurring i) within a joint (i.e., intra-articular) such as avascular necrosis (AVN), arthritis, loose bodies, and labral tears [8]. Disorders occurring ii) around a joint (i.e., periarticular) include conditions such as tendinitis and bursitis [9, 10]. Referred causes of hip pain can develop iii) outside a joint (i.e., extra-articular) stemming from the lumbar spine or the sacroiliac joint and nerve entrapment syndromes [11]. Hip pain can involve any pain in, around or outside the hip joint. Common causes of hip pain often involve pain in and around the hip joint which may not be felt directly over the hip area but instead may present in the groin, thigh, or knee. In older adults, hip pain can be caused by a variety of conditions including, i) arthritis (osteoarthritis, traumatic arthritis, and rheumatoid arthritis), ii) pathology of tendons and bursa, and iii) muscle strain [12].

Hip pain may also be caused by problems in the bones or cartilage of the hip, including i) hip fractures which can cause sudden and acute hip pain [13]. Hip fracture injuries occur more often in people as they get older

because falls are more likely, and as people age, their bones become weaker. In addition, hip pain may be caused by ii) infection in the bones or joints, iii) osteonecrosis (ON) of the hip (tissue death from loss of blood supply to the bone), iv) arthritis which often presents in the front of the thigh or groin, v) labral tear of the hip, and vi) femoral acetabular impingement (abnormal growth around your hip that is a precursor to hip arthritis), causing pain with movement and exercises [5].

Prevalence of Hip Pain

Hip pain is common in adults and often causes functional disability and impairment. Among adults who play sports, the incidence of chronic hip pain is 30 to 40 percent [14, 15]. Among all adults over 60, the incidence of hip pain is 12 to 15 percent [16, 17]. In younger adults, hip pain related to labral injuries and synovitis are common [5]. GTPS and OA are seen more frequently with aging [5]. Hip pain related to referred pain are commonly seen in underlying lumbar spine pathology and aortoiliac artery insufficiency [5].

Clinical Presentation of Hip Pain

Accurate and early diagnosis of the underlying etiology of hip pain cannot be overemphasized. Delay in accurate early diagnosis can lead to mismanagement and progression of refractory (unmanageable) symptoms leading to a poorer overall prognosis. Hip conditions such as OA of the hip, lumbar spine referred pain, and pelvic pathology can be mistaken with other common causes of hip pain [18]. Thus, the sooner a diagnosis of the condition causing the hip pain is made, the sooner therapeutic measures can be implemented leading to improved clinical outcomes.

Patients with anterior hip pain due to OA or ON commonly present with persistent pain localized around the hip joint (generally located in the groin area). As noted in *Hip Osteoarthritis: A primer*, symptoms often present gradually and worsen over time or pain can have a sudden onset [19]. Pain and stiffness can present in early morning or after sitting or resting. As the condition progresses, painful symptoms may occur more frequently. Anterior hip pain of acute onset may be due to labral injury, proximal hip flexor muscle strain or iliopsoas bursitis [5].

Posterior hip and buttock pain is often referred pain to buttock and lower back. Hip joint pathology may refer pain to the leg or foot. Referred pain to the leg or foot, however, is generally indicative of lumbar spine pathology. Labral tears, synovitis, chondral injury, proximal hamstring pathology, piriformis syndrome and sacroiliac joint (SIJ) pathology from L5-S1 often present as posterior hip and buttock pain.

Lateral hip pain may present in the buttock and upper thigh and may become worse with weightbearing activities and side lying at night [18, 20, 21]. There may be associated radiation of pain down the lateral (outside) thigh to the knee. Pain may progressively worsen over time and be triggered or exacerbated by sudden unusual exercise, falls, prolonged weightbearing, or sporting overuse (i.e., commonly seen in long distance runners) [18, 22]. As a constellation of symptoms, GTPS of the hip is a leading cause of lateral hip pain and can be caused by abductor muscle

(gluteus medius and gluteus minimus) tendinopathy, gluteus tear and bursitis [13, 23]. Greater trochanteric, ischiogluteal, and iliopsoas bursitis are well-recognized causes of pain in the lateral hip region [13]. GTPS pain can be described as aching and intense at times of greater aggravation [24]. Symptoms of GTPS include lateral hip tenderness (near the greater trochanter), pain with weightbearing activities such as walking, climbing stairs, standing and running, referred pain to the lateral thigh and knee, pain with prolonged sitting, pain with resisted abduction, increased pain sitting with crossed legs, and side lying [22]. Pain is usually episodic and will worsen over time with continued aggravation. A sign of GTPS is weak hip abductors or the 'jump' sign where palpation of the greater trochanter causes the patient to nearly jump off the bed [21, 22].

Clinical Pearl: The ability to put shoes and socks on is a useful question to differentiate GTPS from hip OA; patients with GTPS will not have difficulty with this task [21].

Associated Risk Factors for Hip Pain

Local risk factors for hip pain include joint dysplasia and developmental disorders that can lead to structural joint abnormalities and can predispose to hip OA [19]. Trauma involving fractures involving the joint articular surface can lead to posttraumatic arthritis [19]. General risk factors for hip OA include age greater than 60-years-old, chondrocalcinosis (an age-related matrix change), sex (men greater than 50-years-old), excess body weight, genetics and certain occupations involving heavy manual work and high-impact sports are linked to hip OA later in life [19]. Risk factors for hip pain related to ON include high doses of glucocorticosteroids, alcohol use, sickle cell anemia, systemic lupus erythematosus, Gaucher's disease, pancreatitis (usually associated with corticosteroids), pregnancy, chemotherapy, smoking, radiation therapy, male sex (when alcohol abuse is an associated risk factor), female sex (when lupus erythematosus or corticosteroid use are associated risk factors) [25]. Risk factors for hip pain related to fractures include increasing age (bones tend to weaken with age), osteoporosis, multiple medication use, poor vision and balance problems [12]. Patients with underlying bone, cartilage or ligament conditions can develop hip pain [13]. Risk factors for hip pain from referred causes are associated with the underlying conditions such as lumbar spine radiculopathy and medical causes such as aortoiliac arterial insufficiency [5].

Physical Examination

A careful medical history should include a review of associated risk factors for hip pain followed by a focused clinical examination of the affected hip with comparison to the contralateral hip. Preliminary questions should be directed to health conditions (e.g., medications, trauma, previous surgery, chronic medical conditions, use of corticosteroids, smoking, and/or alcohol abuse). If a patient has been on prolonged corticosteroid medication use, screening for osteoporosis should be considered. General and specific questions on hip pain are included in (Tables 3 & 4).

Table 3: General questions to ask about hip pain [5].

1.	What activities aggravate hip pain? Most hip pain is aggravated by weight-bearing activities such as prolonged standing or walking, or more vigorous activity such as running.
2.	Did trauma precede the onset of pain (consider hip and pelvic fractures)?
3.	Inquire about medical history, medications (e.g., corticosteroids), and family history.
4.	Ask about active systemic symptoms, such as fever, fatigue, weight loss, and diffuse myalgia or bone pain, raise concern about a medical cause and warrant in-depth evaluation.
5.	Is there nocturnal pain in the absence of increased activity or lying on the affected side increases concern for systemic disease?
6.	Did patient have prior procedures or treatments for hip pain evaluation?

Table 4: Specific evaluation questions to ask about hip pain [18].

1.	Is there pain on activity or on side lying disrupting sleep? On PE, is there tenderness to palpation of the greater trochanter? Is there pain on straight leg raise (SLR) after 30 seconds? (GTPS)
2.	Is there morning stiffness, associated groin pain and progressive nature of symptoms? Does the patient have difficulty putting on socks? On PE, is there reduced range of motion (ROM)? Is there pain with internal rotation and external rotation of the hip? (Hip OA)
3.	Is there low back pain? Is there radiation to a lateral hip? On PE, is there reduced range of movement? Is there tenderness to palpation of the back? Is there a positive straight leg raise (SLR)? (Lumbar spine disease with referred pain)
4.	When evaluating a patient with reported hip pain, it is wise to ask the patient to point to where the pain is.

On physical examination (PE), it is important to observe the patient ambulate and look for evidence of an antalgic gait (limp). Pain and weakness commonly present during gait or testing of hip muscle strength with hip abduction and extension [5]. Evidence of fever suggests an infectious etiology to hip pain. Focal palpation of the hip should detect the point of maximal point tenderness; in GTPS focal tenderness is present over the greater trochanter. Pain localized to the superoposterior aspect of the greater trochanter suggests greater trochanteric pain syndrome (GTPS). Pain and weakness with hip abduction and extension can assist with the diagnosis of GTPS. Examination of the feet is recommended observing for fallen arches and faulty foot mechanics that can maintain the condition [26].

Laboratory Testing

If an infectious etiology of hip pain is suspected, a complete blood count (CBC) and inflammatory markers (e.g., erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) concentration) may be helpful. Rheumatoid factor and cyclic citrullinated peptide antibody tests (expected to be within normal limits in OA) can be ordered if rheumatoid arthritis (RA) is suspected.

Diagnostic Imaging

- i. Plain radiologic films are the most widely used diagnostic test for anterior hip pain involving OA and ON. A grading system for radiological assessment described by Kellgren in 1963 identifies 4 grades of hip OA based on the degree of joint spacing narrowing, osteophyte formation, arthritic changes affected the bone margins, and gross deformity [19]. In hip ON, x-rays are used to first diagnose the joint or referred pain. In patients with lateral hip pain who have symptoms of GTPS, or soft tissue related conditions, plain radiographs are usually normal and not helpful in the diagnosis of GTPS and related conditions but may be helpful to exclude pathologies such as fractures [22]. Calcifications may be seen in the bursa or adjacent soft tissues. Radiologic evaluation of posterior hip pain including labral tears, synovitis, chondral injury, proximal

hamstring pathology, piriformis syndrome and SIJ pathology from L5-S1 is generally reserved to rule out other pathology.

- ii. Magnetic resonance imaging (MRI) is most effective for detecting early stages of ON and should be used to establish definitive dx. An MRI can assess size of ON lesion with abnormal texture. In soft tissue conditions, MRI demonstrates fluid collection within the affected bursa in the case of bursitis, as well as abnormal signal or discontinuity within the abductor muscle tendons in the case of tendinitis and tear.
- iii. Computed tomography (CT) scan can be useful in ON as it produces 3-dimensional picture of bone, helpful to distinguish pre- and post-collapse disease (less sensitive than MRI, significant radiation burden).
- iv. Ultrasound (US) in trochanteric bursitis shows a distended, fluid-filled bursa. US helps in guidance for fluid aspiration and analysis. US can also detect tendinosis and tendon tears of the abductor muscle tendons [27, 28].

Treatment Options

The optimal management of hip pain depends on the underlying pathology and diagnosis. In general, main goals of treatment should be to, i) manage load and reduce compressive forces across greater trochanter, ii) strengthen gluteal muscles, and iii) treat comorbidities. The majority of cases of hip pain can be successfully managed in primary care with, i) weight loss (obesity causes more stress to the hip muscles), ii) nonsteroidal anti-inflammatory drugs (NSAIDs), iii) targeted physical therapy with emphasis on strength training of the hip abductor in GTPS (hip strengthening is directly linked to symptom improvement), iv) load modification, v) optimization of biomechanics and vi) avoidance of activities that cause prolonged stretching of the hip abductors (weightbearing on one hip, sitting cross-legged, sleeping in a side-lying position with top knee flexed and touching the bed [26]).

Refractory or recalcitrant cases may require referral to musculoskeletal experts such as a sports medicine physician, physiatrist or chiropractor supporting further specialist evaluation and management [29]. Adjunct therapies may include therapeutic ultrasound (i.e., shock wave therapy)

and therapeutic laser treatments. Corticosteroid injections (CSIs) can be effective in recalcitrant cases. Surgical intervention is generally reserved for failed conservative measures.

I Non-Surgical Options

In acute phases of hip pain, once a working diagnosis is established, most hip pain can be managed with weight loss, rest, ice, soft tissue therapy,

Table 5: General measures to achieve successful recovery [15].

Maintain good posture at all times.	Avoid Slouching.
Good mattress support and sleep posture. Medium or firm mattress is recommended. Sleeping on back or with pillow between legs.	Avoid waterbeds, thick pillow tops and soft sagging mattresses. Avoid sleeping on stomach.
Use of shock absorbent shoes or an anti-fatigue mat, a footrest and limited standing.	Avoid high-heeled shoes or boots and excessive standing.
Wearing shoes with good arch support, arch supports or orthotics if needed.	Consider changing running shoes every 250 miles.
Select home exercises as prescribed by clinician.	Avoid self-prescribing home exercises.

For soft tissue conditions, such as GTPS and bursa-related injuries, exercise and load management are the cornerstone of an effective tendinopathy management [30]. Physical therapy should be tailored to the individual patient and have a specific focus during the early stages of gluteal strength and control [18]. As hip control improves, muscle strengthening should target the hip abductors [18, 20]. Reducing compressive loads on the gluteal tendons can be achieved by avoidance of positions of excessive hip adduction (such as crossing legs and ITB stretching exercises), and at night patients can sleep with one or two pillows between their legs [18]. Corticosteroid injections (CSIs) provide effective early, short-term analgesia in many cases of hip pain. CSI should provide an analgesic window in which the patient can fully engage with an effective rehabilitation programme involving targeted physiotherapy, load modification, and postural control [18].

II Surgical Options

Surgical treatment for anterior hip pain involving hip OA may include hip arthroscopy during the early stages of OA and provides only temporary relief with high conversion rate to total hip arthroplasty (THA). THA remains the surgical modality for hip OA and end-stage ON patients with intractable pain, for those who have failed conservative management and for those with severe functional impairment. Hip resurfacing surgery, generally reserved for younger patients who have failed conservative measures, remains an alternative to THA in a very specific subset of patients, usually young active men with large femoral heads.

For patients with posterior hip and buttock pain related to labral tears, synovitis, chondral injury, proximal hamstring pathology, piriformis syndrome and sacroiliac joint (SIJ) pathology from L5-S1, referral to an orthopaedic surgeon is indicated when patients fail conservative measures. Hip arthroscopy may be indicated for labral and chondral injuries. Spine surgery may be indicated for lumbar spine disease.

For patients with lateral hip pain, such as GTPS, surgery is generally reserved for recalcitrant cases of patients who have failed optimal conservative treatment options, and functional outcomes following surgery are generally good [31]. Surgical procedures are dependent on

joint manipulation, myofascial release (manual release of muscle tightness and soft-tissue adhesions), activity modification, therapeutic modalities (e.g., therapeutic ultrasound [shockwave therapy], laser therapy), taping, PRP injection, and pain relief medications (NSAIDs and/or acetaminophen). This should be done under clinician-directed care (for general measures to manage hip pain, see Table 5).

underlying pathology but may involve lengthening or release of the ITB band and fascia lata, repair of a gluteal tendon tear, minimally invasive endoscopic bursectomy, or open reduction trochanteric osteotomy [32-35]. The criteria for surgical intervention in refractory cases of GTPS remain ambiguous and not well-established [32, 36].

Conclusion

Accurate and timely diagnosis of the cause of hip pain cannot be overemphasized. If left untreated, progressive hip pain, disability and functional impairment can cause further unnecessary damage to tissues and joints that affect the biomechanics in other joints. In addition, delay of treatment and mismanagement can worsen prognosis due to progression of recalcitrant symptoms leading to ongoing intolerable pain and disability. Utilizing anatomical site of the hip pain within emphasis on the location around, within or outside of the pain may assist in differentiating the underlying condition causing the pain. For patients with anterior hip pain, differentiating between gradual onset of pain and acute abrupt onset may assist in distinguishing whether the underlying condition is due to arthritis or osteonecrosis and soft tissue injuries. Patients' refractory to conservative measures are often indicated for surgery. For patients with posterior hip and buttock pain, targeted physical therapy, home exercises and CSI provide the mainstay of conservative measures. For those refractory to optimal non-surgical treatment options, surgical options are available to treat specific dependent underlying pathology. Accurate and timely diagnosis of lateral hip pain is particularly important to prevent progression of refractory symptoms. Conservative measures, including various therapeutic modalities, myofascial release and targeted hip control and muscle strengthening exercises, are recommended to alleviate pain and improve functional outcomes.

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