Labral Tears

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Pathology

The acetabular labrum is a 2–3 mm thick fibrocartilaginous structure which attaches to the rim of the acetabulum. One of its primary functions is to provide additional stability by deepening the acetabulum [1]. It also functions in shock absorption, pressure distribution, and joint lubrication. It has been reported that the prevalence of labral injuries is anywhere from 22% to 55%, occurring more in females than males [2]. The labrum can be torn secondary to high forces at the hip joint, chondral degeneration, or repetitive microtrauma associated with repeated twisting and pivoting [3]. Isolated lesions occurring from trauma tend to occur more frequently in younger patients while tears secondary to degenerative joint changes are more common in older individuals. Injury is commonly associated with sports where repetitive external rotation occurs such as in ballet, golf, hockey, and soccer [2]. In addition to external rotation, end range motions of hip hyperextension, hyperflexion, and hyperabduction are thought to contribute to injury as the labrum plays a role in pressure distribution and weight bearing [4]. Other factors associated with labral injury

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include femoral acetabular impingement (FAI), laxity/hypermobility, and hip dysplasia [5].

There are two forms of FAI: pincer and cam impingement. Pincer impingement occurs when the acetabulum creates excessive coverage over the femoral head. This can lead to impaired hip mechanics, thus leading to posteroinferior chondral lesions [5]. These lesions can be localized or circumferential. Movement at the hip can result in pinching of the labrum between the acetabular rim and the femoral neck, resulting in degeneration and bony apposition of the adjacent rim [1].

Cam impingement occurs when there is abnormal contact between the femoral head and the acetabulum due to an unusually large femoral head radius. This also leads to dysfunction of normal joint mechanics inadvertently causing anterosuperior labral and chondral lesions [4, 5]. The labrum gets caught between the abnormal femur and the normal acetabular rim, especially during flexion and internal rotation [1].

Capsular laxity and hypermobility decrease hip stability thus increasing the chance of injury. Joint hypermobility can occur in patients with dysplasia due to the shallow acetabular socket resulting in decreased coverage of the femur anteriorly and laterally. This can lead to compression of the labrum, resulting in tears most often occurring at the anterior labrum [5].

Positioning of the femoral head within the acetabulum is compromised in patients with hip dysplasia resulting in joint incongruity or decreased joint surface area. Consequently, this increases stress on the acetabulum and the labrum, potentially causing detachment of the labrum from the acetabulum. Patients with hip dysplasia tend to have hypertrophic labrums occurring in the anterior portion. The hypertrophy likely contributes to the impingement of the labrum between the acetabulum and femoral head [1].

Clinical Presentation

The presence of a labral tear is often associated with complaints of anterior hip or groin pain, locking, clicking, catching, instability, and giving away; about 61% reported an insidious onset [1]. In some

cases, patients report buttock pain as well as posterior and/or lateral hip pain. This can be indicative of a posterior labral tear, although pain in these locations is more commonly associated with lumbosacral spine pathology, posterior hip musculature injuries, trochanteric bursitis, and/or iliotibial band syndrome [5]. Apart from pain, which 90% of patients complain of, clicking is one of the most common symptoms associated with labral tears [6]. Typically, patients report constant dull pain with intermittent sharp pain brought on or worsened by activity [1]. Symptoms can be exacerbated with pivoting, squatting and hip movements in various directions [6]. After provocation, pain typically persists even after rest [1]. In many cases, the duration of symptoms reported by a patient prior to appropriate diagnosis averages about 2 years. This may be due to the difficult nature of identifying labral tears as the source of hip pain [7]. In the case of labral tears associated with FAI, a common symptom includes anterior pinching pain with sitting. Medial thigh pain and morning stiffness is typical of injury secondary to degenerative changes. Patients with capsular laxity often report pain with instability [8].

Physical Exam

The diagnosis of acetabular labral injury can be difficult to make as patient history and physical exam maneuvers lack specificity [6]. Accurate diagnosis is further challenging due to the plethora of hip pathology presenting with similar characteristics. Although this is true, a thorough history and physical exam accompanied with specific provocative maneuvers can help identify a labral tear. Anterior hip impingement tests and femoral acetabular grind maneuvers are most consistent with provoking symptoms of labral tear [6]. Other tests to consider when assessing for labral pathology include FABER, FADIR, hip scour test, and resisted straight leg test, which are described in detail in Table 3.1. One needs to bear in mind that these tests assess the presence of intra-articular lesions. With that in mind, a positive or negative finding alone does not rule a labral pathology in or out. Some provocative maneuvers, such as the scour and resisted straight leg raise may also strain the lumbosacral region helping to identify the location

Table 3.1 Provocative tests to assess for hip pathology

Name of test	Position	Maneuver	Positive finding	Differential diagnosis
Labral anterior impingement test	Supine	Examiner brings the patient's hip to 90° of flexion, 20–25° of hip adduction and maximal internal rotation	The test is considered positive if there is reproduction of anterior or lateral hip pain	FAI, labral impingement, anterior superior labral tear
Labral posterior impingement test	Supine	Start with the patient's hip in full flexion and adduction, then bring the patient's hip into extension, abduction, and lateral rotation	The test is considered positive if patient exhibits sharp catching pain with or without a "click"	Anterior hip instability, posterior inferior hip impingement, posterior labral tear
FABER	Supine	Patient's hip is brought into flexion, abduction, and external rotation (leg position looks like the number 4) with the lateral ankle resting on the contralateral thigh, proximal to the knee	Reproduction of pain in the Sacroiliac Joint (SIJ), groin, or posterior hip	Low back pain; SIJ dysfunction. Groin pain: FAI, labral tear, loose bodies, chondral lesion or hip OA. Posterior hip pain; posterior hip impingement
FADIR	Supine	Patient's knee and hip are brought to 90° of flexion with adduction and internal rotation at the hip	The test is considered positive if there is reproduction of patient's pain	FAI, labral tear, loose bodies, chondral lesion, or hip OA

Table 3.1 (continued)

Name of test	Position	Maneuver	Positive finding	Differential diagnosis
Hip Scour test	Supine	Patient's hip is brought into 90° of flexion and the knee in full flexion. The examiner applies a downward force through the femur while adducting and externally rotating at the hip. The same is done with abduction and internal rotation of the hip	The test is considered positive if there is reproduction of patient's pain	Labral pathology, osteochondral defects, acetabular defects, OA, and femoral acetabular impingement syndrome
Resisted leg test	Supine	Patient actively flexes hip to 30° with knee extended against resistance	The test is considered positive if there is reproduction of the patient's pain and or weakness with resistance	Athletic pubalgia, slipped capital femoral epiphysis, FAI

Lewis CL, Sahrmann SA (2006) Acetabular Labral tears. Physical Therapy 86:110–121; Martin RRL, Enseki KR, Draovitch P, Trapuzzano T, Philippon MJ (2006) Acetabular Labral tears of the hip: Examination and diagnostic challenges. Journal of Orthopaedic & Sports Physical Therapy 36:503–515

of symptoms. In doing so, one can better identify if the etiology originates from the hip or lumbosacral region. If there is high suspicion for a labral tear, associated factors such as FAI, capsular laxity, and articular cartilage degeneration should also be assessed [1].

Diagnostic Studies

Diagnosis of acetabular labral pathology can be challenging due to the lack of specificity in the clinical history and physical exam in addition to overlapping symptoms with similarly presenting intra-articular hip disorders such as snapping hip syndrome and/or femoroacetabular impingement (FAI). Imaging serves as a supplemental tool to help confirm the appropriate diagnosis. Imaging work up should include initial plain radiographs of the hip joint to rule out other sources of disease such as osteoarthritis, dysplasia, deformity, fracture, loose bodies [9], and to look for underlying structural abnormalities that may be the cause of the labral tear. Pertinent views include standing AP pelvis, AP hip, frog-leg lateral, Dunn, cross-table lateral and false profile view. These views allow for specific detection of subtle developmental dysplasia of the hip (DDH) or FAI. MRI can be used for diagnostic evaluation of labral and chondral lesions however offers false positive rates and low sensitivity; furthermore, MRI may underestimate labral pathology. If MRI is utilized, irregular labrum shape, a non-triangular labrum, a thickened labrum with no labral recessus, a labrum with increased signal intensities on T1 images, and a labrum that has detached from the acetabulum are suggestive of labral tear [10]. Definitive diagnosis of labral injuries is by direct visualization with arthroscopy and has four morphological classifications: radial flap, radial fibrillated, longitudinal peripheral and unstable (Table 3.2).

Table 3.2 Arthroscopic morphological classification of labral tears

Classification	Morphologic finding
Radial flap	Disruption of the free margin of the labrum with consequent formation of a discrete flap
Radial fibrillated	Appearance of a shaving brush Hairy appearance at the free margin of the labrum
Longitudinal peripheral	Variable length along the acetabular insertion of the labrum
Unstable	Reflection of abnormal labrum function rather than shape; subluxing acetabular labrum

Lage, Lafayette A., Jig V. Patel, and Richard N. Villar. The Acetabular Labral Tear: An Arthroscopic Classification. *Arthroscopy: The Journal of Arthroscopic & Related Surgery* 12.3 (1996): 269–72. Web [17]

Magnetic resonance arthrography (MRA) with intra-articular contrast, however, is the imaging modality of choice when labral pathology and/or chondral injury is suspected due to its high specificity and sensitivity when compared to plain MRI [11, 12]. Most labral tears occur at the anterior superior labrum with MRA showing a linear hyperintense T2 signal intensity contacting the labral surface with associated findings of subchondral bone marrow edema and/or cystic changes, osseous fragmentation at the superior acetabulum and paralabral cysts which by themselves are a highly specific finding for labral injury [9]. A classification system based on MRA findings is provided by Czerny et al. [13] (Table 3.3). In addition to MRA findings, diagnostic intra-articular anesthetic or steroid injection can be used to confirm intra-articular etiology of hip pain if reduction in pain is correlated with MRA findings [12].

Table 3.3 MRA classification of labral tears

Stage	MRA finding
0	Homogeneous low signal intensity, a triangular shape, and a continuous attachment to the lateral margin of the acetabulum without a notch or a sulcus; labra had a recess between the joint capsule and the labrum (labral recessus) that consisted of a linear collection of contrast material extending between the cranial margin of the acetabular labrum and joint capsule
1A	Area of increased signal intensity within the center of the labrum that did not extend to the margin of the labrum, a triangular shape, and a continuous attachment to the lateral margin of the acetabulum without a sulcus and revealed the labral recessus
1B	Similar to stage IA labra, but the labrum was thickened and no labral recessus was present
2A	Extension of contrast material into the labrum without detachment from the acetabulum, labrum were triangular, and had a labral recessus
2B	Same as stage 2A except the labrum was thickened and a labral recessus was not present
3A	Labra were detached from the acetabulum but were of triangular shape
3B	Labra were thickened and detached from the acetabulum

Czerny, C et al. Lesions of the acetabular labrum: accuracy of MR imaging and MR arthrography in detection and staging. *Radiology* vol. 200(1) (1996): 225–30. https://doi.org/10.1148/radiology.200.1.8657916

If diagnostic intra-articular injection is being considered to confirm labrochondral pathology, imaging guidance with ultrasound or fluoroscopy is recommended due to high miss rate of non-image-guided procedures [12]. Table 3.4 summarizes the diagnostic imaging workup for acetabular labral tears.

Table 3.4 Diagnostic modalities

Imaging modality	Views	Findings[a]	Utility
Plain radiograph	• AP pelvis • Cross table lateral • ± Frog lateral view • False profile view	• Usually normal	• Evaluates underlying structural abnormalities of hip and pelvis • Rules out other causes of pain
MRI	• Standard without contrast	• Irregular labrum shape • Non-triangular labrum • Thickened labrum with no labral recessus • Labrum with increased signal intensities on the T1 images • Labrum that has detached from the acetabulum	• Evaluate labral and chondral pathology • Low sensitivity
MRA	• + Gadolinium/ contrast	• Contrast extending into the labrum • Contrast extending into acetabular/labral interface • Blunted appearance of labrum • Displacement/ detachment from underlying bone	• Modality of choice • Rules out other hip abnormalities • Great for anterior labral tears but not posterior and lateral tears

Table 3.4 (continued)

Imaging modality	Views	Findings[a]	Utility
Arthroscopy	• Direct surgical visualization	• Radial flap • Radial fibrillated • Longitudinal peripheral • Unstable[b]	• Gold standard • Allows for comprehensive evaluation of labral anatomy • Diagnostic and therapeutic
Intra-articular steroid injection (image guided)			• Confirms intra-articular pathology • Prognosticates response to future surgery if needed • Sensitive and specific for intra-articular pathology

[a] Findings that are specific to labral tears

[b] Lage, Lafayette A., Jig V. Patel, and Richard N. Villar. The Acetabular Labral Tear: An Arthroscopic Classification. *Arthroscopy: The Journal of Arthroscopic & Related Surgery* 12.3 (1996): 269–72. Web [17]

Treatment

Non-operative Management

Pharmacologic

Conservative management of labral tears is first line and is guided by pain, mobility, and functional limitation. Treatment usually consists of a 2–4 week course of non-steroidal anti-inflammatory medications (NSAIDs) however, hepatic, gastrointestinal, cardiac, and renal side effects of NSAIDs limit its prolonged use and must be considered on an individual basis. Chronic NSAID use is not recommended. Relative rest, activity modification, and offloading the joint as well as therapeutic exercise aimed at improving femoral head motion within the joint and improving biomechanics around the hip should accompany the initial treatment plan.

Physical Therapy

Therapeutic exercise consists of a 4–12 week focused formal physical therapy (PT) program after which the patient should be reassessed for functional improvement and reduction in pain [1]. The PT program should optimize the alignment of the hip joint and precision of joint motion by avoiding excessive force to the anterior hip joint, correcting movement patterns during gait and exercise and minimizing pivoting motions [14]. A comprehensive therapeutic exercise regimen seeks to restore range of motion (ROM) and strengthen the hip flexors, abductors, external rotators, and extensors. Special emphasis on the correction of knee and hip hyperextension during stance phase is especially important to combat faulty gait patterns and improper gait mechanics. Functional lifestyle modifications should include avoiding sitting in excessive hip flexion, sitting cross-legged, sitting with hip rotated, sitting on the edge of a seat with hip flexors contracted, and avoidance of quadriceps and hamstring weight training [14].

Interventional and Regenerative Medicine

Aside from the diagnostic utility of intra-articular anesthetic injection and prognostic utility of intra-articular steroid injection, intra-articular steroid injection can be used as a therapeutic modality for temporary pain relief if chondrosis or wearing of articular cartilage is present [12].

Indications for regenerative treatments include mild-moderate joint effusion/synovitis, hyaline cartilage degeneration, and fibrocartilage tears/degeneration [15]. The acetabular labrum is a ring of fibrocartilage that lines the border of the acetabulum and thus would benefit from regenerative treatments specific to fibrocartilage including lipoaspirate positive (LA+) platelet-rich plasma (PRP), amniotic membrane, bone marrow concentrate (BMC), and dextrose prolotherapy [15]. Large, detached labral tears are the least likely to respond to regenerative therapy due to vascular supply and limited healing capacity and thus should be referred for surgical evaluation.

1. Platelet-rich plasma

   PRP delivers a supraphysiological concentration of platelet-derived bioactive factors that are capable of modulating

inflammation and promoting tissue healing. PRP has been injected, clinically, into tendons, ligaments, and joints to improve pain and function with variable results and is currently used "off label" due to no FDA-approved indications [15]. Lipoaspirate positive (LA+) denotes the process by which adipose tissue is removed from the body and used to perform fat grafting or lipotransfer to another part of the body, in this case to a torn labrum. Whole LA serves as a structural scaffold for large fibrocartilage tears or hyaline defects thus supporting the healing defect of a partial labral tear. PRP can be leukocyte rich (LR) or leukocyte poor (LP); LP PRP creates a stronger fibrin matrix, LR-PRP stimulates greater inflammation and vascular proliferation. LP-PRP is preferred for intra-articular use because it induces greater chondrocyte proliferation and has lower counts of inflammatory cytokines [15]. Although either can be used for labral tear, theoretically, LP-PRP may confer more benefit.

2. Amniotic membrane

   While there is no literature to support the use of amniotic membrane for labral tears, it contains numerous growth factors and collagen scaffolding that theoretically support its use to "fill in" the labral defect [15].

3. Bone marrow concentrate

   BMC is a concentrated form of bone marrow aspirate containing mesenchymal stem cells (MSCs) and bioactive substances obtained via aspirating bone marrow from the pelvic bone. MSCs inhibit apoptosis/cell death secondary to ischemia, inhibit scar formation, secrete large amounts of growth factor and promote angiogenesis which stimulates MSCs to continue on in a cascade that ultimately leads to tissue regeneration and healing [15]. BMC, however, does not contain an extracellular matrix which is needed to best fill labral defects; this should be taken into consideration when choosing an injectate as it may affect treatment response.

4. Prolotherapy

   This modality involves injecting irritant solutions, usually dextrose, into the labrum/labral defect with the hope of stimulating a low grade inflammatory reaction to promote tissue proliferation and healing.

According to Malanga and Ibrahim, an injectate containing LP-PRP, LR-PRP, adipose-derived mesenchymal stem cells (ADSC), BMC, amniotic membrane (AMG), or a combination of these can be injected into the acetabular labrum using ultrasound guidance. This can be followed by offloading of the hip with crutches for 2–5 days and/or a hip unloading brace for 4–6 weeks post injection; however, there is no literature to support a difference in outcomes with non-weight bearing after injection [15].

Operative Management

Referral to an orthopedic surgeon for surgical management is reserved for the patient who has failed to reach adequate pain control and optimal function with conservative management. Surgical intervention includes hip arthroscopy for labral debridement and/or labral repair. While the current literature supports the superiority of acetabular labral repair compared to debridement in terms of decreased rate of osteoarthritic progression and positive patient outcomes, there is no significant difference in the rate of progression to total hip arthroplasty up to 10 years later [16]. Labral repair, however, remains the gold standard for surgical treatment of labral tears. A good prognosis is anticipated with a positive response to intra-articular steroid injection; a higher degree of chondrosis and/or articular cartilage wearing is associated with poor prognosis after surgical intervention [9].

Return to Activities

Return to activities and/or play depends on the healing and location of the tear in addition to whether or not it responds to conservative vs. surgical intervention. With conservative management (i.e. a short course of NSAIDs and physical therapy) return to activity can occur as early as whenever pain is reduced and function is restored. However, because a labral tear is a mechanical issue, PT may result in only temporary resolution of symptoms with return of symptoms with full activity. Blood vessels supply only the peripheral one-

third of the acetabulum, the inner two-thirds are avascular resulting in poor healing potential based on location. In the case of poor healing, surgical management will likely be required for successful outcome especially for return to play in athletes [14]. In the case of surgical intervention, return to play can occur anywhere between 6 and 12 weeks depending on sport (cutting and running sports) or greater than 12 weeks if intervention for bony abnormalities occurred [9].

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