

Femoral Acetabular Impingement: An overview of Cause, Repair, and Rehabilitation

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It is common place for athletes to sustain muscular strains throughout their career. At times, those muscle strains can be located in the hip flexor or adductor muscle groups. Athletes will sit 2 – 3 weeks allowing for healing time with possibly another 5 – 8 weeks of rehabilitation. Athletes will eventually return to play with some re-injuring the same hip. Those athletes return to non-participation status, receiving treatment and rehabilitation to the injured area.

This scenario becomes an ongoing process over the following years. As an athlete progresses through their career, they continue to experience the same pain or worse. Time after time, the athlete is told that they have a hip flexor strain or groin strain. Not knowing any different, the athlete continues as instructed with the rehabilitation and treatment. Eventually through this process, the athlete has diagnostic testing done by means of an X-Ray or MRI. This diagnostic testing determines that the athlete has not been suffering from muscle strains of the hip flexor or groin muscles, but from a problem called femoral acetabular impingement (FAI).

Philippon et al. notes that the average time from onset of symptoms to treatment in numerous athletes was 2.5 years (1). In a similar study, Bizzini et al. described an average time for athletes to be 13 months (2). FAI can be difficult to diagnosis. The signs and symptoms of this injury often mimic those of a hip flexor strain or groin strain. While inflammation and muscle damage from a muscle strain resolve over time, the symptoms of FAI do not actually resolve. The symptoms of FAI will diminish with time and activity restriction, but the underlying issue never actually resolves.

Causes

FAI occurs for different reasons. The injury site affected is located either on the femur or the acetabulum of the pelvis and can include a cam lesion, a pincer effect, or a combination of both. A cam lesion occurs on the femur while the pincer effect occurs on the pelvis. For the cam lesion, the head-neck junction of the femur is involved. For the pelvis, the aspect affected is the acetabulum; specifically the rim. These aspects can be diagnosed with X-Ray, MRI, MRI with arthrogram, or CT Scans.

For the femur, the cam lesion can be caused by the head of the femur being drawn out distally length-wise toward the greater trochanter of the femur. This creates a cam, or a slight extended rounding of the area, and in turn affects the neck of the femur. The width of the valley that is created at the neck of the femur becomes reduced in size. When hip flexion, internal rotation, or a combination of the two movements occurs, impingement is created by the head contacting the acetabular rim. As stated by Philippon et al, in cam impingement, the “bump” at the femoral head–neck junction produces a shearing force, displacing the labrum toward the capsule and the adjacent articular cartilage into the joint. Softening of the articular cartilage can be observed as a “wave sign” when arthroscopically probed before frank chondral delamination. With repeated insults, the labrum may completely detach from the acetabular rim (4). For example, a wave sign could be correlated to when a door is pushed open causing a rug to bunch together, without the rug leaving the surface of the floor. Articular cartilage becomes soft and a shearing force is applied to the area causing the cartilage to bunch together without becoming unattached from the bone. Chondral delamination would then be the complete separation of articular cartilage from the bone due to shearing forces.

For the pelvis, the pincer effect occurs at the rim of the acetabulum. The rim is slightly thicker or wider. The thicker acetabular rim creates a deeper hip socket, which does not allow for enough room for the head and neck of the femur to rotate or

move without making contact. When contact is created due to movement of the femur, the pincer effect is created resulting in impingement. As stated by Philippon et al, the labrum is essentially trapped between the bony structures, thus it often bruises and flattens. With persistent pincer impingement, the labrum may degenerate, with cyst formation or ossification of the fibrocartilage. Persistent pincer impingement may lead to a chondral defect (a “contrecoup” lesion) at the posteroinferior acetabulum or posteromedial femoral head (4, 6).

A combination of a cam lesion and pincer can occur as well. With these two types of structures, it is highly probable that there would be increased opportunity for impingement to occur, more so than if only one of the underlying complications was present. The effects that would be seen or felt from FAI could be inflammation to the soft tissue around the area of question, a tear of the labrum attached to the acetabular rim, or even damage to the articular surface cartilage of the acetabulum. Recently, Philippon et al. reported their examination findings of the clinical presentations of FAI, which showed that hip flexion on the affected side was nine degrees less than the opposite limb, together with mean reductions of adduction (three degrees less), and internal rotation (four degrees less). They also showed that the impingement test was positive in 99% of athletes, and the FABER (Flexion, Abduction, and External Rotation) test was positive in 97%.

Surgical Repair

Surgical repair of a cam lesion/pincer effect can be performed through open area procedure or arthroscopic procedure. “Open surgical dislocation procedure for FAI decompression has been advocated to provide an unobstructed 360° view of both the femoral head and acetabulum. Although studies have shown good midterm results with this technique, the surgical trauma sustained during the open dislocation may make it difficult for high-level athletes to return to full activity (4). Arthroscopy can help to reduce trauma to the area by minimizing an invasive open area surgical repair with differences between the procedures being well documented, along with successful results (5, 6, 7).

In the arthroscopic procedure, two portals can be made on the antero-lateral aspect of the thigh. A burr is inserted through one of the portals. The burr is a device to reduce the size of the cam, essentially shaves or trims the bone. The burr is taken across the cam, trimming the cam and smoothing the area. This action results in a shortening of the length of the aspherical head-neck of the femur, reforming the head to a more functional structure (5, 6, 7). It also extends the length of the neck of the femur along with adding depth to the neck of the femur. Increased depth allows for greater clearance at the acetabular rim.

An important aspect to remember is that this is a three-dimensional problem that needs to be addressed when reducing a cam lesion. The neck of the femur is rounded in nature and thus the cam will also be rounded, aspherical, or oblong. The cam most likely does not just fall into one single plane, that being either transverse or coronal. Instead, the cam will fall into some combination of the two views. “The goal of cam debridement is to eliminate the bony prominence that impinges the labrum and acetabular rim, and restore the anatomic offset between the femoral head and neck,” (4). So the burr will need to be repositioned numerous times to remove the cam. Typically, the patient’s hip will be passively moved through different combination patterns, including but not limited to, hip flexion and internal rotation. This allows for the remodeling of the area to make sure that all contact points in question are being addressed. As those contact points are determined, the burr is then repositioned for remodeling of the area.

If the labrum of the hip is involved, the repair is similar to repairing the labrum of the shoulder. It can be done arthroscopically at the same time as the cam/pincer issue is addressed. If the tear is small in nature, the area can be repaired fairly easily. If the tear is through the mid-line of the labrum structure, it will essentially be stitched together. If the labrum structure is intact, but is torn away from the acetabular rim, the labrum has to be tacked or anchored back down to the bone (8, 9, 10).

Another possible addition to this surgical remodeling of the hip is a microfracture surgery of the articular cartilage or chondral surface of the head of the femur or the surface of the acetabulum. Microfracture surgical techniques have been described in depth (11) and appear to have successful results. Once the patient has been positioned and prepped, along with the introduction of surgical equipment to the body, multiple holes (or microfractures), are created on the subchondral surface of the affected area. These holes will elicit bleeding and the body will eventually create a clot in the area. The clot, once healed, will leave behind repaired tissue that is similar to the surface cartilage in the area. The depths of the holes, along with the number of holes created, are determined by the amount of trauma to the chondral surface of the injured area. The order to which these surgeries occur first depends wholly upon how many of the aspects listed above, the patient suffers from specifically.

Rehabilitation

The timeline for rehabilitation of FAI/Labrum surgery on average will be 4 – 6 months. Rehabilitation programs vary depending on what restrictions the operating physician has put in place. Those restrictions are usually a direct reflection as to how much trauma was present pre-surgery and how much trauma the body has to recover from post-surgery. The more aspects that need to be repaired, the longer the rehab will be. If other complications accompany FAI, such as a labrum tear, or microfracture surgery of the articular cartilage, the rehabilitation process could be drawn out further.

There are typically several different phases associated with the rehabilitation process for injuries and this is also true of FAI, labrum repair, and microfracture procedures. Those phases each have a set of precautions, a set of goals, and a set of criteria to progress through each phase of rehabilitation. Precautions can be as simple as pain management, inflammation management, range of motion (ROM) restrictions, or types of force used in certain exercises. Goals tend to focus initially on not harming the repair sites, but also include decreasing inflammation of the area, restoring ROM to certain parameters, restoring muscular activity, increasing strength and endurance, restoring proprioception, restoring cardiovascular conditioning, and eventually a return to activity/play. Criteria for progression to advanced phases typically requires the patient attain certain pain-free levels of ROM, proper neural-muscular involvement, a percentage of strength in the involved extremity, a normal gait pattern and proprioception. As rehabilitation programs of these types of injuries continue to adapt and change, parameters for the rehabilitation phases will continue to be changed as well (12).

Initially, the first 7 – 21 days post-surgery, the focus of the rehab will be on ROM. ROM exercises will be passive in nature. Movements that are done consist of straight-leg circumduction in both clockwise and counter clockwise directions, abduction to 20 degrees, internal/external rotation (log roll), hip flexion in the hip flexion/knee bent (90/90 degrees positioning) no further than 120 degrees, hip flexed/knee bent (90/90 degrees positioning) with circumduction both clockwise and counter clockwise directions. Some rehab protocols will have the patient on a stationary bike the same day post-surgery. The patient will need to use a continuous passive motion (CPM) machine also. Time spent in the CPM will range from 4 – 8 hours per day. ROM movements are continued through much of the rehab timeline and are modified at appropriate times as the patient moves further through the rehab process.

Transitioning from weeks two and three, up through week eight, strengthening exercises will be incorporated at appropriate times. Reestablishing firing patterns to different muscle groups becomes the initial focus. Isometric contractions of the quadriceps, hamstrings, and gluteus muscles are utilized (12, 13, 14). Open chain exercises that do not compact the joint or typically compromise the repair/surgery site are utilized. Other muscle groups that need to be emphasized are the adductors/abductors. Adductors can be activated through simple isometric exercises such as ball squeezes. Examples for abduction isometrics would be the use of a belt/strap or heavy resistive bands. Abdominal musculature can also start to be utilized during this time.

Utilization of a pool can begin as early as day four post-surgery during rehabilitation, depending on the specifics of the surgery. If the patient's incisions are not fully healed, a waterproof dressing will need to be applied to the area. The buoyancy characteristics of the water will help keep the joint from being loaded. The depth of the water used will initially need to be around chest deep. Once the patient becomes full weight bearing in day-to-day activities, the depth of the water can be lowered. The water allows for support to functional/gait training along with minor resistance for strengthening and proprioception.

Once the patient has been cleared for full weight bearing, usually around week eight, active ROM can start. Most likely, continued utilization of passive ROM will need to continue to occur. Closed chain exercises can start to be implemented (12). Most exercises will need to be simple to start with as in any initial program and progress to more difficult stages. When dealing with major muscle groups, a bi-lateral approach will need to be utilized initially. As the patient gains strength, the rehabilitation program can begin to focus on the single involved leg. An example of this would be utilizing the squat exercise. Initially, the exercise is performed involving both legs bi-laterally. As the patient becomes stronger, a single-leg squat will be used. When dealing with smaller muscle groups such as the deep internal or deep external rotators of the hip, those muscles will have to be addressed with a single-leg component completely. For example, in the standing position, an athlete will place the knee in flexion to 90 degrees, while resting that same knee on a stool that swivels. A light resistive band is attached to their ankle and a stationary object. The athlete then performs internal or external rotation. Internal/External rotation exercises with resistive bands can be used in the prone position also, either on the ground or a bench.

As the rehabilitation progresses and the patient gains muscular strength and endurance, a full function approach can be taken to complete the rehab process. Exercises at this point will include different movement patterns, change of directions while adding resistance or time parameters to the activity. Elastic cord exercises can be done with marching in place, lateral lunges in both directions, or even backwards stepping with emphasis on which leg is the push off leg or which leg is to step forward with when returning to the starting position. Other simple parameters can be specified such as length or distance of steps while maintaining parameters for technique or form. Initially, the first time with this type of exercise, a time parameter of 20sec activity/30 – 40sec recovery is a good starting point. As the athlete improves an increase to 40sec activity/60sec recovery, or 60sec activity/90 – 120sec recovery late in the rehabilitation process can be implemented. Recovery time can also be reduced as the athlete makes improvements. Foot touches for a set period of time can be another simple parameter that is implemented. Initially, an athlete may be required have two touches every two seconds. As the athlete improves in technique and form, the foot touch requirement could be altered to two touches every 1.5 seconds, eventually changing the requirement to 2 touches every second. Considerations will need to be made for the difference in exercise, however. Marching in place will be easier to achieve two foot touches every second in comparison to a lateral lunge where distance is traveled also.

Further progress can be made into sport-specific movements and on field transitional activities incorporated at appropriate times.

There are specific concerns in the rehabilitation process of surgical repair of FAI or associated pathologies (4,9,11). There can be limits set on ROM exercises early on due to stresses that are associated with end ranges of motion. Those limits directly reflect the type of repair that was done. For the osteoplasty of the FAI, concerns of impingement of the repair area, along with inflammation of the musculature are of concern. Restrictions on ROM and weight bearing activities will be implemented to help reduce those concerns. If a surgical repair of a labrum in the hip is performed, flexion of the hip will not be allowed past 90 degrees for at least the first 10 –14 days. The third week will see an increase in flexion ROM up to 120 degrees. Weeks 4 – 8 will see an increase in ROM up to 135 degrees or more. Abduction will be restricted to 0 – 45 degrees for the first three weeks. In weeks 4 – 8 an increase to normal end range of 50 –55 degrees will be seen. Zero degrees extension will try to be achieved by the end of the first week. Less than zero degrees extension could be attained by the end of week three. As the repair site heals and the area can handle more stress, ROM limits are then extended to greater ranges. For the microfracture of the articular surface of the acetabulum or femoral head, loading or sheering forces over the area of repair are of vital concern over the first eight weeks. A reduction in those types of forces will allow the new cells of the area to heal appropriately. Parameters for ROM exercises and weight bearing activities will thus be extremely important.

Conclusion

Injuries continue to be a prevalent aspect in sports. Evaluation and diagnosis from the initial onset of symptoms or injury is essential. A good patient history and examination, as well as the use of X-Ray, MRI, Arthrogram, or CT scan will help to avoid a prolonged course of rehabilitation of hip pain that has been misdiagnosed. This is of particular interest when one considers that the time from onset of symptoms to appropriate diagnosis is on average two years.

There are many considerations in regard to the type of surgery performed. Techniques and technology for those surgeries continue to advance and become refined. Rehabilitation programs also continue to be reevaluated, parameters redefined, and new rehabilitation programs have evolved. While there are potential negative aspects to surgical repair, advances that have been made to this point continue to indicate that there will be future successes.

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