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## The Vulnerability of the Acetabulofemoral Joint: Examining Acetabular Labral Tears in Classical Ballet Dancers

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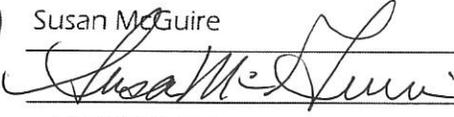
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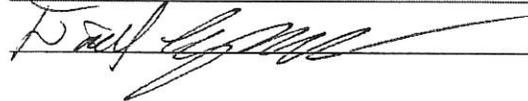
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**The Vulnerability of the Acetabulofemoral Joint:  
Examining Acetabular Labral Tears in Classical Ballet Dancers**

A Thesis

Presented to the Department of Dance

Jordan College of the Arts

and

The Honors Program

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In Partial Fulfillment

of the Requirements for Graduation Honors

Rebecca Tschan

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## Abstract

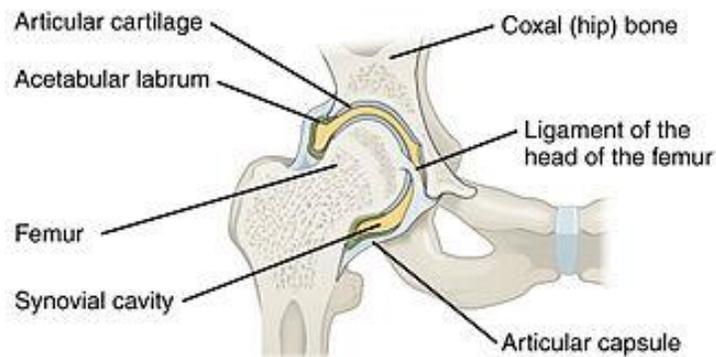
The acetabulofemoral joint, more commonly referred to as the hip joint, is an extremely important mechanism of the human body. It plays a crucial role in a person's ability to sit and stand, walk and run, jump and crouch, and more. Not only this, but the hip joint bears most of the weight of the body, making it necessary for the joint and surrounding anatomical structures to be strong and stable. Fortunately, hip joints are built in such a way that allow for an extreme range of motion while simultaneously providing support for the rest of the body. Additionally, the ball-and-socket construction of the hip joint makes it possible to flex and extend, abduct and adduct, and rotate our legs. In other words, the legs are able to move in nearly every direction, including forwards and backwards, outwards and inwards, and also rotate externally and internally. Comprised of bones, cartilage, muscles, ligaments, tendons, and a synovial membrane, the hip joint is required to be a well-oiled machine. However, the structural complexity and physical demand of the hip joint can make it susceptible to inflammation, degeneration, chronic, and acute injuries. Athletes, who naturally demand more from their bodies, place even more pressure on the hip joints. Classical ballet in particular requires the complex acetabulofemoral joint to move in every conceivable direction. As such, classical ballet dancers can become more prone to acetabular labral tears, a chronic, degenerative condition that affects the cartilage between the acetabulum and femoral head. While the injury can be treated conservatively or more aggressively—with arthroscopic surgery—dancers value every possible second of dancing. So, to what extent can classical ballet dancers with acetabular labral tears safely manage their pain without the need for arthroscopic surgery?

## Introduction

The acetabulofemoral joint is a ball-and-socket joint that connects the femur to the pelvis (*Figure 1*). It is the point where the top of the leg meets the torso. The femoral head (ball) of the leg sits in the acetabulum (socket) of the pelvis and is held in place by ligaments and tendons while also being supported by incredibly strong surrounding muscles. The bones, ligaments, tendons, and musculature, all work together to ensure a smooth and stable flow of movement of the leg. Due to the intricate anatomical nature of the hip joint, it can be categorized as one of the most complex and detailed joints in the human body. Not only is it responsible for bearing the majority of the body's weight, but the hip joint also requires the leg to move freely in space. Seeing as how the hip joint is largely responsible for a human's ability to sit, stand, walk, run, and jump, a lot is expected of the joint. The expectation becomes greater when rigorous activity demands more of it. Classical ballet requires extreme range of motion of the hip joint, creating an incredible amount of pressure and stress. As such, the joint can become susceptible to injury, specifically, acetabular labral tears.

**Figure 1**

### *Hip Anatomy*



(a) Frontal section through the right hip joint

(OpenStax College, 2013)

## **Acetabular Labral Tears**

Acetabular labral tears affect the specialized cartilage on the outside rim of the hip joint socket, or between the femur and acetabulum. This particular piece of cartilage, called the labrum, helps the femur head move smoothly within the acetabulum. It is a dense, fibrocartilaginous connective tissue that has various functions, including shock absorption, joint lubrication, pressure distribution, and overall joint stability (Groh et al., 2009). Increased pressure or stress on the hip joint can naturally lead to increased wearing and tearing of the labrum. While the labrum is designed to withstand some of this pressure and stress, tears in the cartilage can occur, especially in high performance sports. Naturally, athletes who demand a certain physicality from their body, are more at risk for developing labral tears. In fact, “the incidence of labral tears in high-demand athletes is increasing as awareness and knowledge of these injuries expands” (Bharam, 2006). Furthermore, improper development or structural abnormalities of the joint can also put individuals at a higher risk of developing a labral tear. While an isolated traumatic event can easily create a tear in the labrum, this thesis is more interested in the progressive deterioration of the labrum in relation to a high-level sport—classical ballet. Since this repetition-based artform expects so much from the acetabular joints, it is essential to examine how and why the combination of repetition and extreme range of motion can affect the acetabular labrum.

## **Acetabular Labral Tears in Classical Ballet**

A dancer’s hips are some of the most vulnerable and important joints in the body. In fact, the way they are shaped and formed set the standard for a dancer’s turnout, flexibility, and placement, all of which are essential to the life and career of a ballerina. However, repetitive

twisting and torquing motions of the hip, which are present in classical ballet, can lead to a destabilization of the hip joint, which, after some time, can lead to a chronically injured hip joint (Crawford et al., 2007). More specifically, in classical ballet, added stress is placed on the “anterior labrum at the acetabular interface where labral lesions commonly occur” (Kern-Scott et al., 2011). While there are many causes for a hip labral tear, dancers who exhibit extreme ranges of motion—who push their body past the normal physical limits—are definitely at greater risk. Even though hip pain is fairly common in classical ballet dancers, a clinic found that, over a 3-year period, 40% of dancers who were assessed and treated for hip pain were found to have labral tears (Kern-Scott et al., 2011). As the expectation for greater range of motion in classical ballet increases, this percentage of hip labral tears, will only increase as well. But by understanding the anatomy and function of the hip joint, dancers can take preventative measures to minimize hip pain and discomfort whilst dancing.

### **Personal Connection**

For a dancer, aches, pains, and injuries are unavoidable. They come with the territory, but most of the time, it is a small price to pay for the love and passion the artists have for their artform. Nevertheless, a chronic injury can plague a dancer’s physical and mental health. But despite this, a dancer will often have the tendency to push through the pain in hopes of landing a coveted lead role in a ballet or an elusive company contract.

Ever since I was diagnosed with a hip labral tear two years ago, I have come to understand the importance of physical therapy and general pain management. At the moment, my hip labral tear is non-displaced, and more importantly, asymptomatic, so surgery is not necessary just yet. Instead, I have been focusing on physical therapy as a means for relieving any

pain and discomfort. This means attending weekly physical therapy appointments and integrating several hip and core strengthening exercises into my daily routine in hopes of preventing the tear from worsening. I have talked to several dancer colleagues who have gone through the entire labral tear ordeal, many of whom opted to receive surgery, and the results truly vary from person to person. While some say that surgery was the best decision they could have made, others advised to hold off on the surgery for as long as possible. The extreme range of responses I have heard really inspired the premise of my thesis: To what extent can dancer's with hip labral tears manage their pain and discomfort without the need for a surgery that they will potentially regret?

### **Thesis Statement**

The empirical research I gathered and analyzed over the last year regarding acetabular labral tears has truly opened my eyes to the prevalence of acetabular labral tears in classical ballet dancers. Having had the opportunity to interview hip specialists, physical therapists, and other dancers with hip labral tears provided a plethora of insight as well. My hope is that, with this information, dancers become more aware of the subtleties of the hip joints and are able to take preventative measures to decrease the rate at which the labrum deteriorates. There is no denying that the combination of pressure, rotation, and extension in ballet has a lasting impact on the hip joint, and so, it is essential that dancers act in proactive manner rather than a reactive one.

## **Anatomy of the Hip Joint**

As mentioned previously, the hip joint is an extremely intricate part of the body that is made up of bones, ligaments, tendons, muscles, and cartilage, all of which work together to allow the leg to move freely. The combination of these anatomical structures also allows humans the ability to sit, stand, walk, run, and jump.

### **Skeletal**

The acetabulofemoral joint is essentially made up of just two bones, the femur and the acetabulum. The acetabulum is the socket of the pelvic bone and is cupped in such a way that the spherical shape of the femoral head can sit inside the cup. Since they form a ball-and-socket joint, the leg is able to move about freely and in nearly every direction with a great range of motion. The joint is also a concentric joint, “meaning the center of the ball and the center of the socket should be in the same position” (P. Meere, personal communication, January 24, 2021). This concentricity allows for a smooth range of movement, but if the concentricity begins to deviate, problems are likely to ensue, one of which being acetabular labral tears.

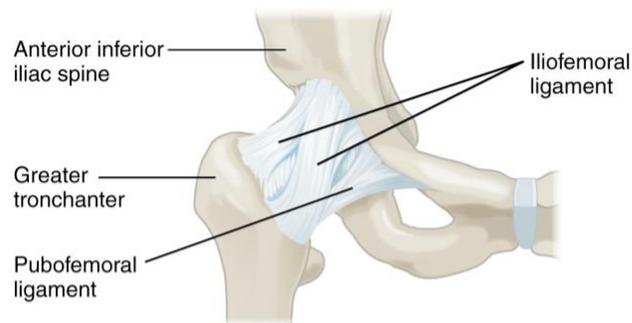
### **Ligaments**

With the help of ligaments, the ball-and-socket joint and the aforementioned concentricity becomes more stable. There are four main ligaments that surround the hip joint, and they can be classified as either intracapsular and extracapsular, meaning within the capsule of the joint or outside the capsule of the joint. The iliofemoral, ischiofemoral, and pubofemoral ligaments are all extracapsular while the ligamentum teres is intracapsular.

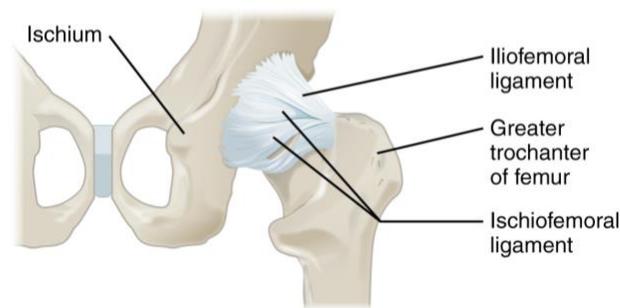
The iliofemoral ligament, also referred to as the Y-ligament, is the strongest out of the four ligaments and prevents the hip joint from hyperextending. It arises from the anterior inferior iliac spine and then splits into two branches before attaching into the intertrochanteric line of the femoral head, which gives it its “Y” appearance. The ischiofemoral ligament, on the other hand, is the weakest of the four ligaments. However, it still prevents excessive extension by spanning from the ischium to the back of the acetabulum to the base of the greater trochanter in a triangular fashion. The pubofemoral ligament connects from the pubis to the femur neck and reinforces the stability of the joint capsule by preventing excessive abduction. Lastly, the ligamentum teres, otherwise known as the ligament of the head of the femur, acts as an important hip stabilizer, preventing the femoral head from subluxation when flexing or abducting.

**Figure 2**

*Ligaments of Hip Joint*



(b) Anterior view of right hip joint, capsule in place



(c) Posterior view of right hip joint, capsule in place

(OpenStax College, 2013)

## **Musculature**

Since the skeletal structure of the hip joint allows for a freer range of motion compared to that of other joints, the muscles that support and surround the hip joint need to be quite large and strong. The gluteal group, which includes the gluteus maximus, gluteus medius, gluteus minimus, and tensor fasciae latae, support the hip from the buttocks, or the posterior part of the pelvis. The muscles in charge of adducting the thigh to the hip joint, are aptly known as the adductor muscle group, which include the adductor brevis, adductor longus, adductor magnus, pectineus, and gracilis. Not only do they pull the inner thigh up to the hip, but they also pull the leg inwards towards the opposite leg. The iliopsoas muscle consists of the iliacus and psoas major, and they connect the lower back to the upper part of the femur. In short, these muscles all help stabilize the hip joint in conjunction with the aforementioned ligaments, and, depending on how tight or relaxed these muscles are, the degree to which the hip can be flexed will vary from person to person.

## **Labrum**

The labrum is a fibrocartilaginous connective tissue that protects the acetabulum from the femur head, and vice versa. It is loosely attached to the acetabular rim and 1) prevents bone from rubbing against bone and 2) prevents dislocation of the femoral head. It also adds additional stability to the hip joint when exposed to tension. When the force distribution of the femoral head increases, the tension “becomes so great that the labrum, unyielding to this force, actually becomes stiffer than the adjacent articular cartilage, thus, stabilizing the joint” (Grant et al., 2012). As a result of this stabilization, a seal is created that obstructs fluid flow in and out of the joint. This seal allows pressure to be distributed more evenly, reducing the stress placed on the

cartilage when bearing weight. Nevertheless, being a fibrous tissue that is under constant stress, the labrum is subject to a lot wear-and-tear.

### **Motion**

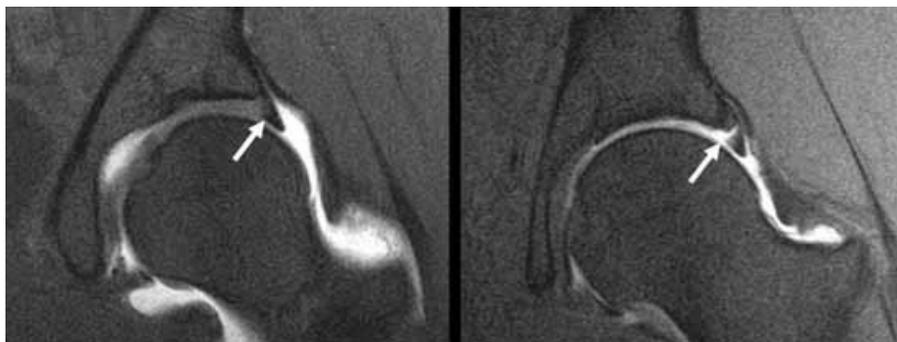
When the bones, ligaments, and muscles are developed properly, the hip joint is able to move very comfortably. Since the center of the axis of the hip joint is at the femoral head, the leg is able to flex, extend, adduct, abduct, and rotate along the transverse, longitudinal, and sagittal axes. For example, when walking along the sagittal dimension, the legs move in a forward/backward manner. Similarly, when sitting down in a chair, the hip joint must flex. These concepts can be applied to other automatic movements that are done without much thought on a daily basis.

## Acetabular Labral Tears

Acetabular labral tears occur when the labrum detaches from the hip or begins to degenerate, and they can be categorized by location (anteriorly, posteriorly, or superiorly), morphology (radial flap, radial fibrillated, longitudinal peripheral, or unstable), and etiology (Groh et al., 2009). Studies have found that most labral tears are situated in the anterior region of the labrum (*Figure 3*). Several reasons have been proposed as to why anterior labral tears are more common. First, since the anterior, or front, portion of the labrum has a poorer vascular supply, less oxygen and nutrients are delivered to that region, which could result in that specific section being more prone to degeneration. Second, the actual labrum is thinner and weaker in the anterior part of the labrum. Furthermore, the fibers of the labrum in the anterior region are parallel to the bony edge, making separation, due to traumatic forces, easier (Grant et al., 2012). In contrast, the fibers of the labrum in the posterior region are perpendicular to the bony edge, making that part of the labrum more resistant to tears. Last, it has been shown that simply more force, pressure, and stress is placed on the anterior portion of the labrum (Groh et al., 2009).

### Figure 3

#### *Acetabular Labrum*



Note MRI of normal acetabular labrum (left) and torn acetabular labrum (right) (Heard, 2016)

## Causes

I was fortunate enough to have the opportunity to speak with Dr. Patrick A. Meere, a board-certified orthopedic surgeon who specializes in hip and knee surgery. When asked how hip labral tears come to be, he explained that labral tears could either be classified as either traumatic or progressive (Appendix A). More often than not, hip labral tears tend to be caused by the latter. Dr. Meere went on to say that the wear-and-tear type injury of the labrum can often be attributed to structural deformities such as hip dysplasia or femoroacetabular impingement (FAI).

Hip dysplasia is a developmental condition whereby the hip joint forms abnormally, causing incomplete coverage of the femoral head from the acetabulum. With hip dysplasia, an important aspect is the amount of deviation from normative degrees of the center edge angle (Harris-Hayes & Royer, 2011). The center-edge angle refers to the alignment of the center of the femoral head in relation to the edge of the superior lateral edge of the acetabulum. If the angle begins to change as a result of the hip dysplasia, the labrum can become affected.

There is a mild to moderate degree of dysplasia that you can see on the superior lateral edge where there is no longer a sharp angle but rather a shallow angle, kind of like a upward rounded edge as opposed to a downward rounded edge, and that's when you know you have some migration or some loss of concentricity and that's when the labrum is being called upon to do the work of the acetabular edge to keep the socket in place. So, that causes a lot of sheer force across the labrum, and the labrum being a fibrocartilage, at some point has a yield point, and once you reach the yield point, that's when you start having problems and having detachments (P. Meere, personal communication, January 24, 2021).

In a nondysplastic hip, however, femoroacetabular impingement (FAI) is the primary cause of labral tears. There are two types of FAI that can present itself: Cam and pincer. Cam FAI refers to the loss of concavity of the head-neck junction of the femur (Harris-Hayes & Royer, 2011). Pincer FAI, on the other hand, refers to the excessive edge of the acetabulum, resulting in an over-coverage of the femoral head. Either way, the structural abnormality will limit the range of motion of the hip joint and “result in repetitive impact of the proximal femoral neck against the acetabular labrum” (Bedi et al., 2008). As a result, the progressive degeneration of the acetabular labrum can potentially be attributed to either hip dysplasia or FAI, or, in some cases even both.

## **Symptoms**

The most common complaint associated with acetabular labral tears is anterior hip pain or pain in the groin area. Other possible symptoms include a clicking or catching sensation when moving the leg or even a weak, giving way feeling consistent with hip instability. “Many patients with labral tears describe a constant dull pain with intermittent episodes of sharp pain that worsens with activity” (Groh et al., 2009). When the labrum is torn, the hydraulics of the joint are negatively affected and there ends up being an acceleration in the eccentric wear of the cartilage, creating a feeling of unsteadiness in the joint (P. Meere, personal communication, January 24, 2021).

I also had the incredible opportunity to speak with a professional ballet dancer who was diagnosed with an acetabular labral tear in her pre-professional days of training. She described that “there was this clunking in my hip that would happen every time I would lift my leg above 90 [degrees]” (Anonymous Dancer 1, personal communication) (Appendix C). When asked to

describe her pain level on a scale of 1-10 prior to surgery, she said that it was usually a dull ache that lingered around a two or three throughout the day. It typically just felt irritated, like it needed to pop, and all the muscles surrounding the joint were constantly tight since they were desperately trying to protect the torn labrum. She said that, at its worse, the pain could reach an eight or a nine. Another dancer that I spoke to described similar symptoms: “I would get snapping, clunking, and grinding. And then a lot of pulsing because it would get really angry and inflamed” (Anonymous Dancer 2, personal communication).

According to Dr. Meere, it is quite common for dancers to exhibit symptoms of hip problems in their early 20s, which is consistent with the dancers I spoke to. However, Wendy Whelan, one of the prima ballerinas of the 21<sup>st</sup> century did not experience her labral tear until very late in her career: “My whole career, 43 years of dancing, I’ve had such minimal pain. That’s a really lucky thing, but two of the last three shows, to cross from one side of the stage to the other, the pain I felt, just walking, was... it’s just shocking” (Saffire et al., 2016). This demonstrates just how different and individual each body is, but the fact of the matter is simple: Classical ballet puts an added pressure on the hip joint that can lead to a progressive degeneration of the protective layer of cartilage between the femoral head and acetabulum.

## **Diagnosis**

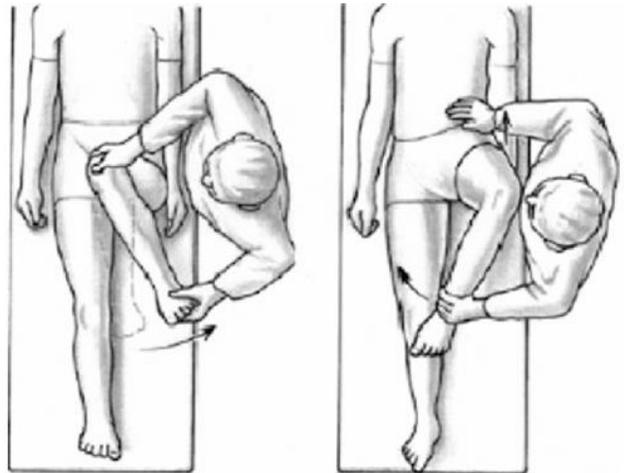
Odds are, if you ask the average person what an acetabular labral tear was, they would have difficulty describing where the injury was located not to mention what the injury entailed. Acetabular labral tears were previously thought to be uncommon injuries; however, they are “becoming diagnosed with increasing frequency,” with 22-55% of patients who present with hip

or groin pain being diagnosed with a labral tear (Groh et al., 2009). Furthermore, due to the relative newness of the injury, it can take 2 years before patients finally receive a diagnosis.

If a patient reports hip pain, with symptoms consistent with a hip labral tear, physical tests are the first to be performed. Dr. Meere mentions that it is important to consider the patient's gait pattern, overall elasticity, leg length, and overall range of motion before diagnosing a tear (Appendix A). But following these tests, an anterior hip impingement test is performed (*Figure 4*). A positive anterior hip impingement test is one of the most common and consistent ways to suggest a labral tear.

**Figure 4**

*Anterior Hip Impingement Test*



(Schwarzkopf, 2012)

Part of the range of motion is a challenge test, specifically the femoral acetabular impingement (FAI) test. This is when you bend the leg at 95-100 degrees and then you cross over to the midline and then twist in. So, what you're trying to do there is put pressure specifically on the anterior portion of the hip and you can find out whether or not there's a partially torn labrum; you will elicit tenderness there, and that's how you have a clinical diagnosis of a femoral acetabular impingement and, secondarily, a labral tear. (P. Meere, personal communication, January 24, 2021).

The combination of the anterior hip impingement test with other tests will typically be a good indication of an acetabular labral tear. Carrie Gaerte, a certified Physical Therapist and Athletic Trainer with St. Vincent Sports Performance, says that part of the reason for the increased incidents of identification of hip labral tears is because the physical therapy tests have gotten so good in identifying them. She described the tests she typically conducts on patients who present with symptoms consistent with hip labral tears:

There's a test called a SADIR test and it stands for hip flexion, adduction, and internal rotation. That position of the hip kind of impinges the joint, and so if there is any inflammation, that will tend to be painful. That can indicate two things: either a potential labral tear or just hip joint impingement which is irritation of the hip and inflammation of several structures. Then there's the hip scour test. You're taking the hip and literally just grinding it in the socket, creating some compression, and you flex the hip all the way towards the abdomen and you stir it around in the joint. A lot of times, if people have impingement, this can also be painful. When it's really eyebrow-raising is when you feel a palpable clunk or click or pop while you're scouring the joint and obviously if that's painful, that's a pretty telltale sign that there is a labral tear. And then the other hip joint test that can give you an indication of a labral tear is called a FABER test, and that stands for hip flexion, abduction, and external rotation (C. Gaerte, personal communication, March 22, 2021).

If some combination of these tests is positive, an MRI is the next thing to be performed, which will indicate the presence of a tear through detailed pictures of the labrum and the

surrounding cartilage and soft tissue. The MRI, however, should be a specialized MRI that is combined with an arthrogram. The arthrogram is quite necessary for the diagnosis of a labral tear because it requires the injection of a fluid contrast which will go into the leaflets of the tear and separate those leaflets. A regular MRI, on the other hand, will not explicitly show a tear. The imaging should also be done from multiple views; “There’s a special MRI that’s specific to labral tears where you look at different quadrants so you have a better understanding of the morphology of the dysplasia and find out how much retroversion or anteversion there is” (P. Meere, personal communication, January 24, 2021).

## **Acetabular Labral Tears in Classical Ballet Dancers**

The intense athleticism that is required of classical ballet dancers goes largely unnoticed most of the time. For an audience, visually, the ethereal quality overpowers the athleticism. Yet, that is the goal of every dancer: executing strength and control all the while projecting softness and gracefulness. The time, effort, and discipline that ballet dancers put into their craft is unparalleled; however, with this dedication and constant work comes the danger of injury. Sprains, stress fractures, and broken bones are all too common in the dance world, but it is the chronic and progressive injuries that can be the most detrimental. Acetabular labral tears are one of many degenerative injuries that can plague a professional dancers' career. The motions that are executed in the classical ballet technique put a lot of stress on the body, particularly the acetabular joint. For example, a *développé à la seconde* is a fundamental step in classical ballet whereby one leg is raised to the knee of the supporting leg, and then unfolded to an extended position directly to the side of you. Ideally, the extension should create an angle that is greater than 90 degrees. In addition, the extension is accomplished with maximum external rotation, which is another motion that puts added pressure on the hip joint. There have also been plenty of studies that focus on the repetitive motion of certain sports. It has been found that the repetitive external rotation, or hyperabduction, that is required in ballet, is more likely to result in labral tears (Charbonnier et al., 2011). It is also interesting to note that, due to the anatomical nature of the female body, there is an increased incidence of hip dysplasia in women which, in turn, can make women more prone to hyper arthritis and labral tears. Seeing as how the dance field is predominantly made up of women, labral tears in female classical ballet dancers become that much more common.

Classical ballet requires a constant external rotation known as turnout. This external rotation of the legs should be solely achieved through the hip joints, avoiding any compensation in the joints above or below the hip, most notably in the knee and ankle joints (Gupta et al., 2004). This external rotation is in constant practice. Whether it is during something as simple as standing in one of the five basic positions, or something more complex such as a pirouette, external rotation is necessary for the overall aesthetic look and fundamental success of the movement. Turnout, however, puts additional stress and pressure on the joint, and the “increased capsular tension can lead to injury of the static hip stabilizers, resulting in painful acetabular labral tears” (Rehmani et al., 2015). Thus, it is essential for the classical ballet dancer to understand the proper function and motion of the joint in order to minimize the stress that is placed on it because the extreme external rotation can cause the head of the femur to sit too far forward in the acetabulum, eventually causing it to give way (Rehmani et al., 2015).

One study conducted by Cianci et al. (2017) followed 76 adolescent patients, all of whom were diagnosed with labral tears. The researchers wished to examine the effects of nonoperative pain management of hip labral tears in these patients. Of the 76 patients, 18.4% were dancers and 7.9% were gymnasts. The researchers found it interesting that almost one quarter of the total participants were performing arts athletes whose sport required extreme flexibility and “moving the hips into extreme ranges of motion, especially in hip flexion and abduction directions” (Cianci et al., 2017). Continuing off of this, another study examined hip strength deficits in patients with symptomatic FAI and labral tears, and they determined that hip strength deficits were found in 92% of patients, with the most common deficits being seen with hip flexion and abduction (Nepple et al., 2015). In other words, a decreased range of motion and overall function. It is quite intriguing to know how big of a role hip flexion and abduction plays in

classical ballet, and yet, when it comes to the strength of the two respective movements, people with labral tears will often experience a lack of strength in their execution.

Furthermore, in classical ballet, a strong sense of muscle memory is required; and for muscle memory to take action, daily repetition of movement is essential. With this repetition, however, come pros and cons, a con of which being that the constant repetition leads to microtraumas (Rehmani et al., 2015). It is no wonder then, that overuse is the most common cause of injury in dancers. A prime example of the effects of repetition and overuse in classical ballet, is a study done by Charbonnier et al. (2010) that assessed the congruence and impingement of the hip joint in professional ballet dancers through a motion capture study. They found that movements such as *développé à la seconde*, *grand écarté facial*, *grand écarté latéral*, and *grand plié* all subjected the hip joint to impingement and subluxation of up to 5mm (Meuffels et al., 2018). These movements are done on a daily basis in ballet classes, and they all require an extreme range of motion in the hip joint. It is important to note that, for these movements, hip flexion and abduction are the main ranges of movement.

As mentioned in an aforementioned section, the presence of dysplasia or FAI in a hip joint can cause and accelerate the degeneration of the labrum. However, in classical ballet, the sole execution of repetitive and extreme movements can be equally responsible for the wear-and-tear of the cartilage. In fact, in one study, 30 dancers with labral tears were examined, all of whom did not have any form of structural abnormality in their hip joints, yet they still exhibited labral tears. It can be assumed then, that overuse was the probable cause of the labral tears in these dancers, and that “extreme compression forces places on the labrum during dance activities accelerate deterioration” (Kern-Scott et al., 2011).

## **Treatment Options**

When first diagnosed with an acetabular labral tear, a conservative treatment approach should always be recommended. When it comes to a labral tear, surgery should be the last option, and sometimes, when the tear is asymptomatic, surgery is not even necessary. Therefore, the first course of action should be rest, anti-inflammatory medicine, and physical therapy.

### **Rest and NSAIDs**

Rest and non-steroidal anti-inflammatory drugs (NSAIDs) are usually prescribed to patients who first receive a hip labral tear diagnosis. Unfortunately, rest is not a readily accepted option for classical ballet dancers. A lot of the time, dancers will continue dancing through minor injuries that can then escalate to major injuries. Even surgeons such as Dr. Meere recognize how competitive dancers are and how long they are willing to dance through pain: “Ballet dancers are a particular challenge, especially when it comes to feet and the lower extremities, and because it’s such a competitive field, they’re willing to sustain injuries and work through injuries a lot longer than others, so they’re self-destructive in a sense” (P. Meere, personal communication, January 24, 2021). As a dancer, I need to constantly remind myself that it is better to take a day or two off to rest in order to preserve my body, long-term. Particularly with an injury such as acetabular labral tears where the surrounding tissue becomes inflamed, it can be beneficial to rest to bring the inflammation down.

## **Physical Therapy**

Physical therapy is typically the next step in attempting to relieve the pain that comes with acetabular labral tears. Dr. Meere emphasized that patients should commit to six months of intense physical therapy before deciding to go the surgical route (Appendix A).

Physical therapists will employ various treatment methods to try and relieve the pain and discomfort associated with labral tears. Ms. Gaerte tends to use the Graston technique, which is an instrument-assisted soft tissue mobilization method that releases tension by helping to break down scar tissue. She will either scrape the affected area with Graston tools or use a cupping technique to make sure there are no fascial restrictions that might mimic a labral tear. She also mentions that, a lot of the time, the psoas muscle becomes irritable because it wants to help out and support the hip joint, creating trigger points in the muscle. And so, she will work on releasing those trigger points with these techniques—Graston and cupping—so as to effectively stretch the hip flexor without overstretching it (C. Gaerte, personal communication, March 22, 2021) (Appendix B). Physical therapists will also do a lot of pelvic corrections and mobilizations since the hip is encased in the pelvis. The reason for this being that a hip joint pathology will cause the surrounding muscles to become irritated, which might lead to them pulling on the pelvis in ways that can put the hip in a precarious situation.

Another non-surgical treatment option that can be done by physical therapists to relieve pressure is dry-needling. Similar to acupuncture, dry-needling uses a thin monofilament needle to penetrate the skin and release trigger points in the underlying musculature. It is primarily used for the management of neuromusculoskeletal pain that cause movement impairments.

Lastly, an important step in the physical therapy process is the strengthening of the surrounding hip joint muscles, most notably the gluteal muscles. Examples of exercises that

engage and strengthen these muscles include glute bridges, single-leg bridges, side-lying clamshells, and side planks with abduction. Ms. Gaerte explains that while the glutes are the largest muscle in the human body, they are, often, also the laziest muscles. Even when you have hip pain, the glute muscles tend to go to sleep because the hip flexor ends up taking over in the front, creating an imbalance. As a result, it is essential for patients to activate and strengthen the gluteal muscles to help support and stabilize the hip joint.

One of the dancers I interviewed said that physical therapy allowed her to strengthen her hips and glute muscles, giving her the chance to truly focus on correct alignment in dance classes (Appendix C). However, there came a point when she decided that physical therapy did all it could do; yes, physical therapy was helping, but the underlying problem was not going away. Labral cartilage cannot regenerate and heal itself like broken bones, so there was no chance for the labral tear to magically repair itself. She said that, for as long as the problem—the labral tear—had been persisting, and the for the amount of damage the labrum had taken, surgery was the best course of action: “There’s only so much you can do about the fact that there’s bone on bone. Even in proper rotation, proper placement, if your labrum isn’t there, it’s not going to buffer” (Anonymous Dancer 1, personal communication). Similarly, another dancer explained that physical therapy and cortisone injections were a short-term solution.

There comes a point when you simply cannot push through the pain any longer, and nonoperative treatment methods are no longer aiding in pain relief. As such, nonoperative pain management such as physical therapy can be beneficial for the short-term, but as a long-term solution, surgery might be necessary, particularly when there is structural abnormality present, such as FAI or hip dysplasia.

## **Arthroscopic Surgery**

As mentioned, surgery should only be considered as a last resort. Of course, if patients are in a lot of pain, their mobility has significantly decreased, and physical therapy is not relieving the pain, then surgery is, naturally, the next course of action. Even though a hip surgery is a hip surgery, Dr. Meere explains that the field of science has progressed rapidly, to a point where surgeons are extremely familiar with the procedure. He proposed a thought that many people struggle with: “At what point do you decide and say, ‘Look, right now, hip surgeries are so good, why are you making yourself miserable?’”

An arthroscopic acetabular labral tear repair surgery is a fairly quick, minimally invasive outpatient procedure that hopes to restore the labral suction seal and hip stability (Woyski & Mather, 2019). The recovery period following the surgery typically takes six months. Ms. Gaerte explains that, for dancers, it could actually take closer to a year before the dancer begins to feel normal again (Appendix B). However, it is comforting to know that with the advancement of technology and an increase in knowledge regarding hip labral tears, an increasing percentage of patients are able to return to higher levels of activity and rigorous exercise following a labral repair surgery (Woyski & Mather, 2019). It does depend on the severity of the tear and the type of surgery the patient ends up getting. Often, the labrum will be debrided, repaired, reconstructed, or augmented. However, it has been found that “excision of the labrum frequently results in a symptomatic hip with a greater frequency of resultant arthritis than when the labrum is preserved or repaired” (Grant et al., 2012).

Surgery, however, is still surgery. It is not something that should be done lightly, and there is always the risk for complication. Not only this, but the rehabilitation process following a hip surgery is extremely tedious. A lot of discipline and effort goes into making sure that the hip

joint heals correctly following the traumatic events of the repair surgery. After all, it is a minimum six-month recovery period that is dedicated to regaining strength, muscle mass, mobility, and range of motion. One of the dancers who had the surgery, took me through a step-by-step process of what her recovery time looked—and felt—like (Appendix C).

Two days after I got out of the hospital, I had my first PT session. The physical therapist looked at the hip and made sure everything was alright. She did the gentlest mobilization I've ever had done on my body, with the brace off. We practiced using crutches, and then I was on the standing bike. Zero resistance, and just very slow. I just remember feeling like, 'this is not my leg. It's so weak, I can't engage it'. So that was really freaky.

Eventually, the brace comes off. I was in physical therapy two or three times a week. I did mobility stuff, strengthening stuff. I would be on the bike. Then, eventually, I got down to one crutch one and a half months later. Two months later, I was completely off crutches. I had to be really careful though. At that point I started doing more bridges and clams. Lots of planking and core exercises too. The biggest thing was engaging the glutes, and not letting the lower back take over, or the hamstrings or the quads take over because even though the hamstrings really did need work, it was more like where they attached to the glutes that really needed the support (Anonymous Dancer 1, personal communication).

Returning to classical ballet following any surgery can be a long and difficult journey. During the recovery period, it is very easy for patients to take one step forward, and two steps backward, and this can be extremely frustrating and demoralizing, particularly for individuals

who have a strong love for a high-demand sport. As a result, Dr. Meere explains that, for dancers, there needs to be a very careful recovery tactic. He says, “You have to have a very special protocol to make sure they don’t go back too quickly or too ferociously because otherwise they can have complications associated with premature return to heavy stress activity” (P. Meere, personal communication, January 24, 2021) (Appendix A). Then again, every high-level sport will have athletes who emphasize a high rate of return following a surgery. Some studies have supported the idea that patients who participate in high-level sports, experience a higher rate of return to the sport after surgery due to “a higher baseline of athletic functioning, improved access to postoperative physical therapy, greater motivation to return to sports sooner” (Memon et al., 2018). Similarly, Dr. Meere concurs that dancers are very dedicated to their physical therapy following a surgery, making their overall recovery period shorter. When it comes to hip arthroscopies, studies have found that athletes will experience a high rate of return to their sport following the surgery (Memon et al., 2018). While the risk factors surrounding hip surgery still need to be considered, the fact that high-level athletes have the capacity to fully return to their sport following a hip arthroscopy is quite remarkable. Hearing first-hand how well a professional ballet dancer recovered from her surgery speaks volumes (Anonymous Dancer 1, personal communication). And the knowledge surrounding acetabular labral tears is only growing, implying that acetabular labral tear repair surgeries and recovery will only become more efficient.

## Conclusion

Dancers are always told that their body is their instrument; and they must take care of it. If your instrument is not in the best condition it can be, execution of the craft becomes substantially more difficult, particularly when the craft requires you to move your body in every way possible. Classical ballet dancers demand so much from their bodies, and it is very easy to push past the physical limits. The body can only endure so much, and when it becomes subject to daily stressors, things can start to give way.

The acetabular joint is a vulnerable joint that is susceptible to injury, especially when it has an unnatural amount of pressure placed onto it, which can be seen in the classical ballet technique. The extreme range of motion that is expected of ballet dancers can have a huge impact on the hip joint. Furthermore, the repetitive setup of ballet class can create damaging habits that unknowingly lead to microtraumas, which could eventually lead to a chronic injury. With acetabular labral tears in classical ballet, the constant external rotation of the femoral head in the acetabulum can create undue stress on the labrum, the fibrous cartilage that protects and stabilizes the hip joint. Due to unnatural force and torque of the legs, dancers are very prone to acetabular labral tears. Not only this, but when a dancer has structural abnormalities such as femoroacetabular impingement or hip dysplasia, the likelihood of tearing the labrum increases automatically.

My hope for this thesis is to educate classical ballet dancers, specifically, on the prevalence of acetabular labral tears. Throughout this research process, I have gained a plethora of knowledge regarding hip labral tears and hip labral tears in dance. And as an athlete who depends on her hips for her career, I think it is crucial for me to understand the mechanics behind

the hip joint, especially since I have been diagnosed with an acetabular labral tear. The truth is, the prevalence of acetabular labral tears is on the rise, so, how can we decrease the prevalence of this chronic injury in the dance world?

## Glossary

<b>Abduction</b>	movement away from the midline
<b>Acetabulofemoral joint</b>	more commonly referred to as the hip joint; a ball-and-socket joint
<b>Acetabulum</b>	the cup-shaped socket of the hip joint
<b>Acute injury</b>	an injury that occurs suddenly; a single, traumatic event
<b>Adduction</b>	movement towards the midline
<b>Anterior</b>	relating to the front of the body
<b>Anteversion</b>	rotational deformity where the femur twists forward (inward)
<b>Arthrogram</b>	series of images done by MRI after injecting a contrast medium
<b>Arthroscopy</b>	an outpatient procedure used to diagnose and treat conditions in joints
<b>Asymptomatic</b>	exhibiting or showing no symptoms
<b>Chronic injury</b>	an injury that is constantly recurring, or persisting for a long time
<b>Contrast (<i>chemical agent</i>)</b>	has magnetic properties which circulate through the bloodstream and get absorbed in certain tissues, which then stand out on an MRI scan
<b>Développé (<i>to develop</i>)</b>	a movement in ballet in which one leg is raised to the knee of the supporting leg, then unfolded to an extended position
<b>Dysplasia (<i>of the hip</i>)</b>	abnormal formation of the ball-and-socket joint
<b>Extension</b>	a straightening movement that increases the angle between body parts
<b>Femoroacetabular Impingement syndrome (FAI)</b>	a condition in which there the hip bones are irregularly shaped, causing them to rub together

<b>Flexion</b>	a bending movement that decreases the angle between body parts
<b>Flexor</b>	a muscle that flexes a joint
<b>Graston technique</b>	an instrument-assisted soft tissue mobilization method that releases tension by helping to break down scar tissue
<b>Labral tear</b>	a condition in which the cartilage of the ball-and-socket joint is torn; cannot heal on its own
<b>Labrum</b>	a piece of fibrocartilage attached to the rim of the hip and shoulder socket that acts a cushion and helps keeps the ball of the joint in place
<b>Lateral</b>	relating to the sides of the body
<b>Magnetic Resonance Imaging (MRI)</b>	a type of medical imaging test that is able to produce a detailed image of nearly every internal structure in the human body
<b>Medial</b>	relating to the middle/center of the body
<b>Morphology</b>	refers to the size, shape, and structure of a given anatomical structure
<b>Nonsteroidal anti-inflammatory drugs (NSAIDs)</b>	over-the-counter pain relievers (i.e. Advil, Motrin, Aleve)
<b>Physical therapy</b>	a rehabilitative treatment method that uses physical methods to help patients regain or improve their physical abilities
<b>Posterior</b>	relating to the back of the body
<b>Retroversion</b>	rotational deformity where the femur twists backward (outward)
<b>Rotation (<i>externa/lateral</i>)</b>	rotation away from the center of the body
<b>Subluxation</b>	a partial dislocation; a slight misalignment
<b>Synovial joint</b>	a connection between two bones consisting of a cartilage-lined cavity filled with fluid
<b>Turn-out</b>	refers to the external rotation of the hips, legs, and feet

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## Appendices

### Appendix A

Dr. Patrick Meere (Hip Surgeon/Specialist) Interview Questions:

1. Was there something that drew you to hip surgery specifically?
2. How would you describe a hip labral tear in lay terms?
3. How do you go about diagnosing a hip labral tear?
4. After the diagnosis, how do you proceed? Is surgery your first option? Or would you recommend physical therapy first or other forms of pain management?
5. Have you performed a hip labral tear repair surgery arthroscopically? How does it differ from a full hip replacement?
6. What percentage of a patient's range of motion is expected to return after surgery (i.e. 100%, 90%, 75%, etc.)?
7. Have you ever treated a dancer for a hip labral tear? Did their surgical treatment differ from that of someone who is not a dancer?

## **Appendix B**

Carrie Gaerte (Physical Therapist) Interview Questions:

1. How do you assess a hip labral tear? What tests do you perform that could indicate a hip labral tear?
2. What type of non-surgical treatment options do you give dancers who are diagnosed with hip labral tears?
3. How do different treatment methods, such as cupping, Graston technique, and dry-needling, help with pain management?
4. What is the rehabilitation process like after an arthroscopic hip surgery? In other words, how does the pain management process (pre-surgery) differ from the rehabilitation/recovery process (post-surgery)?

## **Appendix C**

Dancer, Interview Questions:

1. What prompted you to get your hip checked out?
2. When were you diagnosed with a hip labral tear?
3. On a scale of 1-10 (1 being minimal pain, 10 being the worst pain), how would you rate your pain prior to the surgery?
4. What did the pain feel like? What were your symptoms?
5. How long after your diagnosis did you opt for surgery to get it repaired? Did you do any physical therapy beforehand to try and alleviate the pain?
6. Talk me through the rehabilitation/recovery process after surgery. How did your hip feel in the months after surgery?
7. Do you feel like the surgery helped manage the pain?
8. On a scale of 1-10 (1 being minimal pain, 10 being the worst pain), how would you rate your pain after having had the surgery?
9. How would you rate your range of motion after the surgery?