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INVITED CLINICAL COMMENTARY

REHABILITATION OF SOFT TISSUE INJURIES OF THE HIP AND PELVIS

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ABSTRACT

Soft tissue injuries of the hip and pelvis are common among athletes and can result in significant time loss from sports participation. Rehabilitation of athletes with injuries such as adductor strain, iliopsoas syndrome, and gluteal tendinopathy starts with identification of known risk factors for injury and comprehensive evaluation of the entire kinetic chain. Complex anatomy and overlapping pathologies often make it difficult to determine the primary cause of the pain and dysfunction. The purpose of this clinical commentary is to present an impairment-based, stepwise progression in evaluation and treatment of several common soft tissue injuries of the hip and pelvis.

Key words: adductor strain, gluteal tendinopathy, hip, iliopsoas syndrome, pelvis

Level of Evidence: 5

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INTRODUCTION

The anatomy of the hip is complex, multiple pathologies often coexist, different pathologies may cause similar symptoms, and many systems can refer pain to the pelvis.[1,2] Many athletes with hip pain have tried prolonged rest and various treatment regimens, and received differing opinions as to the cause of their pain. The cause of pain could be as simple as the effects of an adductor strain, which requires strengthening, or as complex as athlete with overlapping pathologies. A common combination seen is a hip flexor strain with an adductor strain and the diagnosis of sports hernia. A thorough history and a physical examination is needed to differentiate groin strains from athletic pubalgia, osteitis pubis, hernia, hip-joint osteoarthrosis, rectal or testicular referred pain, piriformis syndrome or presence of a coexisting fracture of the pelvis or the lower extremities.

MUSCLE STRAINS

Evaluation of sports hernia, athletic pubalgia, and adductor muscle strains can be challenging when overlapping conditions exist. The focus of this clinical commentary is on the evaluation and treatment of muscle strains that occur in the hip and pelvic regions. Specific muscle strains can be identified by certain precise exercises or stretches that isolate and stress the involved muscle. Additionally, palpation of the tissues can help identify the exact muscle. In general, treatment and rehabilitation are designed to relieve pain, restore range of motion, restore strength, and return function. Rest, ice, compression, elevation (RICE) is the standard treatment for mild to moderate muscle strains. Gentle ice massage to the area helps to decrease swelling and promote healing. Compression shorts or an elastic bandage may also be helpful in decreasing swelling and providing support. If walking causes pain, limited weight bearing and use of assistive ambulatory devices may be considered for the first day or two after the injury.

ADDUCTOR MUSCLE STRAINS

Adductor muscle strains can result in missed playing time for athletes in many sports. Adductor muscle strains are encountered more frequently in ice hockey and soccer than other sports.[3-5] These sports require a strong eccentric contraction of the adductor musculature during competition and practice.[6,7] Recently, adductor muscle strength has been linked to the incidence of adductor muscle strains.[8] Specifically, the strength ratio of the adduction to abduction muscles groups has been identified as a risk factor in professional ice hockey players.[8] Intervention programs can lower the incidence of adductor muscle strains but not avoid them altogether. Therefore, when injury occurs, proper treatment and rehabilitation must be implemented to limit the amount of missed playing time and avoid surgical intervention.[9]

The main action of this muscle group is to adduct the thigh in the open kinetic chain and stabilize the lower extremity to perturbation in all planes of motion in the closed kinetic chain. Each individual muscle comprising the adductor group can also provide assistance in femoral flexion and rotation.[10,11] The adductor longus is thought to be the most frequently injured adductor muscle.[12] Its lack of mechanical advantage (due to its origin and insertion) may make it more susceptible to strain.

The exact incidence of adductor muscle strains in sport is unknown. This is due in part to athletes playing through minor groin pain and the injury going unreported. In addition, overlapping diagnoses can also skew the exact incidence. Groin strains are among the most common injuries seen in ice hockey players.[13-15] Groin strains accounted for 10% of all injuries in elite Swedish ice hockey players over the course of a season.[16] Furthermore, Molsa[17] reported that groin strains accounted for 43% of all muscle strains in elite Finnish ice hockey players. Tyler et al[8] described the incidence of groin strains in a single NHL to be 3.2 strains per 1000 player-game exposures. In a larger study of 26 NHL teams, Emery et al[4] reported the incidence of adductor strains in the NHL had increased over 6 years between 1991-1997. The rate of injury was greatest during the preseason as compared to during regular and postseason play. The higher preseason injury rate may possibly due to the lack of activity and associated strength loss that may occur during the offseason. Prospective soccer studies in Scandinavia have reported a groin strain incidence between 10 and 18 injuries per 100 soccer players.[18] Ekstrand and Gillquist[5] documented 32 groin strains in 180 male soccer players over the course of one year, representing 13% of all injuries. Adductor muscle strains, certainly are not isolated to these two sports.

Previous researchers have described an association between strength and/or flexibility and musculoskeletal strains in various athletic populations.[5,19,20] Ekstrand and Gillquist[5] found that preseason hip abduction range of motion was decreased in soccer players who subsequently sustained groin strains compared with uninjured players. This is in contrast to the data published on professional ice hockey players that found no relationship between passive or active abduction range of motion (adductor flexibility) and adductor muscle strains.[8,21] This contrast may be in part due to the fact that ice hockey players need more ROM to perform their sport and do not demonstrate a large dichotomy between players with tight and loose adductors.

Adductor muscle strength has been associated with a subsequent muscle strain. Tyler et al[8] found preseason hip adduction strength was 18% lower in NHL players who subsequently sustained groin strains compared with the uninjured players. Recall that hip adduction to abduction strength ratio was also significantly different between the two groups. Adduction strength was 95% of abduction strength in the uninjured players but only 78% of abduction strength in the injured players. Additionally, in the players who sustained a groin strain, preseason adduction to abduction strength ratio was lower on the side that subsequently sustained a groin strain when compared with the uninjured side. Adduction strength was 86% of abduction strength on the uninjured side but only 70% of abduction strength on the injured side. Conversely, Emery and Meeuwisse found no relationship between peak isometric adductor torque and the incidence of adductor strains.[21] Unlike the Tyler et al study, this study had multiple testers using a hand held dynamometer, which would increase the variability and decrease the likelihood of finding strength differences. However, results from Emery and Meeuwisse[21] demonstrated that players who practiced during the off season were less likely to sustain a groin injury as were rookies in the NHL. The final risk factor was the presence of a previous adductor strain. Tyler et al[8] also linked preexisting injury as a risk factor, as four of the nine groin strains sustained (44%) were recurrent injuries. These findings are consistent with the results of Seward et al[22] who reported a 32% recurrence rate for groin strains in Australian Rules Football.

As researchers have begun to identify players at risk for a future adductor strain, the next step is to design and investigate an intervention program to address all risk factors. Tyler et al[13] were able to demonstrate that a therapeutic intervention of strengthening the adductor muscle group could be an effective method for preventing adductor strains in professional ice hockey players. Prior to the 2000 and 2001 seasons, professional ice hockey players were strength tested. Thirty-three of these 58 players were classified as "at risk" which was defined as having an adduction to abduction strength ratio of less than 80% and placed on an intervention program. The intervention program consisted of strengthening and functional exercises aimed at increasing adductor strength as seen in Table 1.

Injuries were tracked over the course of the two seasons. In this study there were 3 adductor strains which all occurred in game situations for an incidence of 0.71 adductor strains per 1,000 player game exposures. Adductor strains accounted for approximately 2% of all injuries. In contrast, there were 11 adductor strains and an incidence of 3.2 adductor strains per 1,000 player game exposures the previous two seasons prior to the intervention. In those prior two seasons adductor strains accounted for approximately 8% of all injuries. This incidence was also

Table 1. *Adductor Strain Injury Prevention Program*

Warm-up
- Bike
- Adductor stretching
- Sumo squats
- Side lunges
- Kneeling pelvic tilts

Strengthening program
- Ball squeezes (legs bent to legs straight)
  - Different ball sizes
- Concentric adduction with weight against gravity
- Adduction in standing on cable column or elastic resistance
- Seated adduction machine
- Standing with involved foot on sliding board moving in sagittal plane
- Bilateral adduction on sliding board moving in frontal plane (i.e. bilateral adduction simultaneously)
- Unilateral lunges with reciprocal arm movements

Sports specific training
- On ice kneeling adductor pull togethers
- Standing resisted stride lengths on cable column to simulate skating
- Slide skating
- Cable column crossover pulls

Clinical Goal
- Adduction strength at least 80% of the abduction strength

significantly lower than that reported by Lorentzon et al[16] who found adductor strains to be 10% of all injuries. Of the three players who sustained adductor strains, none had sustained a previous adductor strain on the same side. One player had bilateral adductor strains at different times during the first season. These data demonstrate that a therapeutic intervention of strengthening the adductor muscle group can be an effective method for preventing adductor strains in professional ice hockey players.

Despite the identification of risk factors and strengthening intervention for ice hockey players, adductor strains continue to occur in all sports.[23] The high incidence of recurrent strains could be due to incomplete rehabilitation or inadequate time for complete tissue repair. Hölmich et al[9] demonstrated that a passive physical therapy program of massage, stretching, and modalities was ineffective in treating chronic groin strains. By contrast, an 8-12 week active strengthening program consisting of progressive resistive adduction and abduction exercises, balance training, abdominal strengthening, and skating movements on a slide board proved more effective in treating chronic groin strains. An increased emphasis on strengthening exercises may reduce the recurrence rate of groin strains. An adductor muscle strain injury rehabilitation program progressing the athlete through the phases of healing has been developed by Tyler et al[13] and anecdotally seems to be effective. As displayed in Table 2, this type of treatment regimen combines modalities and passive treatment immediately, followed by an active training program emphasizing eccentric resistive exercise. This method of rehabilitation progressing patients through phases of rehabilitation using clinical milestones has been supported throughout the literature.[23,24]

ILIOPSOAS SYNDROME

Anterior hip pain in athletes can be mystifying. This pain may be due to the iliopsoas complex; however it is often challenging to differentiate iliopsoas involvement from intra-articular causes of hip pain, such as labral tears, femoroacetabular impingement, and osteoarthritis. The anatomical source of pain may be the iliopsoas tendon or the iliopectineal bursa, which is the largest synovial bursa in humans, separating the iliopsoas tendon from the hip joint capsule and the pubic bone.[25] When the iliopsoas tendon snaps over a bony prominence or within its own muscle belly during hip motion, causing an audible or palpable "pop," it is termed internal snapping hip or internal coxa saltans.[26] It is important to note, however, that the iliopsoas can be involved in anterior hip pain without evidence of a snapping hip. Iliopsoas tendinopathy, iliopectineal bursitis, and internal snapping hip can be collectively called iliopsoas syndrome.

Primary iliopsoas syndrome may develop as a result of overuse. Secondary pathology has been reported after total hip arthroplasty, or with rheumatoid arthritis or osteoarthritis.[27-29] Although the incidence and prevalence of iliopsoas syndrome is largely unknown, particular athletic populations susceptible to development of iliopsoas pathology include dancers, runners, soccer players, and American football offensive linemen.[30-33] In a cross-sectional survey study of elite ballet dancers, Winston et al[26] reported prevalence of internal snapping hip to be 91%, of which 58% had some degree of pain associated with the snapping hip. The extreme hip motions that are a part of functional hip use for dancers are believed to predispose them to iliopsoas injury.

The iliopsoas, comprised of iliacus and psoas major muscles, is the only muscle directly connecting the spine and the lower limb. Along with its role as flexor and external rotator of the hip, it is active in various movements involved in activities of daily living, including late stance to early swing phase of walking and running, sitting, lateral trunk flexion, carrying a load in the contralateral hand, contralateral hip extension in standing, and supine-to-sitting transition, while providing controlling lumbar posture and pelvic control.[34,35] The fact that the iliopsoas is active in such a variety of activities and body positions, together with its muscle fiber composition being predominantly of Type 1 (slow twitch) fibers, suggests its function as an important postural muscle.[36] Therefore, examination of an athlete with suspected iliopsoas injury must encompass a wide range of body positions, motions, and maneuvers, not only of the hip but of the spine and pelvis also.

The examination of an athlete with suspected iliopsoas syndrome begins with a thorough history.

Table 2. *Adductor Strain Post Injury Program*

<u>Phase I (Acute)</u>

- RICE (rest, ice, compression and elevation) for first ~48 hours after injury
- NSAIDs
- Massage
- TENS
- Ultrasound
- Submaximal isometric adduction with knees bent→with knees straight progressing to maximal isometric adduction, pain free
- Hip passive range of motion (PROM) in pain-free range
- Nonweight-bearing hip progressive resistive exercises (PREs) without weight in anti-gravity position (all except abduction), pain-free, low load, high repetition exercise
- Upper body & trunk strengthening
- Contralateral LE strengthening
- Flexibility program for noninvolved muscles
- Bilateral balance board

Clinical Milestone

- Concentric adduction against gravity without pain

<u>Phase II (Subacute)</u>

- Bicycling/Swimming
- Sumo squats
- Single limb stance
- Concentric adduction with weight against gravity
- Standing with involved foot on sliding board moving in frontal plane
- Adduction in standing on cable column or Theraband
- Seated adduction machine
- Bilateral adduction on sliding board moving in frontal plane (i.e. bilateral adduction simultaneously)
- Unilateral lunges (sagittal) with reciprocal arm movements
- Multiplane trunk tilting
- Balance board squats with throwbacks
- General flexibility program

Clinical Milestone

- Involved lower extremity PROM equal to that of the uninvolved side and involved adductor strength at least 75% that of the ipsilateral abductors

<u>Phase III (Sports Specific Training)</u>

- Phase II exercises with increase in load, intensity, speed and volume
- Standing resisted stride lengths on cable column to simulate skating
- Slide board
- On ice kneeling adductor pull togethers
- Lunges (in all planes)
- Correct or modify ice skating technique

Clinical Milestone

- Adduction strength at least 90-100% of the abduction strength and involved muscle strength equal to that of the contralateral side

Important questions to be asked include nature and location of symptoms, inciting events, aggravating motions or positions, relieving motions or positions, athletic history, and any concurrent or past injuries. One retrospective study reported an associated ipsilateral low back pain in 45% of dancers diagnosed with iliopsoas syndrome.[37] Static postural observation is performed in standing, sitting, and supine positions, focusing particularly on lumbopelvic posture. Dynamic movement assessment is performed in walking, running, squatting, and standing toe touch, paying attention to relative contributions by hip and spine motions. Because of its attachments on the lumbar spine and pelvis, the length of iliopsoas is influenced by lumbar and pelvic posture.

It is important to correlate findings from movement and postural observations with specific tests and measures. Range of motion testing of hips and trunk is performed in all planes, taking note of any asymmetry. Hip impingement tests are useful in ruling out intra-articular pathology. Presence of internal snapping hip can be tested with passive motion of the hip from position of flexion, abduction, and external rotation to position of extension, adduction, and internal rotation.[26] Dynamic ultrasound imaging has been utilized to visualize the snapping phenomenon during this maneuver.[38] The Thomas test for hip flexor flexibility is particularly important to perform when iliopsoas syndrome is suspected. The tonic iliopsoas muscle is expected to be tight in the presence of pathology, however there may be patients who present with iliopsoas syndrome without a positive Thomas test.[39] Manual muscle testing in all planes of hip motion is useful in identifying impairments in muscle function. Use of a hand-held dynamometer improves the validity of manual muscle testing and has been found to be a reliable measurement.[40] Resisted hip flexion with the hip in externally rotated position has been suggested as a specific test for iliopsoas syndrome.[37] Furthermore, core stability tests by means of isometric endurance tests are useful in detecting deficits in postural stability.[41] Based on the findings of this comprehensive examination, an impairment-based intervention program can be designed.

Intervention for iliopsoas syndrome involves a gradual progression which addresses the impairments identified during the examination. Activity modification is advised to the athlete to avoid any activities that aggravate the symptoms. To prevent loss of cardiopulmonary fitness, cycling, elliptical training, or aquatic exercises may be recommended. Running gait modification by means of cadence manipulation may be useful to enable runners to continue running while reducing the amounts of joint excursion and energy absorption, and reducing symptoms during running.[42] Acute pain suggestive of inflammatory response to activities or exercises may be managed with cryotherapy, compression, and sensory electrical stimulation.

If flexibility deficits were found in the examination, interventions to address these may be initiated immediately. Hip flexor tightness is addressed with stretching exercises, therapist-assisted stretch with or without proprioceptive neuromuscular facilitation techniques, and manual release of the iliopsoas myofascial trigger points.[43,44] In the authors' experience one of the most common trigger points is found just medial to the ASIS and under the iliac crest. Patients are instructed to perform self-stretching exercises daily.

Deficits in core stability, hip strength, and other lower extremity musculature are addressed in a gradual progression of exercises. Core activation exercises are initiated in the supine position, and pressure biofeedback may be used to aid the patient in learning the abdominal drawing-in maneuver in neutral spine position.[45] This maneuver forms the basis of all subsequent exercises throughout the progression.

Once the patient is able to perform the drawing-in maneuver without feedback, active hip flexion is added in the supine position, starting with the knees and hips flexed to maintain a short lever arm. With satisfactory and pain-free performance of short lever hip flexion in the supine position, this exercise can be progressed to supine straight leg raise, seated hip flexion at the edge of table, seated hip flexion on Swiss ball, standing hip flexion against a wall, standing hip flexion without support, then standing hip flexion on foam pad (Figure 1). Resistance by means of ankle weights, resistance bands, or cable column is added to increase difficulty of each exercise. It is important for the therapist to observe the patient throughout the performance of these exercises, to provide feedback on lumbopelvic position and quality of movement, ensuring there is not excessive pelvic tilt or not enough lordosis.

Other strength deficits, such as deficits in the hip rotators, abductors or extensors, may be addressed in the same progression, from lying on the table, to sitting, and finally in standing position. In a retrospective case series of runners, Johnston et al reported that a 3-month hip rotation strengthening program performed in sidelying, seated, and standing positions resulted in improved activity level and return to sports, which was maintained at a 13-month follow up.[31] Other core stabilization exercises, such as forward plank, side plank, and quadruped progression, may be added to further address deficits in core stability. Considering that the iliopsoas is active during activities in supine, sitting, and standing, core activation must be emphasized during performance of all exercises, in multiple positions, as well as during activities of daily living, to improve synchronous activation of all postural muscles.

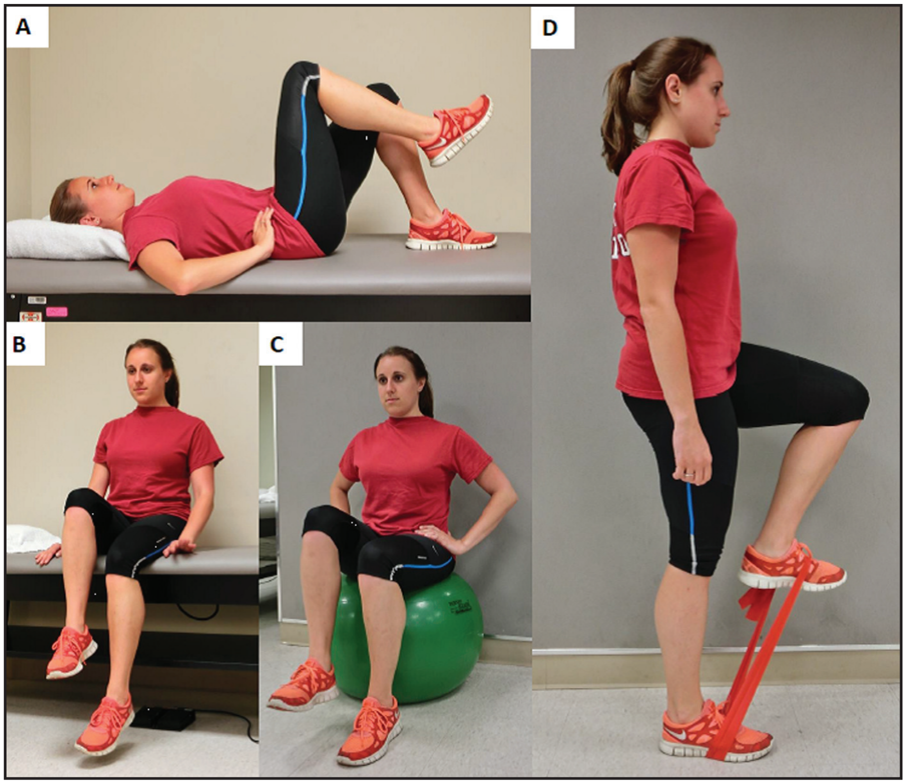

Figure 1. *Hip flexion progression for iliopsoas syndrome. All exercises are performed with simultaneous abdominal drawing-in maneuver and lumbar spine in neutral alignment. A) Supine short-lever hip flexion, B) Seated hip flexion, C) Seated hip flexion on Swiss ball, D) Standing hip flexion with theraband resistance.*

Return to play decision is made when the athlete successfully completes the hip flexion exercise progression without symptoms and maintains good posture and coordination of their pelvis and lower extremities. Rarely, recalcitrant cases have been treated with ultrasound-guided anesthetic steroid injection, endoscopic release, or lengthening with reported success.[46-48] Physical therapy is the mainstay of treatment for iliopsoas syndrome since most patients with this condition improve with conservative management.

GLUTEAL TENDINOPATHY

Gluteus medius and minimus tendinopathy are painful and debilitating disorders suffered by athletes. Abnormal sport-specific mechanics can influence this pathology, when the demands of the sport are greater than the physiologic motion available throughout the kinetic chain. These increased demands place excessive forces through the musculature of the hip. For example the lead hip of a baseball pitcher or batter needs to resist tremendous forces in all three planes of motion and if weakness exists in any plane of movement, pattern compensation can occur and injury may be the result. The combination of overuse and underlying weakness of the gluteus medius and minimis can cause strain, tearing, or degeneration of these muscles or their respective tendons, inducing tendinopathy in the athlete. Tears of the gluteus medius and minimus may be a common cause of lateral trochanteric pain. Gluteal tendinopathy is characterized by lateral hip pain at the shared insertion on the greater trochanter of the femur, and is often associated with greater trochanteric bursitis.[49]

The gluteus medius originates from the dorsal ilium inferior to the iliac crest and spans to the lateral and superior surfaces of the greater trochanter. A primary hip abductor, the anterior fibers internally rotate the hip, while the posterior fibers assist in hip external rotation. In weight bearing positions, these muscles keep the pelvis from dropping. The gluteus medius inserts on two sites on the greater trochanter: the lateral facet and superoposterior facet with the insertion onto the lateral facet having a larger area of insertion.[50,51] The gluteus minimus has a shared origin from the dorsal ilium, as well as the inferior and anterior gluteal lines and the edge of the greater sciatic notch, attaching to the anterior aspect of the greater trochanter. The gluteus minimus is a hip abductor and internal rotator.[51] There are an average of six hip bursae. Two of these bursae (the anterior subgluteus medius bursa and posterior subgluteus medius bursa) are typically found beneath the gluteus medius tendon. A single bursa, the subgluteus minimus is usually found deep to the gluteus minimus tendon.[52] Bunker et al[53] was the first to describe the "rotator cuff of the hip" with regard to the broad origins and flat tendinous insertions of the gluteals, when they noted the presence of a tear in the tendinous insertion of the anterior third of the gluteus medius and the tendon of the gluteus minimus where they insert upon the greater trochanter. To use the rotator cuff of the shoulder as an example, tears may be insertional, partial or full thickness.[54,55]

Dull and achy lateral hip pain, which is frequently aggravated by weight bearing and resisted abduction is a common complaint.[49] To help distinguish underlying muscular pathology, gluteus medius tendinopathy may present as tenderness along the posterior aspect of the greater trochanter at the tendinous insertion, whereas pain at the anterior aspect of the greater trochanter may be attributed to gluteus minimus pathology. Contractile testing may be useful to help distinguish muscular pathology from bursal pathology. Direct palpation may be more beneficial to rule in a diagnosis.[56]

Although there is no gold standard special test to rule in or rule out gluteal tendinopathy, there are a number of tests which can be useful to the sports physical therapist. Taking a thorough stepwise approach to the evaluation is helpful. This includes a thorough history, inspection, palpation, range of motion, stability, and assessment of strength in all planes. Regions and joints proximal (SI joint, lumbar spine, and core/abdomen) and distal to the hip (knee, ankle, foot) should always be examined. Gait should be observed noting leg length discrepancy, compensations due to weakness, as well as heel strike and avoidance patterns. Special tests including Trendelenburg, Ober's, Thomas, FABER, and Ely's tests should be performed.

The Trendelenburg test assesses the functional strength of the gluteus medius. It is performed while the patient stands unsupported on one leg. If the pelvis tilts towards the unsupported leg, the test is positive for abductor weakness on the stance leg. Ober's test is performed by having the patient lie on the unaffected hip. The symptomatic hip and knee are kept in a flexed position while the hip is abducted and extended to center the iliotibial band over the greater trochanter, and then passively adducted. Any difference between the extremities is noted as a positive test. The Thomas test evaluates hip flexor tightness, performed with the patient supine and holding the uninvolved leg in the knee-to-chest position while the affected leg is kept completely extended on the examination table. The test is positive if the thigh is elevated off the table. Ely's test checks for rectus femoris tightness in a prone position, with the examiner passively flexing the knee and bringing the heel toward the buttock. The test is positive if the patient is unable to reach the buttock without raising the hip off the examination table.

To assist in the diagnosis of gluteal tendinopathy, Lequesne et al[57] suggested two additional tests, the resisted external derotation test and single leg stance for 30 seconds. The external derotation test is performed in the supine position with the hip flexed to 90 degrees and brought into end range external rotation (or the point of pain) and then asked to actively return to neutral against the clinician's resistance. Reproduction of pain is considered a positive test. The single leg stance for 30 seconds test is performed with the patient balancing on one leg with patient's hands gently held by the examiner to limit lateral trunk sway. If there is reproduction of pain, a positive test is noted. With a small sample size of 17 patients, high sensitivity (100% and 88%) and specificity (97.3% and 97.3%) were reported for the resisted external derotation test and the single-leg stance test.[57] It should be noted, however, that the authors did not report the reproducibility of these two tests.

These results are in slight contrast to the poor sensitivity and specificity shown by Bird et al[58] with the resisted abduction (sensitivity of 72.7%) and resisted internal rotation (sensitivity of 54.5%) tests. Additionally, magnetic resonance imaging or ultrasound may be useful to evaluate the integrity of the abductor tendon insertions and integrity of gluteal bursa.[55] These test are extremely important when an avulsion is suspected.

Management of gluteal tendinopathy should take a similar approach to that of other tendinopathies. That is, immediate reduction of pain and dysfunction before progressing to eccentric therapeutic training. As seen in Table 3, this criterion-based rehabilitation program utilizes a regime of modalities and passive treatments immediately, followed by an active training program emphasizing eccentric resistive exercise.

Recent electromyographi studies by Selkowitz et al[59] and Philippon et al[60] give a strong theoretical basis of rehabilitation exercises appropriate for various stages of rehabilitation. They do not, however, demonstrate muscle activity of eccentric gluteal medius and minimus exercises, nor are there any current studies that show the benefit of eccentric training

Table 3. *Gluteal Tendinopathy Rehabilitation Program*

Phase I (Acute)
- RICE (rest, ice, compression and elevation) for first ~48 hours after injury if traumatic
- Massage, NSAIDs, TENS, ultrasound
- Pain-free gluteal stretching (knee to opposite shoulder) and passive range of motion (PROM)
- Non-weightbearing hip progressive resistive exercises (PREs) without weight
- Submaximal isometric contractions progressing to maximal isometric
- Therapist-resisted knee extension, hip extension
- Diaphragmatic breathing
- Core stabilization exercises (pelvic tilts, etc.)
- Upper body, trunk, contralateral LE strengthening
- Flexibility program for noninvolved muscles
- Bilateral balance board

Clinical Milestone
- Concentric hip abduction against gravity without pain.

Phase II (Subacute)
- Bicycling/Elliptical/Stair Master/Swimming
- Non-weightbearing hip PREs with weight
- Bridges (bilateral progressing to unilateral)
- Quadruped hip extension, fire hydrants
- Planks, side planks
- Weight-bearing hip PREs with theraband (TB) or cable column (concentric to eccentric)
- TB squats, lateral walks
- Single limb stance, step down, lunges with reciprocal arm movements
- Eccentric short lever ER fall outs
- Balance board squats with throwbacks
- General flexibility program

Clinical Milestone
- Ability to perform pain free short lever eccentric training pain free

Phase III (Sports specific training)
- Phase II exercises with increased load, intensity, speed and volume
- Plank progression: prone plank + hip extension, side plank + abduction with ER
- Standing resisted stride lengths on cable column
- Slide board
- Lunges (in all planes) with progressing balance challenges (aerofoarm → BOSU)
- Progressive balance exercises
- Standing hip ER → standing hip ER + TB unilateral squat
- Eccentric training: standing TB eccentric, treadmill resistance, step up plus eccentrics
- Plyometric sport specific training
- Correct or modify sport specific movements

Clinical Milestone
- Pain-free sport specific activities

with gluteal tendinopathy. The benefits of eccentric training in treatment of the achilles tendon, patellar tendon, and lateral epicondylitis are strongly supported in the literature and these principles could, in theory, be applied in the treatment of gluteal tendinopathy.[61,62]

Examples of eccentric gluteal training include short lever supine ER fallouts, where the patient rolls towards the involved side then externally rotates the uninvolved side, loading the involved side, then slowly resists the band to the starting position (Figure 2). Standing eccentric training can be achieved with a theraloop around both feet stepping out to the uninvolved side, loading the involved limb, then slowly returning to the starting position (Figure 3). And eccentric treadmill resistance, performed by resisting the belt of the treadmill as the leg comes from an abducted to an adducted position (Figure 4).

If conservative therapy fails several more invasive treatment options exist. Corticosteroid injections,

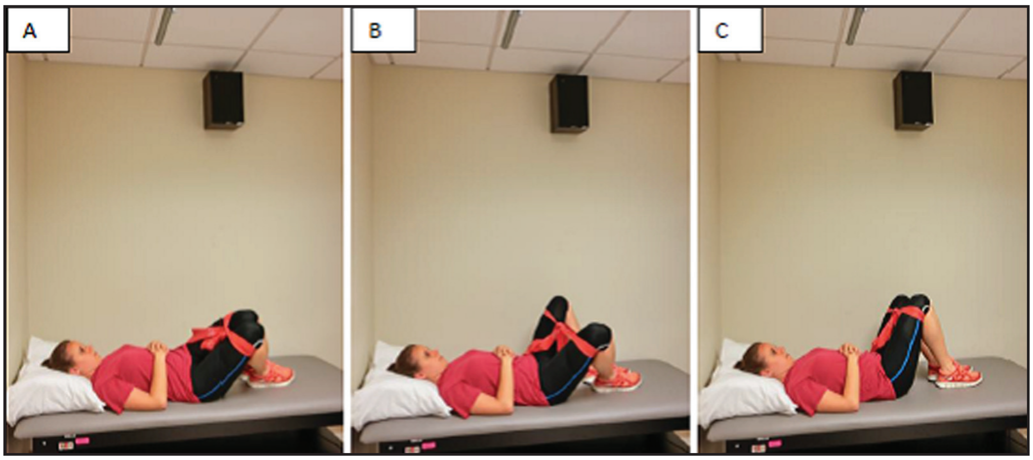

Figure 2. *Short lever supine ER fallouts: A) Lateral trunk rotation, B) Loading position, C) Start/end position.*

Figure 3. *Standing eccentric hip abductor exercise.*

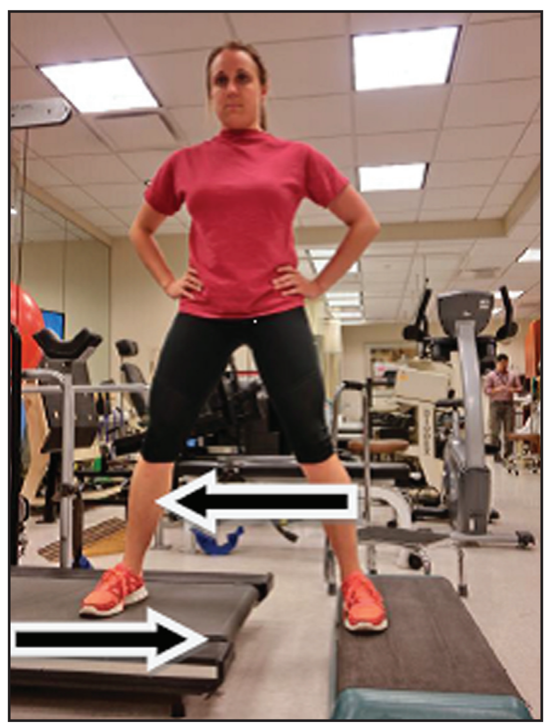

Figure 4.

arthroscopic bursectomy, tendon repair, osteotomy, endoscopic repair of gluteus medius tears are all additional options.

CONCLUSION

In summary, rehabilitation of an athlete with a soft tissue injury of the hip and pelvis starts with identification of known risk factors for injury and a comprehensive examination and evaluation of the entire kinetic chain. Complex anatomy and overlapping pathologies often make it difficult to pinpoint the primary cause of the pain and functional limitations. Once a diagnosis is established, an impairment-based, stepwise progression as outlined in this clinical commentary may be used for returning the athlete to full participation in sports in a safe and timely manner.

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