ISSN 0008-3194 (p)/ISSN 1715-6181 (e)/2018/182–192/$2.00/©JCCA 2018

Conservative management of femoral anterior glide syndrome: a case series

Chris Grant, BSc, DC[1]
Jason Pajaczkowski, BSc, DC, FRCCSS(C), FCCPOR(C)[1]

Background: *Femoral anterior glide syndrome is a movement impairment syndrome, which presents with anterior hip pain aggravated by hip flexion and extension. It is believed to occur because of altered muscle activation patterns contributing to altered gliding of the femoral head within the acetabulum and constant overloading and irritation of the joint structures.*

Study Design: *Case series*

Case Description: *Three elite athletes diagnosed with femoral anterior glide syndrome were treated conservatively with the main goal of improving posterior femoral glide. Rehabilitative exercises were completed to gain independent articular control of the hip and improve hip and low back dissociation.*

Outcomes: *Patients received complete symptom resolution allowing them to continue participating in their sport at full capacity. They were able to perform the*

Contexte : *Le syndrome du glissement antérieur de la tête fémorale est un conflit fémoro-acétabulaire se manifestant par une douleur antérieure de la hanche aggravée par la flexion et l'extension de la hanche. Ce conflit serait causé par des altérations de l'activation musculaire qui contribuent au glissement de la tête fémorale dans l'acétabulum et à une surcharge et une irritation des structures articulaires.*

Méthodologie de l'étude : *Série de cas*

Description des cas : *Trois athlètes d'élite présentant le syndrome du glissement antérieur de la tête fémorale ont suivi un traitement conservateur visant principalement à améliorer le glissement postérieur de la tête fémorale. Des exercices de rééducation ont été effectués pour améliorer le contrôle moteur au niveau de l'articulation de la hanche et améliorer le recrutement des fibres musculaires de la hanche par rapport à celles de la colonne lombaire.*

Résultats : *La disparition complète des symptômes a permis aux patients de recommencer à pratiquer leurs sports à pleine capacité suite à ces interventions. De plus , les tests du glissement antérieur de la tête*

[1] Graduate Education & Research Program, Canadian Memorial Chiropractic College.

Corresponding author:
Chris Grant
Canadian Memorial Chiropractic College, 6100 Leslie Street, Toronto, ON M2H 3J1
Tel: 416-482-2340
e-mail: cgrant@cmcc.ca

This study has been approved by the Institutional Review Board of the Canadian Memorial Chiropractic College.
The authors certify that they have no affiliations with or financial involvement in any organizations or entity with a direct financial interest in the subject matter or materials discussed in the article.
All athletes were informed that data concerning their case would be submitted for publication and have provided consent for the use of their medical information, which has been removed of personal data and any other identifiable information except age and profession.

femoral anterior glide tests without pain and aberrant movement patterns.

Discussion: *This case series provides data to support further investigation of treatment of femoral anterior glide syndrome.*

(JCCA. 2018;62(3):182-192)

KEY WORDS: chiropractic, femoral anterior glide syndrome, hip pain, athlete

fémorale ne déclenchaient aucune douleur et ne causaient aucun mouvement aberrant.

Discussion : *Cette série de cas fournit des données montrant qu'il faut mener d'autres études sur le traitement du syndrome du glissement antérieur de la tête fémorale.*

(JCCA. 2018;62(3):182-192)

MOTS CLÉS : chiropratique, syndrome du glissement antérieur de la tête fémoral, douleur à la hanche, athlète

Background

Groin pain has been reported in the scientific literature as an important athletic injury as early as 1980 by Renström and Peterson.[1] It is a common complaint in athletes from a variety of sports[2–5] despite the fact than an accurate clinical diagnosis of hip and groin pain remains a significant challenge in sports medicine[6]. Potential differential diagnoses for adults presenting with anterior hip pain include hip osteoarthritis, femoroacetabular impingement syndrome, acetabular labral tear, internal snapping hip, stress fracture of the femoral neck, pubic rami or acetabulum, osteonecrosis of the femoral head, hip joint laxity, inguinal disruption and/or a femoral, obturator or ilioinguinal neuropathy.[7] Athletic groin pain is commonly treated with surgical interventions in the athletic population.[8] However, alternative evaluation and treatment methods must also be considered. Sahrmann has proposed the evaluation of movement impairment syndromes such as femoral anterior glide syndrome.[9] Femoral anterior glide syndrome is reported to occur as a result of inadequate posterior glide (or excessive anterior glide) of the femoral head within the acetabulum.[9] As stated by Sahrmann, patients with femoral anterior glide syndrome will experience groin pain with hip flexion or standing and may experience generalized hip pain as the condition progresses.[9] It often occurs in younger athletes, especially those involved in sports that accentuate hip extension, such as gymnastics and running. Patients with femoral anterior glide syndrome will often present with characteristic movement patterns. During a supine active straight leg raise the greater trochanter is observed to move in an anterior or antero-medial direction and the patient will often complain of groin pain (Figure 1). This is proposed to occur as a result of inadequate posterior glide of the fem-

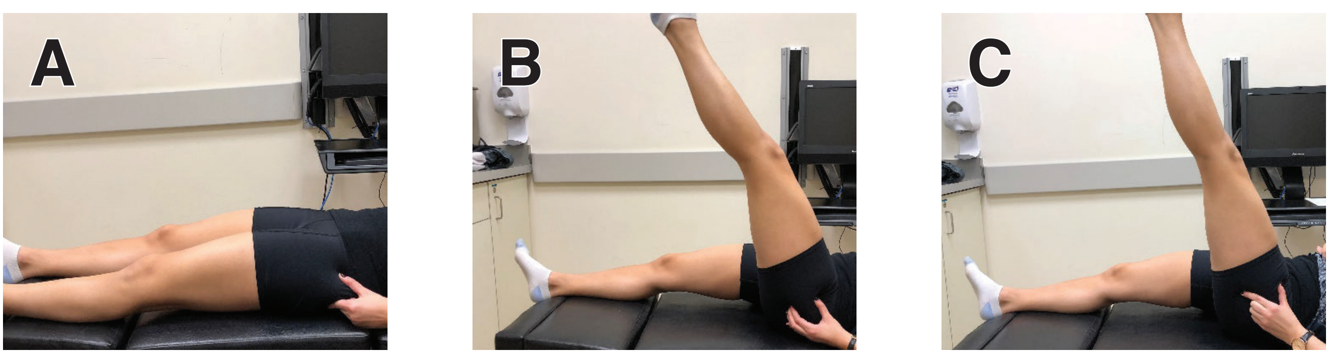

Figure 1.
Supine Active Straight Leg Raise. (A) Resting position and (B) elevated position of a supine active straight leg raise demonstrating minimal movement of the greater trochanter. (C) demonstrates an anteromedial movement of the greater trochanter with movement completion as seen in individuals with femoral anterior glide syndrome.

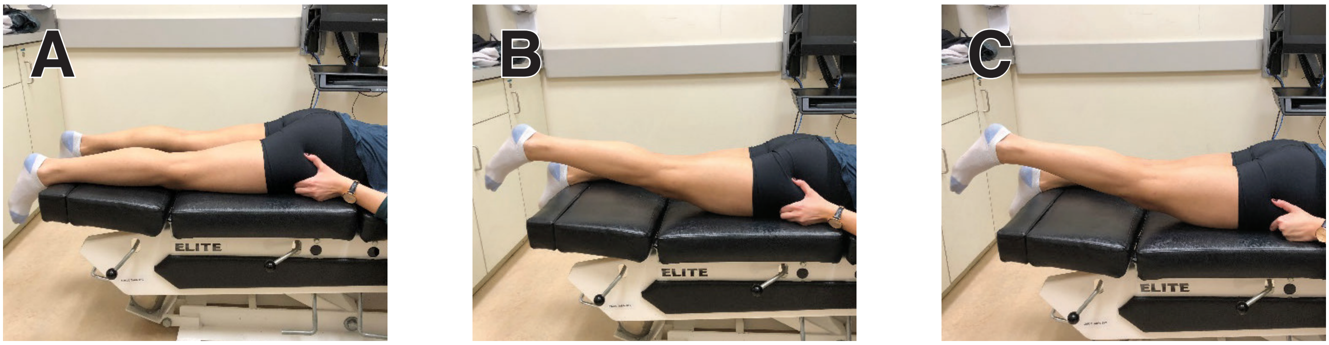

Figure 2.
Prone Hip Extension. (A) Resting position and (B) elevated position of prone hip extension demonstrating minimal movement of the greater trochanter. (C) demonstrates an anteromedial movement of the greater trochanter with movement completion as seen in individuals with femoral anterior glide syndrome.

oral head within the acetabulum. During an active prone hip extension, the greater trochanter is again observed to move in an anterior or antero-medial direction as opposed to staying in relatively the same position (Figure 2). The proposed mechanism behind this movement impairment syndrome is a motor control deficit which manifests as anterior hip pain from tissue overload of the anterior supporting structures. Although femoral anterior glide has not been directly measured in live human subjects during active hip flexion and extension, there is evidence to suggest this movement pattern may be a potential source of hip pain.[9–11]

The hip is a stable ball-and-socket joint having highly congruent joint surfaces: the convex femoral head and the concave articular surface of the acetabulum.[12] Although the articular surfaces of the hip are highly congruent, hip instability has been demonstrated in the athletic population.[13] The femoral head has considerably more articular surface area compared to the acetabulum. In the neutral, anatomical position, the anterior portion of the femoral head is not engaged in the acetabulum.[14] This allows for greater hip mobility but also increases the reliance on anterior soft tissues for stability during hip extension.[15] In addition to the labrum and anterior capsular ligaments, the iliopsoas is suspected to play a role in maintaining the anterior stability of the hip.[9,11–13,15,16] Amongst the purported mechanisms of pain with femoral anterior glide syndrome are irritation of the aforementioned anterior supporting structures, namely the psoas and anterior hip capsule.

According to osteokinematic and arthrokinematic movement principles, the hip must glide anteriorly and posteriorly to have complete hip extension and flexion, respectively (Table 1).[17] In a cadaveric study, Harding *et al*. demonstrated that anterior gliding of the femoral head within the acetabulum does exist when a posterior-to-anterior mobilization of the hip is applied.[12] The amount of glide was highly variable between subjects, ranging

Table 1.
Description of roll and glide of femoral head within the acetabulum during hip flexion and extension.

Hip Joint Movement	**Roll of Femoral Head in the Acetabulum**	**Glide of Femoral Head in the Acetabulum**
Hip Flexion	Anterior Roll	Posterior Glide
Hip Extension	Posterior Roll	Anterior Glide

between 0.25-2.90 mm. In 2013, Loubert *et al*. demonstrated the existence of posterior glide when a posterior mobilization force was applied to the thigh.[18] The average posterior glide amplitude in 20 healthy college students was 2.0 mm when measured by ultrasound. These findings demonstrate that although the hip is a highly congruent joint, both posterior and anterior glide of the femoral head occur within the acetabulum when a mobilization force is applied to that joint.[12,18]

Using a musculoskeletal model, increased anterior hip joint forces were demonstrated with decreased activity of the gluteus maximus during prone hip extension and with decreased iliopsoas activity during supine active hip flexion.[11,16] These studies suggest that altered muscle activation patterns can result in aberrant sagittal plane joint forces of the hip. Specifically, a motor pattern that relies more on the hamstrings and less on the gluteus maximus may be responsible. The bony attachments of the gluteus maximus are close to the axis of rotation of the hip, while the hamstrings are able to create hip extension despite originating from the ischium and inserting onto the tibia and fibula, thereby bypassing the femur entirely. It is thought that this long lever creates anterior gliding of the femoral head while it extends the hip.

Lewis and Sahrmann demonstrated that women perform consistent muscle activation patterns during prone hip extension, that begins with the medial hamstrings and is followed by the lateral hamstrings and gluteus maximus.[19] However, with verbal and tactile cueing to contract the gluteal muscles during prone hip extension, the women demonstrated nearly simultaneous contraction of the hamstrings and gluteus maximus, stronger activation of the gluteus maximus and a reduction in total knee flexion. These studies provide evidence to support the mechanism of femoral anterior glide syndrome. However, there is limited scientific evidence to support the treatment of patients with this condition.

The purpose of this case series is to demonstrate the effectiveness of conservative management of femoral anterior glide syndrome in three elite athletes. The symptom of anterior hip pain is believed to result from inadequate posterior glide of the femoral head within the acetabulum during hip flexion as well as improper muscle activation patterns during hip flexion and extension that result in increased anterior hip joint forces. Therefore, it is logical to expect decreased anterior hip pain with passive care focused on increasing posterior glide of the femoral head and rehabilitative exercises focused on correcting independent articular control of the hip and aberrant muscle recruitment patterns.

Case Description

Two professional football players in the Canadian Football League, ages 27 (Athlete A) and 31 (Athlete B), and a nationally ranked female boxer, age 24 (Athlete C), are included in this case series. All athletes were informed that data concerning their case would be submitted for publication and have provided consent for the use of their medical information, which has been removed of personal data and any other identifiable information except age and profession. All the athletes had anterior hip pain and had no specific mechanism of injury to cause their pain.

Athlete A noted pain in his anterior left hip following an on-field mid-season football practice. He denied experiencing a specific instant or mechanism of pain, but rather he noticed a vague discomfort in the region of the anterior left groin upon standing following a brief period of sitting in the locker room. This was his first instance of hip pain, and no associated signs or symptoms were noted. The pain was characterized as an ache and rated as 3/10 on a Numeric Pain Rating Scale (NPRS) and he scored a 71/80 on the Lower Extremity Functional Scale (LEFS). His pain was exacerbated by running, stretching the hip in extension, lunges and rear foot elevated lunges (both with the affected leg in the posterior position). No palliative factors were noted, including stretching, rolling, soft tissue therapy and hydrotherapy. Relevant past medical history included a self-reported grade II right ankle inversion sprain in his final year of high school, and a right medial meniscal tear, which resulted in an off-season partial meniscectomy, during his first year of college. Athlete A reported that he had not had any issues with either injury since. Coughing, sneezing and straining, including weight training, failed to reproduce his symptoms, as did movement through the lumbar spine. Past medical history, family history, and systems review were otherwise within normal limits and non-contributory to his current chief complaint.

Athlete B reported having experienced right anterior hip pain at the midway point of the past two seasons. There was no specific mechanism of injury during either season, and he reported that he "just began to notice it (groin pain) was there." Athlete B denied reproduction of his symptoms with Dejerine's triad. No abdominal pain, or gastrointestinal symptoms were noted with a sit-up. The pain was described as an "aching pull" across the front of the right hip, without radiation, primarily with sprinting, but he also felt it when the hip was fully flexed as in the bottom portion of a squat. Stretching, acupuncture, hot tub, sauna, heat packs and soft tissue were not helpful in preventing or alleviating his symptoms. He reported four to five previous ankle sprains between the left and right ankles, being unable to recall the exact distribution between the ankles. Athlete B rated his pain as 7/10 on the NPRS and scored 52/80 on the LEFS. Past medical history, family history, and systems review were otherwise within normal limits and non-contributory to his chief complaint.

Athlete C described her pain as a "stretching ache" that was localized over the right anterior hip in the region of the femoral head and anterior joint space. She denied having discomfort while boxing other than throwing right-handed uppercuts near the end of a sparring session. Once triggered, the pain was present until the end of her training whenever she would "flex the glute" or throw a right-handed uppercut. She noted that sprint training and distance running were also provocative, and once the pain began it persisted until the end of the workout. She scored a 66/80 on the LEFS and rated her intensity as "an average 4/10" on the NPRS. Other than avoiding the aforementioned activities, there were no palliative factors noted. Stretching prior to activity was not effective and stretching afterwards increased intensity and prolonged the duration of her symptoms. Past medical history, family history, and systems review were otherwise within normal limits and non-contributory to her chief complaint.

In summary, the duration of their pain was varying from three months to two years of intermittent pain. They described the pain as a pinching sensation during hip flexion and an aching, stretching sensation during hip extension. During hip flexion pain intensity was rated between 3-7/10 on the NPRS. Pain intensity during hip extension was rated between 3-4/10. None of the athletes reported snapping of their hip with movement. None of the athletes had previous hip pathology or trauma.

During the physical examination, all participants were observed to be in a relative posterior pelvic tilt with hyperextension of the hips and knees. They also had a decreased thoracic kyphosis and cervical lordosis. The anterior hip capsule was painful on palpation and tenderness was noted along the femoral nerve through the femoral triangle and proximal portion of the adductor canal of the affected hip. Tight and tender myofascial structures were noted, including the gluteus medius and minimus, tensor fascia lata, lumbar spine erectors and transversospinalis, adductor magnus, longus and brevis, pectineus, obturator externus, gracilis and the sacrotuberous ligament. All passive, active and resisted hip ranges of motion were 5/5 and pain-free, except for resisted hip flexion on the affected side, which was graded as 4/5 when tested in a seated position. A curvature of the lumbar spine towards the ipsilateral leg was noted for all athletes during seated resisted hip flexion of the affected side. This implies an inability to adequately stabilize the lumbar spine as per Dynamic Neuromuscular Stabilization (DNS) principles, which aim to establish a quality spinal stabilization for any dynamic movement of the extremities.[20,21] However, this curvature disappeared with core muscle irradiation, which was accomplished by having the athletes squeeze their palms together as forcefully as possible during hip flexion. Similarly, all three athletes demonstrated a tendency for apical breathing patterns and difficulty generating intra-abdominal pressure during the supine DNS breathing screen.[21] Hip adduction was not painful at 0° or 90° of hip flexion, nor was internal rotation at either position.

The femoral anterior glide tests proposed by Sahrmann, were completed on these athletes.[9] During an active straight leg raise they were noted to have anterior hip joint pain that increased as the angle of hip flexion increased. The greater trochanter was observed to move in an antero-medial direction during the active straight leg raise. Because of the positive findings from this test a passive straight leg raise was performed with simultaneous postero-inferior pressure application at the inguinal crease to maintain the axis of rotation of the hip. This decreased the severity of hip pain in all athletes. However, tightness of the hamstrings prevented the affected legs of all 3 athletes from achieving 90° of hip flexion. During prone hip extension, the athletes again experienced anterior hip pain but to a lesser intensity than hip flexion. A hamstring dominant prone hip extension pattern was displayed, and the greater trochanter was observed to move anteriorly during hip extension. In the quadruped

Figure 3.
Quadruped Rocking. (A) Starting and (B) finishing position of quadruped rocking demonstrating maintenance of the natural spinal curvature. (C) demonstrates the quadruped rocking position with loss of the lumbar lordosis as seen in individuals with femoral anterior glide syndrome.

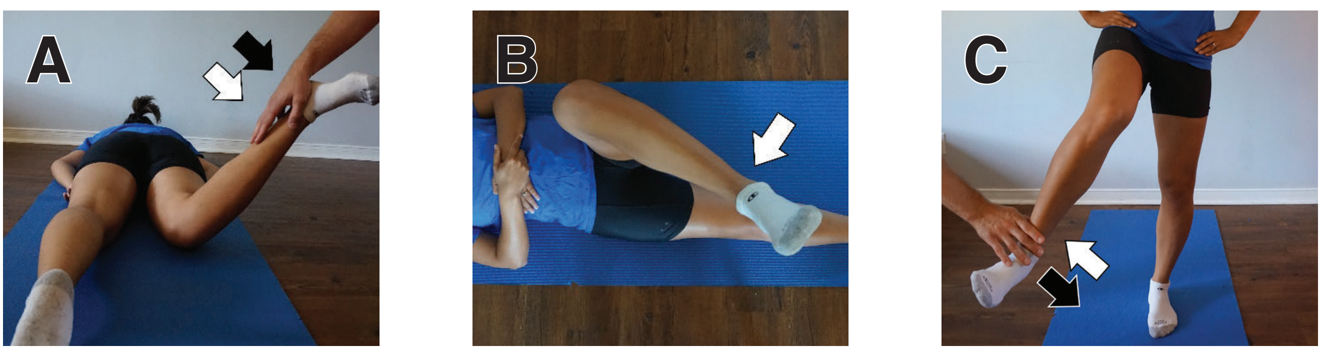

Figure 4.
Hip Rotation Exercise Progression. (A) Prone active-assisted hip internal rotation, (B) Supine active hip external rotation and (C) Standing resisted hip internal rotation. Black arrow indicates practitioner's applied force. White arrow indicates patient's force.

Figure 5.
Prone Hip Extension – Blocking Femoral Anterior Glide. (A) Resting position and (B) elevated position of prone hip extension rehabilitation exercise with a pelvic block preventing the femoral head from moving anteriorly.

Table 2.
Exercise Progression Principles

1. Improve independent articular control of the hip relative to the pelvis
    a. Prone internal and external hip rotation (0° of hip flexion)
        i. Active-assisted
        ii. Active
        iii. Resisted
    b. Supine internal and external hip rotation (90° of hip flexion)
        i. Active-assisted
        ii. Active
        iii. Resisted
    c. Standing internal and external hip rotation (90° of hip flexion)
        i. Active-assisted
        ii. Active
        iii. Resisted
2. Develop a gluteal-dominant hip extension pattern
    a. Prone hip extension
        i. Knee bent (90°) and pelvic block used
        ii. Knee straight and pelvic block used
        iii. Knee bent (90°)
        iv. Knee straight
3. Increase posterior glide of the femoral head within the acetabulum
    a. Quadruped rocking while maintaining a lumbar lordosis
4. Develop intra-abdominal pressure to maintain spinal control while moving the hip and shoulder
    a. 3-month supine developmental position
        i. Legs supported
        ii. Legs unsupported
        iii. Cross-crawling
        iv. Resisted cross-crawling
5. Integration of new movement pattern into strength and conditioning program
    a. Deadlift
        i. Hip hinging
        ii. Kettlebell deadlifts
        iii. Offset weight deadlifts (different weight in each hand)
    b. Squat
        i. Pull-down into a squat (i.e. holding weighted latissimus dorsi pull-down bar above head)
        ii. Overhead squat facing a wall
        iii. Reactive neuromuscular training using a band around the knees during a squat
        iv. Toe touch to overhead squat progression

position, the athletes were asked to rock their buttocks back toward their heels (Figure 3). All of them experienced anterior hip pain described as a pinching sensation and demonstrated compensatory pelvic rotation that was observed as the affected hip being higher.

All three athletes had plain film imaging, which failed to demonstrate any evidence of pathology. Both athlete A and B received diagnostic ultrasounds of their affected hips and no pathology was noted. Additionally, athlete A underwent magnetic resonance imaging without contrast which was read as negative for labral, bursal or tendon pathology.

Passive care for each athlete had the primary goal of decreasing pain and improving posterior glide of the femoral head within the acetabulum. They received soft tissue therapy of the posterior hip capsule, gluteus medius, gluteus minimus, tensor fascia lata, obturator externus, adductor magnus and rectus femoris as well as post-isometric relaxation stretching of the hamstrings on the affected side. They also received hip joint mobilizations, in which the patient was lying supine and a long-axis distraction was applied while bringing the hip up to 90° of flexion (practitioner's force is directed toward the ceiling) as well as a continuous passive motion mobilization in which the patient's leg was brought from neutral to 90° of flexion while oscillating between long-axis distraction and compression every two seconds. Frequency specific microcurrent used at the extremity setting (extremity joint 1-4 weeks) was applied to the anterior aspect of the affected hips.

Active care consisted of a variety of rehabilitative exercises with the primary focus of dissociating hip and low back movement and gaining independent articular control of the hip (Table 2). Specific exercises were completed to address each of the positive femoral anterior glide tests. Independent control of the hip relative to the pelvis was accomplished by slowly internally and externally rotating the hip without allowing motion of the pelvis, which began as active assisted and progressed to active and then resisted, in the prone position. Once competency was achieved this was repeated in the supine position with the hip flexed to 90° and finally with the patient standing (Figure 4). To develop a gluteal-dominant hip extension pattern the athletes completed prone hip extension with the knee flexed and extended. However, a pelvic block was placed under the proximal femur to prevent anterior

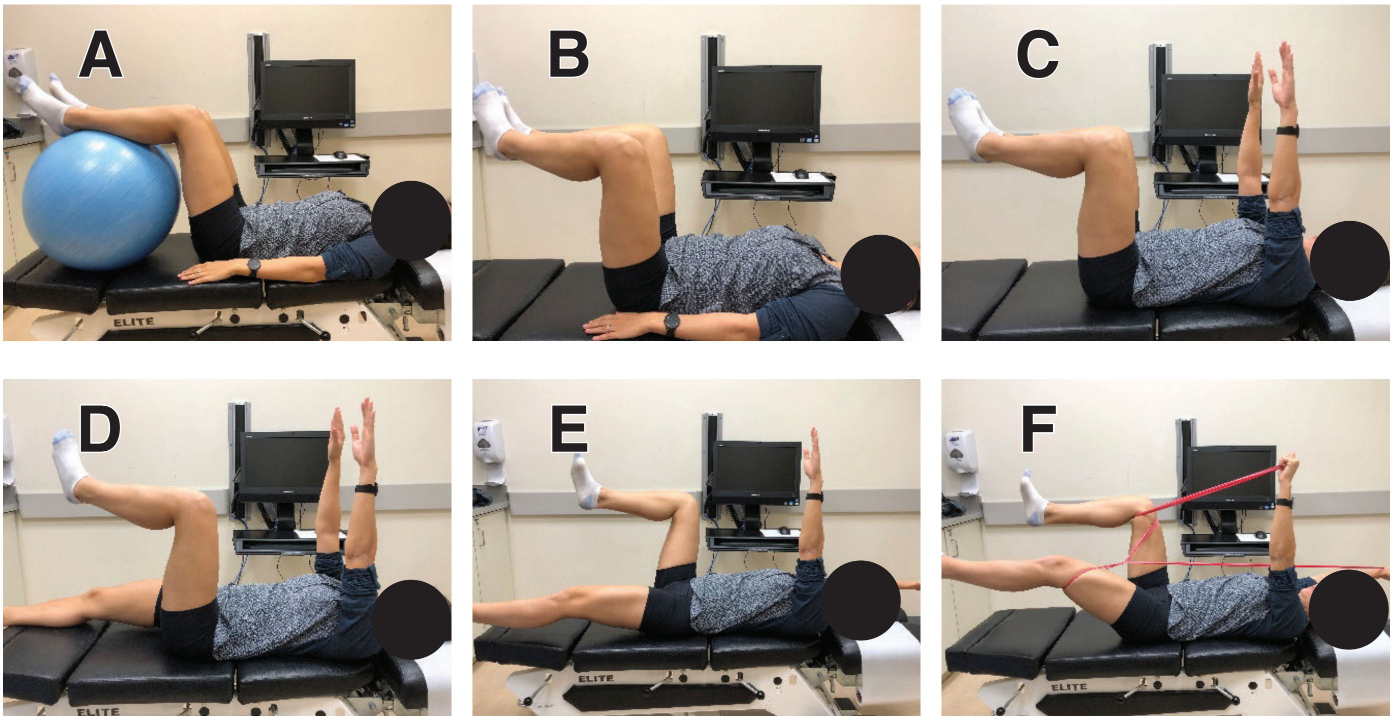

Figure 6.
Exercise Progression of 3-Month Supine Position. (A) legs supported, (B) legs raised, (C) arms and leg raised, (D) lowering one leg, (E) lowering opposite arm and leg and (F) resistance band lowering opposite arm and leg progressive rehabilitation exercises focusing on abdominal breathing and gaining independent articular control of the hip.

glide of the femoral head (Figure 5). Patients performed quadruped rocking while maintaining a lumbar lordosis and completed supine straight leg raises after passive therapy, which was aimed to increase posterior glide of the femoral head within the acetabulum. All athletes underwent training to be able to generate a proper corset with intra-abdominal pressure, which began in the three-month supine developmental position with their legs supported, transitioning to legs unsupported, then cross-crawl and finally resisted cross-crawl using tubing (Figure 6).

Deadlifts and squats were primary exercises in each of their training programs. Once, they demonstrated competency in femoral anterior glide tests (prone hip extension, supine active straight leg raise and quadruped rocking) they were coached on squat and deadlift mechanics. Deadlift progressions consisted of hip hinging, kettlebell deadlifts and offset weight deadlifts. Squat progressions included a pull-down into a squat, squatting facing a wall, reactive neuromuscular training using a band around the knees during a squat and finally reverse positioning of an overhead squat from a toe touch. Athlete A was treated twice per week for four weeks. Athletes B and C were treated twice per week for six weeks. All three athletes were given exercises at each treatment based on their level of competency with each movement progression, which were to be performed daily until the next appointment.

Outcomes

After the combination of passive care focused on addressing the inadequate posterior glide of the femoral head, and rehabilitative exercises designed to improve independent articular control of the hip, all the athletes were able to return to their sport without any hip pain for the remainder of the season. All athletes recorded 0/10 pain intensity on the NPRS and 80/80 on the LEFS. When retested with the femoral anterior glide tests they demonstrated adequate movement proficiency. During the supine active straight leg raise and prone hip extension the greater trochanter was observed to maintain a relatively constant position and they experienced no pain. During quadruped rocking, they could maintain a lumbar lordosis while rocking their buttocks toward their heels. Long-term follow-up has been completed with each athlete. Athletes A, B and C have been symptom-free for four years, three years and six months, respectively, and have been able to continue full participation in their athletic endeavours.

Discussion

This case series presents preliminary findings to support the conservative treatment of femoral anterior glide syndrome. All three participants had a complete resolution of hip pain symptoms and were able to continue with a full practice and training load and compete in their sport.

The scientific rationale for treatment of femoral anterior glide syndrome begins with research that demonstrates that there are accessory movements of the hip. In order for a joint to move there is a combination of angular displacement of the bones and their articular surfaces as well as a translational glide of one articular surface over the other in a linear or curvilinear direction.[18] This translational glide is often referred to as an accessory joint movement. Because of the high joint congruency of the articular surface of the femoral head and the acetabulum as well as the strong ligaments that surround the hip joint, it has been debated whether accessory movements of the hip exist. In 2003, Harding *et al*. demonstrated that there is anterior glide of the femoral head within the acetabulum when a postero-anterior hip joint mobilization is applied, and the magnitude of this glide is highly variable between subjects, when tested in a cadaveric model.[12] Loubert *et al*. added to this research by analyzing posterior glide of the femoral head within the acetabulum in live human subjects without any hip or low back musculoskeletal conditions.[18] They reported an average posterior glide of 2.0 mm. when a posterior force with a magnitude of 50% of the subject's bodyweight was applied posteriorly to the femur.

Considering that there is evidence of both anterior and posterior glide of the femoral head within the acetabulum, the next logical progression would be to analyze if improper muscle activation patterns (i.e. hamstring dominant prone hip extension) would result in aberrant sagittal plane joint forces (i.e. increased anterior joint forces of the hip). Lewis *et al*. used a pelvis and lower limb biomechanical model which could determine sagittal plane hip joint forces. These studies demonstrate that as the hip extension angle increases there are increased anterior joint forces on the hip.[11,16] Additionally, during a prone hip extension from 10° of flexion to 20° of extension, with decreased force contribution from the gluteal muscles there are increased anterior hip joint forces.[11] With a decrease of hamstring force contribution there was a decrease in anterior hip joint forces.[16] They also used the biomechanical model to estimate sagittal plane forces on the hip during supine hip flexion. With hip flexion, decreased force contribution from the iliopsoas resulted in increased anterior hip joint forces. As the model decreased the force contribution of the iliopsoas it increased the force contribution of the gluteus minimus, pectineus, rectus femoris, tensor fascia lata, sartorius and adductor longus.[16] The outcomes from this biomechanical model are consistent with the clinical observations proposed by Sahrmann.[9]

This evidence that altered muscle activation patterns can result in aberrant sagittal plane joint forces of the hip supports the mechanism of femoral anterior glide syndrome. However, for treatment to be effective those movement patterns would have to be modifiable. Lewis and Sahrmann, assessed the typical movement pattern of healthy women in prone hip extension and found that the subjects demonstrated a consistent muscle activation pattern of medial hamstrings followed by the lateral hamstrings and gluteus maximus.[19] They also demonstrated that with verbal and tactile cueing they were able to alter the timing of muscle activation and muscle force contribution, which resulted in a change in joint kinematics. This collection of research provides scientific evidence supporting the mechanism of femoral anterior glide syndrome and provides a rationale for conservative treatment.

This case series supports the successful outcomes of previous research in which a professional ballet dancer was treated for femoral anterior glide syndrome with conservative management. Khoo-Summers and Bloom reported on a 29-year-old professional ballet dancer with a suspected labral tear and femoral anterior glide syndrome based on the diagnostic criteria proposed by Sahrmann.[9,10] This patient had anterior hip pain and positive findings during the prone hip extension, supine straight leg raise and quadruped rocking tests. However, she also had positive orthopedic tests indicating the presence of a labral tear. Treatment focused on decreasing anterior hip joint stresses and improving the precision of hip motion through correction of alignment and movement impairments noted during functional activities and dance. After six treatments over a two-month period she had no pain with activities of daily living and the majority and dance movements. At a five-month follow-up she had complete resolution of her hip pain and had returned to her role as the principal dancer in a ballet company. These case reports highlight the importance of assessing and treating movement impairment syndromes, both in the absence and presence of pathology, such as an acetabular labral tear.

Future research should aim to objectively measure timing of muscle activation and force contribution in healthy subjects and those suspected to have femoral anterior glide syndrome. For movement impairment syndromes to gain traction in the scientific literature, future research will also need to identify objective measures and provide specific diagnostic criteria which can be used to identify healthy subjects and those with a movement impairment, such as femoral anterior glide syndrome.

Conclusion

The results of this case series suggest that conservative management of femoral anterior glide syndrome in elite athletes can result in resolution of anterior hip pain symptoms and may provide a basis for conducting a larger scale study.

References

1. Renström P, Peterson L. Groin injuries in athletes. Br J Sports Med. 1980; 14(1): 30–36.
2. Emery CA, Meeuwisse WH, Powell JW. Groin and abdominal strain injuries in the National Hockey League. Clin J Sport Med. 1999; 9(3): 151–156.
3. Mosler AB, Weir A, Eirale C, Farooq A, Thorborg K, Whiteley RJ, Hölmich P, Crossley KM . Epidemiology of time loss groin injuries in a men's professional football league: a 2-year prospective study of 17 clubs and 606 players. Br J Sports Med. 2018; 52(5):292-297.
4. Taylor R, Vuckovic Z, Mosler A, Agricola R, Otten R, Jacobsen P, Hölmich P, Weir A. Multidisciplinary assessment of 100 athletes with groin pain using the Doha Agreement: high prevalence of adductor-related groin pain in conjunction with multiple causes. Clin J Sport Med. 2018; 28(4): 364-369.
5. O'Connor DM. Groin injuries in professional rugby league players: a prospective study. J Sports Sci. 2004; 22(7): 629–636.
6. Hölmich P. Long-standing groin pain in sportspeople falls into three primary patterns, a "clinical entity" approach: a prospective study of 207 patients. Br J Sports Med. 2007; 41(4): 247–252.
7. Battaglia PJ, D'Angelo K, Kettner NW. Posterior, lateral, and anterior hip pain due to musculoskeletal origin: a narrative literature review of history, physical examination, and diagnostic imaging. J Chiropr Med. 2016; 15(4): 281–293.
8. de Sa D, Hölmich P, Phillips M, Heaven S, Simunovic N, Philippon MJ, Ayeni OR. Athletic groin pain: a systematic review of surgical diagnoses, investigations and treatment. Br J Sports Med. 2016; 50(19): 1181–1186.
9. Sahrmann S. Diagnosis and Treatment of Movement Impairments Syndromes. St. Louis: Mosby Inc., 2002: 144-54.
10. Khoo-Summers L, Bloom NJ. Examination and treatment of a professional ballet dancer with a suspected acetabular labral tear: a case report. Man Ther. 2015; 20(4): 623–629.
11. Lewis CL, Sahrmann SA, Moran DW. Anterior hip joint force increases with hip extension, decreased gluteal force and decreased iliopsoas force. J Biomech. 2007; 40(16): 3725–3731.
12. Harding L, Barbe M, Shepard K, Marks A, Ajai R, Lardiere J, Sweringa H. Posterior-anterior glide of the femoral head in the acetabulum: a cadaver study. J Orthop Sports Phys Ther. 2003; 33(3): 118–125.
13. Shindle MK, Ranawat AS, Kelly BT. Diagnosis and management of traumatic and atraumatic hip instability in the athletic patient. Clin Sports Med. 2006; 25(2): 309–326.
14. Kelly BT, Williams RJ 3rd, Philippon MJ. Hip arthroscopy: current indications, treatment options, and management issues. Am J Sports Med. 2003; 31(6): 1020–1037.
15. Retchford T, Crossley KM, Grimaldi A, Kemp JL, Cowan SM. Can local muscles augment stability in the hip? A narrative literature review. J Musculoskelet Neuronal Interact. 2013; 13(1): 1–12.
16. Lewis CL, Sahrmann SA, Moran DW. Effect of position and alteration in synergist muscle force contribution on hip forces when performing hip strengthening exercises. Clin Biomech. 2009; 24(1): 35–42.
17. Hertling D, Kessler RM. Management of common musculoskeletal disorders: physical therapy principles and methods. 3rd ed. Philadephia: Lippincott Williams & Wilkins, 2006: 22-33.
18. Loubert P V, Zipple JT, Klobucher MJ, Marquardt ED, Opolka MJ. In vivo ultrasound measurement of posterior

femoral glide during hip joint mobilization in healthy college students. J Orthop Sports Phys Ther. 2013; 43(8): 534–541.
19. Lewis CL, Sahrmann SA. Muscle activation and movement patterns during prone hip extension exercise in women. J Athl Train. 2009; 44(3): 238–248.
20. Frank C, Kobesova A, Kolář P. Dynamic neuromuscular stabilization & sports rehabilitation. Int J Sports Phys Ther. 2013; 8(1): 62–73.
21. Kolář P. Clinical rehabilitation. 1st ed. Prague: Alena Kobesová, 2013: 54-60.