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Clinical Examination, Diagnostic Imaging, and Testing of Athletes With Groin Pain: An Evidence-Based Approach to Effective Management

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Groin pain is common in athletes participating in multidirectional sports. It is especially prevalent in the various football codes and in ice hockey, which involve repetitive and forceful hip movements, such as those that occur during high-intensity kicking, skating, and direction change.[22,62,104] Traditionally, groin pain has been considered difficult to understand, diagnose, and manage.[33] A lack of detailed scientific understanding concerning the underlying pathology of pain originating from the pubic symphysis, adjacent bone, and many surrounding musculotendinous attachments has caused controversies and disagreements concerning diagnoses and terminology.[94] Furthermore, current improvements in understanding hip joint pathologies causing groin pain in athletes have made the clinical examination and classification of groin pain more complex and comprehensive, sometimes resulting in an ambiguous diagnostic work-up process.[94]

Until recently, a lack of agreement regarding terminology, definitions, or classification of groin pain in athletes[85,94,105] has led to poor communication and research interpretation between clinicians. However, during the past decade, the field has evolved and an evidence-based understanding is now emerging.[33,94] Numerous groups around the world are working together to create clear terminology, provide information on the diagnostic accuracy of relevant clinical examination and imaging techniques, and improve the assessment of impairment, function, and performance to optimize management of athletes with groin pain.

The aim of this paper was to synthesize recent advances in the clinical examination, diagnostic imaging, and testing of athletes with groin pain. Furthermore, we describe how information from reliable and valid clinical examination, diagnostic imaging, and testing of impairment, function, and performance can guide current evidence-based management of athletes with groin pain.

The clinical framework suggested in this commentary (**FIGURE 1**) is based on consensus between experts[31,105] and reliable and valid investigations where available.[9,36,58,83,86,92,98]

SYNOPSIS: Groin pain is common in athletes who participate in multidirectional sports and has traditionally been considered a difficult problem to understand, diagnose, and manage. This may be due to sparse historical focus on this complex region in sports medicine. Until recently, there has been little agreement regarding terminology, definitions, and classification of groin pain in athletes. This has made clear communication between clinicians difficult, and the results of research difficult to interpret and implement into practice. However, during the past decade, the field has evolved rapidly, and an evidence-based understanding is now emerging. This clinical commentary discusses the clinical examination (subjective history, screening, physical examination); imaging; testing of impairments, function, and performance; and management of athletes with groin pain in an evidence-based framework. *J Orthop Sports Phys Ther 2018;48(4):239-249. Epub 6 Mar 2018. doi:10.2519/jospt.2018.7850*

KEY WORDS: *abdominals, adductors, athletes, groin, hip, pubic symphysis*

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CLINICAL EXAMINATION

History

Groin pain is generally more common in male athletes,[62,104] but some specific injuries, such as stress fractures in and around the pelvic ring, are more common in female athletes.[23] In young, skeletally immature athletes, the pelvic apophyses are vulnerable to injury.[74] High-load activities, such as kicking and sprinting, may result in avulsion fractures, with the anterior inferior and superior iliac spines being the 2 most frequently injured locations.[72,81] Additionally, as the pubic symphysis is the last part of the human skeleton to mature, pubic apophysitis should be considered in the differential diagnosis of hip and groin pain in athletes as they age into their early twenties.[74] Adolescent athletes are also at increased risk of hip-related problems if they have a previous history of slipped capital femoral epiphysis,[18] Legg-Calvé-Perthes disease,[55] or acetabular dysplasia. Hip-related groin pain is more likely to occur in mature athletes starting in their early twenties,[16,45] and hip joint osteoarthritis (OA) as a cause of groin pain should also be considered in older athletes.[16]

Types of Sports and Injuries

Due to the high number of athletes competing in multidirectional sports, such as football, many athletes with either acute strains or overuse injuries related to the groin region are seen in clinical practice. Acute strains often occur at the musculotendinous junction, specifically of the adductor longus, rectus femoris, and iliopsoas muscles.[87,88] Acute adductor longus and rectus femoris injuries may also involve tendinous rupture/avulsion, primarily at the proximal insertions (**FIGURE 2**).[87,88] In contrast to strains, groin overuse injuries more often involve bone and tendons and their insertions, and rarely involve the rectus femoris.[34] Acute adductor muscle injuries usually occur during kicking and change of direction.[84] In comparison, acute rectus femoris injuries primarily occur during kicking and sprinting, whereas acute iliacus and psoas major injuries mainly occur with movement requiring change of direction.[88] Runners and dancers can also present with groin pain, often due to overuse. Hip flexor injuries, hip joint pain, and stress fractures are the most common injuries seen in these individuals,[8,43,47,66] and, like most other overuse injuries, these are more often related to repetitive and accumulated overload.

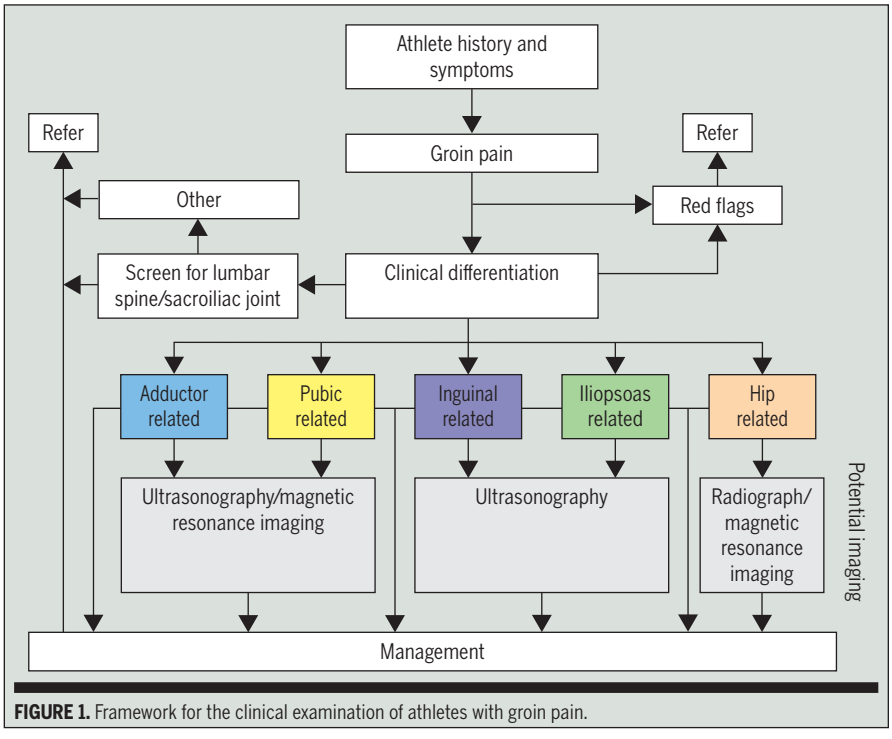


FIGURE 1. Framework for the clinical examination of athletes with groin pain.

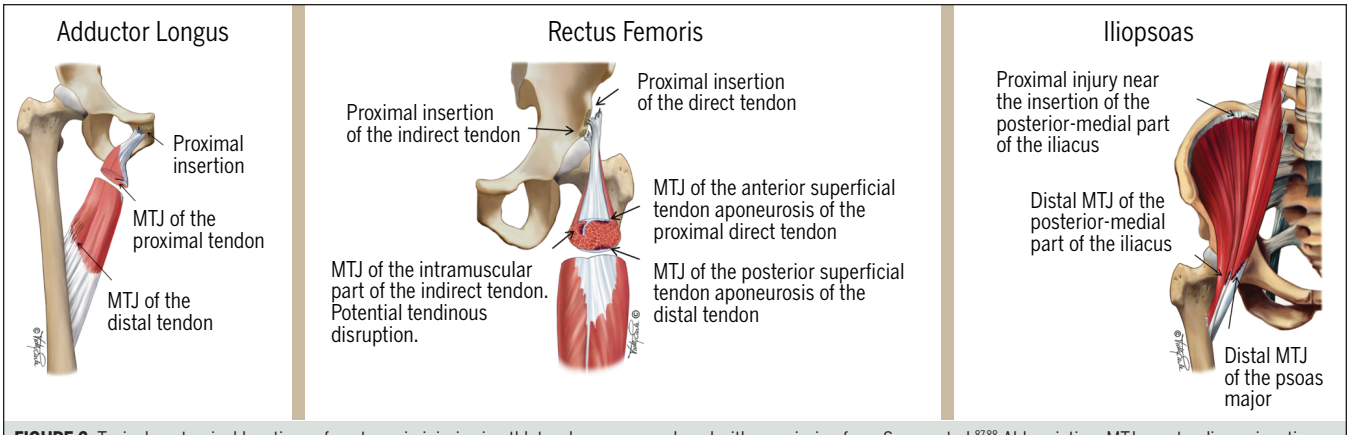


FIGURE 2. Typical anatomical locations of acute groin injuries in athletes. Images reproduced with permission from Serner et al.[87,88] Abbreviation: MTJ, myotendinous junction.

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Screening for Serious Pathology Causing Groin Pain

Evidence supporting diagnostically accurate red flag signs and symptoms in the groin region is limited[21] and inconsistent across current practice guidelines.[48] Still, clinicians must be aware of abdominal and pelvic organ disorders mimicking musculoskeletal-related groin pain.[15] A history of cancer, such as prostate cancer in men, breast cancer in women, or cancer in any reproductive organs, is a potential red flag, as it is associated with metastases in the hip and groin region.[32] Other red flags of concern are history of trauma, fever, unexplained weight loss, painful urination, night pain, and prolonged corticosteroid use.[29,51,100]

Serious pathology causing groin pain includes avascular necrosis, femoral neck fracture, or femoral shaft stress fracture. Information on screening for avascular necrosis is limited, but it has been suggested that having normal hip range of motion (ROM) is helpful in ruling out this condition.[42] The patella-pubic percussion test (sensitivity, 95%; negative likelihood ratio = 0.07) and fulcrum test (sensitivity, 88%; negative likelihood ratio = 0.92) provide good to limited clinical utility to help rule out femoral neck fractures and femoral shaft stress fractures, respectively.[68]

If there is suspicion of serious underlying pathology, specific imaging should always be performed. Plain radiographs are a good primary examination to detect neoplasms in the skeleton. Even in seemingly healthy athletes, this should be considered for unexplained or long-standing groin pain not improving with treatment. If a stress fracture is considered, radiographs are frequently negative, especially in the early stages, and therefore cannot be used to rule out these injuries.[17,47] Alternatively, magnetic resonance imaging (MRI), which visualizes bone stress reactions at an earlier stage, especially in high-risk sites, is therefore recommended.[17,47] In the skeletally immature adolescent athlete, plain radiographs are used to detect osseous avulsions in musculotendinous distraction injuries, avascular necrosis, and epiphysiolysis of the femoral neck.[6,30]

Physical Examination

Once serious pathology has been ruled out, the clinician should screen for potential lumbar spine– and sacroiliac joint–related pathology using subjective history and clinical examination tests that are highly sensitive. A lack of peripheralization or centralization (sensitivity, 92%; negative likelihood ratio = 0.12) of the athlete's symptoms with repeated lumbar spine ROM testing and negative straight leg raise (sensitivity, 97%; negative likelihood ratio = 0.05) and slump testing (sensitivity, 83%; negative likelihood ratio = 0.32) assist with ruling out the potential existence of discogenic/radiculopathy pathology.[19,101] Facet joint pathology is best ruled out with a negative extension-rotation test (sensitivity, 100%; negative likelihood ratio = 0.00).[50,82] Despite the controversial nature of sacroiliac joint pathology testing, the thigh thrust test has good clinical utility to rule out (sensitivity, 88%; negative likelihood ratio = 0.18) potential sacroiliac joint pathology.[49]

The Doha agreement regarding the examination of athletes with groin pain suggests classifying athletes according to certain clinical entities based on pain-provocation tests.[34,36,105] Tenderness with palpation is present in the defined clinical entities of adductor-, pubic-, inguinal-, and iliopsoas-related groin pain (**TABLE**). Tenderness with palpation denotes the presence of recognizable pain related to anatomical structures encompassed by the specific entity (**FIGURE 3**).[105] The same applies to resistance testing of the adductors, where the pain must be felt in the adductor region to be classified as being adductor-related groin pain.[105] Good intraobserver and interobserver agreement for this approach ($\kappa \geq 0.70$)[36] has been documented. New studies examining the accuracy of the clinical examination of pain-provocation tests using palpation, stretch, and resistance testing in athletes with acute groin injuries have been published since the Doha agreement meeting.[84,86] These studies demonstrate that clinical examination is accurate in locating acute injuries to the adductors, generally with an accuracy greater than 90% for the various adductor tests.[86] For acute hip flexor injuries, it can sometimes be hard to distinguish between iliopsoas or proximal rectus femoris involvement based on clinical findings. The accuracy of the different hip flexor tests is not much better than flipping a coin.[86] Importantly, absence of palpation pain in the adductors and hip flexors has the highest predictive value for ruling out acute injury in these structures, with an accuracy greater than 90%.[86]

Hip-related intra-articular pathology is a possible cause of groin pain in athletes.[31] Clinical tests work best as screening tests, with negative tests assisting in ruling out intra-articular hip pathology. A positive test can only indicate the need for further investigation of the hip.[67,68] To further elucidate actual intra-articular injury, diagnostic imaging is necessary to corroborate the athlete's symptoms and the clinical findings.[69] This approach was established by a panel of specialists and formulated in the 2016 Warwick Agreement on femoroacetabular impingement (FAI) syndrome. Femoroacetabular impingement syndrome was defined as a motion-related clinical hip disorder with a triad of symptoms, clinical signs, and imaging findings.[31] The primary symptoms of FAI syndrome are motion- or position-related pain in the hip or groin region,[31] with potential clicking, catching, locking, stiffness, restricted hip ROM, or giving way (**TABLE**).

Therefore, current best evidence supports a comprehensive examination (eg, subjective history, screening, physical examination) of the entire groin region for athletes presenting with groin pain (**FIGURE 1**).

IMAGING

Does imaging add to clinical decision making beyond its potentially important role in the detection/

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ruling out of serious pathology? When serious pathology is not suspected, the guidelines from the Doha agreement classification system are useful.[105] For athletes with symptoms and clinical findings who can readily be classified into 1 or more of the 4 defined clinical entities (**TABLE**, **FIGURE 3**), there is currently no available evidence to suggest an improvement of diagnostic or prognostic indicators with imaging.[11] Additionally, inappropriate and excessive use of imaging can be problematic, because morphology alone does not equate to pathology.[10,26] The consequence of unnecessary imaging is that athletes may focus on these normal morphological tissue changes, which may make them fearful of movement and exercise and impede effective treatment.

Imaging for Pubic- and Adductor-Related Groin Pain

Abnormal imaging findings around the pubic symphysis are commonly reported in athletes with adductor- and pubic-related groin pain.[11] Many of these findings, such as low-grade pubic bone marrow edema, are also found in asymptomatic athletes.[10] In football players with and without groin pain, only higher grades of pubic bone marrow edema and a protrusion of the symphyseal joint disc were associated with pain.[10] Pubic bone marrow edema can be described as a bone stress reaction, as histologic analyses of bone biopsies show no signs of inflammation.[102] Therefore, the diagnostic term "osteitis pubis" is not recommended based on current evidence. Whether a higher pubic bone marrow edema severity grading is associated with a longer rehabilitation time has never been reported, but cannot be discarded. Based on current evidence of imaging findings in relation to the symphysis joint and the adjacent pubic bone, clinicians need to consider age, type of sport, loading, and the athlete's presenting symptoms when interpreting these imaging findings. In adolescents, pubic- or adductor-related groin pain could be due to apophysitis.[74] This is an important differential diagnostic consideration, as the mainstay of treatment is supervised load management. The best imaging modality to show the apophyses is computed tomography, a modality not recommended for young athletes due to the high dose of ionizing radiation. In-

TABLE Classification System of Groin Pain in Athletes*

Nomenclature	Symptoms	Definition	More Likely if Patient Presents With
Adductor-related groin pain†	Pain around the insertion of the adductor longus tendon at the pubic bone. Pain may radiate distally along the medial thigh	Adductor tenderness and pain on resisted adduction testing	Pain on adductor stretching
Iliopsoas-related groin pain†	Pain in the anterior part of the proximal thigh, more laterally located than adductor-related groin pain	Iliopsoas tenderness (either suprainguinal or infrainguinal)	Pain reproduced with resisted hip flexion and/or pain with hip flexor stretching
Inguinal-related groin pain†	Pain in the inguinal region that worsens with activity. If pain is severe, often inguinal pain occurs when coughing or sneezing or sitting up in bed	Pain in the inguinal canal and inguinal canal tenderness, or pain with Valsalva maneuver, coughing, and/or sneezing. No palpable inguinal hernia found, including on invagination of the scrotum to palpate the inguinal canal	Pain reproduced with resisted abdominal muscle testing
Pubic-related groin pain†	Pain in the region of the symphysis joint and the immediately adjacent bone	Local tenderness of the pubic symphysis and the immediately adjacent bone	No particular resistance test, but more likely if pain is reproduced by resisted abdominal and hip adductor testing
Hip-related groin pain†		Clinical suspicion that the hip joint is the source of groin pain, either through history or clinical examination	Mechanical symptoms present, such as catching, locking, clicking, or giving way
FAI syndrome‡	Motion- or position-related pain in the hip or groin. Pain may also be felt in the back, buttock, or thigh. Patients may also describe clicking, catching, locking, stiffness, restricted range of motion, or giving way	Motion-related clinical disorder of the hip with a triad of symptoms, clinical signs, and imaging findings. Cam and/or pincer morphology must be present on imaging	Limited range of hip motion, typically restricted internal rotation, and evidence of labral and/or chondral damage on imaging
Other†	Clinical suspicion if symptoms cannot be easily classified into any of the commonly defined clinical entities	Any other orthopaedic, neurological, rheumatological, urological, gastrointestinal, dermatological, oncological, or surgical condition causing pain in the groin region	

Abbreviation: FAI, femoroacetabular impingement.
**Adapted from Griffin et al[31] and Weir et al.[105]*
†Doha agreement.
‡Warwick Agreement.

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stead, age, location of the pain at the adductor insertion on the pubic bone, and uncharacteristic worsening of pain with adductor exercises should make one consider this diagnosis.

Imaging may be considered to determine the initial severity of acute adductor muscle strains. Avulsion injuries account for a high proportion of injuries at the proximal adductor longus insertion,[87] and these injuries generally have a longer rehabilitation time than lower-grade injuries.[79,107] Therefore, if an avulsion is suspected, ultrasonography or MRI can be used for confirmation.[84,86] In athletes with long-standing adductor-related groin pain, ultrasonography is often the imaging modality of choice.[35]

Imaging for Inguinal-Related Groin Pain

In inguinal-related groin pain, ultrasonography is also most often the imaging of choice, used as part of the diagnostic process. One proposed etiology of inguinal-related pain is that posterior abdominal wall weakness leads to bulging of abdominal structures that compresses the genital branch of the genitofemoral nerve.[14] This weakness can sometimes be visualized through dynamic ultrasonography. However, bulging alone has not been associated with groin pain, and there is a high risk of false-positive findings due to the high prevalence of bulging in asymptomatic athletes.[63] Currently, there is no evidence on the validity or reproducibility of these ultrasonography imaging findings,[11,63] and therefore ultrasonography findings in athletes with inguinal-related groin pain should be interpreted with caution.

Imaging for Iliopsoas-Related Groin Pain

In athletes with groin pain, diagnosing iliopsoas-related groin pain can sometimes be difficult,[84] as widespread pain can result in multiple positive clinical examination tests.[86] Magnetic resonance imaging or ultrasonography may therefore be helpful to improve accuracy in the initial diagnosis,[7,59] although evidence regarding the therapeutic or prognostic relevance of such findings is currently lacking.

Imaging for Hip-Related Groin Pain

In hip-related groin pain, there are several cases where imaging may assist in the diagnosis.[67,68,71] As previously mentioned, assessment of radiological measures of cam and/or pincer morphology is required for the diagnosis of FAI syndrome.[31] Initial diagnostic imaging should therefore include an anteroposterior radiograph of the pelvis and a lateral femoral-neck view to examine bony hip morphology and determine the presence of other possible sources of hip-related groin pain.[31]

In prospective studies, the presence of acetabular dysplasia and the presence of cam morphology are associated with an up to 5-fold[2] and 10-fold[1,61] increased risk of OA development, respectively, in middle-aged cohorts presenting with hip pain. Large cam morphology, defined as an alpha angle greater than 78°, has been identified as the threshold best distinguishing hips that proceed to develop OA.[3] In contrast, it appears that the presence of a pincer deformity may have a protective effect against the development of OA.[3,73] Whether these findings can be extrapolated to athletes younger than 40 years of age is currently unknown. In older athletes, hip OA should always be considered and is clinically indicated by hip flexion of 115° or less and hip internal rotation less than 15°, and radiographically verified as joint space narrowing or presence of femoral or acetabular osteophytes.[5]

If further assessment of morphology, cartilage, or labral injury is warranted, then cross-sectional imaging is appropriate, preferably using 3.0-T MRI.[3,31] In accordance with the Warwick Agreement[31] and other work,[70] we also suggest that imaging findings of intra-articular pathology be matched with clinical examination findings and the athlete's symptoms before a specific diagnosis is provided under the umbrella of hip-related groin pain.

Based on the many false-positive findings and the lack of understanding between the specific underlying pathology and its specific manifestation on imaging, utilizing imaging as the main guide for treatment is not recommended. However, as previously mentioned, imaging has a role in detecting serious pathology, and may in some cases also serve to give more credence to the diagnostic work-up

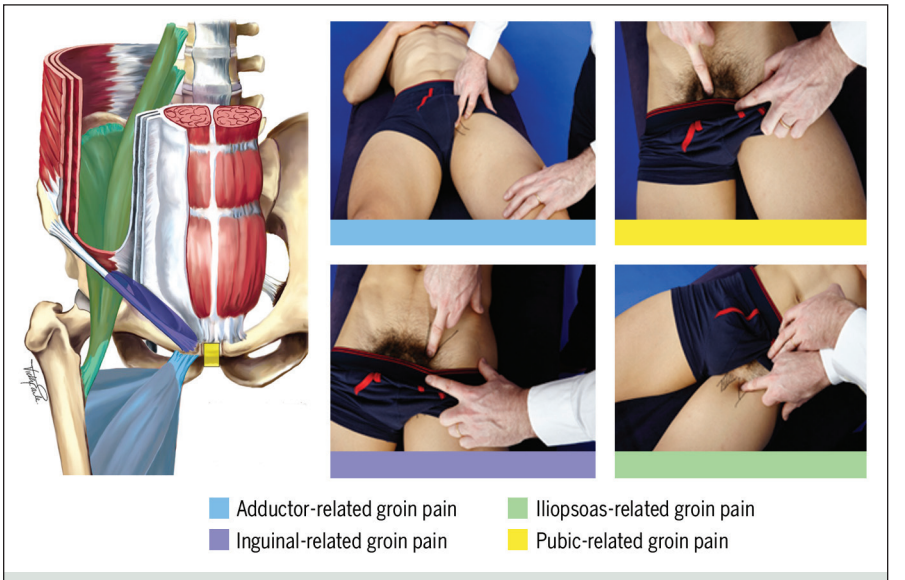


FIGURE 3. Palpation areas and defined clinical entities for groin pain in athletes according to the Doha agreement. Images reproduced with permission from Weir et al[105] and from Brukner and Khan[13] (*Brukner & Khan's Clinical Sports Medicine*, 5th ed. ©2016 McGraw-Hill Education).

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process if it matches clinical signs and symptoms.

IMPAIRMENT AND FUNCTION TESTING

Most athletes with groin pain are able to continue training for several months prior to pain forcing them to discontinue their sport.[93] Continuing to train and play with groin pain can result in movement compensation strategies, resulting in decreased function and performance.[24,27,41,56,57,93]

Therefore, in addition to the use of pain-provocation tests,[69,92] joint ROM, muscle strength, function, and performance must be systematically assessed (**FIGURE 4**)[69] and the appropriate patient-reported outcome measures must be completed (**FIGURE 5**).[69]

Hip ROM

There is conflicting evidence on whether athletes with groin pain have impairments in ROM compared to controls.[46,57,90] A recent systematic review examining impairments in athletes reported no significant differences in ROM between athletes with FAI syndrome and healthy controls.[28] The clinical value of including hip ROM still remains uncertain. If clearly measurable side-to-side differences or changes between test and retest exist (greater than 5°),[90] then this could potentially inform individually targeted management strategies.[31] However, it is important to understand whether ROM restrictions are caused by bony morphology or are the consequence of underlying chondral status and/or protective muscle guarding.

Hip Muscle Strength

Decreased hip muscle strength seems to be a consistent finding in athletes with groin pain.[46,57] Hip muscle strength deficits have been demonstrated in athletes with adductor- and pubic-related groin pain,[53,93] and in individuals with hip-related groin pain, FAI syndrome, or after having hip arthroscopy, often for several hip movement planes.[20] In particular, reduced hip adduction strength is commonly reported in athletes with groin pain[46] and is important to target through rehabilitation. Athletes with adductor- and pubic-related groin pain have also shown reduced hip abduction and abdominal muscle strength.[46,57]

Objective measurements of hip strength in all planes of motion are therefore important. When using handheld dynamometry, results can either be interpreted based on published normative values for specific populations (types of athletes)[58] or in comparison with the unaffected limb in individuals with unilateral presentations.[58] When comparing to the unaffected side, a lower-limb symmetry index can then be calculated by dividing the strength of the affected limb by the unaffected limb. In addition, ratios between agonist and antagonist hip muscle groups have been reported for athletes with and without groin pain, providing additional reference criteria for measuring progress.[58,93,97,99] Clinically, changes/differences in muscle strength greater than 15% to 20% can be reliably measured across all movement directions of the hip when using the same tester.[96]



FIGURE 4. Physical testing of impairments, function, and performance. (A) Bent-knee fall-out for testing hip range of motion. (B) Adductor squeeze strength test for pain (0-to-10 numeric pain rating and traffic-light analogy) and force using a handheld dynamometer. (C) Star Excursion Balance Test for testing balance and mobility. (D) Timed 10-meter test for cutting performance (5-m sprint with 75° cut and 5-m sprint finish).[20,52,54,57,92] This figure includes images reproduced with permission from Thorborg et al.[92]

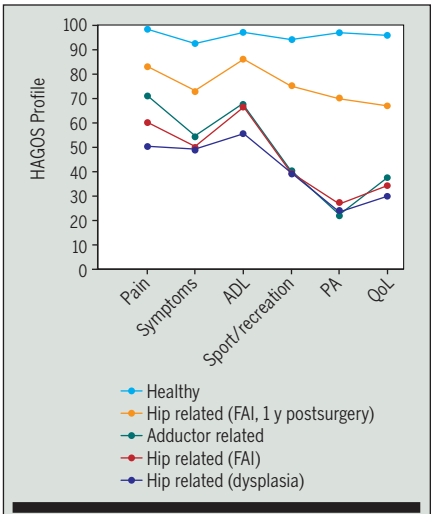


FIGURE 5. Patient-reported outcome measures used in the evaluation of athletes and physically active individuals with different hip and groin problems, here exemplified by the HAGOS profile (mean values) from 3 scientific studies.[40,60,75] Abbreviations: ADL, activities of daily living; FAI, femoroacetabular impingement; HAGOS, Copenhagen Hip and Groin Outcome Score; PA, participation in physical activity; QoL, quality of life.

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Interestingly, deficits greater than 20% for adductors and abdominals have been frequently documented in athletes with adductor- and pubic-related pain.[53,60,77,93] Adductor squeeze strength testing is a very precise clinical measure.[52,53] In athletes with adductor- and pubic-related pain, a numeric pain rating (0-10) can be obtained simultaneously,[108] and the test is a quick, valid indicator of hip- and groin-specific sports function.[92]

Function and Physical Performance

The use of the single-leg stance, single-leg squat, and the Star Excursion Balance Test for athletes with hip pathology is supported by a recent systematic review.[20] However, functional and physical performance deficits have not been consistently reported in athletes unless clear hip pathology or a history of hip surgery is present.[109] In athletes without clear hip pathology or a history of hip surgery, decreased functional performance has only been documented in laboratory settings, using 3-D motion analysis, showing changes and differences in kinematics during movements requiring changes of direction.[24,27] Although these results are intriguing, it is not yet clear how clinically applicable these kinematic measures are and how they relate to management. Performance measures that include actual cutting time, however, seem promising, as cutting functionally relates to pelvic lateral tilt range and lateral thorax rotation.[54] In addition, cutting-time testing is reliable and possible in most clinical settings.[54] More research is, however, needed prior to suggesting the widespread, standard clinical implementation of performance-related tests for athletes with groin pain that is not hip related.

Patient-Reported Outcome Measures

Athletes with groin pain demonstrate substantial reductions in self-reported questionnaire scores on pain, physical function, participation/performance, and quality of life.[76,93] Both the Copenhagen Hip and Groin Outcome Score (HAGOS) and the international Hip Outcome Tool are reliable, valid, and responsive measures for patients with hip and/or groin pain.[98] Both of these measures have recently been translated and validated in different languages and by different research groups, and reference values have been provided in different subgroups.[98] The HAGOS has been translated into 14 languages and is easily accessible and free of charge (www.koos.nu). Standard and repeated completion of the HAGOS and/or the international Hip Outcome Tool can help evaluate progress and guide the treatment plan. Clinically, changes of 10 to 30 points can be measured at the individual level, depending on specific patient population and the subscale used.[91,95] Such changes also exceed the minimal important change,[91,95] and most athletes with groin pain will seek treatment when their HAGOS scores for sports-related function and participation/performance are less than 50 points on a 100-point scale, where 100 points indicates perfect function.[76,93]

EVIDENCE-BASED MANAGEMENT

At present, there is limited evidence based on clinical trials comparing nonsurgical to surgical interventions for groin pain in athletes, but a recent systematic review has indicated that nonsurgical and surgical interventions have similar return-to-play times.[44] We therefore generally recommend nonsurgical management as the first line of treatment for athletes with hip and groin pain. This less invasive option will in many cases result in satisfactory results.

Athletes With Adductor- and Pubic-Related Groin Pain

For athletes with adductor-related groin pain, there is level 1 evidence that a supervised active approach to rehabilitation, including physical training, results in a higher success of return to play when compared to the use of passive physical therapy modalities.[39] The use of adjunct treatments, such as manual adductor manipulation or shockwave therapy, in addition to exercises seems to result in a faster return to play,[80,106] but not higher overall treatment success, than a supervised active physical training program alone.[39] Around 50% to 75% of athletes with adductor-related groin pain will return to their previous pain-free level of activity using a general exercise approach.[39,106] Monitoring of impairment, function, and performance can help individualize the plan of care. For athletes with adductor- and pubic-related groin pain, hip adductor and abductor muscle strength, as well as abdominal muscle strength, is important to monitor for optimal loading in the rehabilitation program. In refractory cases, level 2 evidence suggests that partial surgical release of the adductor longus tendon may be effective for returning athletes to preinjury level.[78] Weakness of the adductors is a possible consequence of adductor tenotomy,[4] and tenotomy should therefore be avoided if possible. Athletes with adductor-related groin pain and cam morphology on imaging have a good long-term prognosis using an exercise-based rehabilitation program.[38] Therefore, imaging findings of cam morphology appear less important in athletes with adductor-related groin pain than in athletes with hip-related groin pain. The clinical difference between adductor-related and pubic-related pain in the current literature seems minimal.[10,11,25,39,80,89,103,106] Therefore, pubic-related pain should be treated in a manner similar to adductor-related groin pain.

Athletes With Inguinal-Related Groin Pain

For athletes with inguinal-related groin pain, laparoscopic hernia surgery has been shown to result in lower pain and a higher percentage returning to play than nonsurgical treatment in a randomized controlled trial.[64] However, as nonsurgical treatment with exercises and injections showed some promise, with 50% of participants fully recovered after 1 year in this randomized controlled trial,[64] we

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advise a nonoperative approach first, given the risk of possible surgical complications. Again, monitoring hip adductor, hip abductor, and abdominal muscle strength is relevant in relation to individual weaknesses in these patients.[46]

Athletes With Iliopsoas-Related Groin Pain

There is no high-level evidence to support or refute the use of exercise or other nonsurgical treatments to address iliopsoas-related groin pain. We therefore propose to base treatment on impairments and functional deficits. Because arthroscopic iliopsoas release or tenotomy results in iliopsoas atrophy with substantial volume loss and reduced hip flexion strength,[12] surgery is not recommended as first-line treatment. Iliopsoas-related groin pain can coexist with hip-related groin pain,[65] and any issues related to impairments in hip flexion strength may need to be addressed.

Athletes With Hip-Related Groin Pain

Suggested management strategies for hip-related groin pain (specifically FAI syndrome) include rehabilitation (eg, physical therapy programs), medication, and surgery (particularly arthroscopy).[31] There is no high-level evidence supporting the superiority of any single approach. Therefore, the best available evidence to guide appropriate physical therapy treatment for hip-related groin pain involves targeting characteristic impairments seen in hip-related groin pain, such as hip and trunk strength, function, and performance.[20,28]

Athletes With Multiple Entities

As athletes with groin pain often present with multiple entities,[34,37] specific attention toward impairments, function, and performance can be helpful. In these athletes, the most prominent deficits can be identified by clinical testing. It is advisable to direct treatment toward these deficits first, and then monitor how this affects the clinical signs and symptoms. Sound clinical reasoning and systematic testing using the evidence-based instruments provided in this clinical commentary are also recommended for these athletes.

CONCLUSION

This clinical commentary highlights an evidence-based examination and management approach to athletes with groin pain based on science and consensus among clinical experts around the world. Further improvements are needed in relation to nonsurgical and surgical management—and the timing of these management approaches. Such progress is now easier due to better clinical differentiation and management strategies being reported.

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