Eccentric and Isometric Hip Adduction Strength in Male Soccer Players With and Without Adductor-Related Groin Pain

An Assessor-Blinded Comparison

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Background: Adductor-related pain is the most common clinical finding in soccer players with groin pain and can be a long-standing problem affecting physical function and performance. Hip adductor weakness has been suggested to be associated with this clinical entity, although it has never been investigated.

Purpose: To investigate whether isometric and eccentric hip strength are decreased in soccer players with adductor-related groin pain compared with asymptomatic soccer controls. The hypothesis was that players with adductor-related groin pain would have lower isometric and eccentric hip adduction strength than players without adductor-related groin pain.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: Male elite and subelite players from 40 teams were contacted. In total, 28 soccer players with adductor-related groin pain and 16 soccer players without adductor-related groin pain (asymptomatic controls) were included in the study. In primary analysis, the dominant legs of 21 soccer players with adductor-related groin pain (≥4 weeks duration) were compared with the dominant legs of 16 asymptomatic controls using a cross-sectional design. The mean age of the symptomatic players was 24.5 ± 2.5 years, and the mean age of the asymptomatic controls was 22.9 ± 2.4 years. Isometric hip strength (adduction, abduction, and flexion) and eccentric hip strength (adduction) were assessed with a handheld dynamometer using reliable test procedures and a blinded assessor.

Results: Eccentric hip adduction strength was lower in soccer players with adductor-related groin pain in the dominant leg ($n = 21$) compared with asymptomatic controls ($n = 16$), namely 2.47 ± 0.49 versus 3.12 ± 0.43 N·m/kg, respectively ($P < .001$). No other hip strength differences were observed between symptomatic players and asymptomatic controls for the dominant leg ($P = .35$-.84).

Conclusion: Large eccentric hip adduction strength deficits were found in soccer players with adductor-related groin pain compared with asymptomatic soccer players, while no isometric strength differences were observed between the groups.

Keywords: groin injury; male soccer; adductor muscles; hip strength; eccentric strength; hip adduction/abduction ratio

Adductor-related groin pain refers to a clinical entity defined by pain on palpation and isometric contraction of the adductors[17,18] and is the most common clinical entity encountered in elite and subelite soccer players.[10,17,20,43] Hip adductor and hip flexor weakness have been suspected of being associated with this condition,[17,22] but few studies have evaluated hip muscle strength in athletes with groin pain.[27,29,36,37]

In athletes with nonspecific groin pain, it seems that bilateral isometric hip adductor strength is decreased by 20% to 25% compared with asymptomatic controls when using a sphygmomanometer in the squeeze test.[27,29] These studies use a bilateral adduction testing approach[27,29] where the squeeze output will be determined by the weaker side.[37] Furthermore, the squeeze test is often performed in different degrees of hip flexion (30°, 45°, and 90°), possibly including a considerable force contribution from both hip

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adductors and hip internal rotators.[9,26,27,29] The squeeze test may therefore not necessarily correspond to unilateral hip adduction strength performance.[37]

In the existing literature on hip adductor strength in athletes with groin pain compared with asymptomatic controls, 2 important methodological aspects have not been controlled for.[27,29] First, blinding of the assessor conducting the strength measurements has not been applied,[27,29] which may influence the results, as any prior expectation of the assessor concerning the behavior of the subjects being measured may affect the measurement procedure. Second, using the absolute squeeze test values does not take normalization of the subject's hip muscle strength into account, which means that body mass and external lever length, factors known to influence hip muscle strength (torque),[37] have not been accounted for.[27,29]

The primary purpose of the present study was, in a blinded testing setup, to investigate whether isometric and eccentric hip adduction strength differences exist in soccer players with and without adductor-related groin pain. Second, we also wished to investigate hip adduction/abduction strength ratios and hip flexion strength in the 2 groups. We hypothesized that lower isometric and eccentric hip adduction strength exist in soccer players with adductor-related groin pain compared with soccer players without adductor-related groin pain.

MATERIALS AND METHODS

This study is part of a larger cohort investigation of male soccer players with and without hip and/or groin pain including clinical characteristics, muscle strength, range of motion (ROM), radiological findings, and self-reported outcome. All participants provided written informed consent according to the Helsinki Declaration. The project (H-2-2010-127) was approved by the Danish National Committee on Health Research Ethics.

In total, 700 players representing 40 teams (divisions 1-4) in Eastern Denmark were eligible for the study. These players were offered to be examined clinically at our institution if they experienced hip and/or groin injury during the 2011-2012 season (July 2011 to June 2012). Forty-eight soccer players with hip and groin pain contacted us. A physical therapist (K.T.) blinded to players' injury history, present symptoms, and pain during testing performed all physical assessments (strength and ROM) in the study.

After the physical assessments, all players went through a clinical examination performed by the same physical therapist. The clinical examination was not blinded, as the participant had to express verbally the pain and symptoms he experienced during this examination. Players were examined clinically using the classification system previously described by Hölmich,[17] and hip and/or groin pain was classified as being adductor-, psoas-, abdominal-, or inguinal-related. Furthermore, 2 hip pain–provocation tests were also performed and reported.[4,28] These tests were the flexion/adduction/internal rotation test (FADIR) and positive flexion/abduction/external rotation tests (FABER), as described by Martin and Sekiya.[28] These specific clinical tests were chosen as they have previously shown to have moderate to almost perfect intra- and intertester reliability.[17,28] To be included in the symptomatic group, patients had to have adductor-related groin pain, with symptoms for at least 4 weeks, and no clinical signs of osteoarthritis. In total, 28 players had adductor-related groin pain, of which 11 players presented with bilateral pain. Of the 28 players with adductor-related groin pain, 21 had pain in the dominant leg (preferred kicking leg) and 18 in the nondominant leg. The 21 players with adductor-related groin pain in the dominant leg represented 18 different clubs. Twenty symptomatic players were excluded—2 because of acute injuries (<4 weeks) and 18 who did not have clinical representation of adductor-related groin pain.[17,18]

In total, 20 players without hip and/or groin pain within the previous year were also recruited from the 700 eligible players. Players with recollection of hip and groin pain experienced more than a year ago that had kept them out of training or games were not included in the study. Of these 20 players, strength measurements were obtained from 19 players (data missing from 1 person because of technical problems with the dynamometer on the test day). Of these 19 players, 3 players had groin pain (1 or more clinical entities) on clinical examination, at the time of the strength assessment, and could therefore not serve as asymptomatic controls. Thus, data from 16 soccer players without adductor-related groin (asymptomatic controls), representing 11 different clubs, were included for comparison.

Both symptomatic and asymptomatic participants reported no medical conditions compromising their physical function and were not allowed to exercise or take pain medication on the day prior to the test. None of the participants had previously undergone hip strength measurements using a handheld dynamometer (HHD).

Muscle Strength Testing

Testing was performed in a clinical examination room at the Arthroscopic Centre Amager. The testing setup included a portable HHD and a table. Muscle strength was tested with the Power Track II commander (JTech Medical, Salt Lake City, Utah, USA). The dynamometer was calibrated on each test day, and all test procedures were standardized. One tester and 1 assistant were present during the testing sessions. The tester, a physical therapist (K.T.) with extensive experience in using the HHD, performed all of the testing. The assistant (M.P.N.) registered all hip strength measurements, including elicited pain during strength testing. The tester was blinded and therefore unaware of the test results and whether the tested person was symptomatic or asymptomatic. Furthermore, the tester was blinded for leg dominance, hip muscle strength values, flexibility values, and patients' ratings of pain during testing. Every participant performed 5 strength tests bilaterally; 4 of the tests were isometric strength tests, also known as make tests, and 1 test was eccentric, also known as a break test.[33,35] The 5 tests were isometric hip adduction (HADD-ISO),[35] isometric hip abduction (HABD-ISO),[35] hip flexion (HFLEXION-ISO),[35] isometric hip flexion–modified Thomas test (HFLEXION-MT-ISO),[12,15] and eccentric hip adduction(HADD-ECC)[33] tests, and were tested in that order. The right leg was always tested before the left leg for each hip action. All tests followed previously published test protocols reporting substantial test-retest reliability of these procedures.[12,15,33,35] After each test, the participant rated the pain experienced during testing by pointing to a number on an 11-point numerical rating scale (0-10).

Lever length was used to calculate torque, and all force values were weight adjusted (N·m/kg). Lever length was measured from the most prominent point on the anterior superior iliac spine in the supine position to the application point of the dynamometer 5 cm proximal to the malleoli (hip adduction and abduction tests) and the patella (hip flexion tests).[33,35]

Data Reduction and Statistical Analyses

For the primary and secondary analyses, 21 players with adductor-related pain in the dominant leg were used and compared with the dominant leg in the 16 controls. It was decided a priori not to include measurements from dominant and nondominant legs in the same analysis when comparing symptomatic and asymptomatic players, as the dominant legs in soccer players display higher isometric and eccentric hip adduction strength values compared with the nondominant legs.[33,37]

A 15% hip adduction strength difference between groups was chosen as the minimal clinically relevant difference. This was based on clinical experience and suggestions that a 10% deficit or less is considered the clinical milestone for return-to-play of athletes with groin injury.[30] Based on pilot data from eccentric hip adduction strength testing, it was estimated that, to achieve 80% power with a significance level of 5%, 8 and 12 participants were required for each group to be able to show a clinically relevant difference of 15% in isometric and eccentric adduction strength. To account for potential dropouts before and/or during testing, we aimed to recruit at least 20 players for testing in each group.

Distributions of variables are presented as means ± standard deviation (SD) for parametric data and as medians (25th-75th percentiles) for nonparametric data. All dependent variables demonstrated a normal distribution (Shapiro-Wilk test). Paired and unpaired Student t tests were used appropriately, and 2-sided F tests were used for assessing equality of variance. Secondary analyses of hip flexion strength and hip adduction/abduction strength ratio were performed for both legs. Post hoc analyses of the nondominant leg were subsequently performed to verify whether the results obtained from the dominant leg also existed in the nondominant leg. Analyses involving pain during testing (ordinal data) were performed using nonparametric statistics, including Mann-Whitney U test for independent group comparisons and Spearman rho (ρ) for correlations. A level of $P < .05$ was chosen to indicate statistical significance. No correction for multiple analyses of isometric and eccentric hip adduction strength of the dominant leg was applied, but 95% confidence intervals are presented for all hip muscle strength comparisons of the dominant leg.

RESULTS

The characteristics of the 21 players with adductor-related groin pain in the dominant leg are shown in Table 1. Of these players, 10 had concomitant psoas-related groin pain, 3 had concomitant inguinal-related groin pain, and 2 had concomitant abdominal-related groin pain. Positive FADIR and FABER tests were present in 5 players. Eight players (38%) reported an originally acute onset, and 13 players (62%) an originally gradual onset of their hip and groin pain. Fourteen players (67%) with adductor-related groin pain were still playing soccer at the time of clinical assessment, meaning that only 7 players (33%) were not playing at the time of assessment as a consequence of their hip and groin pain.

Hip strength values in the dominant leg in soccer players with and without adductor-related groin pain are presented in Table 2. Eccentric hip adduction strength was lower in soccer players with adductor-related groin pain in the dominant leg (n = 21) compared with asymptomatic controls (n = 16), namely, 2.47 ± 0.49 versus 3.12 ± 0.43 N·m/kg ($P < .001$). No other hip strength differences were identified between symptomatic players and asymptomatic controls for the dominant leg ($P = .35$-.84).

Post hoc analyses of the nondominant leg (n = 18) showed similar findings. Again, eccentric hip adduction strength was lower in soccer players with adductor-related groin pain compared with asymptomatic controls (n = 16), namely, 2.54 ± 0.51 versus 3.17 ± 0.45 N·m/kg ($P = .001$). As with the dominant leg, no other strength differences were found between asymptomatic players and controls for the nondominant leg ($P = .21$-.90). Isometric and eccentric hip adduction strength values in the dominant and nondominant leg are presented in Figure 1.

Players with adductor-related groin pain in the dominant leg (n = 21) reported higher subjective pain levels than controls during the testing of all hip actions ($P < .001$) in a between-group comparison (Table 3). However, no differences in subjective pain levels reported by symptomatic players were observed between isometric and eccentric strength testing (Table 3) in a within-group comparison ($P = .511$). Furthermore, no significant correlation was found between pain during testing and isometric or eccentric hip adduction strength (Spearman $\rho = -0.27$, $P = .23$ [isometric]; Spearman $\rho = 0.22$, $P = .35$ [eccentric]).

DISCUSSION

The present study investigates isometric and eccentric hip adduction strength in male soccer players with and without adductor-related groin pain. Our data show that a large eccentric hip adduction strength deficit (effect size ≥ 0.8)[5] exists in the injured leg in soccer players with adductor-related groin pain compared with asymptomatic controls, while isometric strength measurements of hip adduction, abduction, and hip flexion strength seem to be unaffected.

Previous studies including hip adduction strength evaluation in football players with groin pain have indicated a possible occurrence of isometric strength deficits supported by

TABLE 1
Characteristics of Soccer Players With and Without Adductor-Related Groin Pain (Dominant Leg)[a]

	Players With Adductor-Related Groin Pain (n = 21)	Controls (n = 16)	*P*
Anthropometrics, mean ± SD			
Age, y	24.5 ± 2.5	22.9 ± 2.4	.05
Weight, kg	74.6 ± 6.4	78.6 ± 6.3	.07
Height, cm	179.8 ± 5.9	179.8 ± 5.0	>.999
Hip ROM, deg, mean ± SD			
Abduction	45.0 (7.2)	47.5 (5.9)	.27
Internal rotation	36.9 (12.6)	35.4 (8.6)	.68
Extension (Thomas test)	13.7 (4.9)	14.5 (2.7)	.57
HAGOS, median (25th-75th percentile)[b]			
Pain	70 (60.0-87.5)	100.0 (95.6-100.0)	<.001
Symptoms	60.7 (46.4-73.2)	92.9 (83.0-99.1)	<.001
Activities of daily living	75.0 (55.0-90.0)	100.0 (100.0-100.0)	<.001
Sport/recreation	50.0 (25.0-64.1)	100.0 (93.8-100.0)	<.001
Participation	25.0 (18.8-75.0)	100.0 (100.0-100.0)	<.001
Quality of life	40.0 (27.5-65.0)	100.0 (91.3-100.0)	<.001
Hip and groin pain, median (25th-75th percentile)			
Duration, wk	36 (10-195)	—	—
Pain during isometric adduction[c]	8.0 (5.0-8.5)	0.0 (0.00-0.00)	<.001
Physical activity level, median (25th-75th percentile)			
Training sessions per week	4.0 (3.0-4.0)	4.0 (3.0-4.0)	.58
Level of play (divisions 1-4)	3.0 (2.0-4.0)	3.0 (1.0-3.75)	.25

[a]HAGOS, Copenhagen Hip And Groin Outcome Score; ROM, range of motion; SD, standard deviation.
[b]Graded on a 0-100 scale, with 0 representing extreme hip and/or groin problems and 100 representing no hip and/or groin problems.
[c]Graded on a 0-10 scale, with 0 representing no pain and 10 representing worst imaginable pain.

TABLE 2
Hip Strength (N·m/kg) in Soccer Players With and Without Adductor-Related Groin Pain[a]

	Hip Strength (Dominant Leg), mean ± SD			
Strength Test	Players With Adductor-Related Groin Pain (n = 21)	Controls (n = 16)	Difference (95% CI)	*P*
HADD-ECC	2.47 ± 0.49	3.12 ± 0.43	–0.65 (–0.96, –0.34)	<.001
HADD-ISO	1.83 ± 0.59	1.87 ± 0.43	–0.04 (–0.39, 0.32)	.841
HABD-ISO	1.98 ± 0.34	1.89 ± 0.25	0.09 (–0.12, 0.30)	.395
HADD/HABD-ISO	0.92 ± 0.23	0.99 ± 0.18	–0.07 (–0.21, 0.08)	.353
HFLEX-MT-ISO	1.91 ± 0.42	1.98 ± 0.20	–0.07 (–0.28, 0.15)	.518
HFLEX-ISO	2.32 ± 0.33	2.28 ± 0.19	0.03 (–0.15, 0.21)	.737

[a]CI, confidence interval; HADD-ECC, eccentric hip adduction; HABD-ISO, isometric hip abduction; HADD-ISO, isometric hip adduction; HADD/HABD-ISO, isometric hip adduction/abduction ratio; HFLEX-MT-ISO, isometric hip flexion–modified Thomas test; HFLEX-ISO, isometric hip flexion; SD, standard deviation.

decreased squeeze tests values,[27,29] performed in 0°, 30°, and 45° of hip flexion.[9,27,29] In a study by Nevin and Delahunt,[29] bilateral isometric hip adduction squeeze tests in athletes with adductor-related groin pain showed lower squeeze values (bilateral squeeze in 45°) in Gaelic soccer players with adductor-related groin pain compared with asymptomatic controls. We were therefore surprised not to find any isometric strength deficits but only eccentric strength deficits in soccer players with adductor-related groin pain when introducing unilateral strength testing. However, the assertion that only eccentric strength deficits exist in patients with hip tendon disorders is not new.[23] In a previous study of patients with external snapping hip (gluteal muscle tendinous structures and the iliotibial band involved), only eccentric hip abduction strength was affected, with no isometric hip abduction strength differences seen between symptomatic and asymptomatic controls.[23] In general, eccentric testing produces larger mechanical stress to the muscle-tendon complex and its integrity,[23,24,33,37] and therefore an increasing number of studies (including the present study) now seem to suggest that eccentric testing is more specific to longstanding musculotendinous disorders of the hip than isometric and concentric testing.[8,23]

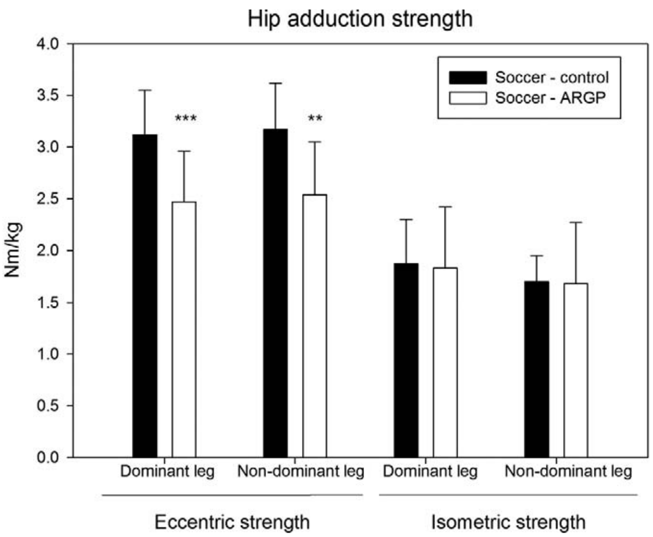

Figure 1. Isometric and eccentric hip adduction strength in the dominant and nondominant leg, presented as mean (error bars indicate standard deviations). ARGP, adductor-related groin pain. $^{**}P < .01$. $^{***}P < .001$.

TABLE 3
Pain During Strength Testing in Soccer Players With and Without Adductor-Related Groin Pain[a]

Strength Test	Pain (Dominant Leg), Median (25th-75th Percentile): Players With Adductor-Related Groin Pain (n = 21)	Controls (n = 16)	P
HADD-ECC	5.0 (3.5-6.5)	0.0 (0.0-0.0)	<.001
HADD-ISO	6.0 (3.0-7.0)	0.0 (0.0-0.0)	<.001
HABD-ISO	2.0 (0.0-5.0)	0.0 (0.0-0.0)	<.001
HFLEX-MT-ISO	5.0 (1.0-8.0)	0.0 (0.0-0.0)	<.001
HFLEX-ISO	4.0 (0.5-5.5)	0.0 (0.0-0.0)	<.001

[a]Pain was graded on a 0-10 scale, with 0 representing no pain and 10 representing worst imaginable pain. HADD-ECC, eccentric hip adduction; HABD-ISO, isometric hip abduction; HADD-ISO, isometric hip adduction; HFLEX-MT-I1SO, isometric hip flexion–modified Thomas test; HFLEX-ISO, isometric hip flexion.

The hip adductor longus muscle–tendinous complex is stressed substantially in soccer, especially during kicking, where the adductors are exposed to large eccentric forces that may induce adductor longus injury.[3] Decreased eccentric muscle strength may contribute to compromise the energy absorption in the tissues, possibly increasing stresses at the adductor longus tendon and the insertion site.[3,13,24] The finding of contraction-specific (eccentric) strength deficits in soccer players is therefore interesting, as this may have implications for the prevention and rehabilitation of adductor-related groin pain in soccer. Eccentric strengthening in the treatment of these athletes has previously been included in an effective training program, which showed an 80% success rate of returning to full sports participation without groin pain.[22] For groin injury prevention, a large randomized controlled trial (including 1000 soccer players) introducing hip adduction strengthening exercises in the intervention group, showed a 30% numeric reduction in groin injuries compared with a nonexercising control group; however, this was not statistically significant.[19] This program included eccentric hip adduction strengthening, but adherence of participants to the eccentric exercises was not accounted for.[19] A recent study has shown significant improvement in eccentric hip adduction strength in asymptomatic soccer players compared with nonexercising controls when performing 1 specific exercise (hip adduction with elastic bands) based on progressive strength training principles with a slow concentric and eccentric contraction phase.[24] These studies suggests that it may be important to include a systematic and progressive hip adduction strengthening approach with a strong eccentric emphasis in future prevention and treatment programs of soccer players with adductor-related groin pain.[24]

In the present study, we did not find any evidence of reduced isometric hip flexion strength or a decreased hip adduction/abduction strength ratio in soccer players with adductor-related groin pain. A previous study has shown reduced hip isometric adduction/abduction strength ratios in a small sample of 10 soccer players with unspecific groin pain during testing, with no information on its duration, acute or longstanding.[37] The present study reports a numerically, but not statistically, lower hip adduction/abduction ratio in soccer players with adductor-related groin pain (0.92) compared with asymptomatic controls (0.99). Isometric hip adduction/abduction ratios around 1.05 have previously been reported in injury-free soccer players using this approach.[37] Our study therefore seems to support previous studies, where injury-free athletes (soccer players and ice hockey players) seem to have an isometric hip adduction/abduction strength ratio approximating 1.[37,39] In ice hockey players, it has previously been shown that eccentric hip adduction/abduction strength ratios of less than 0.80 constitute an increased risk of adductor-related groin injury.[39] Whether a reduced hip adduction/abduction strength ratio of less than 0.80 (isometric or eccentric) also constitutes an increased risk for adductor-related groin injuries in soccer players is unknown.

In the present study, 5 players presented with positive hip pain provocation tests (FADIR and FABER). However, no players displayed $\leq 10^\circ$ of hip internal rotation (performed in 90° of hip flexion), which seems to be indicative of pathological femoroacetabular impingement.[4] However, based on our findings of positive hip pain provocation test results, it cannot be ruled out that some of the players with adductor-related groin pain may also suffer from radiological and/or symptomatic femoroacetabular impingement, as this is not an unusual combination in these patients.[21,42] Hip range of motion, especially decreased hip internal rotation, has been suggested to be associated with groin injury.[1,40,41,44] Based on player characteristics (Table 1) from the present study, no differences in hip range of motion (internal rotation, abduction, and extension) existed in soccer players with adductor-related groin pain compared with asymptomatic controls. Furthermore, these hip range of motion values were similar to those reported previously in asymptomatic individuals[31,47] when using the goniometry approach validated by Nussbaumer et al.[31]

In terms of blinding, it is also worth noting that previous studies in footballers with groin pain have not used a blinded assessor,[27,29] which may be an important source of bias when testing hip muscle strength, as these measures can be highly influenced if the tester is aware of factors such as the clinical condition, pain, and fear of movement related to the person being tested. Moreover, the possibility exists that the tester may unconsciously manipulate strength measurements by providing insufficient or too much resistance during HHD measurements to confirm or refute preexisting hypotheses. We therefore believe that the use of a blinded tester is an important strength of the present study.

In general, it is difficult to compare our study with most other studies on athletes with groin pain. Athletic groin pain may be caused by many different anatomical structures, not only the adductors,[17] as also seen in the present study, where 18 soccer players with long-standing groin pain could not be included in the study because they showed no signs of symptomatic adductor involvement. As athletes with groin pain often present with several clinical findings from different anatomical structures,[17] we decided to report findings that can be reliably assessed by different assessors[17,18,28,32] to provide insight into some of the additional structures affecting soccer players with adductor-related groin pain. In this way, we hope that other clinicians and researchers will be able to "recognize" these patients clinically and thereby extrapolate or reproduce findings from the present study.[34] The exact pathologies of athletic groin pain are not fully understood,[2,34] and therefore, our clinical approach obviously has some limitations. However, we believe this approach of reporting reliable clinical findings, which refers to the patients "known pain," is the best solution available when no alternative exists.[34] We therefore decided to only describe these patients clinically without adding diagnostic imaging, as no evidence exists concerning the interpretation of apparent pathological findings such as femoroacetabular impingement,[14,25] sportsman's hernia,[11] and pubic bone marrow edema.[2,34] While future studies on the significance of diagnostic imaging findings may provide further and relevant subclassification of athletic groin injuries,[34] we believe that the clinical classification system provided in the present study[17,18] is of great relevance to clinicians as this is not dependent on expensive investigations and dubious interpretations but merely reflects clinical symptoms observed during specific and reliable clinical tests.[17,18,28,32]

In the present study, any pain experienced during testing was reported. It has previously been demonstrated, in both pathological pain studies and experimental pain studies, that acute pain inhibits muscle strength.[16,38,45] Altered motor control has been documented in cases of long-standing groin pain,[7] but it is unclear how pain of more long-standing nature affects muscle strength. We therefore decided to report subjective pain levels during hip strength testing to investigate whether possible differences in hip adduction strength could be related to differences in pain levels during testing. The results of the present study suggest that pain during testing was not related to weakness, as patients reported no differences in pain during isometric and eccentric testing conditions, and no significant correlation existed between isometric and eccentric hip adduction strength and pain during strength testing. These findings seem to be in accordance with other studies on patients with long-standing painful musculoskeletal conditions where no or only moderate associations of pain and strength have been documented.[6,46] It can be argued that subjective pain levels may not be related to the physiological inhibitory mechanisms associated with pain during testing,[6,16,38] and this may therefore be a limitation of the present study. However, subjective reporting of pain is, to the best of our knowledge, the only possible way to quantify individual pain levels clinically.[6,37,46]

The present study shows that large eccentric hip adduction strength deficits exist in soccer players with adductor-related groin pain, while no isometric strength differences were observed. Specific exercises aimed for improving eccentric hip adduction strength are therefore important to include in future prevention and treatment of adductor-related groin pain in soccer players.

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