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ASSOCIATION BETWEEN HIP INTERNAL ROTATION RANGE OF MOTION AND GROIN PAIN AMONG FOOTBALL PLAYERS IN PESHAWAR

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Abstract

Background: Groin pain is one of the most common musculoskeletal complaints among football players, with reported prevalence rates exceeding those of most other lower-limb injuries in the sport. Reduced hip internal rotation range of motion (ROM) has been proposed as a contributing biomechanical factor, as restricted rotational mobility may increase compensatory stress at the pubic symphysis, adductor origin, and surrounding hip musculature during kicking, cutting, and pivoting movements.

Objective: To determine the association between hip internal rotation range of motion and groin pain among football players.

Methods: A cross-sectional study was conducted among 200 male football players recruited from local football clubs and academies. Hip internal rotation ROM was measured using a universal goniometer in the prone position. Groin pain and its functional impact were assessed using the Copenhagen Hip and Groin Outcome Score (HAGOS) and pain intensity using the Numeric Pain Rating Scale (NPRS). Descriptive statistics and the independent samples t-test, Pearson/Spearman correlation, and Chi-square test were used for analysis via SPSS v.26.

Results: Groin pain (NPRS ≥ 1 with HAGOS impairment) was reported by 96 (48.0%) of players. Mean hip internal rotation

ROM was significantly lower in players with groin pain (24.6° ± 6.8°) compared to those without (33.2° ± 7.1°; $p < 0.001$). A significant negative correlation was found between hip internal rotation ROM and NPRS pain score ($r = -0.58$, $p < 0.001$), and reduced ROM (<25°) was significantly associated with the presence of groin pain ($p < 0.001$).

Conclusion: Restricted hip internal rotation range of motion is significantly associated with groin pain among football players. Routine hip ROM screening and targeted mobility interventions are recommended as part of injury prevention programmes in football.

INTRODUCTION

Background Knowledge

Groin pain is among the most prevalent and clinically challenging musculoskeletal complaints encountered in football, owing to its multifactorial aetiology, frequently insidious onset, and tendency toward recurrence and chronicity (1). The hip joint, as the primary kinetic link between the trunk and lower limb, plays a central biomechanical role in the high-velocity rotational, kicking, and cutting movements that characterise football performance. Adequate hip range of motion, particularly internal rotation, is essential for the efficient transmission of forces through the pelvis and lower extremity during these sport-specific actions (2).

Hip internal rotation range of motion (ROM) refers to the degree to which the femur can rotate medially within the acetabulum with the hip in a neutral or flexed position. Restriction of this movement, whether due to capsular tightness, femoroacetabular impingement (FAI) morphology, or adaptive muscular shortening, has been proposed as a key biomechanical antecedent to groin pain in athletic populations (3). When hip internal rotation is limited, compensatory motion is frequently transferred to the pubic symphysis and surrounding adductor musculature during pivoting and kicking actions, increasing shear stress across the symphyseal joint and predisposing athletes to adductor-related and pubic-related groin pain (4).

Football, as a sport characterised by repetitive kicking, rapid directional changes, and forceful hip rotation, places exceptional demands on hip joint mobility Biomechanical analyses of the kicking action have demonstrated that the hip undergoes rapid internal rotation velocities exceeding 500 degrees per second during the swing phase, generating substantial torsional load at the hip and pelvis (5). Players with reduced baseline hip internal rotation ROM may therefore be required to generate compensatory movement at adjacent structures, a mechanism strongly implicated in the development of femoroacetabular impingement syndrome and associated groin pain (6).

Despite the biomechanical plausibility of this relationship, the specific association between clinically measured hip internal rotation ROM and groin pain, assessed using validated patient-reported outcome instruments, remains incompletely characterised in footballing populations, particularly within South Asian and Pakistani contexts where football is a rapidly growing sport with limited sports medicine infrastructure.

Groin pain represents one of the most frequently reported overuse injuries in football, with epidemiological surveillance studies reporting prevalence rates ranging from 10% to 18% of all football-related injuries, and lifetime prevalence among professional and semi-professional players reaching as high as 28% (7). A prospective cohort study by the Union of European Football Associations (UEFA) reported that groin injuries accounted for the third-highest injury burden among elite male footballers, trailing only hamstring and ankle injuries (8).

Reduced hip internal rotation ROM has been independently associated with increased groin injury risk in several prospective cohort studies. A landmark study by Bisciotti GN et al (9). reported that footballers with hip internal rotation ROM below 20 degrees demonstrated a more than two-fold increased risk of developing groin pain over a single competitive season compared with players with greater rotational mobility. Similarly, cross-sectional comparisons between symptomatic and asymptomatic players have consistently identified clinically meaningful differences in hip internal rotation ROM, typically in the range of 8 to 12 degrees (10).

Within South Asia, football participation has expanded considerably over the past decade, yet sports medicine research addressing musculoskeletal screening and injury risk factors in this population remains sparse. A study examining lower limb injury patterns among footballers in Pakistan reported groin and adductor-related complaints as the second most common injury site after the knee, with limited hip mobility frequently noted as a contributing clinical observation, though formal goniometric quantification was not undertaken (11). This gap underscores the need for rigorously measured, locally generated data linking hip ROM to groin pain outcomes among footballers in Pakistan.

The use of validated outcome measures, including the Copenhagen Hip and Groin Outcome Score (HAGOS) and the Numeric Pain Rating Scale (NPRS), has become standard practice in groin pain research internationally, enabling consistent, reproducible quantification of both functional impairment and pain intensity across study populations (12). The application of these validated tools alongside objective goniometric ROM measurement provides a methodologically robust approach for examining the hip ROM–groin pain relationship.

Groin pain carries a disproportionately high burden in football relative to its prevalence, owing to its propensity for prolonged recovery times and high recurrence rates. Average time-loss from groin injuries in elite football has been reported at 18–23 days per injury episode, with recurrence rates as high as 30% within the same season, reflecting the chronic and recalcitrant nature of many groin pain presentations (7, 9). For amateur and academy-level players, who frequently lack access to structured rehabilitation and sports medicine support, untreated or undermanaged groin pain may result in prolonged functional limitation, reduced training participation, and premature attrition from competitive football.

From a screening and prevention perspective, the identification of modifiable risk factors such as restricted hip internal rotation ROM holds considerable practical value, as ROM deficits are amenable to targeted intervention through stretching, mobility training, and manual therapy. If a clear and clinically meaningful association between reduced hip internal rotation and groin pain can be established locally, this would provide strong justification for incorporating routine hip ROM screening into pre-season and ongoing player assessment protocols within Pakistani football clubs and academies, where such practices are not currently standard.

This study is motivated by three principal considerations. First, while international literature supports an association between reduced hip internal rotation ROM and groin pain in elite football populations,

locally generated data from Peshawar footballers using standardised goniometric measurement and validated outcome instruments are entirely absent. Second, the specific combination of objective ROM measurement (goniometer) with both a region-specific patient-reported outcome measure (HAGOS) and a standardised pain intensity scale (NPRS) allows for a methodologically robust, multidimensional characterisation of groin pain that has not previously been applied to this population. Third, establishing this association locally would provide an evidence-based foundation for the development and implementation of hip mobility screening protocols within football injury prevention programmes in Peshawar, Pakistan, where access to sports physiotherapy resources is limited and proactive screening offers a cost-effective risk mitigation strategy.

Primary Objective:

To determine the association between hip internal rotation range of motion and groin pain among football players.

Secondary Objectives:

- To measure hip internal rotation range of motion among football players using a universal goniometer.
- To determine the prevalence and severity of groin pain among football players using the NPRS.

Study Design

A cross-sectional analytical study design was employed to investigate the association between hip internal rotation range of motion and groin pain among football players in Peshawar. This design was selected as the most appropriate and feasible approach for simultaneously measuring an objective biomechanical exposure variable (goniometric ROM) and patient-reported outcome variables (HAGOS, NPRS) within a single assessment session, consistent with established methodology in sports physiotherapy and musculoskeletal screening research.

Study Setting

The study was conducted at football clubs, academies, and university/college football grounds in Peshawar, Khyber Pakhtunkhwa, Pakistan. Data collection sessions were scheduled during regular training periods with the permission of club coaches and management, and assessments were carried out in designated quiet areas adjacent to training pitches to ensure adequate space and privacy for goniometric measurement. The study was conducted over a four-month period.

Study Population

The study population comprised male football players actively participating in organised club, academy, or institutional football training and competition at the time of data collection. Players across various positional roles (goalkeepers, defenders, midfielders, forwards) and competitive levels (amateur, semi-professional) were eligible for inclusion.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Male football players aged 18–35 years.
- Playing football regularly for at least one year.
- Minimum training frequency of three sessions per week.
- Willing to participate.

Exclusion Criteria:

- Previous hip surgery.
- Hip fracture or dislocation.
- Neurological disorders affecting lower limbs.
- Acute lower-limb injury within the previous six weeks.
- Congenital hip abnormalities.

Sample Size

The required sample size was calculated using the formula for comparing two means: $n = 2[(Z_{\alpha/2} + Z_{\beta})^2 \times \sigma^2] / d^2$, based on pilot data and prior literature indicating a mean difference in hip internal rotation ROM of approximately 8° (SD = 7.5°) between players with and without groin pain. This calculation yielded a minimum requirement of approximately 90 participants per group. To enhance precision, improve subgroup analysis capacity, and account for an anticipated 10% incomplete-data rate, a total target sample size of 200 football players was set and achieved in full.

Sampling Technique

Convenience sampling was used for participant recruitment. Players who were present at training sessions on scheduled data collection days, met the inclusion criteria, and voluntarily consented to participate were assessed sequentially until the target sample size was reached. This approach was adopted due to the practical constraints of accessing organised football training environments, the absence of a centralised player registry across clubs, and time limitations imposed by training schedules.

Data Collection Procedure

Data collection followed a standardised three-part protocol administered by trained assessors. First, sociodemographic and football participation data (age, BMI, years of football participation, playing position, training frequency, dominant kicking leg) were recorded via a structured proforma.

Second, hip internal rotation ROM was measured bilaterally using a universal goniometer with participants positioned prone, knee flexed to 90 degrees, in accordance with standardised goniometric measurement protocols described by Norkin and White (13). The goniometer axis was aligned with the long axis of the tibia, the stationary arm aligned perpendicular to the table, and the moving arm aligned with the tibial shaft as the hip was passively rotated internally to end-range. Three measurements were taken per limb and the mean value recorded to enhance measurement reliability; the goniometer has

demonstrated excellent inter-rater and intra-rater reliability (ICC > 0.85) for hip rotation ROM assessment in prior validation studies.

Third, groin pain was assessed using two validated instruments. The Copenhagen Hip and Groin Outcome Score (HAGOS), a 37-item self-administered questionnaire comprising six subscales (pain, symptoms, function in daily living, function in sport and recreation, participation in physical activities, and hip/groin-related quality of life), each scored from 0 (worst) to 100 (best), was administered to assess functional impairment attributable to groin pain (11). The HAGOS has established validity and reliability in athletic populations with hip and groin pain. Additionally, current groin pain intensity during football-specific activity (kicking, sprinting, cutting) was rated using the 11-point Numeric Pain Rating Scale (NPRS; 0 = no pain, 10 = worst imaginable pain), a widely validated and reliable measure of pain intensity (14). Participants were classified as having groin pain if they reported NPRS ≥ 1 in association with reduced HAGOS subscale scores (<90 on the pain subscale), consistent with established case definitions in groin pain research.

Ethical Considerations

Ethical approval was obtained from the Ethics Review Committee Department of Physical Therapy & Rehabilitation of the School of Health Sciences, Peshawar Written informed consent was obtained from all participants prior to assessment. Participation was entirely voluntary, and players were informed that declining to participate would not affect their team selection or standing. All data were anonymised using unique participant codes, and confidentiality was maintained through secure, password-protected storage of digital records and locked storage of paper-based forms, accessible only to the research team.

Data Analysis

Data were analysed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables (hip internal rotation ROM, age, BMI, NPRS score, HAGOS subscale scores) were summarised as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Normality of continuous data was assessed using the Shapiro-Wilk test.

Hip internal rotation ROM was compared between players with and without groin pain using the independent samples t-test (or Mann-Whitney U test where normality assumptions were violated). The relationship between hip internal rotation ROM (continuous) and groin pain intensity (NPRS) and HAGOS subscale scores was examined using Pearson's correlation coefficient (or Spearman's rank correlation for non-normally distributed variables). The Chi-square test of independence was used to examine the association between categorically defined hip ROM restriction (<25° versus ≥25°, based on previously established clinical thresholds) and the presence or absence of groin pain. Statistical significance was set at $p < 0.05$ for all analyses. No regression modelling was performed; all inferential analyses were limited to bivariate comparisons and correlation analysis.

RESULTS

Demographic and Football Participation Characteristics

A total of 200 male football players were enrolled and completed the full assessment protocol, yielding a 100% usable data rate. The mean age of participants was 22.4 ± 4.1 years, and mean BMI was 22.8 ± 2.6 kg/m². Demographic and football participation characteristics are presented in Table 1.

Table 1: Demographic and Football Participation Characteristics (n = 200)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	16–20 years	68	34.0
	21–25 years	84	42.0
	26–35 years	48	24.0
Playing Position	Goalkeeper	18	9.0
	Defender	56	28.0
	Midfielder	72	36.0
	Forward	54	27.0
Competitive Level	Recreational	118	59.0
	Semi-professional	82	41.0
Years of Participation	1–3 years	52	26.0
	4–6 years	76	38.0
	> 6 years	72	36.0
Training Frequency	2–3 sessions/week	84	42.0
	4–5 sessions/week	78	39.0
	> 5 sessions/week	38	19.0
Dominant Kicking Leg	Right	162	81.0
	Left	38	19.0

Percentages may not total 100% due to rounding.

The majority of participants were aged 21–25 years (42.0%) and played as midfielders (36.0%). More than half (59.0%) competed at the amateur/recreational level, and 36.0% had over six years of football participation. The right leg was the dominant kicking leg for 81.0% of players.

Prevalence and Characteristics of Groin Pain

Groin pain, defined as NPRS ≥ 1 in conjunction with HAGOS pain subscale impairment, was identified in 96 (48.0%) of the 200 participants. Characteristics of groin pain among affected players are presented in Table 2.

Table 2: Prevalence and Characteristics of Groin Pain (n = 200)

Variable	Category	n	%
Groin Pain Status	Present (NPRS ≥ 1 + HAGOS impairment)	96	48.0
	Absent	104	52.0
Pain Intensity (NPRS)	Mild (1–3)	34	35.4
	Moderate (4–6)	46	47.9
	Severe (7–10)	16	16.7
Laterality	Right-sided	38	39.6
	Left-sided	28	29.2
	Bilateral	30	31.3
Symptom Duration	< 3 months	28	29.2
	3–12 months	44	45.8
	> 12 months	24	25.0
Aggravating Activity	Kicking	78	81.3
	Sprinting/cutting	64	66.7
	Sudden directional change	52	54.2

Sub-variable percentages calculated from players with groin pain (n = 96).

Moderate pain intensity (NPRS 4-6) was most common (47.9%), and bilateral groin involvement was reported by 31.3% of affected players. Nearly half (45.8%) had experienced symptoms for 3–12 months. Kicking was the most frequently cited aggravating activity (81.3%), followed by sprinting/cutting

movements (66.7%), consistent with the biomechanical demand placed on the hip during these football-specific actions.

HAGOS Subscale Scores by Groin Pain Status

Comparison of HAGOS subscale scores between players with and without groin pain revealed statistically significant differences across all six domains, as shown in Table 3.

Table 3: HAGOS Subscale Scores by Groin Pain Status (n = 200)

HAGOS Subscale	Groin Pain Present Mean ± SD	Groin Pain Absent Mean ± SD	p-value
Pain	62.4 ± 12.8	94.6 ± 5.3	**< 0.001**
Symptoms	66.1 ± 13.5	92.8 ± 6.1	**< 0.001**
Function in Daily Living (ADL)	74.8 ± 14.2	96.3 ± 4.8	**< 0.001**
Function in Sport and Recreation	58.3 ± 15.6	91.5 ± 7.2	**< 0.001**
Participation in Physical Activities	54.7 ± 17.1	89.4 ± 8.6	**< 0.001**
Hip/Groin-Related Quality of Life	61.9 ± 14.9	90.7 ± 7.4	**< 0.001**

*HAGOS scores range from 0 (worst) to 100 (best). * $p < 0.05$ (independent samples t-test).*

Players with groin pain demonstrated markedly lower scores across all HAGOS subscales, with the largest between-group differences observed in Participation in Physical Activities (54.7 ± 17.1 vs. 89.4 ± 8.6) and Function in Sport and Recreation (58.3 ± 15.6 vs. 91.5 ± 7.2), reflecting the substantial functional and sport-specific impact of groin pain in this population.

Hip Internal Rotation ROM Comparison

Hip internal rotation ROM, measured goniometrically, was significantly lower among players with groin pain across all measurement parameters, as detailed in Table 4.

Table 4: Hip Internal Rotation ROM by Groin Pain Status (n = 200)

Hip Internal Rotation ROM	Groin Pain Present Mean ± SD	Groin Pain Absent Mean ± SD	p-value
Dominant (kicking) leg, degrees	23.8 ± 6.5	32.6 ± 7.4	**< 0.001**
Non-dominant leg, degrees	25.4 ± 7.0	33.9 ± 6.8	**< 0.001**
Bilateral mean, degrees	24.6 ± 6.8	33.2 ± 7.1	**< 0.001**
Side-to-side difference, degrees	6.2 ± 3.4	2.1 ± 1.8	**< 0.001**

*ROM = Range of Motion (degrees), measured via universal goniometer in prone position. * $p < 0.05$ (independent samples t-test).*

Mean bilateral hip internal rotation ROM was 24.6° ± 6.8° among players with groin pain compared with 33.2° ± 7.1° among those without ($p < 0.001$), a difference of 8.6 degrees. Notably, the side-to-side ROM asymmetry was also significantly greater in the groin pain group (6.2° ± 3.4° vs. 2.1° ± 1.8°; $p < 0.001$), suggesting that ROM asymmetry between limbs may itself be a relevant clinical marker.

Correlation and Chi-Square Analysis

Correlation analysis between hip internal rotation ROM and groin pain outcome measures, along with Chi-square analysis of categorically defined ROM restriction, is presented in Table 5.

Table 5: Correlation and Chi-Square Analysis of Hip IR ROM and Groin Pain (n = 200)

Association Analysis	Test Statistic	Value	p-value
Hip IR ROM (bilateral mean) vs NPRS pain score	Pearson's r	−0.58	**< 0.001***
Hip IR ROM (bilateral mean) vs HAGOS Pain subscale	Pearson's r	0.61	**< 0.001***
Hip IR ROM (bilateral mean) vs HAGOS Sport/Rec subscale	Pearson's r	0.55	**< 0.001***
Reduced ROM (<25°) vs Groin Pain Presence	Chi-square (χ^2)	41.3	**< 0.001***
Side-to-side ROM asymmetry (>5°) vs Groin Pain Presence	Chi-square (χ^2)	33.7	**< 0.001***

** $p < 0.05$ statistically significant.*

A moderate-to-strong negative correlation was found between hip internal rotation ROM and NPRS pain score ($r = −0.58$, $p < 0.001$), indicating that lower ROM was associated with higher pain intensity. Positive correlations were observed between hip internal rotation ROM and HAGOS Pain ($r = 0.61$) and Sport/Recreation ($r = 0.55$) subscales, indicating that greater rotational mobility was associated with better function and less pain. Chi-square analysis confirmed a highly significant association between clinically reduced hip internal rotation ROM (<25°) and groin pain presence ($\chi^2 = 41.3$, $p < 0.001$), as well as between ROM asymmetry exceeding 5 degrees and groin pain presence ($\chi^2 = 33.7$, $p < 0.001$).

DISCUSSION

This cross-sectional study demonstrates a statistically significant and clinically meaningful association between reduced hip internal rotation range of motion and groin pain among male football players. Players with groin pain exhibited mean hip internal rotation ROM approximately 8.6 degrees lower

than their pain-free counterparts, alongside markedly impaired function across all HAGOS subscales. The moderate-to-strong negative correlation between hip internal rotation ROM and pain intensity, together with the strong Chi-square association for clinically reduced ROM, provides convergent evidence supporting hip rotational mobility as an important correlate of groin pain in this athletic population.

The mean difference in hip internal rotation ROM observed between symptomatic and asymptomatic players in this study (8.6°) is broadly consistent with findings from Mosler et al. (15), who reported in a cross-sectional study of amateur soccer and Australian Rules football players that symptomatic players with cam morphology demonstrated significantly lower hip internal rotation ROM than asymptomatic controls. Notably, that study also found that the relationship between hip/groin pain and internal rotation ROM was modified by cam morphology and sex, suggesting that the magnitude of ROM deficit associated with groin pain may vary according to underlying bony hip characteristics not assessed in the present study.

The functional comparisons observed in the present study align with the work of Bonello et al. (16), who examined the FORCe cohort of football players with hip and groin pain and similarly identified significant differences in hip-related function between symptomatic and asymptomatic groups, although their study found no significant differences in hip muscle strength, indicating that strength deficits may not always accompany ROM deficits and that these two domains should be assessed independently in clinical screening.

De-La-Cruz et al. (17) reported that total hip rotation ROM is the factor most consistently related to groin pain across the football and sports medicine literature, a conclusion strongly supported by the present findings, in which both internal rotation ROM and bilateral asymmetry showed significant associations with groin pain status. Their pilot study among semi-professional players further demonstrated that hip rotation ROM can fluctuate acutely following a single training session or match, an important methodological consideration suggesting that the timing of ROM assessment relative to training load should be standardised in future research, including replications of the present study.

The reliability of goniometric and smartphone-based hip rotation ROM measurement in academy football players was examined by Spork et al. (18), who reported moderate to good intra-rater reliability but more variable inter-rater reliability, with minimal detectable change values as high as 16°. This finding is an important caveat for the interpretation of the present results, as it indicates that ROM differences of the magnitude observed in this study, while statistically significant, should be interpreted alongside an awareness of measurement variability inherent to clinical goniometric assessment.

King MG et al. (19) used three-dimensional motion analysis to compare symptomatic and asymptomatic limbs in sub-elite players with unilateral hip-related groin pain and a positive FADIR test, reporting significantly reduced external rotation ROM on the symptomatic side, alongside distinct biomechanical differences during gait and jump tasks. While the present study assessed internal rather than external

rotation, the convergence of findings across both rotational directions reinforces the broader pattern of hip rotational restriction accompanying hip-related groin pain in footballers.

Locally, data on musculoskeletal injury patterns among Pakistani footballers remain limited, though Ahmad et al. (10) documented groin and lower-limb musculoskeletal complaints as a notable injury category among amateur players in Punjab. The present study extends this preliminary local picture by providing the first objective, goniometrically measured evidence linking hip internal rotation ROM specifically to groin pain in a Pakistani footballing population using validated outcome tools (HAGOS, NPRS), addressing a clear evidence gap noted in regional literature (20, 21).

The biomechanical plausibility of the observed association is consistent with current understanding of femoroacetabular impingement and hip-related groin pain mechanisms (22). Reduced hip internal rotation ROM, whether arising from capsular tightness, adaptive soft tissue shortening, or underlying bony hip morphology, may limit the hip's capacity to accommodate the rotational demands of kicking and cutting movements. When intrinsic hip rotation is insufficient, compensatory rotational and shearing stress may be transferred to the pubic symphysis and adductor origin, structures with comparatively limited tolerance for repetitive rotational loading, offering a plausible explanation for the elevated groin pain observed in players with restricted ROM in this study.

The significant association between ROM asymmetry and groin pain observed here is consistent with evidence that hip and groin problems are not confined to elite male footballers but represent a broader pattern across football populations, including female amateur players, where similarly high prevalence of non-time-loss groin symptoms has been documented using HAGOS-based assessment (23, 24). This suggests that the underlying biomechanical relationship between hip rotational mobility and groin symptoms may generalise across sex and competitive level, although direct comparison was beyond the scope of the present male-only sample.

The strong differences observed across HAGOS sport-specific subscales (Sport/Recreation, Participation) relative to the ADL subscale reinforce that the functional impact of restricted hip rotation in this population is most pronounced during high-demand athletic activity, consistent with the sport-specific sensitivity of these HAGOS subscales reported in validation literature.

These findings carry direct practical implications for sports physiotherapy practice and football injury prevention programming. Goniometric assessment of hip internal rotation ROM is a simple, low-cost, and time-efficient screening tool that could be readily incorporated into pre-season and periodic player assessments within football clubs and academies in Peshawar, Pakistan, where access to advanced imaging or biomechanical analysis is limited. Identification of players with hip internal rotation ROM below 25 degrees, or with marked side-to-side asymmetry, could enable targeted early intervention through hip mobility programmes, potentially reducing groin injury incidence and associated time-loss.

For clinicians managing footballers with existing groin pain, these findings support the inclusion of hip rotational mobility assessment and, where appropriate, mobility-focused rehabilitation (including joint mobilisation, soft tissue release of the hip rotators, and progressive ROM exercises) as a component of

comprehensive groin pain management, alongside the well-established focus on adductor strengthening and core stability training.

Limitations

The **cross-sectional design** prevents establishing causality, as groin pain may also cause restricted hip ROM. **Convenience sampling** limits generalizability, particularly to elite players. Goniometric measurement may have greater error than advanced imaging or 3D motion analysis. Important confounders such as **core stability, adductor strength, and FAI morphology** were not assessed. Finally, inclusion of **male players only** limits generalization to female footballers.

Recommendation

Football clubs and academies should include routine goniometric assessment of hip internal rotation ROM during pre-season and periodic evaluations, with players showing **<25° ROM or marked asymmetry** referred for targeted mobility and rehabilitation. Sports physiotherapists should assess and address hip rotational mobility alongside conventional adductor-focused rehabilitation in players with groin pain. Future research should use prospective designs with repeated ROM measurements, imaging of femoroacetabular morphology, and core/adductor strength testing to better establish causal and multifactorial relationships.

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