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Original Article

Retrospective Comparison of Corticosteroid, Platelet-Rich Plasma, and Exercise-Based Therapies in the Management of Adductor-Related Groin Pain Among Football Players

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ABSTRACT

Objective: To compare the clinical outcomes of exercise-based therapy, corticosteroid injection, and platelet-rich plasma (PRP) injection in football players with magnetic resonance imaging (MRI)-confirmed adductor-related groin pain.

Materials and Methods: This retrospective study included 111 male football players diagnosed with adductor lesions on MRI. Patients were categorized into three treatment groups: exercise therapy alone (n=73), corticosteroid injection plus exercise (n=18), and PRP injection plus exercise (n=20). Injections were administered into the adductor peritendinous and pubic symphysis regions. The Hip Outcome Score–Sport Subscale (HOS–Sport) and return to sport (RTS) status were assessed at final follow-up. Statistical comparisons were performed using ANOVA, Kruskal-Wallis, or chi-square tests, with $p<0.05$ considered significant.

Results: The mean age, height, weight, and symptom duration did not differ significantly among the groups ($p>0.05$). Most patients had chronic lesions, with no significant difference in lesion type distribution (p=0.288). The mean follow-up duration and HOS–Sport scores were similar across groups (p=0.107 and p=0.821, respectively). RTS rates were 89.0% in the exercise group, 88.9% in the corticosteroid group, and 85.0% in the PRP group, with no statistically significant difference (p=0.880).

Conclusion: All three treatment modalities yielded comparable outcomes in terms of function and RTS. Exercise-based therapy alone appears to be equally effective as corticosteroid or PRP injections in managing adductor-related groin pain in football players. Given its non-invasive nature and cost-effectiveness, structured exercise therapy should be considered the first-line conservative treatment approach.

Keywords: Adductor-related groin pain, corticosteroid injection, exercise therapy, football, MRI classification, platelet-rich plasma

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INTRODUCTION

Adductor-related groin pain is one of the most common musculoskeletal injuries among football players, with an annual incidence ranging from 10% to 18% in this population.[1,2] It often results in prolonged symptoms, recurrent episodes, and considerable time away from sport, significantly affecting athletic performance and participation. The underlying pathology typically involves strain injuries, tendinopathy, or enthesopathic changes at the pubic symphysis, often confirmed by magnetic resonance imaging (MRI).[3,4]

Various conservative treatment strategies have been proposed for managing adductor-related groin pain, including structured exercise programs, corticosteroid (CS) injections, and platelet-rich plasma (PRP) therapy.[5–7] Exercise therapy, particularly protocols focusing on core stabilization and adductor-abductor muscle balance, has demonstrated favorable outcomes in both short- and long-term recovery.[8,9] Corticosteroid injections are widely used to reduce inflammation and provide rapid symptom relief, while PRP has emerged as a regenerative option that may enhance tissue healing, although evidence remains inconclusive.[10–13]

Despite the widespread use of these interventions, there is limited comparative data assessing their relative effectiveness, particularly in well-defined athlete populations with imaging-confirmed lesions. Retrospective studies evaluating functional recovery and return-to-sport (RTS) outcomes are valuable for guiding clinical decision-making in sports medicine practice. This study aimed to retrospectively compare the functional outcomes and return-to-sport rates of football players with MRI-confirmed adductor-related groin pain treated with structured exercise therapy alone or combined with corticosteroid or PRP injections. We hypothesized that adding corticosteroid or PRP injections to exercise therapy would not provide superior outcomes compared to exercise therapy alone.

MATERIALS AND METHODS

Patients and Study Design

This retrospective study was conducted using radiology reports and digital patient records from the hospital database. Patients who presented with adductor-related groin pain were identified. Patients were excluded if their clinical or imaging data were incomplete or inaccessible, if they were unwilling to participate, if no AL was detected on MRI, or if they participated in sports other than football. Furthermore, patients with a follow-up period of less than one year or those who underwent surgery related to the AL during the follow-up period were excluded from the study. After applying the inclusion and exclusion criteria, 111 patients with completed follow-ups were included in the final analysis (Fig. 1). The study

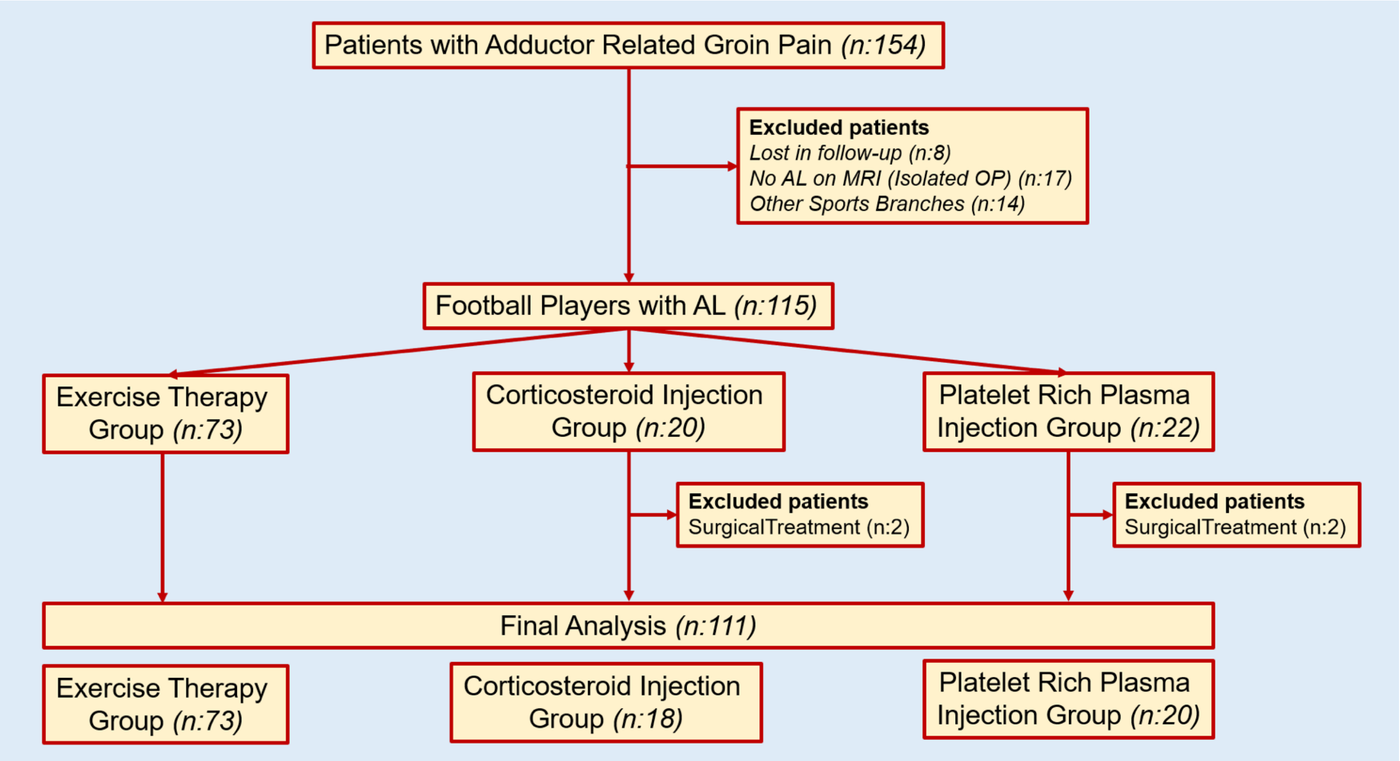

Figure 1. Flowchart of patient selection and group allocation.

was conducted following the principles of the Declaration of Helsinki and its later amendments. Before the initiation of the study, the institutional review board granted ethical approval, and informed consent was obtained from all participants.

Evaluation of Magnetic Resonance Imaging

All participants were diagnosed using magnetic resonance imaging (MRI). Adductor pathologies were assessed collaboratively by a radiologist and a sports medicine physician and subsequently classified into four distinct categories based on their imaging features.

Type 1 (Strain): These lesions appear hyperintense on MRI and are typically located within the adductor muscles or at their musculotendinous junctions. Depending on injury severity, findings may include varying levels of edema, intramuscular bleeding, and architectural disruption (Fig. 2). The lesion size may vary from small localized changes to more diffuse involvement.[14–18]

Type 2 (Tendon Avulsion): This injury pattern most commonly affects the adductor longus tendon (Fig. 3). MRI typically reveals tendon detachment accompanied by a hyperintense hematoma between the retracted tendon and the symphysis pubis.[14–16,19,20]

Type 3 (Tendinopathy): Characterized by linear intratendinous edema, this type is often seen at the enthesis of the adductor brevis and is also referred to as "enthesopathy".[9,10,17,20–22] When the adductor longus tendon is involved, MRI findings may include tendon thickening, contour irregularity, or enhancement at the insertion site (Fig. 4).[16,21–23]

Type 4 (Secondary Cleft Sign): This sign indicates capsular disruption deep to the adductor attachment on the symphysis pubis, leading to fluid tracking into the defect (Fig. 5). It appears as a horizontal hyperintense line extending from the vertical physiological (primary) cleft [14,19,22,24,25] and is also referred to as an "adductor enthesis microtear".[26]

Lesions classified as Type 1 and Type 2 were considered acute, whereas Type 3 and Type 4 were categorized as chronic injuries.

Treatment Methods

Patients were divided into three groups based on the treatment approach. Group 1 received exercise therapy alone. Group 2 received exercise therapy combined with a corticosteroid injection. Group 3 received exercise therapy and a platelet-rich plasma (PRP) injection prepared from peripheral venous blood.

PRP was prepared using autologous peripheral venous blood obtained from each patient under sterile conditions. Approximately 20 mL of whole blood was drawn into a sterile tube containing an anticoagulant (3.2% sodium citrate). The blood was centrifuged at 1500 rpm for 10 minutes to separate the red blood cells. The platelet-rich plasma supernatant was

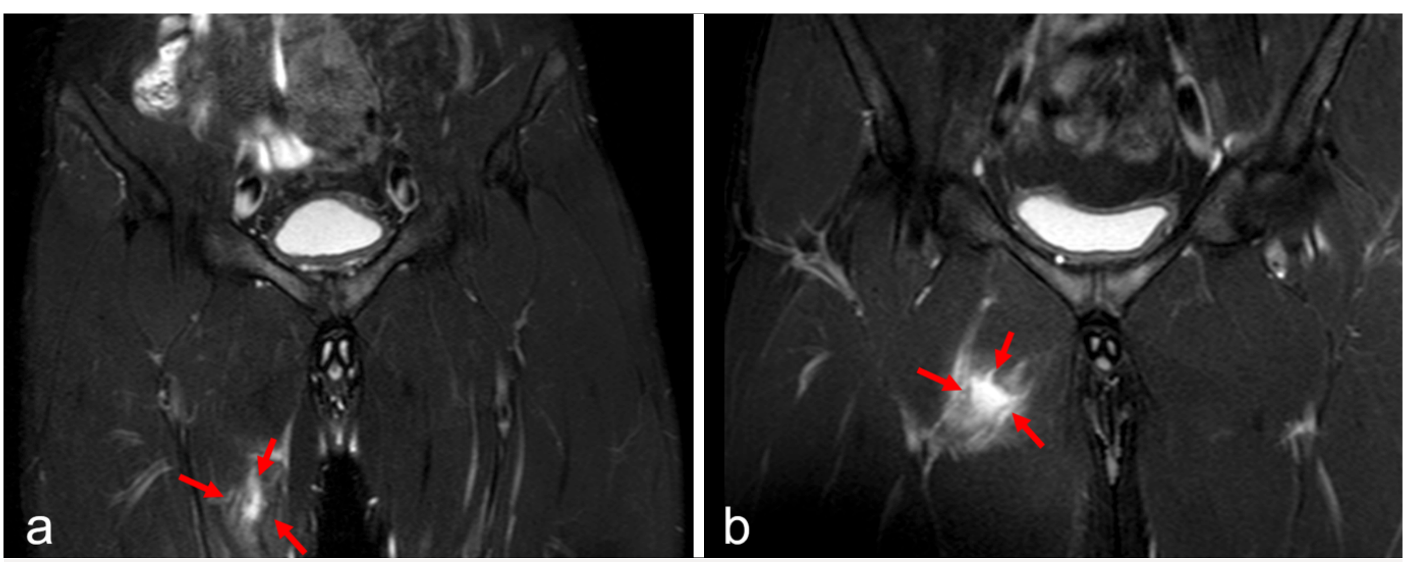

Figure 2. Coronal T2-weighted MR images of two different football players with Type 1 adductor lesions (strain injuries). **(a)** Hyperintense signal changes are observed within the adductor longus muscle belly and musculotendinous junction, consistent with edema and partial fiber disruption. **(b)** A more extensive hyperintense area is visible at the proximal myotendinous junction, indicating a more severe strain. Red arrows indicate regions of muscle edema and architectural distortion within the adductor compartment.

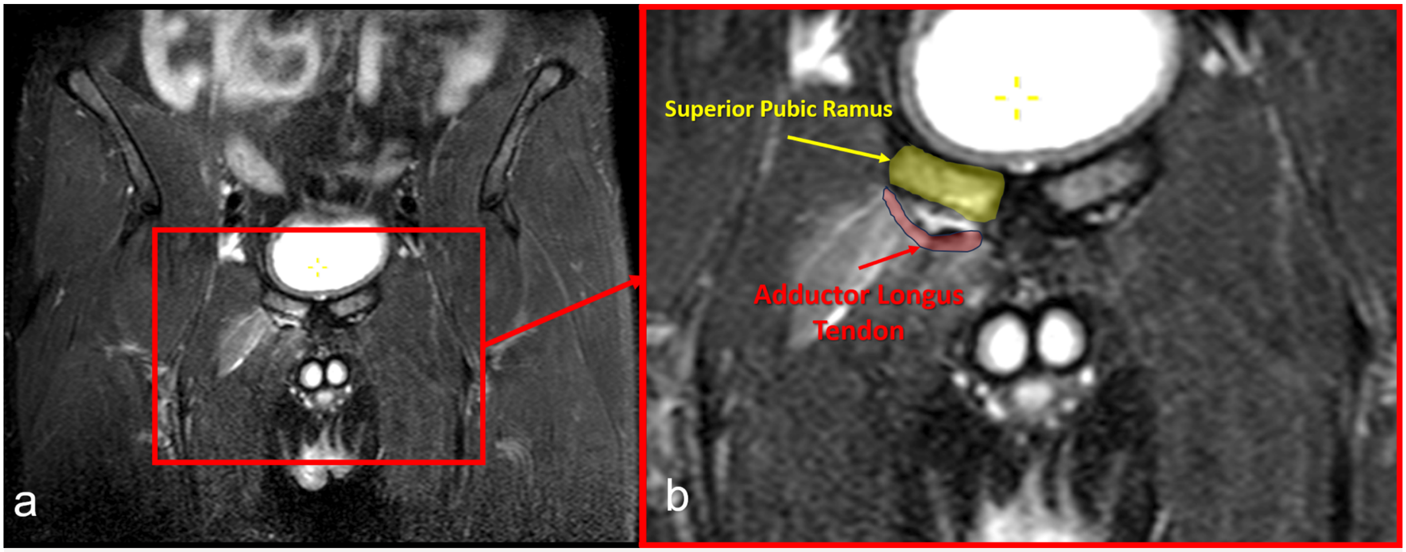

Figure 3. Coronal T2-weighted MR images demonstrating a Type 2 adductor lesion (tendon avulsion) in a football player. **(a)** Overview image showing disruption at the level of the pubic symphysis. **(b)** The magnified view of the affected area highlights the retracted adductor longus tendon (red label) and the adjacent superior pubic ramus (yellow label). A hyperintense area consistent with hematoma and soft tissue edema is present between the symphysis and the retracted tendon, typical of tendon avulsion injuries.

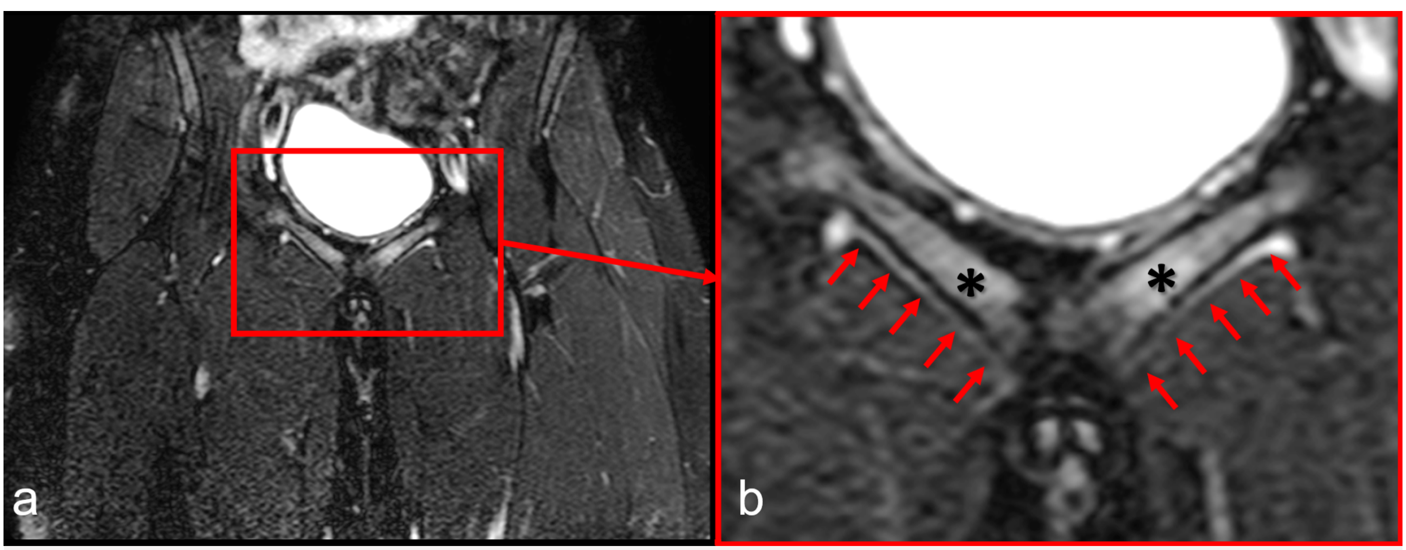

Figure 4. Coronal T2-weighted MR images showing a Type 3 adductor lesion (tendinopathy) in a football player. **(a)** General view of the pubic symphysis and bilateral adductor tendon insertions. **(b)** The magnified view demonstrates linear intratendinous hyperintensity (red arrows) at the enthesis of the adductor brevis, consistent with tendinopathy (enthesopathy). Asterisks (*) indicate intraosseous bone marrow edema within the pubic bodies, representing accompanying osteitis pubis.

then collected and subjected to a second centrifugation at 3500 rpm for 10 minutes to concentrate the platelets further. The final PRP volume obtained was approximately 3–5 mL per patient.[27] The PRP was injected on the same day of preparation. The final PRP product was leukocyte-poor with an estimated 4-fold increase in platelet concentration over baseline. Under sterile conditions, PRP was administered into the adductor peritendinous region and the symphysis pubis

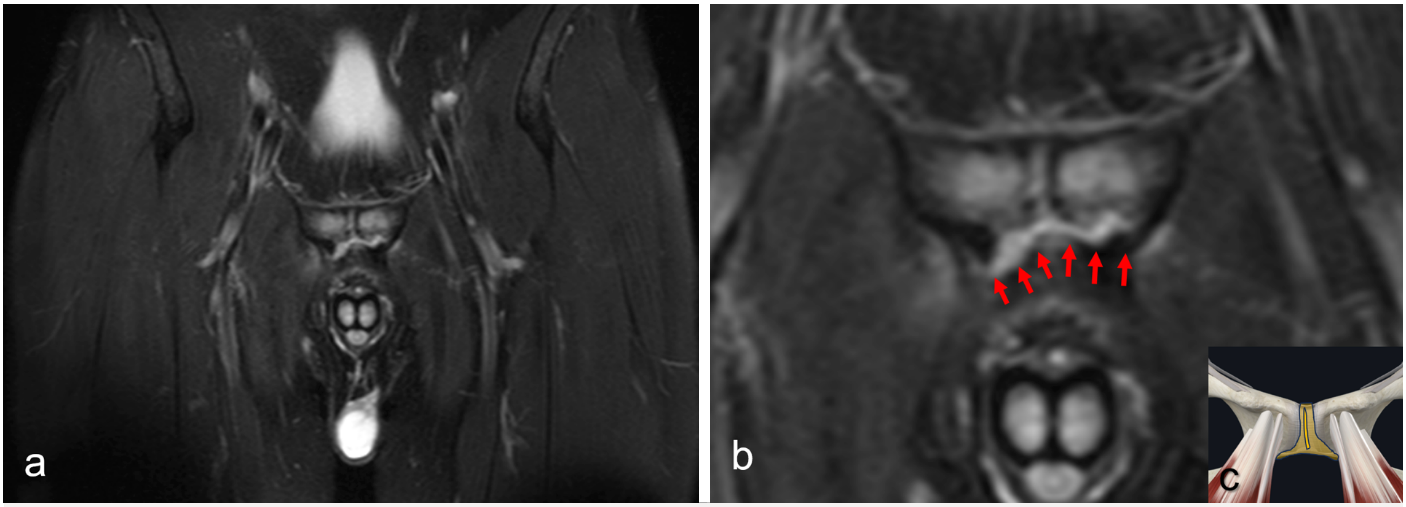

Figure 5. Coronal T2-weighted MR images and schematic illustration demonstrating a Type 4 adductor lesion (secondary cleft sign). **(a)** General coronal view of the pelvis. **(b)** Magnified image shows a linear hyperintense signal (red arrows) extending horizontally from the vertical physiological cleft, located beneath the symphyseal attachment of the adductor tendons—characteristic of the secondary cleft sign, indicating deep capsular tearing and fluid tracking. **(c)** The Schematic diagram illustrates fluid's horizontal extension from the primary cleft into the subcapsular zone.

area, targeting the site of pathology. An experienced sports medicine specialist performed the procedure. Following the injection, patients were advised to refrain from strenuous activity for at least 48–72 hours, after which they resumed the structured rehabilitation and exercise program. Similarly, corticosteroid injections were delivered under sterile conditions into the same anatomical region as the PRP group. A combination of 1 mL corticosteroid (3mg/ml betamethasone sodium phosphate and betamethasone acetate) and 2 mL of prilocaine hydrochloride (20 mg/mL) was used.

All athletes in this series were treated conservatively to reduce inflammation, restore muscle balance, and ensure a gradual return to sport (RTS). At the onset of symptoms, all patients were prescribed a rest period during the acute painful phase. Short-term nonsteroidal anti-inflammatory drugs (NSAIDs) and ice therapy were administered for pain relief. Following the initial pain control, activity modification was implemented, which involved avoiding high-impact activities and including low-impact alternatives such as swimming or cycling. A structured exercise program was initiated once the symptoms subsided and tolerance improved. Exercise programs were designed to improve muscle coordination and functional recovery. Patients attended supervised sessions two times per week for 8 weeks, followed by a home-based continuation phase. They included core stabilization exercises, hip adductor and abductor muscle groups strengthening, pelvic floor exercises, and specific stretching techniques to reduce tension and improve mobility.

Outcome Measures

A final follow-up was performed at 12 months after treatment completion when patients gave informed consent to participate. To evaluate their functional status related to groin pain, the Hip Outcome Score–Sport Subscale (HOS–Sport) was used. Additionally, it was recorded whether each athlete successfully returned to their pre-injury sport level, defined as participation in training and match schedules without groin pain.

Statistical Analysis

Descriptive statistics were presented as means and standard deviations for continuous variables and as frequencies with percentages for categorical variables. The normality of the continuous variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Among the variables, BMI and follow-up duration were normally distributed, while age, height, weight, symptom duration, and HOS scores did not follow a normal distribution. For between-group comparisons, normally distributed continuous variables were analyzed using one-way analysis of variance (ANOVA), while non-normally distributed continuous variables were compared using the Kruskal-Wallis test. Categorical variables were analyzed using the chi-square test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 111 male football players with adductor-related groin pain were included in the study. The mean age of the participants was similar across the treatment groups (p=0.722).

Table 1. Comparison of baseline demographic and clinical characteristics of treatment groups

Variables	Exercise Group (n=73)	CS Injection Group (n=18)	PRP Injection Group (n=20)	p
Age (year±SD)	25.5±8.0	24.3±7.8	24.3±6.6	0.722[1]
Height (cm±SD)	179.0±6.2	180.7±10.6	179.3±6.7	1.000[1]
Weight (kg±SD)	82.0±8.5	83.0±11.3	82.3±9.4	0.953[1]
BMI (kg/m^2±SD)	25.6±2.5	25.3±2.2	25.5±2.0	0.934[2]
Duration of symptoms (month±SD)	3.0±3.6	4.7±5.7	4.6±3.1	0.059[1]
AL Lesion Type (n, %)				0.288[3]
Chronic AL	59 (80.8%)	14 (77.8%)	12 (60.0%)	
Acute AL	8 (11.0%)	1 (5.6%)	4 (20.0%)	
Mixed AL	6 (8.2%)	3 (16.7%)	4 (20.0%)	

SD: Standard Deviation; AL: Adductor Lesion; CS: Corticosteroid; PRP: Platelet-Rich-Plasma; BMI: Body Mass Index; n: number. [1]Kruskal-Wallis Test, [2]ANOVA, [3]Chi-Square Test; Differences in baseline characteristics and outcome measures across treatment groups were not statistically significant (p>0.05).

No statistically significant differences were observed between the groups in terms of height (p=1.000), weight (p=0.953), or BMI (p=0.934). Although the mean duration of symptoms appeared longer in the corticosteroid and PRP groups, this difference did not reach statistical significance (p=0.059). Concerning lesion type distribution, chronic adductor lesions were the most prevalent in all groups, particularly in the exercise group (80.8%). Acute and mixed lesion types were observed less frequently, and the distribution of lesion types did not differ significantly among the three groups (p=0.288). Table 1 presents patients' baseline demographic and clinical characteristics among treatment groups.

The mean follow-up duration was 78.1±28.5 months in the exercise group, 93.9±33.2 months in the corticosteroid group, and 86.4±31.1 months in the PRP group (p=0.107). A similar outcome was observed in the Hip Outcome Score–Sports Subscale (HOS–Sport), where no statistically significant differences were identified (p=0.821). The mean HOS–Sport scores were 35.4±1.7 in the exercise group, 35.6±1.0 in the corticosteroid group, and 35.8±0.8 in the PRP group. Return to sport (RTS) rates were comparable between the groups, with the majority of athletes in all groups able to return to their pre-injury level of sport: 89.0% in the exercise group, 88.9% in the corticosteroid group, and 85.0% in the PRP group, with no statistically significant difference (p=0.880) (Table 2).

DISCUSSION

This study evaluated and compared the clinical outcomes of three conservative treatment strategies in football players with MRI-confirmed adductor-related groin pain: exercise therapy alone, corticosteroid injection combined with exercise therapy, and platelet-rich plasma (PRP) injection combined with exercise therapy. Our results demonstrated that all three treatment approaches were similarly effective in terms of functional improvement and return to sport (RTS) rates. No statistically significant differences were observed among the groups regarding Hip Outcome Score–Sports Subscale (HOS–Sport) values or RTS success in the long term. These findings suggest that structured exercise therapy alone may be sufficient for achieving satisfactory clinical outcomes in this specific athlete population.

Our results are consistent with prior literature supporting the effectiveness of exercise-based rehabilitation for adductor-related groin pain. In a randomized controlled trial by Hölmich et al.,[4] active physical training was superior to passive treatment modalities in athletes with long-standing adductor pain. Similarly, Yousefzadeh et al.[5] demonstrated significant improvements in pain and function using the Hölmich protocol, with high rates of return to sport. Systematic reviews by Almeida et al.[2] and Jansen et al.[9] also concluded that active physiotherapy focusing on core strength and pelvic control yields better long-term results than injection-based therapies. Our findings align with these studies, reinforcing the central role of targeted rehabilitation in managing groin pain.

On the other hand, previous reports have suggested potential benefits of corticosteroid or PRP injections, particularly in cases refractory to exercise therapy. Ozkan et al.[7] reported functional improvements following PRP injections in patients with chronic groin pain, although their study lacked a control

Table 2. Comparison of outcome measures between treatment groups

Variables	Exercise Group (n=73)	CS Injection Group (n=18)	PRP Injection Group (n=20)	p
Follow-up (month±SD)	78.1±28.5	93.9±33.2	86.4±31.1	0.107[1]
HOS (Score±SD)	35.4±1.7	35.6±1.0	35.8±0.8	0.821[2]
Full Return to Sport				0.880[3]
Yes	65 (89.0%)	16 (88.9%)	17 (85.0%)	
No	8 (11.0%)	2 (11.1%)	3 (15.0%)	

[1]ANOVA; [2]Kruskal-Wallis Test; [3]Chi-Square Test; SD: Standard Deviation; CS: Corticosteroid; PRP: Platelet-Rich-Plasma; HOS: Hip Outcome Score Sports Subscale; n: number. Note: Differences in baseline characteristics and outcome measures across treatment groups were not statistically significant (p>0.05).

group. A meta-analysis noted that PRP might slightly shorten the time to recovery in muscle injuries, but the overall quality of evidence was low, and the results were heterogeneous.[13] In contrast, our study did not find any added benefit of PRP or corticosteroid injections over exercise therapy alone. Although we applied injection treatments in cases with longer symptom duration, this did not affect long-term clinical outcomes. This may be attributed to the standardized exercise protocol applied across all groups, which likely provided a strong therapeutic effect regardless of adjunctive interventions.

More recent studies have continued to examine the comparative effectiveness of structured rehabilitation and adjunctive injection-based therapies. Bisciotti et al.[1] and Quintana-Cepedal et al.[28] emphasized that targeted strengthening and manual therapy protocols — such as the Copenhagen adduction exercises — are effective first-line approaches, especially in athletes with long-standing symptoms. These findings are consistent with the outcomes of our study, which support the sufficiency of structured exercise therapy in promoting functional recovery and return to sport. Conversely, Zeppieri et al.[29] reported beneficial effects of PRP injections combined with physical therapy in a competitive soccer player, while Di Lorenzo et al.[30] demonstrated functional improvement following ultrasound-guided corticosteroid injections in cases of osteitis pubis. However, despite these findings, our data did not show a significant advantage of adding injection therapies to a robust physiotherapy program. This discrepancy highlights the potential influence of exercise protocol standardization and patient selection on treatment efficacy.

The strengths of this study include a relatively large and homogeneous sample of MRI-confirmed adductor lesions, clearly defined treatment groups, and a long-term follow-up period. The classification of lesion types and the use of validated outcome measures (HOS–Sport and RTS status) further enhance the study's internal validity. However, several limitations should be noted. First, the retrospective design introduces the risk of selection bias and limits causal inference. Second, the lack of randomization and control over treatment allocation may have affected group comparability. Lastly, although the MRI-based classification system used in our study is comprehensive, interobserver variability in lesion typing was not formally assessed.

CONCLUSION

This study demonstrated that structured exercise therapy alone is as effective as combined exercise and injection therapies (corticosteroid or PRP) in improving functional outcomes and facilitating return to sport in football players with MRI-confirmed adductor-related groin pain. Given its noninvasive nature, low cost, and absence of procedural risks, exercise-based rehabilitation should remain the cornerstone of conservative management in this athlete population. Adjunctive injection therapies may be considered unresponsive to exercise in selected cases, but their routine use requires further validation through randomized controlled trials.

DECLARATIONS

Ethics Committee Approval: The Antalya Training and Research Hospital Scientific Research Ethics Committee granted approval for this study (2025.6/17).

Informed Consent: Participants provided informed consent for inclusion.

Conflict of Interest: The authors declared they have no conflict of interest to declare.

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Peer-review: Externally peer-reviewed.

ABBREVIATIONS

AL: Adductor Lesion

ANOVA: Analysis of Variance

BMI: Body Mass Index

CS: Corticosteroid

HOS–Sport: Hip Outcome Score – Sport Subscale

MRI: Magnetic Resonance Imaging

NSAID: Non-steroidal anti-inflammatory Drug

PRP: Platelet-Rich Plasma

RTS: Return to Sport

SD: Standard Deviation

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