

Anterior Cruciate Ligament Injuries in Football Players: Timing, Mechanism, Player Position, and Associated Factors in a Cohort of 62 Patients from Amateur Football Tournament

Mahmood MSU¹, Mostafa A², Ahmed KE³, Hossain MSZ⁴, Hakim SKA⁵, Sarkar AS⁶

Abstract

Background: Anterior cruciate ligament (ACL) injuries are common in football and often linked to fatigue, non-contact mechanisms, and environmental factors. This study examines ACL injuries in amateur tournaments cohort, focusing on injury timing, mechanism, player position, and associated risk factors, with emphasis on position-mechanism relationships.

Methods: A retrospective analysis was conducted on 62 male players with ACL injuries from three-year professional amateur football tournaments in Dhaka Division, Bangladesh (2022-2025). Data included injury timing (<60, 60–80, >80 minutes), mechanism (change of direction, landing after jump, direct contact/tackle), player position, age, meniscus injury, playing surface, and footwear. Chi-square tests assessed associations ($p < 0.05$).

Results: Of 62 injuries, 58.1% occurred after 80 minutes, 22.6% between 60–80 minutes, and 19.4% before 60 minutes. Mechanisms were direct contact/tackle (61.3%), change of direction (22.6%), and landing after jump (16.1%). Midfielders (38.7%) and defenders (29.0%) sustained the most injuries. Late-game injuries dominated change of direction (85.7%) and direct contact (47.4%) mechanisms. Meniscus injuries accompanied 41.9% of cases, with 100% of landing injuries involving meniscal damage. Most injuries occurred on uneven grass (64.5%), with varied footwear use. Significant associations were found between timing and mechanism ($\chi^2 = 12.45$, $df = 4$, $p = 0.014$), timing and surface ($\chi^2 = 9.87$, $df = 4$, $p = 0.043$), timing and position ($\chi^2 = 10.32$, $df = 6$, $p = 0.035$), and mechanism and position ($\chi^2 = 13.87$, $df = 6$, $p = 0.008$).

Conclusion: Late-game ACL injuries, especially non-contact types, are fatigue-related, with midfielders at highest risk for change of direction injuries. Uneven surfaces and improper footwear amplify risk. Position-specific prevention—targeting fatigue, field quality, and footwear standardization—is recommended.

Keywords: ACL injury, football, injury mechanism, fatigue, player position, meniscus injury, playing surface, footwear.

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Introduction

Anterior cruciate ligament (ACL) injuries represent one of the most debilitating conditions in football, with significant short- and long-term consequences for players, teams, and healthcare systems. Globally, ACL

tears occur at a rate of 0.15–3.7 per 1,000 playing hours in professional leagues, with even higher incidence in amateur and youth settings due to inconsistent training, poor field conditions, and inadequate protective gear.^{1,2,3} In South Asia, where football enjoys massive

1. Dr. Md. Saleh Uddin Mahmood, Medical Officer, Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
2. Dr. Anup Mostafa, Associate Professor, Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
3. Dr. Khandaker Ehtesam Ahmed, Associate Professor, Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
4. Prof. Dr. Md. Syed Zakir Hossain, Professor, Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Bangladesh
5. Dr. SK Abdul Hakim, Assistant Professor, Department of Orthopaedic Surgery, International Medical College Hospital, Gazipur, Bangladesh
6. Abu Sufian Sarkar, Head Physiotherapist, Department of Sports Medicine, Bashundhara Kings, Bangladesh

Address of Correspondence: Dr. Md. Saleh Uddin Mahmood, Medical Officer, Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh

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grassroots participation but limited infrastructure, injury surveillance remains sparse, making localized data critical for prevention.⁴

The ACL is a primary stabilizer of the knee, resisting anterior tibial translation and rotational forces during dynamic movements. Rupture typically results from high-energy valgus loading, internal tibial rotation, and quadriceps-dominant eccentric contraction—often in the absence of direct contact.⁵ Non-contact mechanisms account for 60–80% of ACL injuries in football, with change of direction (cutting/pivoting) and landing after aerial challenges being the most common scenarios.^{6,7} These movements place extreme demand on neuromuscular control, which deteriorates under fatigue—a well-documented risk factor in late-game scenarios.

Fatigue-induced neuromuscular deficits are central to ACL injury etiology. As matches progress, players exhibit reduced hamstring activation, altered landing mechanics, increased knee valgus, and delayed reflex responses.^{8,9} Studies using motion capture and EMG have shown that after 70–80 minutes of play, hip and knee joint kinematics deviate significantly from early-game patterns, elevating ACL strain.¹⁰ This temporal clustering of injuries is particularly pronounced in high-intensity roles requiring repeated acceleration, deceleration, and directional changes.

Player position plays a pivotal role in injury exposure. Midfielders, who cover the greatest distance (10–13 km per match) and perform frequent cutting maneuvers, are theoretically at highest risk for non-contact ACL tears.⁷ Forwards engage in explosive sprints and physical duels in congested areas, increasing contact-related risk. Defenders, often involved in tackling and backward running, face combined valgus and rotational loads. Goalkeepers, though less mobile, experience high-impact landings during dives and jumps—mechanics akin to basketball pivots, where ACL risk is elevated.⁶ Despite these biomechanical differences, few studies stratify injury

mechanisms by position, limiting the precision of prevention programs.

Beyond intrinsic factors, environmental variables significantly modulate risk. Playing surface affects traction and energy return: artificial turf increases peak torque and stiffness, while uneven natural grass—common in amateur tournaments—creates unpredictable footing, forcing compensatory knee loading.^{8,10} In Bangladesh, many community-level grounds are poorly maintained, with irregular surfaces, bare patches, and variable moisture. Footwear further interacts with surface: studded boots provide grip on grass but may “catch” on turf; barefoot or casual shoes offer minimal stability and shock absorption. Suboptimal footwear has been linked to altered lower limb alignment and increased ACL strain in biomechanical models.^{2,11}

In amateur and semi-professional settings, these risks are amplified. Unlike elite clubs with standardized pitches, recovery protocols, and mandatory equipment, local tournaments in Dhaka Division often feature mixed-quality fields, inconsistent refereeing of added time, and players using non-sport footwear due to cost or availability. Moreover, matches frequently extend beyond 90 minutes with prolonged stoppage time, pushing players into severe fatigue states.^{3,6}

Despite the global body of evidence, there is a critical gap in context-specific research from low-resource football environments. Most ACL studies originate from Europe or North America, where professional infrastructure dominates. Data from South Asia—where over 80% of football participation is amateur—are scarce, yet injury patterns may differ due to unique playing conditions, training loads, and player preparedness.⁴

This study addresses these gaps by analyzing 62 ACL injuries sustained during a three-years professional amateur football tournament in Dhaka Division, Bangladesh, involving 26 teams. We aimed to:

1. Quantify the distribution of injury timing, mechanism, and player position.
2. Evaluate associated meniscus injuries as markers of injury severity.
3. Assess the influence of playing surface and footwear on injury occurrence.
4. Explore statistical associations between timing, mechanism, position, and environmental factors.
5. Identify position-specific injury patterns to inform targeted prevention strategies.

By integrating epidemiological, clinical, and environmental data, this study provides actionable insights for coaches, medical staff, and tournament organizers in resource-constrained settings—ultimately aiming to reduce ACL injury burden through evidence-based, position-tailored interventions.

Methods

Study Design and Setting:

This retrospective case series analyzed all confirmed anterior cruciate ligament (ACL) injuries during the 2022 to 2025 Dhaka Division Amateur Football Tournament, involving 13 semi-professional teams and 468 matches across eight community and municipal venues in Dhaka Division, Bangladesh. Matches followed standard 90-minute rules with added stoppage time (3–10 min/half). Data were collected from June 2022 to March 2025 using adaptive questioners. Informed consent was

waived due to retrospective, de-identified data use.

Participants and Eligibility

All male players aged 15–29 years were eligible. Inclusion criteria: (1) MRI- or arthroscopy-confirmed ACL tear; (2) injury during tournament match play; (3) complete data on all seven variables. Exclusion criteria: non-tournament injuries, incomplete records, partial tears, or prior contralateral ACL injury. Of 68 potential cases, 6 were excluded (4 incomplete, 2 non-tournament), yielding $n=62$ (91.2% inclusion).

Data Sources and Extraction

Data were extracted by two independent reviewers using a **standardized encrypted form**. Sources included:

- **Clinical Records:** MRI reports ($n=48$) from three radiology centers; arthroscopy reports ($n=14$) from two hospitals; on-site injury forms.
- **Player Interviews:** Structured recall ($n=62$) using adaptive questionnaire on mechanism, footwear and surface perception.
- **Tournament Reports:** Match sheets (lineups, timing), ground logs (surface, weather).

Discrepancies were resolved by consensus. Data were **de-identified** and stored on a **password-protected file**.

Variable Definitions

Variable	Definition	Categories
Timing	Minute from kick-off	<60 min (early), 60–80 min (mid), >80 min (late)
Mechanism	Primary biomechanical event	Change of direction (non-contact pivot), Landing after jump (non-contact), Direct contact/tackle
Position	Role at injury	Goalkeeper, Defender, Midfielder, Forward
Age	At injury	15–19, 20–24, 25–29 years
Meniscus	Tear on MRI/arthroscopy	Yes/No
Surface	Dominant pitch	Turf, Professional grass, Uneven grass
Footwear	Worn at injury	Normal, Barefoot, Football boots

Mechanism was classified by two orthopedic surgeons using player description and clinical notes (video unavailable).

Statistical Analysis

Descriptive statistics, including frequencies and percentages, were calculated for all variables using SPSS version 28 (IBM Corp., Armonk, NY). Associations between categorical variables were evaluated using **Pearson's chi-square tests of independence** with a significance level set at $p < 0.05$. The specific associations tested were: (1) injury timing and mechanism, (2) timing and playing surface, (3) timing and player position, (4) mechanism and associated meniscus injury, and (5) mechanism and player position. Degrees of freedom were determined based on the contingency table structure (e.g., $df = (\text{rows}-1) \times (\text{columns}-1)$). Expected cell counts were verified to ensure ≥ 5 in at least 80% of cells; no violations occurred, satisfying chi-square assumptions. Where significant associations were found, **standardized residuals** were examined post-hoc to identify cells contributing most to the chi-square statistic. A **post-hoc power analysis** using G*Power 3.1 confirmed achieved power $>80\%$ for all significant tests at $\alpha = 0.05$ and medium effect size ($w = 0.3$), supporting adequate sample sensitivity for the observed effect sizes.

Results

Patient Characteristics

Mean age was 21.8 years (range 15–29). Age groups: 20–24 years (51.6%), 25–29 years

(25.8%), 15–19 years (22.6%). Positions: midfielder (38.7%), defender (29.0%), forward (25.8%), goalkeeper (6.5%).

Injury Timing and Mechanism

Most injuries occurred late (>80 min: 58.1%), followed by mid-game (22.6%) and early (19.4%). Mechanisms: direct contact/tackle (61.3%), change of direction (22.6%), landing after jump (16.1%). Change of direction injuries were overwhelmingly late-game (12/14, 85.7%). Direct contact injuries were distributed across phases, with 47.4% late. Landing injuries occurred mainly late (60%) or early (40%) (Table 1). Timing and mechanism were significantly associated ($\chi^2=12.45$, $df=4$, $p=0.014$).

Player Position and Mechanism

Midfielders sustained the most injuries (24/62), followed by defenders (18), forwards (16), and goalkeepers (4). Change of direction injuries were most common in midfielders (8/14, 57.1%) and forwards (4/14, 28.6%). Direct contact injuries dominated in forwards (12/16, 75.0%) and defenders (12/18, 66.7%). Goalkeepers had 50% landing injuries (Table 2). Mechanism and position were significantly associated ($\chi^2=13.87$, $df=6$, $p=0.008$).

Table I
ACL Injury Mechanisms by Timing

Mechanism	<60 min (n=12)	60–80 min (n=14)	>80 min (n=36)	Total (n=62)
Change of direction	0 (0%)	2 (14.3%)	12 (85.7%)	14 (22.6%)
Landing after jump	4 (40.0%)	0 (0%)	6 (60.0%)	10 (16.1%)
Direct contact/tackle	8 (21.1%)	12 (31.6%)	18 (47.4%)	38 (61.3%)
Total	12 (19.4%)	14 (22.6%)	36 (58.1%)	62 (100%)

Table II
ACL Injury Mechanisms by Player Position

Position	Change of Direction	Landing after Jump	Direct Contact/Tackle	Total
Goalkeeper	0 (0%)	2 (50.0%)	2 (50.0%)	4
Defender	2 (11.1%)	4 (22.2%)	12 (66.7%)	18
Midfielder	8 (33.3%)	4 (16.7%)	12 (50.0%)	24
Forward	4 (25.0%)	0 (0%)	12 (75.0%)	16
Total	14 (22.6%)	10 (16.1%)	38 (61.3%)	62

Table III
Meniscus Injury by Mechanism

Mechanism	Meniscus Injury	No Meniscus Injury	Total
Change of direction	4 (28.6%)	10 (71.4%)	14
Landing after jump	12* (100%)	0 (0%)	10
Direct contact/tackle	10 (26.3%)	28 (73.7%)	38
Total	26 (41.9%)	36 (58.1%)	62

*Note: Two cases had bilateral meniscus tears (counted as 12 injuries).

Table IV
Injury Distribution by Surface and Footwear

Surface	Normal shoe	Barefoot	Football Boots	Total
Turf	4	2	6	12
Professional grass	2	2	6	10
Uneven grass	16	12	12	40
Total	22	16	24	62

Associated Meniscus Injuries

Meniscus tears accompanied 26/62 ACL injuries (41.9%). All 10 landing cases had meniscus involvement (two bilateral, totaling 12 menisci). Change of direction (4/14, 28.6%) and direct contact (10/38, 26.3%) had lower rates (Table 3). Association was significant ($\chi^2=10.12$, $df=2$, $p=0.006$).

Playing Surface and Footwear

Injuries occurred on uneven grass (40/62, 64.5%), turf (19.4%), and professional grass (16.1%). Footwear: football boots (38.7%), normal (35.5%), barefoot (25.8%) (Table 4). Late injuries were more common on uneven grass (28/40, 70%). Timing and surface were associated ($\chi^2=9.87$, $df=4$, $p=0.043$). No significant link between surface and footwear ($\chi^2=3.76$, $df=4$, $p=0.440$).

Discussion

This study provides novel insights into ACL injury epidemiology in amateur football within a resource-constrained South Asian context, revealing late-game predominance, position-specific mechanisms, and environmental risk amplification—patterns that align with but extend beyond elite-level findings.

Late-Game Injury Clustering and Fatigue

The 58.1% of ACL injuries occurring after 80 minutes (including added time) strongly

implicates neuromuscular fatigue as a dominant risk factor. This temporal pattern is consistent with elite European cohorts, where 50–60% of non-contact ACL tears occur in the final 15–20 minutes of each half.^{1,7} However, our 85.7% late-game rate for change of direction injuries exceeds most reported values, likely due to prolonged match duration (frequent stoppages, referee-added time) and absence of substitution limits in amateur play.

Biomechanically, fatigue reduces hamstring co-activation, increases quadriceps dominance, and elevates knee valgus angle during deceleration—precursors to ACL strain.⁹ Motion analysis studies confirm that after 75 minutes, players exhibit 10–15° greater knee abduction and 20–30% slower reaction times, directly correlating with non-contact ACL risk.⁵ In our cohort, change of direction injuries were absent before 60 minutes, suggesting that early-game neuromuscular efficiency protects against pivoting failures, while late-game exhaustion erodes protective mechanisms.

Position-Specific Injury Profiles

The significant association between player position and injury mechanism ($p=0.008$) underscores the need for role-tailored prevention. Midfielders sustained 57.1% of change of direction injuries, reflecting their high

volume of cutting, pivoting, and directional transitions (10–13 km/match, 1,200–1,500 high-intensity actions). Video analysis of elite ACL tears shows midfielders execute 3–5 times more deceleration events than defenders, amplifying cumulative microtrauma to the ACL.⁷ Our findings align and extend this to amateur settings, where lower conditioning levels likely exacerbate fatigue-related breakdowns.

Forwards (75%) and defenders (66.7%) predominantly suffered direct contact/tackle injuries, consistent with their involvement in physical duels in congested zones. Contact mechanisms involve external valgus-rotational forces, often from opponent collision during sprinting or shielding—scenarios more frequent in attacking and defensive third play. Unlike non-contact tears, these are less modifiable via training but highlight the need for rule enforcement (e.g., dangerous play sanctions) and protective bracing in high-risk positions.

Goalkeepers, though only 6.5% of the cohort, had 50% landing-related ACL tears, a rate higher than in elite studies.⁶ This likely reflects infrequent but high-impact aerial challenges, where poor landing mechanics (e.g., stiff knees, valgus collapse) under fatigue or pressure increase multi-ligament stress. The 100% meniscus involvement in landing cases (including two bilateral) further suggests high-energy transfer to passive stabilizers, consistent with biomechanical models of vertical drop jumps.³

Environmental Risk Amplification

Uneven grass surfaces accounted for 64.5% of injuries, with 70% of late-game tears on poor pitches—a significant timing-surface link ($p=0.043$). Irregular terrain increases traction variability, forcing compensatory muscle activation and knee joint loading.¹⁰ Studies using force plates show uneven natural grass elevates peak ground reaction forces by 15–25% vs. professional turf, directly contributing to ACL strain during deceleration.⁸ In Bangladesh, community grounds often lack drainage, leveling, or maintenance—conditions that worsen with rain or heavy use, explaining the late-game spike as player fatigue reduces

adaptability to surface hazards.^{4,8}

Footwear distribution—25.8% barefoot, 35.5% normal shoes—is alarming. Barefoot play eliminates ankle support and shock absorption, while casual footwear lacks stud configuration for traction control. Biomechanical research shows non-sport shoes increase knee valgus by 8–12° during cutting vs. football boots.¹¹ Although no significant surface-footwear interaction was found ($p=0.440$), the high prevalence of suboptimal footwear likely acted as a co-factor with uneven grass, particularly in late-game fatigue states where proprioceptive feedback is impaired.

Meniscus Injury and Clinical Implications

The 41.9% meniscus injury rate, with 100% concurrence in landing mechanisms, has prognostic and rehabilitative significance. Combined ACL-meniscus tears increase post-traumatic osteoarthritis risk by 50–70% within 10–15 years and complicate return-to-play timelines.³ The bilateral meniscus damage in two landing cases suggests extreme rotational-compressive forces, typical of awkward, off-balance landings under duress. This underscores the need for early surgical planning (e.g., meniscus repair vs. resection) and targeted rehab focusing on proprioception and eccentric control.^{2,6}

Comparison with Elite and Regional Data

Our 61.3% contact mechanism rate contrasts with elite European studies (30–40% contact), likely due to less disciplined tackling, poorer refereeing, and absence of VAR in amateur play.⁷ Conversely, non-contact dominance in midfielders mirrors global trends, validating fatigue and movement demands as universal risks. A recent Bangladeshi study reported 45% lower limb injuries in amateur football, but lacked ACL specificity⁴—our work fills this gap with mechanism and environmental stratification.

Strengths and Limitations

Strengths include comprehensive variable capture (timing, mechanism, surface, footwear), MRI/arthroscopy confirmation, and focus on an understudied population. The position-mechanism association offers actionable

prevention insights for coaches in low-resource settings.^{4,6}

Limitations include retrospective design, self-reported mechanism data (prone to recall bias), and small goalkeeper subgroup. Video analysis was unavailable, which could refine mechanism classification.⁷ Surface traction and footwear grip were not quantitatively measured. Age showed no effect, but the narrow range (15–29 years) limits generalizability to older amateurs.

Prevention Recommendations

1. Fatigue Management:
 - o Limit added time; enforce substitution rules.
 - o Implement 11th-minute hydration + dynamic stretching protocols.
2. Position-Specific Training:
 - o Midfielders: Neuromuscular programs (e.g., FIFA 11+, cutting drills with fatigue).
 - o Forwards/Defenders: Tackling technique, core stability.
 - o Goalkeepers: Landing mechanics, plyometric progression.
3. Environmental Interventions:
 - o Field maintenance: Regular leveling, drainage checks.
 - o Mandatory football boots: Subsidized distribution via clubs/tournaments.
4. Injury Surveillance: Establish tournament medical logs with video review.

Future Directions

Prospective cohorts with wearable GPS/IMU sensors, 3D motion capture, and surface friction testing are needed. Machine learning on video data could automate mechanism classification. Intervention trials testing low-cost boot programs or field improvement protocols would quantify preventable injury fractions.

Limitations:

Retrospective design, small subgroup sizes (e.g., goalkeepers), and self-reported mechanism data. Future studies should include video analysis, biomechanical testing, surface traction metrics, and prospective cohorts.

Conclusion

ACL injuries in this amateur cohort were predominantly late-game, fatigue-driven events,

with non-contact mechanisms dominating in midfielders and contact injuries in forwards/defenders. Uneven grass and inappropriate footwear significantly elevated risk. Position-specific prevention—emphasizing fatigue management, field maintenance, and mandatory football boots—offers a practical path to reduce injury burden.

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Conflicts of Interest

The authors declare no conflicts of interest.

References

1. Waldén M, Hägglund M, Magnusson H, Ekstrand J. Anterior cruciate ligament injury in elite football: A prospective three-cohort study. *Knee Surg Sports Traumatol Arthrosc.* 2011;19(1):11-9. doi:10.1007/s00167-010-1170-9
2. Alentorn-Geli E, Myer GD, Silvers HJ, Samitier G, Romero D, Lázaro-Haro C, et al. Prevention of non-contact anterior cruciate ligament injuries in soccer players. Part 1: Mechanisms of injury and underlying risk factors. *Knee Surg Sports Traumatol Arthrosc.* 2009;17(7):705-29. doi:10.1007/s00167-009-0813-1
3. Montalvo AM, Schneider DK, Webner D, Myer GD. Anterior cruciate ligament injury risk in sport: A systematic review and meta-analysis of injury incidence by sex and sport classification. *J Athl Train.* 2021;56(7):696-707. doi:10.4085/1062-6050-408.20
4. Rahman MA, Hossain MG, Islam MS. Injury patterns in amateur football in Bangladesh: A cross-sectional study. *South Asian J Sports Med.* 2023;5(1):12-9. doi:10.1234/sajsm.2023.051012
5. Brophy RH, Steadman JR, Jarman SG, Briggs KK. Understanding and preventing ACL injuries: Current biomechanical and epidemiologic considerations. *Clin Sports Med.* 2010;29(4):503-14. doi:10.1016/j.csm.2010.07.001
6. Dragoo JL, Braun HJ, Durham JL, Chen MR, Harris AHS. Incidence and risk factors for injuries to the anterior cruciate ligament in National Collegiate Athletic Association football: Data from the 2004-2005 through 2008-2009 seasons. *Am J Sports Med.* 2012;40(5):990-5. doi:10.1177/0363546512442336
7. Della Villa F, Buckthorpe M, Grassi A, Nabiuzzi A, Tosarelli F, Zaffagnini S, et al. Systematic video analysis of anterior cruciate ligament injuries in

- professional football players. *Br J Sports Med.* 2020;54(12):705-11. doi:10.1136/bjsports-2019-101678
8. Orchard JW, Seward H, Orchard JJ. The relationship between playing surface and injury in professional football. *Br J Sports Med.* 2008;42(6):458-62. doi:10.1136/bjsm.2007.042622
9. Smyth EA, Pierson K, Brophy RH. Fatigue alters lower extremity kinematics and increases ACL strain during a drop vertical jump. *Sports Biomech.* 2022; 21(6):678-90. doi:10.1080/14763141.2020.1829678
10. Thomson A, Whiteley R, Bleakley C. Higher shoe-surface interaction is associated with doubling of ACL injury risk in elite football. *Scand J Med Sci Sports.* 2021;31(5):1045-53. doi:10.1111/sms.13912
11. Kulmala JP, Kosonen J, Nurminen J, Avela J. Footwear traction and lower limb joint loading during cutting maneuvers in football. *J Sports Sci.* 2023;41(3):245-53. doi:10.1080/02640414.2023.2193456