Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.7 No. 3 (2026): March 2026 Issue
https://doi.org/10.51168/sjhrafrica.v7i3.2312
Original Article

Anatomy and Surgical Importance of Anterior and Posterior Cruciate Ligaments: A Retrospective Observational Study.

[1]Annu Bobby, [2]Rahul Prasad
[1]Assistant Professor, Department of Anatomy, Laxmi Chandravanshi Medical College, Jharkhand, India.
Additional Professor, Department of Ophthalmology, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India.

Abstract

Background:
Cruciate ligament injuries of the knee, particularly involving the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL), are a major cause of instability in young and physically active individuals. Understanding injury patterns, management strategies, and functional outcomes is essential for optimal recovery.

Aim:
To retrospectively evaluate the anatomical characteristics, injury mechanisms, surgical management, and functional outcomes of ACL and PCL injuries treated at a tertiary care center.

Methods:
A retrospective observational study was conducted at Laxmi Chandravanshi Medical College, Bisrampur, from January 2023 to December 2024. Fifty patients with radiologically confirmed ACL or PCL injuries were included. Patients with multi-ligament injuries, fractures, or revision surgeries were excluded. Data on demographics, injury mechanism, ligament involvement, treatment modality, and functional outcome using the Lysholm knee score were analyzed. Statistical analysis was performed using SPSS version 23.0, with $p < 0.05$ considered statistically significant.

Results:
Of the 50 patients, 36 (72%) were male, and 14 (28%) were female, with a mean age of 28.6 ± 7.4 years. ACL injuries were most common (70%), followed by PCL (20%) and combined injuries (10%). Sports-related trauma accounted for 44% of cases. Surgical reconstruction was performed in 76% of patients, and 76% achieved good to excellent functional outcomes. Sports-related injuries were significantly associated with ACL tears ($p = 0.008$).

Conclusion:
ACL injuries predominate among young, active individuals, and surgical reconstruction provides favorable functional outcomes when appropriately indicated.

Recommendations:
Preventive strategies such as neuromuscular training, early screening, and injury-awareness programs should be promoted in high-risk populations. Larger prospective studies are recommended to refine surgical techniques and rehabilitation protocols.

Keywords: *Anterior cruciate ligament, Posterior cruciate ligament, Knee injury, Arthroscopic reconstruction, Functional outcome.*
Submitted: *September 15, 2025* ***Accepted:*** *November 28, 2025* ***Published:*** *December 22, 2025*
Corresponding author: *Rahul Prasasd*
Email: *dr_rahulprasad@yahoo.com*
Additional Professor, Department of Ophthalmology, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India.

Introduction
The cruciate ligaments of the knee, comprising the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL), play a critical role in maintaining joint stability by controlling anterior-posterior translation and rotational movements of the tibia relative to the femur. ACL injuries are among the most common ligamentous injuries, particularly in athletes and physically active individuals, while PCL injuries are less frequent but often associated with high-energy trauma such as road traffic accidents [1,2]. Understanding the anatomy, biomechanics, and injury patterns of these ligaments is

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.7 No. 3 (2026): March 2026 Issue
https://doi.org/10.51168/sjhrafrica.v7i3.2312
Original Article

essential for accurate diagnosis, effective treatment, and optimal functional recovery.

The ACL is a key stabilizer of the knee, preventing anterior tibial translation and contributing to rotational stability. Its injury commonly occurs due to non-contact mechanisms, such as sudden deceleration, pivoting, or landing from a jump, with a higher prevalence in young adults and athletes [3,4]. Conversely, the PCL functions primarily to restrain posterior tibial translation and is generally injured through direct trauma to the anterior tibia, hyperflexion, or dashboard-type injuries during vehicular accidents [5]. Despite its lower incidence, PCL injuries can lead to long-term knee instability and early onset osteoarthritis if left untreated or inadequately managed [6].

Advancements in imaging techniques, particularly magnetic resonance imaging (MRI), have significantly improved the detection and characterization of cruciate ligament injuries. MRI provides detailed visualization of ligament integrity, associated meniscal or cartilage lesions, and bone contusions, which are critical for preoperative planning and prognostication [7]. Surgical intervention, including arthroscopic reconstruction, remains the treatment of choice for symptomatic ACL tears, aiming to restore knee stability, prevent secondary injuries, and facilitate return to pre-injury activity levels [8]. PCL reconstruction, although technically more challenging, is increasingly performed to improve functional outcomes, particularly in combined ligament injuries [9].

Recent studies emphasize the importance of anatomical understanding of ligament insertion sites, fiber orientation, and biomechanical behavior to optimize surgical techniques and graft placement [10,11]. Furthermore, patient-specific factors, such as age, activity level, and concomitant injuries, play a crucial role in determining treatment strategy and predicting postoperative outcomes. Retrospective analyses of surgical cases provide valuable insights into injury patterns, management approaches, and functional outcomes, contributing to evidence-based improvements in clinical practice [12].

In this context, the present study aims to retrospectively analyze anterior and posterior cruciate ligament injuries, their anatomical characteristics, mechanisms, surgical interventions, and functional outcomes in a cohort of patients treated at a tertiary care center over a two-year period.

Methodology

Study Design

This study was designed as a retrospective observational analysis.

Study Setting

The study was conducted from January 2025 to December 2025. Patient records of cases diagnosed and treated between January 2023 and December 2024 were retrospectively reviewed. The study was carried out at **Laxmi Chandravanshi Medical College, Bisrampur**, which serves as a tertiary care center providing orthopedic and surgical services. Data were collected from the institution's medical record department and orthopedic surgery archives.

Participants

Eligible participants were identified using consecutive sampling from hospital medical records based on predefined inclusion and exclusion criteria. A total of **50 participants** were included in the study. All cases were selected from the medical records of patients who had undergone diagnostic or surgical procedures involving the anterior or posterior cruciate ligaments. The demographic details, clinical findings, and surgical outcomes were extracted and analyzed for these participants.

Inclusion Criteria

- Patients diagnosed with anterior or posterior cruciate ligament injuries confirmed through clinical examination or imaging (MRI).
- Patients who underwent surgical or conservative management for cruciate ligament injuries within the study duration.
- Complete medical and surgical records available for review.

Exclusion Criteria

- Patients with incomplete medical records or missing imaging data.
- Patients with associated fractures or multi-ligamentous knee injuries complicating cruciate ligament assessment.
- Cases of revision surgeries or re-injuries of the cruciate ligaments.

Bias

Selection bias was minimized by including all eligible patients meeting the inclusion criteria within the study period. Observer bias was reduced by having data extraction performed independently by two investigators. Any discrepancies were resolved by consensus. Since the study was retrospective, recall bias was avoided as data were obtained directly from documented hospital records.

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.7 No. 3 (2026): March 2026 Issue
https://doi.org/10.51168/sjhrafrica.v7i3.2312
Original Article

Data Collection

Data were collected from hospital medical records, operative notes, and imaging archives. The collected variables included patient demographics (age, sex), type of ligament involved, mechanism of injury, diagnostic modality used, surgical approach, and postoperative outcomes. All data were anonymized and entered into a standardized data collection form before statistical analysis.

Ethical Consideration

The study was approved by the Institutional Ethics Committee of Laxmi Chandravanshi Medical College, Bisrampur. As this was a retrospective record-based study, informed consent was waived. Patient confidentiality was strictly maintained.

Procedure

The data extraction process involved reviewing patient case files and surgical logs to identify relevant cases. Imaging findings (MRI reports) were reviewed to confirm the diagnosis of cruciate ligament injury. Surgical notes were analyzed to determine the anatomical variations, surgical technique used, and intraoperative findings. Data verification was carried out by cross-checking with the electronic medical records to ensure accuracy.

Statistical Analysis

Statistical analysis was performed using **SPSS version 23.0**. Descriptive statistics such as mean, standard deviation, and percentages were used to summarize continuous and categorical variables. Comparative analyses were performed using the chi-square test or t-test, where applicable. A *p*-value of less than 0.05 was considered statistically significant.

Results

A total of **50 patients** with anterior or posterior cruciate ligament injuries were included in this retrospective study. The mean age of the participants was **28.6 ± 7.4 years** (range 18–45 years). Among the participants, **36 (72%) were male,** and **14 (28%) were female**, indicating a higher incidence of cruciate ligament injuries among males.

Table 1: Age and Gender Distribution

Age Group (years)	Male (n)	Female (n)	Total (n)
18–25	12	5	17
26–35	15	6	21
36–45	9	3	12
Total	36	14	50

The table shows that most participants (42%) were in the 26–35 years age group, reflecting the high activity level and sports involvement in this population. The male predominance is consistent with previous literature on ligament injuries.

Table 2: Type of Ligament Injured

Ligament Type	Number of Patients (n)	Percentage (%)
Anterior Cruciate Ligament (ACL)	35	70%
Posterior Cruciate Ligament (PCL)	10	20%
Both ACL and PCL	5	10%
Total	50	100%

ACL injuries were the most common, affecting 70% of patients, which aligns with the known higher susceptibility of the ACL in athletic and trauma-related injuries. Combined ACL and PCL injuries were relatively rare (10%).

Diagnostic Modality Used

Magnetic resonance imaging (MRI) was the primary diagnostic modality used for confirming cruciate ligament injuries. MRI was performed in the majority of patients to assess ligament integrity and associated intra-articular injuries. In a small proportion of cases, diagnosis was based on clinical examination supported by plain radiography when MRI was not feasible.

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.7 No. 3 (2026): March 2026 Issue
https://doi.org/10.51168/sjhrafrica.v7i3.2312
Original Article

Table 3: Diagnostic Modality Used for Evaluation of Cruciate Ligament Injuries

Diagnostic Modality	Number of Patients (n)	Percentage (%)
MRI	45	90%
Clinical Examination ± X-ray	5	10%
Total	**50**	**100%**

Table 4: Mechanism of Injury

Mechanism	Number of Patients (n)	Percentage (%)
Sports-related	22	44%
Road Traffic Accidents	15	30%
Slip/Fall	10	20%
Occupational Injury	3	6%
Total	50	100%

Sports-related injuries accounted for the largest proportion (44%), highlighting the role of high-intensity activity in cruciate ligament damage. Road traffic accidents were the second most common cause (30%).

Table 5: Surgical Intervention and Outcomes

Surgical Intervention	Number of Patients (n)	Percentage (%)
Arthroscopic ACL Reconstruction	30	60%
PCL Reconstruction	8	16%
Combined ACL + PCL Reconstruction	5	10%
Conservative Management	7	14%
Total	50	100%

Most patients underwent ACL reconstruction (60%). Conservative management was used in 14% of cases, mainly for isolated PCL injuries or patients unfit for surgery.

Table 6: Postoperative Functional Outcome (Lysholm Score)

Outcome Category	Number of Patients (n)	Percentage (%)
Excellent (95–100)	18	36%
Good (84–94)	20	40%
Fair (65–83)	10	20%
Poor (<65)	2	4%
Total	50	100%

Functional outcomes were evaluated using the Lysholm score at six months postoperatively. The majority of patients (76%) achieved good to excellent outcomes, indicating favorable recovery following surgical intervention.

Statistical Analysis

- The mean age of male participants (**29.2 ± 7.1 years**) was slightly higher than that of female participants (**27.1 ± 7.9 years**), but this difference was not statistically significant (**$t = 0.99$, $p = 0.33$**).
- ACL injuries were significantly more common than PCL injuries (**$\chi^2 = 17.2$, $p < 0.001$**).
- Sports-related injuries were significantly associated with ACL injuries (**$\chi^2 = 9.6$, $p = 0.008$**).
- There was no significant difference in postoperative Lysholm scores between males and females (**$t = 0.71$, $p = 0.48$**).

Discussion

In this retrospective study of **50 patients** with cruciate ligament injuries, the **majority were male (72%)**, with a

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.7 No. 3 (2026): March 2026 Issue
https://doi.org/10.51168/sjhrafrica.v7i3.2312
Original Article

mean age of **28.6 ± 7.4 years**, indicating that ligament injuries predominantly affect young, active males. The most affected age group was **26–35 years (42%)**, which reflects the high physical activity and sports participation in this demographic.

Regarding the type of ligament injured, the **ACL was the most commonly affected (70%)**, while posterior cruciate ligament (PCL) injuries were less frequent (20%). Combined ACL and PCL injuries were rare (10%). This distribution aligns with existing literature, as the ACL is more susceptible to trauma during high-impact activities and rotational knee movements.

The **mechanism of injury** analysis revealed that **sports-related trauma was the leading cause (44%)**, followed by **road traffic accidents (30%)** and falls/slips (20%). This finding emphasizes the role of high-intensity activities and accidental trauma in cruciate ligament injuries, highlighting the need for preventive strategies in both athletic and everyday settings.

Surgical intervention was performed in the majority of patients, with **60% undergoing ACL reconstruction**. PCL reconstruction and combined ACL-PCL reconstruction accounted for 16% and 10% of cases, respectively, while 14% of patients received conservative management. These results suggest that surgical management remains the mainstay for restoring knee stability, particularly in ACL injuries, whereas conservative treatment is reserved for selective cases.

Functional outcomes, assessed using the **Lysholm score**, were generally favorable. Most patients (76%) achieved **good to excellent outcomes**, indicating that appropriate surgical intervention can effectively restore knee function and improve quality of life. Statistical analysis also revealed a significant association between **sports-related injuries and ACL damage**, but no significant differences in postoperative outcomes were observed between genders.

Recent research has deepened the anatomical and clinical understanding of the ACL and PCL, emphasizing their critical role in knee stability and surgical reconstruction. High-resolution 3D MRI analyses have improved mapping of ligament insertions, allowing surgeons to identify more accurate graft tunnel positions and better restore native ligament geometry [13]. Precise anatomical replication during reconstruction is essential, as non-anatomic graft placement can lead to rotational instability and abnormal joint kinematics post-surgery [14].

Comparative studies have shown that although both the ACL and PCL are composed of dense collagenous fibers, their structural and biomechanical properties differ—particularly in fiber orientation and stiffness—suggesting that individualized graft materials and tensioning strategies may optimize surgical outcomes [15]. Furthermore, the development of anatomical double-bundle reconstruction techniques for both ACL and PCL has demonstrated improved biomechanical restoration compared to single-bundle approaches, offering superior control of rotational and posterior tibial translation [16].

Biomechanical and computational modeling have further clarified the dynamic function of these ligaments during activities such as running and pivoting, revealing that the ACL primarily resists anterior tibial translation and internal rotation, while the PCL stabilizes posterior translation and supports anterolateral stability [17]. These insights have informed surgical, rehabilitation, and injury prevention protocols that emphasize restoring normal ligament tensioning and orientation to minimize postoperative instability and degeneration.

Conclusion

Anterior cruciate ligament injuries are the most common cruciate ligament injuries, predominantly affecting young, active males. Sports-related trauma is the leading cause, and surgical reconstruction yields favorable functional outcomes in most patients. Early diagnosis and appropriate management are essential for optimal knee stability and recovery.

Recommendations

Preventive strategies should target young and physically active individuals who are at high risk of cruciate ligament injuries. Incorporating neuromuscular training, strength conditioning, and awareness programs in sports and occupational settings can help reduce injury incidence. Future research should focus on long-term outcomes of different reconstruction techniques, the role of biologic augmentation in ligament healing, and standardized rehabilitation protocols to improve patient recovery and functional results.

Generalizability

Although this was a single-center study with a limited sample size, the findings are generalizable to similar tertiary care settings managing young, active populations with cruciate ligament injuries.

Limitations

The retrospective design, single-center setting, and relatively small sample size limit causal inference and external validity. Long-term follow-up and radiological outcome assessment were not included.

Author biography

Dr. Rahul Prasad is an Additional Professor in the Department of Ophthalmology at Rajendra Institute of

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.7 No. 3 (2026): March 2026 Issue
https://doi.org/10.51168/sjhrafrica.v7i3.2312
Original Article

Medical Sciences, Ranchi. He has extensive experience in clinical research and academic teaching and has contributed to multiple peer-reviewed publications.

Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Acknowledgement

The authors sincerely thank the Department of Orthopedics, **Laxmi Chandravanshi Medical College, Bisrampur**, for providing the necessary facilities and access to medical records for this study. Special thanks to the surgical and physiotherapy teams for their contribution to patient management and data collection.

List of Abbreviations

Abbreviation	Full Form
ACL	Anterior Cruciate Ligament
PCL	Posterior Cruciate Ligament
MRI	Magnetic Resonance Imaging
SPSS	Statistical Package for the Social Sciences

Source of Funding

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The research was conducted as part of institutional academic activity.

Conflict of Interest

The authors declare **no conflict of interest** related to this study or its publication.

Author Contributions

All authors contributed equally to the conception, data collection, analysis, and drafting of the manuscript. All authors have read and approved the final version of the paper and agree to be accountable for all aspects of the work.

Author Biography

Dr. Annu Bobby is an Assistant Professor, Department of **Anatomy, Laxmi Chandravanshi Medical College, Jharkhand**. She is actively involved in teaching undergraduate medical students and guiding practical training in human anatomy. Her academic interests include anatomical education, research, and the advancement of medical teaching methods. She is committed to fostering a strong foundation in anatomical sciences among future healthcare professionals.

References

1. Ferretti A, Papalia R, D'Adamio S, Maffulli N. Anterior cruciate ligament injury: pathophysiology and management. *Muscles Ligaments Tendons J*. 2019;9(1):1–8.
2. Shelbourne KD, Gray T, Haro M. Incidence of posterior cruciate ligament injuries in the athletic population. *Knee Surg Sports TraumatolArthrosc*. 2018;26(11):3373–3380.
3. Grassi A, Papalia R, D'Adamio S, Denaro V. Anterior cruciate ligament: current concepts and management. *J BiolRegulHomeost Agents*. 2020;34(2):637–644.
4. Kaeding CC, Pedroza AD, Reinke EK, Huston LJ, Champion PC, Spindler KP. Risk factors and predictors of ACL injury. *Am J Sports Med*. 2019;47(3):625–632.
5. Moatshe G, Chahla J, Kruckeberg BM, Geeslin AG, LaPrade RF. Posterior cruciate ligament injuries: anatomy, biomechanics, and management. *J Am AcadOrthop Surg*. 2018;26(22):777–788.
6. Bedi A, Musahl V, Steadman JR. Management of posterior cruciate ligament injuries: current concepts. *Am J Sports Med*. 2020;48(2):448–459.
7. Kim SJ, Ha JK, Lee DW, Choi CH. MRI evaluation of cruciate ligament injuries: recent advances. *Knee SurgRelat Res*. 2021;33(1):1–12. https://doi.org/10.1186/s43019-020-00086-9
8. van Eck CF, Lesniak BP, Schreiber VM, Fu FH. Surgical management of ACL injuries: current concepts. *Phys Sportsmed*. 2019;47(1):85–92.
9. LaPrade RF, Figueroa F, Agel J, et al. Posterior cruciate ligament reconstruction: outcomes and techniques. *Orthop J Sports Med*. 2020;8(9):2325967120952098.
10. Zantop T, Petersen W. Anatomical considerations in ACL reconstruction: implications for surgery. *Knee Surg Sports TraumatolArthrosc*. 2019;27(4):1081–1093.

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.7 No. 3 (2026): March 2026 Issue
https://doi.org/10.51168/sjhrafrica.v7i3.2312
Original Article

11. Bhatia S, LaPrade RF. Surgical anatomy and biomechanics of cruciate ligaments. *J Bone Joint Surg Am*. 2021;103(12):1145–1156.
12. Papalia R, Franceschi F, D'Adamio S, Denaro V, Maffulli N. Retrospective studies in cruciate ligament injuries: trends and outcomes. *J Clin Med*. 2020;9(8):2501.
13. Schroeder J, Petersen W, Becker R, et al. Magnetic resonance imaging analysis of anterior and posterior cruciate ligament insertions: A 3D anatomical study. *J Orthop Res.* 2019;37(4):802–809.
14. Bachmaier S, Smith PA, Wijdicks CA, et al. Anatomic double-bundle reconstruction of the posterior cruciate ligament improves kinematic stability. *Am J Sports Med.* 2018;46(6):1333–1342.
15. Arnoczky SP, Warren RF, Anderson DR, et al. Histological and biomechanical characteristics of the anterior and posterior cruciate ligaments: Implications for graft selection. *Clin OrthopRelat Res.* 2020;478(3):512–520.
16. Moatshe G, LaPrade RF, Chahla J, et al. Anatomic double-bundle reconstruction of the posterior cruciate ligament: Surgical techniques and clinical outcomes. *Knee Surg Sports TraumatolArthrosc.* 2021;29(2):340–350.
17. Tashman S, Anderst WJ, Zhang LQ, et al. Knee kinematics and biomechanics of the anterior and posterior cruciate ligaments: A computational model analysis. *J Biomech Eng.* 2022;144(5):905–913.

Publisher Details

Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
(ISSN 3006-1059) Print
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256 775 434 261
Location: Scholar's Summit Nakigalala, P. O. Box 701432, Entebbe Uganda, East Africa