Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/t8ajy674

OUTCOME ANALYSIS IN POSTTRAUMATIC ANTERIOR CRUCIATE LIGAMENT INJURY: REVIEW OF PAIN AND RECOVERY POST SURGICAL MANAGEMENT

Dr. Nalluri Akhil[1*], Dr Rajadurai[2], Dr Thulasi Raman[3], Dr Soni Neel[4], Dr Hari Kishore[5]

[1*]Post Graduate, Department of Orthopedics, Meenakshi Medical College Hospital and Research Institute, Meenakshi Academy of Higher Education and Research (Deemed to be University) , Kanchipuram, Tamil Nadu, India
[2]Professor , Meenakshi Medical College Hospital and Research Institute Kanchipuram, Tamil Nadu, India.
[3]Professor and HOD, Meenakshi Medical College Hospital and Research Institute Kanchipuram, Tamil Nadu, India.
[4] Post Graduate (Meenakshi Medical College Hospital and Research Institute Kanchipuram, Tamil Nadu, India.)
[5] Post Graduate (Meenakshi Medical College Hospital and Research Institute Kanchipuram, Tamil Nadu, India.)

***Corresponding Author**- Dr. Nalluri Akhil
*Post Graduate, Department of Orthopedics, Meenakshi Medical College Hospital and Research Institute, Meenakshi Academy of Higher Education and Research (Deemed to be University) , Kanchipuram, Tamil Nadu, India

ABSTRACT

Anterior cruciate ligament (ACL) injuries are frequent among young, active individuals and often necessitate surgical reconstruction for optimal functional recovery, yet effective postoperative pain management remains a major clinical challenge. This prospective, randomized, controlled study evaluated the impact of a multimodal analgesic regimen—comprising intravenous lidocaine and magnesium sulfate as adjuncts to standard fentanyl-based analgesia—on postoperative pain control, opioid requirements, and short-term functional recovery in 90 ASA I–II patients aged 16 to 50 years undergoing elective arthroscopic ACL reconstruction with peroneus longus tendon autografts. Patients were randomly assigned to receive either fentanyl alone, fentanyl with lidocaine, or fentanyl with both lidocaine and magnesium sulfate. Pain was assessed at 30 minutes, 6 hours, and 18 hours postoperatively using the Visual Analog Scale (VAS), while functional and psychological outcomes were evaluated at six weeks using the IKDC, KOOS, and ACL-RSI scoring systems.

Patients receiving both lidocaine and magnesium sulfate with fentanyl demonstrated significantly lower postoperative pain scores at all assessed intervals, a reduced need for rescue opioid analgesia, and superior IKDC, KOOS, and ACL-RSI scores at six weeks, indicating enhanced early functional and psychological recovery. No delays in anesthetic emergence or adverse effects were associated with the multimodal analgesic regimen. These findings suggest that the addition of intravenous lidocaine and magnesium sulfate to conventional opioid analgesia provides a safe, effective strategy for improving postoperative outcomes after ACL reconstruction, supporting broader implementation of multimodal pain management protocols in knee ligament surgery.

INTRODUCTION

The anterior cruciate ligament (ACL) is a key stabilizer of the knee joint and is often injured, particularly in young and physically active individuals. ACL injuries are among the most frequently encountered musculoskeletal conditions in orthopaedic and sports medicine, accounting for nearly 60% of all knee trauma cases and resulting in substantial functional impairment if not adequately managed [1–3]. The rising incidence is linked to increased participation in high-risk sports and recreational activities, improved diagnostic tools, and greater clinical awareness .

Arthroscopic ACL reconstruction is the treatment of choice for complete ligamentous rupture, especially in active individuals aiming to return to high-demand activities. Of the available autograft options, hamstring tendons are widely favored due to their favorable biomechanical characteristics, ease of harvest, and reliable clinical outcomes . However, early postoperative recovery—even with advances in surgical techniques—remains a clinical challenge, often hindered by moderate-to-severe pain, shivering, nausea, and delayed mobilization .

Postoperative pain not only impairs functional rehabilitation and neuromuscular recovery but also impacts patient satisfaction and return to sports. Opioid-based analgesia, although effective, is limited by adverse effects such as sedation, respiratory depression, postoperative nausea and vomiting (PONV), and risk of chronic dependence [8–10]. This has led to increased clinical interest in multimodal analgesia—a strategy combining pharmacological agents targeting multiple pain pathways to enhance pain control and reduce opioid reliance .

Intravenous magnesium sulfate and lidocaine have emerged as effective adjuvants in multimodal regimens. Magnesium sulfate, through NMDA receptor antagonism and calcium channel blockade, exhibits analgesic and antihyperalgesic effects and has demonstrated perioperative benefits, including reduced PONV and shivering [12–14]. Lidocaine, known for its analgesic, anti-inflammatory, and opioid-sparing properties, has also shown promising results in reducing postoperative pain and accelerating functional recovery [15–17].

Although both agents have shown individual efficacy, limited data exist on their combined use in ACL reconstruction, particularly when using autologous grafts with similar profiles, such as peroneus longus tendons. There remains a need to investigate whether combining lidocaine and magnesium sulfate can improve early postoperative outcomes and facilitate faster rehabilitation while reducing opioid-related complications.

Therefore, this study aimed to evaluate the effectiveness of multimodal analgesia using intraoperative intravenous lidocaine and magnesium sulfate in reducing postoperative pain, opioid consumption, and associated recovery parameters—including PONV and shivering—in patients undergoing ACL reconstruction using peroneus longus tendon autografts. Anatomical variations and ACL morphometry are known to influence postoperative recovery, as noted in a South Indian cadaveric study published in the National Journal of Clinical Anatomy [28].

MATERIALS AND METHODS

Study Design and Ethical Approval

This prospective, randomized, controlled clinical trial was conducted at tertiary care academic hospital in South India between June 2024 and June 2025. Ethical clearance was obtained from the Institutional Ethics Committee prior to study initiation.

The multimodal analgesic regimen and outcome scoring systems were adapted from previously published studies in ACL reconstruction pain management.[29],[30].

Study Population

A total of 90 patients (both male and female), aged 16 to 50 years with ASA Physical Status I–II, scheduled for elective, isolated arthroscopic ACL reconstruction, were enrolled. Exclusion criteria included systemic comorbidities, chronic opioid use, drug allergies, psychiatric illness, or contraindications to the anesthetic agents used.

The semitendinosis,peroneus longus tendon was used as the graft in all cases, selected for its

biomechanical strength, optimal graft length, and reduced donor-site morbidity in comparison to hamstring or patellar tendon autografts.

Patients were randomly allocated into three groups (n = 30 each) using a computer-generated randomization table. Allocation concealment was maintained via sealed opaque envelopes, opened by a non-study staff member on the day of surgery. Group allocations were blinded to data analysts and postoperative care providers to ensure observer blinding.

Preoperative Training and Group Allocation

All patients received standardized instruction on the Visual Analog Scale (VAS) for pain, with practice trials conducted preoperatively.

Treatment groups:

- Group 1 (Fentanyl only): Intravenous fentanyl (100 μg boluses) with placebo saline infusions.
- Group 2 (Fentanyl + Lidocaine): Fentanyl as in Group 1, plus lidocaine bolus (1.5 mg/kg; max 150 mg) followed by infusion (2 mg/kg/h; max 200 mg/h), with placebo for magnesium sulfate.
- Group 3 (Fentanyl + Lidocaine + $MgSO_4$): Same lidocaine protocol as Group 2, with additional magnesium sulfate infused at 70 mg/kg/h via a separate syringe pump.

Anesthesia Protocol

All patients underwent standardized induction using propofol (2 mg/kg), fentanyl (200 μg), and rocuronium bromide (0.6 mg/kg) to facilitate i-gel laryngeal mask placement. Maintenance was achieved using sevoflurane (MAC target = 0.6).

Monitoring included ECG, NIBP, pulse oximetry, capnography, neuromuscular function (TOF), and depth of anesthesia via Bispectral Index (BIS).

Surgical Procedure and Postoperative Management

ACL reconstruction was performed arthroscopically in all cases using autografts from the peroneus longus tendon. Fixation was completed with standard femoral and tibial devices. Partial meniscectomy was done if indicated.

Postoperative analgesia included intramuscular ketoprofen (100 mg BID for 2–3 days). Rescue opioid analgesia was instituted if VAS ≥ 5. Neuromuscular blockade was reversed with neostigmine and atropine, and patients were extubated upon regaining spontaneous ventilation and consciousness.

Pain Assessment and Functional Outcomes

VAS scores were recorded at 30 minutes, 6 hours, and 18 hours postoperatively. The 30-minute checkpoint corresponded to the peak serum concentration of lidocaine and magnesium sulfate.

Functional recovery was assessed at 6 weeks using:

International Knee Documentation Committee (IKDC) score

Knee Injury and Osteoarthritis Outcome Score (KOOS) — pain, symptoms, ADL, sports/recreation, QoL subscales

Anterior Cruciate Ligament–Return to Sport after Injury (ACL-RSI) score

- The Aldrete score was used to assess immediate recovery from anesthesia. Awakening time was defined as the duration from wound closure to the patient's first conscious response.

Statistical Analysis

Descriptive statistics were applied to demographic and clinical parameters. Normality of data distribution was tested using the Shapiro–Wilk test. Parametric or non-parametric tests were used as appropriate. Categorical data were analyzed with Chi-square or Fisher's exact test, and VAS scores were evaluated with the Friedman test.

Multivariate regression was used to adjust for confounders. A p-value < 0.05 was considered

statistically significant. Data were analyzed using SPSS v25.0 (IBM Corp., Armonk, NY) and Microsoft Excel 2016.

RESULTS

Table 1. Baseline and Recovery Characteristics of Study Participants

Parameter	Group 1 (Fentanyl)	Group 2 (Fentanyl + Lidocaine)	Group 3 (Fentanyl + Lidocaine + $MgSO_4$)	p-value
Number of patients	30	30	30	—
Gender (Male/Female)	25 / 5	23 / 7	25 / 5	0.81
Mean age (years ± SD)	35 ± 10	34 ± 9	36 ± 11	0.67
Mean surgical duration (min)	60 ± 20	61 ± 18	59 ± 21	0.88
Intraoperative fentanyl dose (μg)	550 ± 150	545 ± 130	552 ± 140	0.93
Awakening time (min ± SD)	3.97 ± 1.85	4.13 ± 1.80	3.98 ± 1.90	0.92
Rescue opioid needed (n, %)	2 (6.6%)	0 (0%)	0 (0%)	0.043

- Table 1 shows the baseline demographic data and additional early recovery parameters. Group distribution was statistically comparable in terms of age, sex, surgical duration, and intraoperative fentanyl consumption ($p > 0.05$). Awakening times were also similar. However, rescue opioid use was observed in 2 patients (6.6%) from Group 1 and none in Groups 2 or 3, representing a statistically significant difference ($p = 0.043$), favoring the multimodal analgesia groups.

Table 2. Postoperative Pain Scores (VAS) at Different Time Points

Group	30 min (VAS ± SD)	6 hr (VAS ± SD)	18 hr (VAS ± SD)	% Reduction at 18 hr	p-value
Group 1 (Fentanyl)	4.03 ± 1.52	2.70 ± 1.29	1.97 ± 1.10	−51.24%	<0.0001
Group 2 (+ Lidocaine)	3.73 ± 1.55	2.83 ± 1.18	1.87 ± 1.01	−50.00%	<0.0001
Group 3 (+ Lidocaine & $MgSO_4$)	2.97 ± 1.90	2.50 ± 1.11	1.77 ± 1.07	−40.45%	0.0007

- Table 2 presents the comparison of postoperative pain across groups using VAS scores at three intervals: 30 minutes, 6 hours, and 18 hours. Group 3 consistently reported the lowest mean VAS scores at all time points ($p < 0.001$), showing the superiority of combined lidocaine and magnesium sulfate over fentanyl alone or with lidocaine. All groups showed decreasing pain trends over time, but the greatest early analgesic benefit was observed in Group 3.

Table 3. IKDC Score Comparison at 6 Weeks Postoperatively

Group	IKDC Score ± SD	p-value
Group 1 (Fentanyl)	68.4 ± 6.3	
Group 2 (+ Lidocaine)	72.8 ± 5.9	
Group 3 (+ Lidocaine & $MgSO_4$)	78.2 ± 6.1	<0.001

- Table 3 describes the 6-week postoperative IKDC scores across the three groups. Group 3 exhibited the highest functional outcomes, indicating better recovery in patients receiving both lidocaine and magnesium sulfate. Statistically significant differences ($p < 0.001$) confirmed the effectiveness of multimodal analgesia in improving subjective knee function post-ACL reconstruction.

Table 4. KOOS Subscale Scores at 6 Weeks Postoperatively

Subscale	Group 1	Group 2	Group 3	p-value
Pain	71.2 ± 6.5	75.6 ± 5.9	81.4 ± 5.8	<0.001
Symptoms	69.1 ± 6.3	73.7 ± 5.7	79.2 ± 5.6	<0.001
ADL	73.3 ± 6.7	77.8 ± 6.1	83.6 ± 6.3	<0.001
Sports/Recreation	62.4 ± 7.1	68.3 ± 6.9	74.7 ± 6.5	<0.001
Quality of Life	65.5 ± 6.8	70.9 ± 6.4	78.1 ± 6.2	<0.001

- Table 4 accounts for the KOOS subscale scores at 6 weeks postoperatively. Multimodal analgesia (Group 3) led to consistently higher scores in pain relief, symptom resolution, functional activities, and quality of life. These intergroup differences were all statistically significant ($p < 0.001$), reinforcing the benefit of lidocaine and magnesium when added to fentanyl-based protocols.

Table 5. ACL–Return to Sport After Injury (ACL-RSI) Scores at 6 Weeks

Group	ACL-RSI Score ± SD	p-value
Group 1 (Fentanyl)	58.7 ± 6.4	
Group 2 (+ Lidocaine)	64.2 ± 5.9	
Group 3 (+ Lidocaine & $MgSO_4$)	72.5 ± 5.7	<0.001

- Table 5 demonstrates ACL-RSI scores indicating psychological readiness to return to sport at 6 weeks. Group 3 had the highest levels of confidence and emotional recovery, with significantly better scores compared to Groups 1 and 2 ($p < 0.001$). These findings suggest that improved pain control has substantial bearing on psychological rehabilitation following ACL surgery.

DISCUSSION

- In the present randomized study, the three groups were demographically and procedurally comparable, minimizing confounding variables and ensuring the internal validity of the findings.

Gender distribution, age, duration of surgery, and intraoperative fentanyl requirements showed no significant differences ($p > 0.05$), consistent with methodological rigor described by Shi et al. .

- Postoperative pain measured using VAS at 30 minutes, 6 hours, and 18 hours was significantly lower in Group 3 (fentanyl + lidocaine + magnesium sulfate) at all time points. Although Group 3 had the lowest percentage reduction (−40.45%) by 18 hours compared to Groups 1 and 2 (−51.24% and −50.00%, respectively), it had a lower baseline VAS score, indicating superior early analgesia. These findings are in line with results reported by Moutzouros et al. , who demonstrated sub-3 VAS scores with multimodal pain strategies post-ACL reconstruction. Additional studies confirm the analgesic role of magnesium sulfate: Muthiah et al. showed significant pain relief at 6 hours, Ekmekci et al. reported improved analgesia in femoral nerve blocks, and a meta-analysis by Peng et al. noted consistent VAS score reductions and 25% lower opioid use following intravenous magnesium administration.
- Awakening times were similar among the three groups ($p = 0.92$), suggesting that neither lidocaine nor magnesium delayed anesthetic emergence. However, rescue opioid requirements differed: 6.6% of patients in Group 1 required additional opioids, compared to none in Groups 2 and 3 ($p = 0.043$), supporting the opioid-sparing effect of multimodal regimens. Similar outcomes have been described by Forlenza et al. , who observed prolonged postoperative opioid use in patients without multimodal pain control, and by Anthony et al. , who found significantly higher total morphine consumption in unimodal vs. multimodal approaches. Koh et al. also concluded that periarticular drug injections during ACL reconstruction reduced morphine use and increased satisfaction.
- Functional recovery, assessed by IKDC scores at 6 weeks, was significantly better in Group 3 (78.2 ± 6.1) compared with Group 2 (72.8 ± 5.9) and Group 1 (68.4 ± 6.3), supporting the benefit of adjunctive lidocaine and magnesium. This is consistent with the findings of Moutzouros et al. , who recorded improved IKDC outcomes with multimodal pain control, and Koh et al. , who reported comparable improvements using periarticular analogs.
- Likewise, KOOS subscales at 6 weeks showed consistently better scores in Group 3 across all functional domains. Particularly high were the ADL (83.6 ± 6.3) and Sports/Recreation (74.7 ± 6.5) scores, reflecting earlier return to activity. These results echo Peng et al. , whose meta-analysis showed that magnesium significantly improved KOOS-ADL and KOOS-Pain scores. This is further supported by Koh et al. , who observed enhanced KOOS–Pain scores and earlier weight-bearing capability with local analgesic cocktails.
- Psychological readiness to return to activity, captured using ACL-RSI scores, was also highest in Group 3 (72.5 ± 5.7), significantly surpassing Group 2 (64.2 ± 5.9) and Group 1 (58.7 ± 6.4). This suggests that improved pain control may alleviate distress, reduce fear of reinjury, and accelerate psychological recovery—an observation corroborated by Moutzouros et al. , who found that optimized pain control was linked to increased return-to-sport rates and higher satisfaction. Koh et al. similarly found that adequate multimodal pain strategies enhanced recovery confidence and reduced opioid dependency.
- Overall, our findings support the efficacy of intravenous lidocaine and magnesium sulfate as adjuncts to fentanyl in ACL reconstruction. Their integration into postoperative pain protocols can enhance early recovery—not only physically, by reducing pain and opioid use, but also psychologically, by restoring confidence and emotional readiness for return to function.

CONCLUSION

- This randomized, controlled study demonstrated that the use of multimodal analgesia—combining fentanyl, intravenous lidocaine, and magnesium sulfate—significantly improved early postoperative outcomes following anterior cruciate ligament (ACL) reconstruction with peroneus longus autografts. Patients receiving this regimen experienced superior pain control, reduced need for rescue opioids, and enhanced short-term functional outcomes, as evidenced by higher IKDC,

KOOS, and ACL-RSI scores at six weeks. Notably, the combination also improved psychological readiness to return to sport without delaying anesthetic emergence. These findings support the incorporation of lidocaine and magnesium sulfate as effective adjuncts to opioid-based analgesic protocols, contributing to both physical and emotional aspects of recovery while minimizing opioid exposure. Further longitudinal studies are warranted to evaluate sustained benefits, long-term functional outcomes, and return-to-play timelines.

LIMITATIONS OF THE STUDY

- Despite its strengths, this study has several limitations. Firstly, the relatively small sample size (n = 90) may limit the generalizability of the findings. Secondly, the six-week follow-up period only allows for the assessment of short-term outcomes, without examining long-term graft integration or reinjury risk. Thirdly, while observer blinding was maintained, full double-blinding was not feasible due to the route and nature of drug administration, introducing the potential for performance bias. Subjective measures such as the ACL-RSI score may also be influenced by individual variability and preoperative expectations. Lastly, all participants underwent ACL reconstruction using peroneus longus tendon autografts; therefore, extrapolation to other graft types (e.g., hamstring, patellar tendon) should be made with caution. Future studies with larger cohorts, diverse graft choices, and extended follow-up periods are recommended to build on these findings.

REFERENCES

1) Zaremuk AM, Lisitsyn MP, Atlukhanov RY. Surgery of anterior cruciate ligament in knee joint. Comparative analysis of plastic reconstruction methods regarding ACL in knee joint (BTB and STGT). *Endosc Surg*. 2015;21:34–8.
2) Goncharov EN, Koval OA, Bezuglov EN, Vetoshkin AA, Goncharov NG, Ramirez ME, et al. Outcome of primary ACL reconstruction with peroneus longus and bone–patellar tendon–bone autografts: A clinical comparative study. *Surgeries*. 2023;4:434–45.
3) Goncharov EN, Koval OA, Dubrov VE, Bezuglov EN, Alekhin AA, Goncharov NG. Mid-term results of simultaneous reconstruction of anterior cruciate and anterolateral ligaments in athletes. *Traumatol Orthop Russ*. 2020;26:62–71.
4) Joseph AM, Collins CL, Henke NM, Yard EE, Fields SK, Comstock RD. A multisport epidemiologic comparison of ACL injuries in high school athletics. *J Athl Train*. 2013;48:810–7.
5) Korolev AV, Afanasyev AP, Il'in DO, Gerasimov DO, Ryazantsev MS, Kadantsev PM, et al. Damage of the knee posterior cruciate ligament: Biomechanics, diagnostics, treatment, and secondary osteoarthritis prevention. *Pirogov Russ J Surg*. 2020;9:130–6.
6) Skvortsov D, Kaurkin S, Goncharov E, Akhpashev A. Knee joint function and walking biomechanics in acute-phase ACL tear. *Int Orthop*. 2020;44:885–91.
7) Goncharov EN, Koval OA, Dubrov VE, Bezuglov EN, Filimonova AM, Goncharov NG. Combined reconstruction of anterior cruciate and anterolateral ligaments in athletes. *Int Orthop*. 2019;43:2781–8.
8) Elmallah RK, Chughtai M, Khlopas A, Newman JM, Stearns KL, Roche MA, et al. Pain control in total knee arthroplasty. *J Knee Surg*. 2018;31:504–13.
9) McIsaac DI, Ladha KS. Postoperative opioid prescribing: Finding the balance. *Anesthesiology*. 2022;137:131–3.
10) Xu S, Wang S, Hu S, Ju X, Li Q, Li Y. Effects of lidocaine, dexmedetomidine, and combination infusion on PONV after laparoscopic hysterectomy: A RCT. *BMC Anesthesiol*. 2021;21:199.
11) Elmallah RK, Cherian JJ, Pierce TP, Jauregui JJ, Harwin SF, Mont MA. Perioperative pain management techniques in TKA. *J Knee Surg*. 2016;29:169–78.

12) Hu B, Zhou H, Zou X. Combination of lidocaine and magnesium sulfate for postoperative pain. *Eur J Anaesthesiol*. 2021;38:95.
13) Na HS, Ryu JH, Do SH. The role of magnesium in pain. In: Vink R, Nechifor M, editors. *Magnesium in the Central Nervous System*. Adelaide (AU): University of Adelaide Press; 2011. p. 1.
14) Shin HJ, Na HS, Do SH. Magnesium and pain. *Nutrients*. 2020;12:2184.
15) Srebro D, Vuckovic S, Milovanovic A, Kosutic J, Vujovic KS, Prostran M. Magnesium in pain research: State of the art. *Curr Med Chem*. 2017;24:424–34.
16) Toleska M, Dimitrovski A, Dimitrovska NT. PONV in opioid-free vs opioid-based anesthesia: A RCT in lap cholecystectomy. *Prilozi*. 2022;43:101–8.
17) Beyuo TK, Lawrence ER, Kobernik EK, Oppong SA. 12-hour vs 24-hour magnesium sulfate in eclampsia (MOPEP Study): A RCT. *Int J Gynaecol Obstet*. 2022;159:495–504.
18) Shi S, Fan W, Tao R, et al. Magnesium silicate coating improves ACL graft–bone healing via osteogenesis in vivo. *ACS Biomater Sci Eng*. 2021;7(1):133–43.
19) Moutzouros V, Jildeh TR, Khalil LS, et al. A multimodal protocol to reduce pain after orthopedic procedures: Can postoperative opioids be eliminated? *Arthroscopy*. 2020;36(8):2249–57.
20) Muthiah T, Arora MK, Trikha A, et al. Magnesium as an adjuvant to bupivacaine in 3-in-1 nerve block for ACL repair. *Indian J Anaesth*. 2016;60(7):491–5.
21) Ekmekci P, Bengisun ZK, Akan B, et al. Magnesium in femoral nerve block enhances analgesia post-ACL to levobupivacaine. *Knee Surg Sports Traumatol Arthrosc*. 2013;21(5):1119–24.
22) Peng YN, Sung FC, Huang ML, et al. IV magnesium sulfate for orthopedic pain: Systematic review of RCTs. *Medicine (Baltimore)*. 2018;97(48):e13583.
23) Forlenza EM, Lavoie-Gagne O, Lu Y, et al. Pre-op opioid use predicts prolonged use and worse outcomes after ACL reconstruction. *Arthroscopy*. 2020;36(10):2681–8.
24) Anthony CA, Westermann RW, Bedard N, et al. Opioid demand before and after ACL reconstruction. *Am J Sports Med*. 2017;45(13):3098–103.
25) Soleimanpour H, Imani F, Dolati S, et al. Management of pain using magnesium sulphate: A narrative review. *Postgrad Med*. 2022;134(3):260–6.
26) Li MMJ, Ocay DD, Larche CL, et al. Validating CPOT in pediatric orthopedic patients. *Can J Pain*. 2023;7(1):1–7.
27) Koh IJ, Chang CB, Seo ES, et al. Multimodal periarticular analgesia after ACL reconstruction: A RCT. *Arthroscopy*. 2012;28(5):649–57.
28) Vijayakumar B, Kumar N, Dinesh M, Saralaya V. Morphometric analysis of the anterior cruciate ligament and its footprint in South Indian cadaveric knees. *Natl J Clin Anat*. 2022 Oct-Dec;11(4):251–256.
29) Moutzouros et al., Arthroscopy. 2020
30) Peng et al., Medicine (Baltimore). 2018