

PICO #2- Pediatrics

Summary: 15 y/o male with no significant PMHx presents for referral to orthopedic surgeon s/p complete tear of right ACL on 11/14/2025. Patient was wrestling when a large component fell on him, causing immediate pain. Went to the ED and subsequent MRI showed a complete tear of right ACL with recommendation for surgical repair. Mom wants to wait until the end of school year so that patient does not miss school.

Search Question: In pediatric patients with ACL tears, how does immediate surgical intervention compare to delayed surgical intervention in regards to knee function, stability, re-injury rates, and return to sport?

Question Type: What kind of question is this? (boxes now checkable in Word)

- Prevalence
- Screening
- Diagnosis
- Prognosis
- Treatment**
- Harms

Although meta-analysis and systemic reviews are the highest level of evidence to answer this research question, some other study types include randomized control trials, narrative reviews, prospective cohort studies, retrospective cohort studies, and case-control studies. RCTs are the gold standard for interventional studies and provide the strongest direct evidence. Narrative reviews can provide a broad overview of the current knowledge regarding early vs late surgical intervention for ACL repairs. Cohort studies can also be used. Prospective cohort studies can follow patients over time, comparing outcomes between early and delayed surgical groups. Additionally, retrospective cohort studies can be used as well to compare the timing of surgery to outcomes. Lastly, case control can be used to compare patients with good vs poor outcomes and see if they had different timing of surgery.

PICO Search Terms

P	I	C	O
Child	Early surgery	Delayed surgery	Knee function
Pediatric	Early surgical intervention	Delayed surgical intervention	Stability
Adolescent	Immediate surgery	Late surgery	Re-injury
Anterior Cruciate Ligament	Immediate surgical intervention	Late surgical intervention	Return to sport

ACL			
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Search tools and strategy used:

Pub Med:

Search terms: ("Child"[Mesh] OR pediatric OR child OR adolescent) AND ("Anterior Cruciate Ligament"[Mesh] OR ACL) AND ("surgery" OR "surgical intervention") AND ("immediate" OR "early") AND ("delayed" OR "late") AND ("knee function"[tiab] OR stability[tiab] OR "re-injury"[tiab] AND (return to sport)

With out filters 267 articles.

With filters: 221 (10 years and published journal articles)

Cochrane Library:

Search terms: (child OR pediatric OR adolescent) AND ("anterior cruciate ligament" OR ACL) AND (surgery OR surgical OR intervention OR treatment) AND (early OR immediate OR delayed OR late OR timing) AND (function OR stability OR reinjury OR outcome OR recovery)

Without filters: 23

With filters: 19 (past 10 years)

With 240 articles, I had to narrow down my choices to choose the best articles for my PICO. First I skimmed the titles to make sure it actually addressed my PICO. I excluded articles that did not focus on pediatrics, did not discuss surgical intervention, were surgical technique overviews rather than outcome based. I also prioritized meta-analysis and systemic reviews over other study types. Once I skimmed the abstract, I eliminated articles that did not have strong levels of evidence, such as small sample size, or did not use any articles or studies that were based in the United States. Ultimately, I selected three articles from Pub Med, as they were the most relevant and applicable.

Results found

1. Mallinos, A., & Jones, K. (2024). The Double-Edged Sword: Anterior Cruciate Ligament Reconstructions on Adolescent Patients-Growth Plate Surgical Challenges and Future Considerations. *Journal of clinical medicine*, 13(24), 7522. <https://doi.org/10.3390/jcm13247522>

Abstract: The management of anterior cruciate ligament (ACL) injuries in pediatric patients presents unique challenges due to the presence of open growth plates in the proximal tibia and distal femur. Delaying ACL reconstruction until skeletal maturity may protect the physes but increases the risk of secondary injuries, such as meniscal tears and chondral damage, due to prolonged joint instability. Conversely, early surgical intervention restores knee stability but raises concerns about potential growth disturbances, including leg-length discrepancies and angular deformities. This narrative

review examines current approaches to pediatric ACL management, highlighting the risks and benefits of both conservative and surgical treatments. Additionally, it explores the role of finite element modeling (FEM) as an innovative tool for pre-surgical planning. FEM offers a non-invasive method to optimize surgical techniques, minimize iatrogenic damage to growth plates, and improve patient outcomes. Despite its potential, FEM remains underutilized in clinical practice. This review underscores the need to integrate FEM into pediatric ACL care to enhance surgical precision, reduce complications, and improve long-term quality of life for young patients. By synthesizing available evidence, this review aims to provide clinicians with a comprehensive framework for decision-making and identify future directions for research in pediatric ACL reconstruction.

Keypoints:

- Narrative review
- There is no clear consensus about the standard of care for ACL reconstruction in pediatric patients with immature skeletons. Both delayed ACL surgery and early surgical intervention has pros and cons.
- Delayed intervention can be a good option, as waiting until skeletal muscle maturity may protect the physes, but it also increases risk of secondary injuries due to joint instability.
- Early intervention restores knee stability, but can contribute to potential growth disturbances, including leg-length discrepancies and angular deformities.

Selection Explanation:

I found this article pertinent because it reviews a large amount of studies, including those in the United States, that focuses specifically on pediatric ACL injuries and examines the risks vs benefits of early vs delayed surgery.

2. Khurana, K., & Pisulkar, G. (2023). Functional Rehabilitation of Anterior Cruciate Ligament Tear in the Pediatric Population: A Comprehensive Review. *Cureus*, 15(12), e49863. <https://doi.org/10.7759/cureus.49863>

Abstract: Pediatric sports injuries are a growing concern due to increased youth participation in sports. Effective rehabilitation strategies are essential for ensuring optimal recovery, restoring knee function, and preventing long-term consequences. This research aims to explore and evaluate various functional rehabilitation approaches tailored to pediatric anterior cruciate ligament (ACL) tear injuries. Functional rehabilitation of ACL tears in pediatric sports injuries is an important area of research due to the unique considerations and challenges that arise when treating ACL injuries in young athletes. Over the last 20 years, there has been a well-documented uptick in ACL injuries among pediatric populations. This rise can be attributed to the growing involvement of the younger population in competitive sports, as well as heightened awareness regarding sports-linked injuries. This study highlights the importance of early surgical reconstruction in children to enable a quick return to sports and prevent long-term cartilage and meniscal damage resulting from instability. The use of physseal-sparing ACL reconstruction techniques, particularly hamstring autografts, is recommended for favorable clinical outcomes while minimizing growth disturbances. This study offers valuable insights for healthcare professionals and researchers, serving as a reference to guide optimal approaches in managing pediatric ACL injuries and achieving successful results in this field.

Keypoints:

- Systemic review of 62 articles
- Early surgical reconstruction in pediatric patients is important to prevent long-term cartilage and meniscal damage due to instability and to enable a quick return to sports.

Selection Explanation:

I selected this systemic review because although it does not directly compare it to delayed surgical intervention, it examines pediatric ACL repair and the need for early surgical intervention.

3. Jin, H., Tahir, N., Jiang, S., Mikhail, H., Pavel, V., Rahmati, M., Lee, S. W., Xiao, W., & Li, Y. (2025). Management of Anterior Cruciate Ligament Injuries in Children and Adolescents: A Systematic Review. *Sports medicine - open*, 11(1), 40. <https://doi.org/10.1186/s40798-025-00844-7>

Abstract:

Background: Due to rising sports participation, anterior cruciate ligament (ACL) tears are increasingly prevalent in children and adolescents. This systematic review aimed to evaluate and summarize the management strategies for ACL injuries in children and adolescents.

Methods: A comprehensive search of PubMed, Embase, Web of Science, and Cochrane Library databases was conducted to identify studies reporting outcomes of ACL injuries in children and adolescents. Key outcomes were synthesized descriptively, including knee instability, secondary damage, growth disturbances, and return-to-sport (RTS) rates

Results: A total of 7,507 publications were initially screened, with 105 studies involving 8294 children or adolescents satisfying the inclusion criteria. Conservative treatments were associated with elevated rates of knee instability (35.85-100%), secondary meniscal and cartilage damage, and long-term degenerative changes. Conversely, surgical interventions, including physeal-sparing and transphyseal techniques, demonstrated superior outcomes with lower instability rates (0-7.41%), fewer complications, and higher RTS rates (83.4-92.6%). Pooled RTS rates for conservative treatments were 44.0% (95%CI: 0.018–0.927), while physeal-sparing ACL reconstruction showed a pooled RTS rate of 92.6% (95%CI: 0.732-1.000) and transphyseal ACL reconstruction reported an RTS rate of 83.4% (95%CI: 0.722–0.924).

Conclusion: Conservative management of ACL injuries in children and adolescents is linked to higher rates of knee instability, secondary meniscal and cartilage damage, and degenerative changes. In contrast, surgical interventions, such as physeal-sparing and transphyseal techniques, yield better outcomes in knee stability, complications reduction, and RTS rates. However, risks such as graft rupture, repeat surgeries, and potential growth disturbances emphasize the importance of tailoring surgical approaches to the patient's growth stage and anatomical characteristics.

Keypoints:

- Systematic review including 105 studies consisting of 8,294 participants from multiple countries including the United States
- Found that surgical interventions had better outcomes than conservative treatments, mainly lower levels of knee instability, secondary meniscal and cartilage damage, and degenerative changes.
- Found that delaying surgery resulted in significantly higher rates of medial meniscal tears compared to those with early surgical intervention.
- Early surgical intervention shows improved functional outcomes and less complications.

Selection Explanation:

This systemic review has a large number of participants across many countries, including the United States, and is applicable to my PICO because it addresses early vs late surgical intervention for ACL tears in the pediatric patient.

Clinical Bottom Line:

Although both early and delayed surgical repairs of ACL tears has its pros and cons, ultimately early intervention is best as it improves joint stability, thereby decreasing risk of meniscal injury or other related injuries.

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