



Impact of time between meniscal injury and isolated meniscus repair on post-operative outcomes: A systematic review

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Abstract

BACKGROUND

Meniscal tears are one of the most common knee injuries. After the diagnosis of a meniscal tear has been made, there are several factors physicians use to guide clinical decision-making. The influence of time between injury and isolated meniscus repair on patient outcomes is not well described. Assessing this relationship is important as it may influence clinical decision-making and can add to the preoperative patient education process. We hypothesized that increasing the time from injury to meniscus surgery would worsen postoperative outcomes.

AIM

To investigate the current literature for data on the relationship between time between meniscus injury and repair on patient outcomes.

METHODS

PubMed, Academic Search Complete, MEDLINE, CINAHL, and SPORTDiscus were searched for studies published between January 1, 1995 and July 13, 2023 on isolated meniscus repair. Exclusion criteria included concomitant ligament surgery, incomplete outcomes or time to surgery data, and meniscectomies. Patient demographics, time to injury, and postoperative outcomes from each study were abstracted and analyzed.

RESULTS

Five studies met all inclusion and exclusion criteria. There were 204 (121 male, 83 female) patients included. Three of five (60%) studies determined that time between injury and surgery was not statistically significant for postoperative Lysholm scores ($P = 0.62$), Tegner scores ($P = 0.46$), failure rate ($P = 0.45$, $P = 0.86$), and International Knee Documentation Committee scores ($P = 0.65$). Two of five (40%) studies found a statistically significant increase in Lysholm scores with shorter time to surgery ($P = 0.03$) and a statistically significant association

between progression of medial meniscus extrusion ratio ($P = 0.01$) and increasing time to surgery.

CONCLUSION

Our results do not support the hypothesis that increased time from injury to isolated meniscus surgery worsens postoperative outcomes. Decision-making primarily based on injury interval is thus not recommended.

Key Words: Meniscus; Meniscal; Meniscus repair; Meniscectomy; Patient reported outcomes; Postoperative outcomes; Time to surgery; Injury interval

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Core Tip: The influence of time between injury and isolated meniscus repair on patient outcomes is not well described. Following systematic review of the literature, five studies met all inclusion and exclusion criteria, describing 204 (121 male, 83 female) patients. A majority of studies included found that the interval between injury and surgery did not have statistically significant impact on postoperative outcomes. These results do not support our hypothesis that increased time interval between injury and surgery leads to worse postoperative outcomes. Thus, decision-making primarily based on injury interval is not recommended. Further research exploring the relationship between injury interval and outcomes is recommended.

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INTRODUCTION

Meniscal tears are one of the most common knee injuries worldwide and often require surgical intervention due to pain and mechanical symptoms[1]. In the United States, more than 850000 meniscus surgeries occur annually[2]. The overall incidence of meniscal tears is estimated to be 60 per 100000 people which is expected to increase with increased involvement in athletics and improved diagnostic testing[3]. Isolated meniscal tears often occur secondary to rotational or shearing forces placed across the tibiofemoral joint in the young active population[4]. Synovial inflammation is frequently found in patients with meniscal injury, which correlates with joint dysfunction, pain, and increase risk of osteoarthritis [5]. In older patient populations, meniscus tears are commonly degenerative and associated with articular cartilage changes secondary to osteoarthritis[6]. Meniscus tears typically present with knee pain and associated mechanical symptoms of clicking, catching, popping, locking, and giving way[6].

After the diagnosis of a meniscal tear has been made, there are several factors physicians use to guide clinical decision-making. The decision to pursue nonoperative management or surgical intervention is influenced by patient factors (age, expectations, activity level, health status, *etc.*) and characteristics of the tear (location, type, size, and associated lesions, *etc.*) which have been shown to affect surgical outcomes[7,8]. Current operative methods include meniscectomy, meniscal debridement, meniscal repair, and meniscal transplant[7]. Preservation of the meniscus is vital to the biomechanical function of the knee; therefore, surgeons repair the meniscus if feasible to reduce the risk of osteoarthritis development [7].

Although meniscus repair is one of the most common orthopedic procedures, it is not well understood if postoperative patient outcomes are affected by the time interval between injury and isolated meniscus repair. Assessing this relationship is important as it may influence clinical decision-making and can add to the preoperative patient education process. In this study, we systematically review the literature to investigate the impact of the time between meniscus injury and isolated meniscus repair on postoperative outcomes.

MATERIALS AND METHODS

The literature was systematically reviewed for studies reporting postoperative outcomes associated with time between meniscal injury and isolated meniscus repair in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis checklist[9]. An electronic literature search of peer-reviewed articles was conducted using PubMed, Academic Search Complete, MEDLINE, CINAHL and SportDiscus. Reference lists from included articles were also screened to yield any additional articles. The following Boolean search phrase was used “(Isolated) AND (meniscal OR meniscus) AND injury AND (surgery OR surgical OR repair) AND outcomes AND time”. Published studies were only found between January 1, 1995 and July 13, 2023. Studies were included if they evaluated isolated meniscus injury and repair, reported postoperative outcomes associated with time between injury and surgery, and were published in English. Studies were excluded if they included concomitant ligament surgery, revision surgery, recurrent meniscus injury, or

meniscectomy. Each article next underwent data abstraction through individual review and recording of previously identified data metrics. Patient demographics including study population description, age, sex, surgery type, and location and type of meniscus injury were recorded for each study. Further data including time to surgery, patient-reported outcomes, and length of postoperative course were recorded for each study.

The Methodological Index for non-randomized studies (MINORS) was used as a quality assessment tool for each study [10]. The index consists of 12 questions with 3 designed specifically for comparative studies. A global ideal score for non-comparative studies is 16 and 24 for comparative studies. A MINORS score was assigned to each study following review by two investigators who came to one collaborative decision on scores (Table 1)[11-15].

RESULTS

The primary literature review yielded 220 studies. After removing duplicate records, 78 studies were screened based on their titles and abstracts. This yielded 21 articles, with 4 found not to be full-length texts. The remaining 17 studies were then screened for adherence to the inclusion or exclusion criteria, with 5 being included in the final review (Figure 1)[11-15]. All steps in the review process were done independently by 3 reviewers before discussion and resolution of discrepancies at each stage.

Our search identified five studies that reported the time between meniscus injury and isolated meniscus repair and postoperative outcomes (Table 2)[11-15]. Three of the five studies reported that the time interval between injury and surgery was not statistically significant with failure rate and patient-reported outcome scores. Two of the five studies found time between injury and surgery was statistically significant with postoperative Lysholm scores and increased progression of medial meniscus extrusion (MME) ratio.

A total of 204 (121 male, 83 female) patients were included with an average age of 34.2 years (range: 9-58 years). The average time to surgery was 3.12 months (range: 3 weeks–1 year). Most of the included studies found no significant association between time to surgery and outcomes. Three of the five (60%) studies determined that the time between injury to surgical intervention was not statistically significant. Time to surgery was not associated with postoperative Lysholm scores ($P = 0.62$)[13], Tegner scores ($P = 0.46$)[14], failure rate ($P = 0.45$, $P = 0.86$)[11,12], and International Knee Documentation Committee (IKDC) scores ($P = 0.65$)[12]. Two of the five (40%) studies found a statistically significant increase in postoperative Lysholm scores with shorter time to surgery ($P = 0.03$)[14] and a statistically significant association between the progression of MME ratio ($P = 0.01$)[15] and time to surgery (Table 3)[11-15].

Four of the five selected studies were evaluated as moderate quality based on the MINORS assessment tool, and one study was evaluated as high quality[10]. A strength of recommendation grade was assigned based on the evaluation of the quality, quantity, and consistency of selected studies and their reported findings[16]. The strength of recommendation taxonomy was utilized to evaluate the strength of evidence[16]. Due to the inconsistency in reported findings, a grade B recommendation is given on the effect of time between meniscus injury and isolated meniscus repair on postoperative outcomes. Furthermore, only five studies have statistically analyzed this clinical question indicating limited evidence. Our review finds that while the literature has reported statistical significance in the relationship between some patient-reported outcomes and the time interval between injury and repair, most studies did not find any statistically significant relationships between outcomes and the time interval.

DISCUSSION

The interval between injury and surgery was not statistically significant with postoperative outcomes in patients undergoing meniscus repair in most studies. Postoperative outcomes that were found to have no significant association with time to surgery included both objective (failure rate) and subjective (Lysholm score, Tegner score, and IKDC score) metrics. Failure rate was described as insignificant in two studies[11,12]. Egli *et al*[11] reported that while menisci repair within 8 weeks saw a decreased failure rate from 29 to 20 percent, findings were still statistically insignificant. Hagmeijer *et al*[12] similarly found no statistical significance with failure rate and found no impact on patient-reported outcomes such as IKDC and Tegner score changes over time.

Lysholm score was a frequently included patient-reported outcome measure across our search and was reported to have both significant and nonsignificant associations with the time between injury and surgery. Lucas *et al*[13] found Lysholm scores to be statistically nonsignificant, compared to Hupperich *et al*[14] which reported that the change in Lysholm score was significant. Variations in study design and population could explain the differing results. Lucas *et al*[13] focused on pediatric patients with an isolated meniscus tear, with an average age of 14 compared to 31.1 years in Hupperich *et al*[14]. Pediatric patients with meniscus tears have been reported to have worse outcomes due to increased participation in sports, a factor that decreases with age[12,13]. The two studies also varied on the type and location of the tear. Lucas *et al*[13] reported on a variety of tear types including longitudinal, complex, radial, and bucket handle tears in both the medial and lateral meniscus equally. Hupperich *et al*[14] instead focused on bucket handle tears only, with injuries occurring mainly to the medial meniscus. Bucket handle tears and medial meniscus tears have both been reported to have worse recovery and outcomes when compared to other tear patterns or lateral meniscus tears[11,14].

Another statistically significant outcome was the progression of the MME ratio. MME is a radiographic value proposed for estimating meniscus function through the evaluation of hoop tension as well as predicting early onset osteoarthritis in the knee[14]. As meniscal extrusion is a known risk factor for the progression of osteoarthritis, increased extrusion similarly would be a predictor of worse patient outcomes[14]. The study group with worse progression of extrusion was

Table 1 The methodological index for non-randomized studies

Quality assessment criteria	Eggl <i>et al</i> [11], 1995	Lucas <i>et al</i> [13], 2015	Hupperich <i>et al</i> [14], 2018	Hagmeijer <i>et al</i> [12], 2019	Moon <i>et al</i> [15], 2020
Clearly stated aim	2	2	2	2	2
Inclusion of consecutive patients	1	2	1	2	2
Prospective collection of data	0	0	2	0	2
Endpoints appropriate to the aim of the study	2	2	2	2	2
Unbiased assessment of study endpoint	0	0	0	0	2
Follow-up period appropriate to the aim of the study	2	2	2	2	2
Loss to follow up less than 5%	2	2	2	0	2
Prospective calculation of study size	0	0	0	0	2
Adequate control group	0	0	0	0	0
Contemporary groups	0	0	0	0	0
Baseline equivalence of groups	0	0	0	0	0
Adequate statistical analysis	1	1	1	1	2
Total score	10	11	12	9	18

Table 2 Study characteristics

Ref.	Type of study	Level of evidence	Type of surgery	Patient No.	Patient population
Eggl <i>et al</i> [11], 1995	Retrospective Cohort	3	Arthroscopic repair	52	Patients undergoing arthroscopic isolated meniscal repairs
Lucas <i>et al</i> [13], 2015	Retrospective Cohort	3	Arthroscopic repair	17	Pediatric patients undergoing arthroscopic meniscal repairs
Hupperich <i>et al</i> [14], 2018	Retrospective Cohort	2	Arthroscopic repair	38	Patients with an acute bucket handle tear undergoing arthroscopic meniscal repairs
Hagmeijer <i>et al</i> [12], 2019	Case Series	4	Arthroscopic repair	32	Pediatric patients undergoing arthroscopic meniscal repairs
Moon <i>et al</i> [15], 2020	Case-Control	3	Arthroscopic repair	63	Patients undergoing arthroscopic isolated meniscal repairs

found to have higher time intervals between injury and repair of meniscus tear[15]. The two studies reporting significant outcomes both focused on a specific type of meniscus tear within their study design, with the patient population described in Hupperich *et al*[14] having only bucket-handle meniscus tears and the population in Moon *et al*[15] being only medial meniscus root tears. All other studies included a variety of meniscus injuries including bucket handles, simple, radial, and complex tears.

Analysis of the five studies discussed in this systematic review demonstrated multiple limitations that require the need for future-focused and standardized research. Differences in outcome metrics used throughout the studies made advanced statistical analyses difficult to further help determine the impact of time to surgery on any specific outcome. Variations in the patient population, including demographics as well as the type of meniscus injury being studied also introduce difficulty in understanding the impact of time without the effect of possible confounding variables (Table 4)[11-15]. Patients with longer intervals between time of injury and surgical intervention potentially increase their risk of further degeneration leading to inability to perform a repair, which was not reported in our review. Furthermore, it is common for meniscal tears to be associated with a concomitant ligament injury therefore, a large number of studies were excluded due to including concomitant anterior cruciate ligament repair in their study.

CONCLUSION

Based on our findings, it cannot be confidently stated that time to surgery following injury influences outcomes in isolated meniscus repairs. Other factors are also important to consider in surgical management, such as deciding between

Table 3 Study outcomes

Ref.	Mean time to surgery	Outcome measured	Mean postoperative follow up	Findings	Statistical analysis	P value
Eggli <i>et al</i> [11], 1995	≤ 8 weeks: Acute, > 8 weeks: Delayed	Failure rate	7.5 years	No significant difference in failure rate between patients that were operated on within or outside of 8 weeks after injury	χ^2 test	0.45
Lucas <i>et al</i> [13], 2015	5.3 months	Lysholm score	22.3 months (3.5-46 months)	No significant association between mean time to repair and clinical outcomes	Fisher's Exact test	0.62
Hupperich <i>et al</i> [14], 2018	45.5 days	Lysholm score	44.4 months (15-96 months)	Surgery within the first week was associated with significant increase in Lysholm score	Unpaired <i>t</i> test	0.03 ^a
Hagmeijer <i>et al</i> [12], 2019	50.7 days	Failure rate, Tegner score, and IKDC	17.6 years (13.1-25.9 years)	No significant difference in mean time to repair between failed and successful surgeries, IKDC score or Tegner score	Spearman correlation	0.86, 0.46, 0.65
Moon <i>et al</i> [15], 2020	18.1 weeks	Progression of MMER	≥ 2 years	Preoperative symptom duration is significantly correlated with change in MMER	Univariate	0.01 ^a

^aStatistically significant findings.

IKDC: International Knee Documentation Committee; MMER: Medial meniscus extrusion ratio.

Table 4 Patient characteristics

Ref.	Average age (range) (years)	Male (%)	Meniscus tear type	Meniscus tear location	Laterality of tear
Eggli <i>et al</i> [11], 1995	29 (13-58)	85.2	X	X	Medial: 43, lateral: 9
Lucas <i>et al</i> [13], 2015	14 (9-18)	52.9	Longitudinal: 7, horizontal cleavage: 3, radial: 2, complex: 3, bucket handle: 4	Posterior: 12, middle: 6, anterior: 2	Medial: 10, lateral: 9
Hupperich <i>et al</i> [14], 2018	31.1 (14-58)	63.2	Bucket handle: 38	X	Medial: 24, lateral: 14
Hagmeijer <i>et al</i> [12], 2019	16.1 (9.9-18.7)	90.6	Bucket handle: 17, simple (longitudinal, horizontal cleavage, radial): 11, complex: 5	X	Medial: 17, lateral: 16
Moon <i>et al</i> [15], 2020	54.9	20.6	Medial meniscus root tear: 63	X	Medial: 63

X: Not reported.

meniscus repair and meniscectomy. Meniscectomy is often indicated for patients with increased age or chronic injury, due to the decreased vascularity of the meniscus[17]. Studies reporting on meniscectomy were not included due to the significant differences between meniscectomy and meniscus repair in terms of procedure and expected outcomes. Reparation of the meniscus to preserve native tissue, instead of removal of damaged tissue in meniscectomies, has been found to protect against the development of osteoarthritis[18-20]. Meniscus repairs when compared to meniscectomy also have better patient-reported outcomes and return to functionality[18-20]. Since meniscal tissue does not have an extensive blood supply, it can be at risk for continued injury with increased time to surgery[21]. While increased time following a meniscal injury can be a contributing factor in a patient requiring meniscectomy instead of repair, other factors such as patient age, pattern of tear, and zone of tear are also key indications for the procedure[21]. Clinical decision-making based on the interval between meniscal injury and surgery needs to be further studied in this patient population due to current limited and inconsistent reporting.

The time to repair following isolated meniscus injury has been described in clinical decision-making, with our review further highlighting the scarcity of data found in the literature. Our analysis demonstrates that there is inconsistent evidence on the effect time between injury and surgery has on postoperative outcomes. Future prospective research examining the influence of time between meniscal injury and meniscus repair will help improve decision-making for physicians with this patient population.

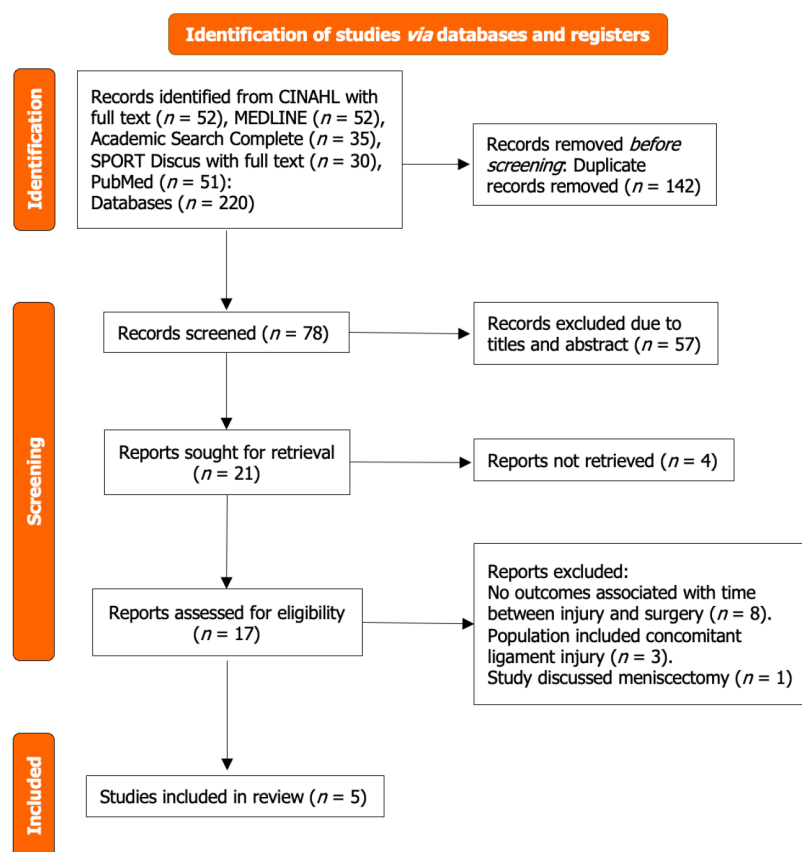


Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analysis flow chart.

FOOTNOTES

Author contributions: Javid K, Akins X, Lemaster NG, and Stone AV contributed to formulation and design of the research study; Javid K, Akins X, Lemaster NG, and Ahmed A were responsible for data abstraction and analysis; Javid K, Akins X, and Lemaster NG were responsible for manuscript writing; Javid K, Akins X, Lemaster NG, Ahmed A, and Stone AV contributed to manuscript editing and revision; all authors have read and approved the final manuscript.

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