

# Surgical Treatment of Isolated Meniscal Tears in Competitive Male Wrestlers

## Reoperations, Outcomes, and Return to Sport

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**Background:** Wrestlers are highly active, young athletes prone to meniscal injuries that often require surgery. However, there is a lack of data evaluating the results of meniscal repair or partial meniscectomy in this cohort.

**Purpose:** To describe the outcomes (subjective function, return to play, complications, reoperation rates, and progression of osteoarthritis) for treatment (meniscectomy or repair) of meniscal injuries in a cohort of competitive wrestlers.

**Study Design:** Case series; Level of evidence, 4.

**Methods:** All competitive wrestlers (high school, collegiate, or professional leagues) with a history of a meniscal injury and isolated meniscal surgery at a single institution between 2001 and 2017 were retrospectively identified. Failure was defined as a reinjury of the operative meniscus by clinical or advanced imaging examination, reoperation, or any additional surgical treatment of the meniscus after the index procedure. All patients were contacted for determination of reinjury rates, current sport status, and International Knee Documentation Committee and Tegner activity scores.

**Results:** Of 85 male wrestlers with isolated meniscal tears, 34% underwent a meniscal repair, and 66% received a partial meniscectomy. Index surgery failed for 9.4% of the cohort. Among wrestlers treated with initial meniscal repair, 21% required a subsequent partial meniscectomy at a mean 2.2 years, and of those treated with partial meniscectomy, 3% underwent a second operation ( $P < .001$ ). All secondary operations were revision partial meniscectomies occurring at a mean 3.2 years (95% CI, 0.01-6.4 years) after the index procedure. At final follow-up, 89% of patients were able to return to sport, with 65% returning to wrestling competition. There was significant improvement in the Tegner score from a mean 6.5 (95% CI, 5.9-7.2) preoperatively to 8.3 (95% CI 8.0-8.6) postoperatively ( $P < .001$ ).

**Conclusion:** The reoperation rate after meniscal surgery in wrestlers was quite low, but only 65% returned to competitive wrestling. Meniscal repair and partial meniscectomy improved patient-reported outcomes and activity levels at short-term follow-up. However, 21% of wrestlers treated with initial meniscal repair required a subsequent partial meniscectomy at a mean 2.2 years.

**Keywords:** meniscal tear; meniscal repair; return to sport; wrestling

The sport of wrestling is one of the world's oldest disciplined sports, with origins dating back as early as 5000 BCE.<sup>6,9</sup> Wrestling was first included in the ancient Olympic games in 708 BCE,<sup>19</sup> with subsequent styles of Greco-Roman making a debut in the first modern Olympics in Athens (1896) and with freestyle appearing in the Olympic program in St Louis, Missouri (1904).<sup>6</sup> Since then, wrestling has remained a premier world sport with >2.5 million participants in amateur, high school, collegiate, Olympic, and professional ranks.<sup>1,2,6,15,19</sup> Wrestling is a contact sport with extensive physical demands resulting in an elevated risk of orthopaedic injuries, especially

at competitive levels.<sup>11,17,19</sup> Several studies have investigated the incidences, patterns, and characteristics of wrestling injuries, demonstrating relatively high levels of injuries per athlete, secondary only to football.<sup>1,2,6,11,15,17,19,25</sup>

The knee is one of the most frequently injured joints in wrestlers, often leading to missed participation and high rates of surgical treatment.<sup>15</sup> Meniscal tears are common, since the hyperflexed knee is often loaded with high forces, including the opponent's body weight, placing stress on the knee. Prior investigations of meniscectomy in high-level athletes demonstrated a clearly defined pattern of progressive chondral damage in the mid- to long term or even short term.<sup>8,10,13</sup> Prevention of cartilage degeneration through meniscal preservation is paramount in these highly active, young athletes.

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Meniscal repair techniques first described by Annandale<sup>4</sup> have evolved to become a reliable treatment option for certain tear patterns in athletes and nonathletes.<sup>5,14,20-22</sup> However, there is still uncertainty and a lack of data evaluating the results of various treatment strategies with regard to meniscal injuries in wrestlers. The purpose of this study was to report the outcomes, including subjective function, return to play, complications, and reoperation rates, for partial meniscectomy and meniscal repairs in a large sample of competitive wrestlers. It was hypothesized that meniscal repairs will improve pain and function while conversely resulting in an elevated rate of failure when compared with partial meniscectomy.

## METHODS

### Patients

After institutional review board approval, medical records were retrospectively reviewed, identifying 178 wrestlers with a history of wrestling and a diagnosis of a meniscal tear between 2001 and 2017. Patients were then excluded if they underwent concomitant surgical procedures in the ipsilateral knee, such as anterior cruciate ligament, posterior cruciate ligament, medial collateral ligament, lateral collateral ligament, or multiligament injury, as well as full-thickness (grade IV) osteochondral lesions, periarticular fractures, or osteotomies.

A manual chart review was then performed for proper documentation of wrestling participation and level of competition ranging from high school to professional. Competitive wrestlers were defined as athletes who trained and participated in athletic competition. All common styles of wrestling were included (folk style, freestyle, and Greco-Roman). Professional wrestlers were defined as individuals receiving compensation. Club sport wrestlers were defined as competitors who were not professional nor part of a high school or college league. Medical record review was then performed to obtain patient age, sex, body mass index, previous surgery, meniscal tear type and laterality, and subsequent meniscal treatment. The final cohort consisted of 29 patients in the meniscal repair group and 56 in the meniscectomy group (Figure 1). All patients had a minimum 2-year follow-up as obtained through chart review,

with the exception of 9 patients who had <2 years of electronic medical record follow-up but were subsequently called by our research fellows (L.K.K. and M.D.L.) to acquire necessary data and become included in the study.

### Surgical Procedures

All surgical procedures were performed at the same academic institution, and treatment was driven by meniscal tear pattern. The meniscal tears were described during arthroscopy and categorized as simple (1 major tear component—longitudinal, horizontal/cleavage, or radial), bucket-handle (vertical tear with a displaced bucket-handle fragment), or complex (multiplane combination with  $\geq 2$  tear components). Partial meniscectomy was performed for degenerative complex tears, those deemed inappropriate for repair, or unable to be repaired. These tears included partial-thickness tears (<50%), small radial tears, and segmental tears within the white-white zone. Indications for meniscal repair included traumatic, unstable tears and full-thickness tears within the red-red and red-white zone. Specific techniques for meniscal repair varied across the study duration and included bioabsorbable arrows, all-inside and/or inside-out, and root repair.

Postoperative rehabilitation was dictated by meniscal pathology and treatment choice. Patients undergoing meniscectomy were allowed immediate weightbearing with gait aids as needed, early progressive range of motion exercises and strengthening, and return to sport (RTS) after 6 weeks. For patients undergoing meniscal repair, the first 4 weeks involved partial weightbearing with a hinged knee brace locked in full extension when walking, and knee flexion limited to 90°. From 4 to 8 weeks, patients were then able to bear weight as tolerated and perform full range of motion. Knee loading at flexion angles >90° was prohibited until 4 months postoperatively. At around 3 months, patients were allowed to begin jogging and light activity. RTS occurred at 4 to 6 months after surgery based on clinical progress.<sup>16</sup>

### Outcome Measures

Data were collected from pre- and postoperative periods to obtain baseline and postprocedural patient characteristics

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Ethical approval for this study was obtained from the Mayo Clinic (IRB ID No. 15-000601).

TABLE 1  
Patient Demographics and Injury Details

	Patients, No. (%) <sup>a</sup>			P Value
	Total (N = 85)	Meniscal Repair (n = 29)	Partial Meniscectomy (n = 56)	
Age, y <sup>b</sup>	17.6 ± 2.7	16.7 ± 2.9	18.0 ± 2.8	.08
Level of competition				.51
High school	61 (72)	22	39	
College	17 (20)	3	14	
Professional	2 (2)	1	1	
Club sport	5 (6)	3	2	
Chronicity of injury				
Acute	62 (73)	20	42	
Chronic	23 (27)	9	14	
Laterality of knee injury				.62
Right	50 (59)	16	34	
Left	35 (41)	13	22	
Laterality of meniscal tear				.09
Medial	54 (64)	14	40	
Lateral	29 (34)	14	15	
Both	2 (2)	1	1	
Type of tear				<.01 <sup>c</sup>
Simple	24 (28)	15	9	
Bucket-handle	28 (33)	10	18	
Complex	33 (39)	4	29	

<sup>a</sup>All patients were male.

<sup>b</sup>Mean ± SD.

<sup>c</sup>P < .05.

and outcomes. For preoperative documentation, we used consultation notes and history and physical documentation closest to the time of surgery. For postoperative documentation, we used operative notes, 2-year follow-up visits, and the most recent follow-up visits. Phone calls were made for any patients who did not have at least 2 years of clinical follow-up electronically. We then assessed reinjury rates, the presence or absence of symptoms, and outcome measures including visual analog scale (VAS) for pain (0-10 scale, 10 = worst pain), International Knee Documentation Committee (IKDC) subjective evaluations, and Tegner activity scores. As compared with other outcome measures, the IKDC score has demonstrated the best performance in measuring treatment effects for patients with meniscal tears.<sup>23</sup> Patients were considered clinically successful when they denied pain with activities, no reinjury occurred, no subsequent surgery was performed, and no further care was sought for the injured knee.

Failure was defined as reinjury of the operative meniscus as determined by a combination of clinical symptoms (pain, disability, and significant limitation in activity) and advanced imaging examination (magnetic resonance imaging) or reoperation of the operative meniscus with revision repair or partial meniscectomy for the injured meniscus after the index procedure. All cases of suspected failure were reviewed by the senior author (A.J.K.) and research

TABLE 2  
Types of Meniscal Repairs (n = 29)

Technique	No.
Bioabsorbable arrows	3
All-inside	10
Inside-out	10
Root repair	3
Combination: inside-out and all-inside	3

fellow (L.K.K.) for supportive radiological evidence, pertinent arthroscopic images, or documentation in operative reports.

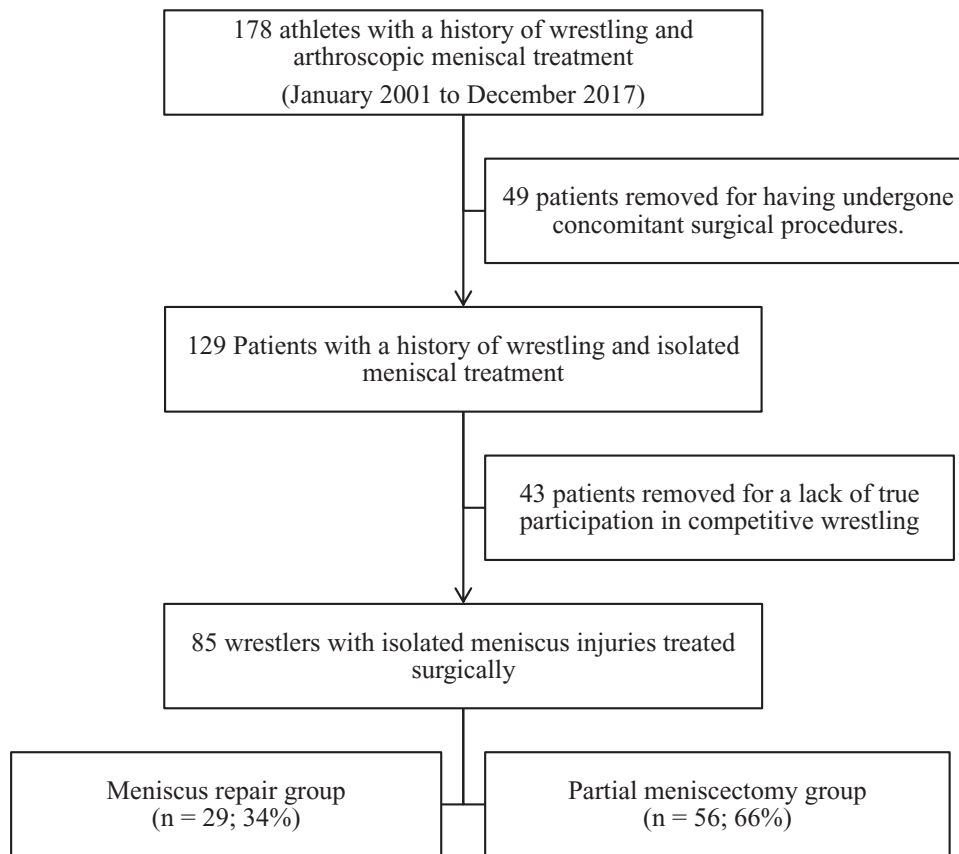
### Statistical Analysis

Statistics (mean, standard deviation, median, range, and frequencies) were analyzed for patient demographics (including age, sex, body mass index, activity level), details of the meniscal injury (traumatic, sport specific, etc), imaging findings, operative reports, and postoperative outcome scores. All patient data were inputted and stored in Microsoft Excel (2010). Data analysis was performed using Microsoft Excel and JMP Pro (Version 14.1.0; SAS Institute). Demographic information was presented using descriptive statistics, including mean, percentage, and range. The Student *t* test was used to compare numerical values (ie, age, body mass index), which were expressed as means and standard deviations. The Fisher exact test and chi-square test were used to compare nominal variables (ie, laterality of knee injury and meniscal tear, type of tear, and reoperation rate), when appropriate. Wilcoxon signed-rank analysis was used to compare means of continuous variables (ie, group comparisons of time between surgery and reoperation, as well as VAS pain, Tegner, and IKDC scores, and time to return to wrestling). Kaplan-Meier analysis was used to determine overall progression after surgery without reoperation. *P* values <.05 were considered statistically significant.

### RESULTS

The study included 85 wrestlers treated surgically for isolated meniscal injuries with a mean follow-up of 7.2 years (median, 6.7; range, 2.0-18.7) (Table 1). Of these, 56 (66%) patients underwent a partial meniscectomy of the torn meniscus, and 29 (34%) underwent meniscal repairs (bioabsorbable arrows, all-inside, inside-out, or root repair techniques) (Table 2). Baseline demographic characteristics were similar; however, there was a significant difference in the types of tear between patients who received meniscal repairs and partial meniscectomy (*P* < .01). A post hoc power analysis was performed to assess the adequacy of our sample size. We then calculated that the sample size in each treatment group should ideally be 59 patients at an alpha of .05 and power of 0.80.

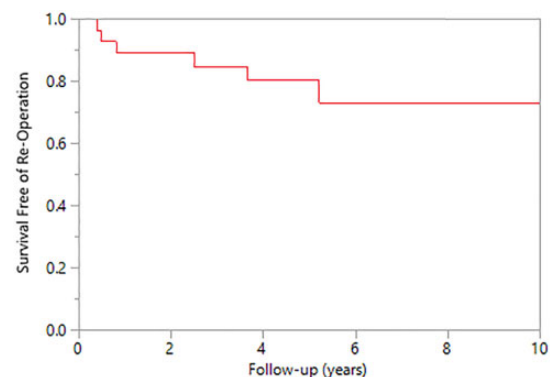
At the time of final follow-up, 11 (12.9%) patients required a reoperation, all of which consisted of a meniscal



**Figure 1.** Flowchart of patients included for analysis.

debridement and partial meniscectomy. Clinical failures leading to reoperation were observed in 8 (9.4%) patients, all as a result of wrestling, 6 (75%) of whom had been initially treated with meniscal repair ( $P = .026$ ). The remaining 3 patients sustained reoperation for subsequent meniscal injuries that occurred as a result of various other athletic activities. The reoperation rate attributed to failed index meniscal repair was 21%, versus 3% for those treated with meniscectomy ( $P < .001$ ). The mean time between the index operation and reoperation for the 8 patients requiring it was 3.2 years (95% CI, 0.01-6.4). Six meniscal repairs failed, requiring a partial meniscectomy after a mean 2.2 years (95% CI, 0.1-4.2) (Figure 2). The meniscal repairs had a disproportionately higher rate of reoperation in this cohort, but there was no significant difference in time between index operation and reoperation when compared with those initially treated with meniscectomy ( $P = .389$ ). No patients required  $>2$  surgical procedures.

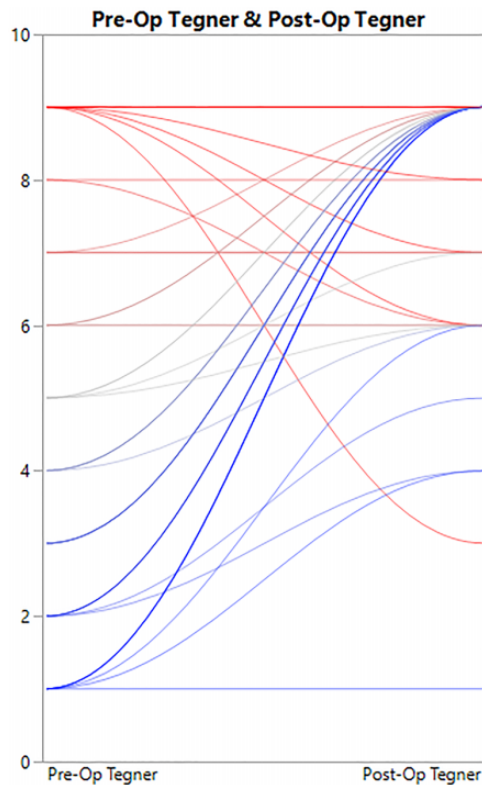
Of 85 total patients, 76 (89%) returned to sports, and 55 (65%) returned to wrestling. There was significant improvement in the Tegner activity level, from a mean score of 6.5 (95% CI, 5.9-7.2) preoperatively to 8.3 (95% CI, 8.0-8.6) postoperatively ( $P < .001$ ) (Figure 3). Of the 11 who required reoperation, all (100%) returned to sports, and 9 (82%) returned to wrestling. There was no significant difference in rates of RTS and return to wrestling between



**Figure 2.** Kaplan-Meier curve demonstrating reoperation-free progression of 29 patients after having undergone the index meniscal repair.

those treated initially with meniscectomy and those with repair ( $P = .671$ ).

The mean pre- and postoperative VAS scores for pain were 4.6 (95% CI, 4.1-5.1) and 0.54 (95% CI, 0.35-0.73), respectively ( $P < .001$ ). Additionally, there was significant improvement from a mean IKDC score of 67.3 (95% CI, 64.1-70.6) preoperatively to 96.0 (95% CI, 94.5-97.5) postoperatively ( $P < .001$ ) (Figure 4). Wrestlers who underwent



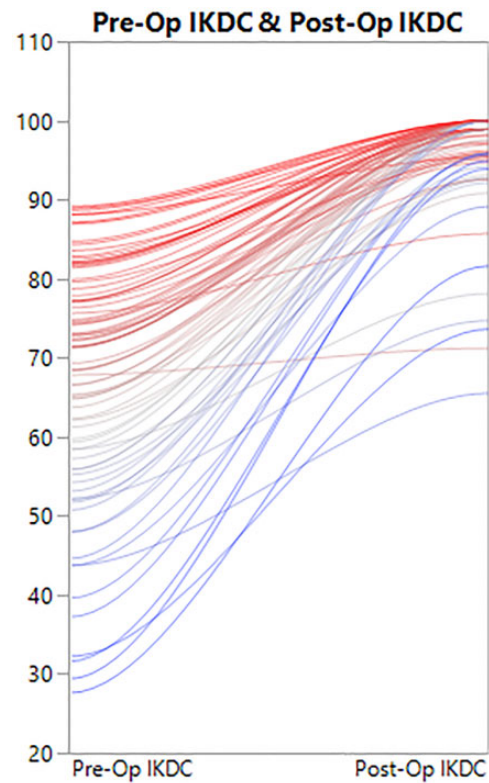
**Figure 3.** Inpatient pre- and postoperative Tegner scores for all patients included in analysis, with each line representing the scores of an individual patient. Red represents those treated with partial meniscectomy and blue represents those treated with repair.

meniscal repair had significantly lower preoperative IKDC scores (mean, 62.0; 95% CI, 55.5-68.4) than those managed with meniscectomy (mean, 70.0; 95% CI, 66.3-73.6;  $P = .032$ ); however, there was no significant difference in postoperative IKDC scores ( $P = .739$ ).

## DISCUSSION

The principal finding of the present study is that 9.4% of patients failed index surgery and that arthroscopic meniscal fixation resulted in a disproportionately high risk of reoperation when compared with meniscectomy (21% reoperation rate for meniscal repair vs 3% for partial meniscectomy;  $P < .001$ ). This was also demonstrated in a meta-analysis by Paxton et al,<sup>18</sup> where isolated meniscal repair resulted in reoperation rates of 16.5% and 20.7% as opposed to 1.4% and 3.9% with partial meniscectomy at short- and long-term follow-up, respectively. Studies focusing on meniscal repair in athletes also demonstrated a moderate reoperation rate of 21% to 29% and a subsequent meniscectomy rate from 8% to 24%.<sup>3,7</sup>

RTS in competitive wrestlers after meniscal injuries in the mid- to long-term follow-up has not been confirmed, to our knowledge. Otero et al<sup>15</sup> reported a 71% rate of return to wrestling of collegiate athletes who received meniscal



**Figure 4.** Inpatient pre- and postoperative International Knee Documentation Committee (IKDC) scores for all patients included in analysis, with each line representing the scores of an individual patient. Red represents those treated with partial meniscectomy and blue represents those treated with repair.

surgery (repair or partial meniscectomy) within their eligibility period. Return to play after meniscal repair for athletes in general has been estimated between 80% and 95%, with partial meniscectomy reaching up to 98%.<sup>12,24</sup> Eberbach et al<sup>7</sup> evaluated the sport-specific outcomes after isolated meniscal repair in a systematic review, revealing a return to preinjury level of sport of 89% at a mean 4.3 to 6.5 months after injury. The present study demonstrated a RTS rate of 89%, with a return-to-wrestling rate of 65%. Our results suggest that successful RTS after meniscal injury and surgery can be expected. However, the rate of return to wrestling was much lower, likely because of the increased physical demand of the sport. This information can serve as a point of reference for shared decision making and counseling during treatment discussions.

Several subjective and objective outcome measures are used to evaluate surgical treatment outcomes. Meniscal tear treatment in athletes often leads to improved functional results.<sup>7</sup> Meniscal repair results in better patient-reported outcomes when compared with partial meniscectomy, especially in young and active athletes.<sup>7,18,26</sup> The present study demonstrated a significant improvement in VAS pain scores from 4.6 preoperatively to 0.54 at final follow-up. In addition, the Tegner activity rating increased from

6.5 preoperatively to 8.3 postoperatively, which matched the high return to athletics observed. Preoperative IKDC scores also improved from a baseline 67.3 to a postoperative 96.0. This improvement has been observed in the literature as described earlier and supports treatment of meniscal tears for wrestling athletes. It is important to note that patients who underwent a meniscal repair began with a significantly lower preoperative IKDC score of 62, as opposed to 70 in the partial meniscectomy group, and this effect was not observed postoperatively.

A number of limitations to this study merit discussion. First, this retrospective nonrandomized investigation introduces the possibility for surgeon and selection bias. All patients were treated at a single tertiary institution and followed similar perioperative protocols, which served as a strength for group comparisons but may not be as generalizable to different practices. Second, the relatively small sample size makes it difficult to perform subgroup analyses. This includes the analysis of additional athletics outside of wrestling that some of our athletes may have participated in. Third, magnetic resonance imaging and second-look arthroscopy were not utilized to identify true healing rates in asymptomatic patients, leading to underreporting of surgical failures. Finally, although our study had extensive clinical follow-up, we were unable to ascertain substantial serial postoperative radiography to track the speculated difference in osteoarthritis progression between the repair and partial meniscectomy groups.

## CONCLUSION

The reoperation rate after meniscal surgery in wrestlers was quite low, but only 65% returned to competitive wrestling. Meniscal repair and partial meniscectomy improved patient-reported outcomes and activity levels at short-term follow-up. However, 21% of wrestlers treated with initial meniscal repair required a subsequent partial meniscectomy at a mean 2.2 years.

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