

Good Long-Term Clinical Results And Patient Satisfaction After Arthroscopic Repair of Large Meniscus Bucket Handle Tears of the Knee



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- Meniscal tears are a common cause of surgical intervention in orthopedics, with a prevalence of 61 cases per 100,000 and an incidence of 12 – 14%¹. Within this group, bucket-handle tears represent some of the largest and most serious lesions.
- Resection of bucket handle meniscal tears leads to significant functional meniscal insufficiency, with subsequent rapid joint degeneration and development of early osteoarthritis²⁻⁴. Therefore, surgical repair is the preferred treatment approach in such cases⁵. However, bucket handle tears are non-trivial to properly repair, and might not always heal well.
- We therefore designed and conducted a retrospective study to evaluate clinical outcomes, failure rate, and patient satisfaction after arthroscopic repair of large posterior horn and pars intermedia bucket handle tears to assess the viability of this approach as an alternative to meniscectomy. Our hypothesis was that arthroscopic meniscal repair using both all-inside and outside-in sutures would be able to significantly improve outcome measures without incurring unacceptable failure rates even with large bucket-handle tears.

- After obtaining approval from our local ethics committee, we performed a retrospective single-center study of patients who received surgical repair of a large meniscus bucket handle tear at our institution between 2008 and 2020. Eligibility criteria are detailed in **Table 1**. Written informed consent was obtained from all participants.
- The follow-up duration was 86.5 ± 41.3 (20 – 158) months, constituting a mean follow-up duration of over 7 years.
- We assessed the following patient reported outcome measures: International Knee Documentation Committee Subjective Knee Form⁶, Knee Injury and Osteoarthritis Outcome Score⁷, Tegner Activity Scale⁸, Lysholm score^{8,9}, and visual analog scale (VAS) for patient satisfaction¹⁰. Failure rates were also assessed. The IKDC was the primary outcome measure.
- Arithmetic mean, standard deviation (SD), median, and range were calculated for complete datasets. Data distributions were assessed for normality using Shapiro-Wilk tests, histograms, and Q-Q plots. Pre- and postoperative values were compared using paired t tests or Wilcoxon signed rank tests. No alpha adjustment was used. All tests were two-sided and p value of ≤ 0.05 was considered significant.

Inclusion Criteria	Exclusion Criteria
Presence of a large meniscus bucket handle tear, involving at least the posterior horn and pars intermedia	Relevant complex trauma to the affected knee joint
Surgical treatment with inside-out and outside-in sutures	Rheumatoid or neurological comorbidity
Age at index surgery 15-70 years	Follow-up duration less than 12 months
Normal lower extremity alignment	High-grade chondromalacia (Outerbridge 3 – 4°)

Table 1. Study inclusion and exclusion criteria.

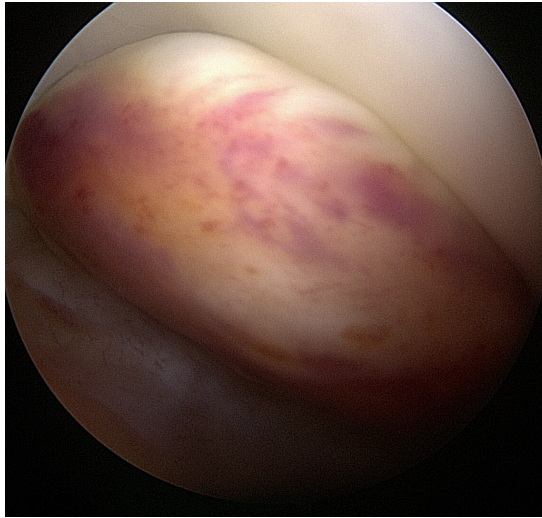


Figure 1. Intraarticular view of a large bucket handle tear, dislocated into the femoral intercondylar notch.

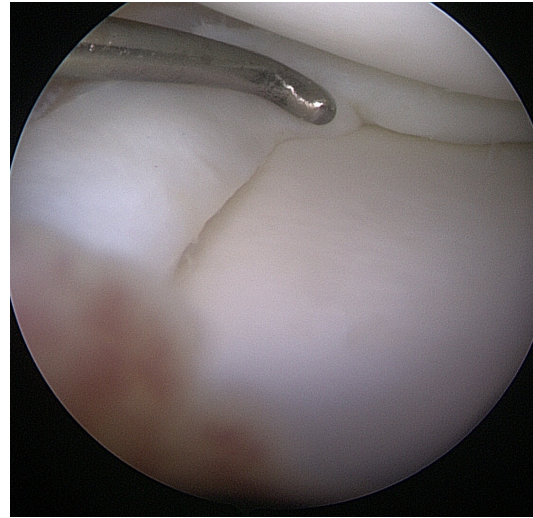


Figure 2. Repositioned meniscus with large bucket handle tear.

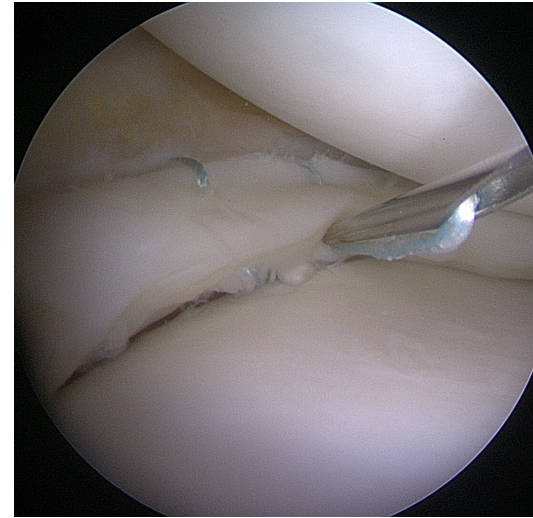


Figure 3. Outside-in suturing of the pars intermedia.



Figure 4. Final repair.

- At the time of writing, data were available from 54 patients (33 male, 21 female), including 10 lateral and 42 medial posterior horn and pars intermedia bucket handle tears (two patients had tears of both menisci).
- Baseline patient characteristics of our cohort are provided in **Table 2**.
- All postoperative clinical outcome measures showed statistically significant improvements compared to preoperative values. IKDC scores improved from 37.4 ± 23.6 to 81.4 ± 16.9 ($p < 0.001$). Lysholm scores improved from 43.5 ± 30.1 to 87.7 ± 15.9 ($p < 0.001$). Visual analog scale for patient satisfaction improved from 2.7 ± 2.7 to 7.6 ± 2.8 ($p < 0.001$). All KOOS subcategories, KOOS total, and Tegner activity scale showed statistically significant improvements as well ($p < 0.001$).
- The failure rate was 11% at final follow-up.
- Improvements in patient reported outcome measures are detailed in **Figures 5 – 7**.

Characteristics	Unit/coding	Range or count (n)	Mean ± SD or proportion
Age at index surgery	years	12 – 63	30 ± 14.4
Sex	male	33	61%
	female	21	39%
Affected compartment	lateral	10	18.5%
	medial	42	77.8%
	both	2	3.7%
Tear location	red-red zone	51	94%
	red-white zone	3	6%
Tear dislocated into intercondylar notch	yes	37	69%
	no	17	31%
Sutures used	count	4 – 16	11 ± 3.2
Follow-up	months	20 – 158	86.5 ± 41.3

Table 2. Baseline patient and defect characteristics. *Abbreviations: SD, standard deviation.*

Pre- vs. postoperative IKDC and Lysholm Scores

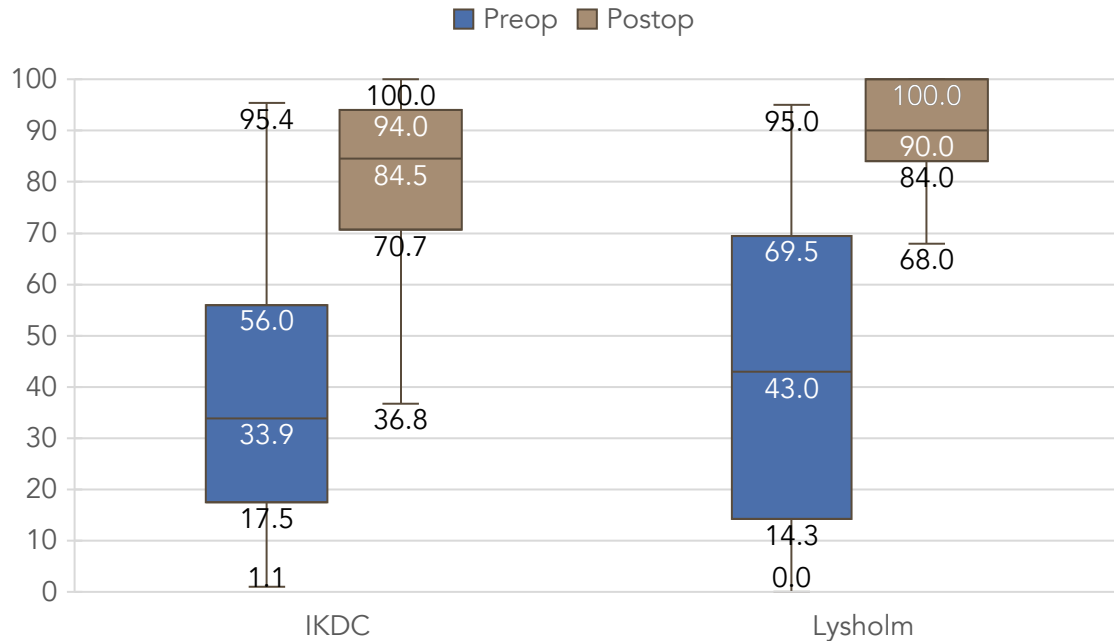


Figure 5. Pre- vs. postoperative IKDC and Lysholm scores. All $p < 0.001$. *Abbreviations: IKDC, International Knee Documentation Committee Subjective Knee Form.*

Pre- vs. postoperative Tegner and VAS scores for satisfaction

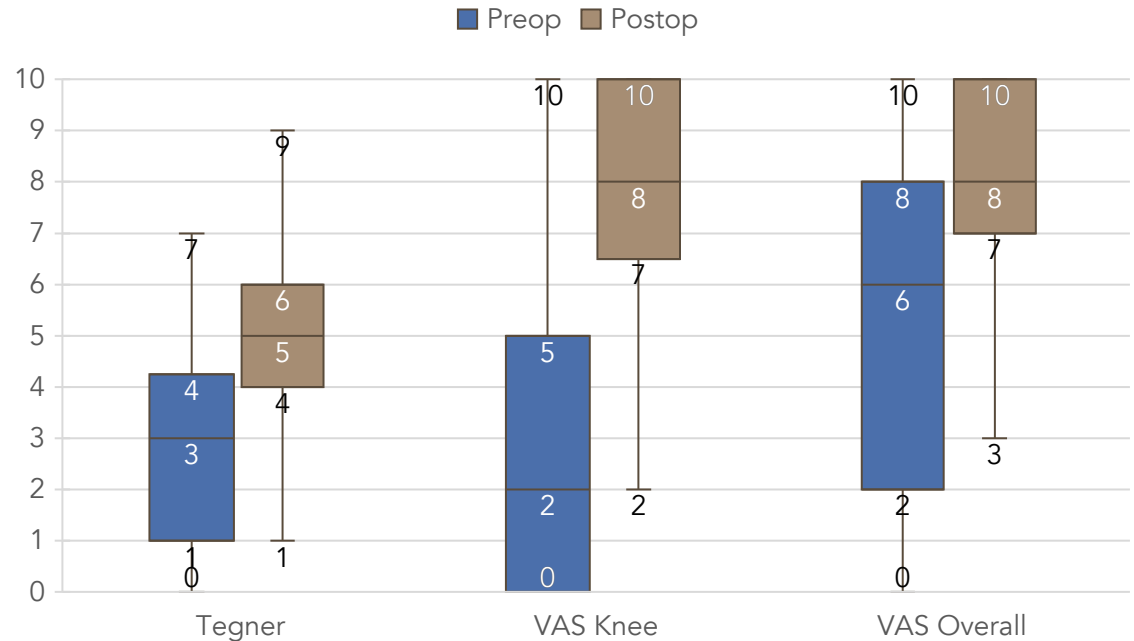


Figure 6. Pre- vs. postoperative Tegner activity scale and visual analog scale (VAS) for patient satisfaction with the affected knee joint (VAS Knee) and overall (VAS Overall). All $p < 0.001$.

Pre- vs. postoperative KOOS

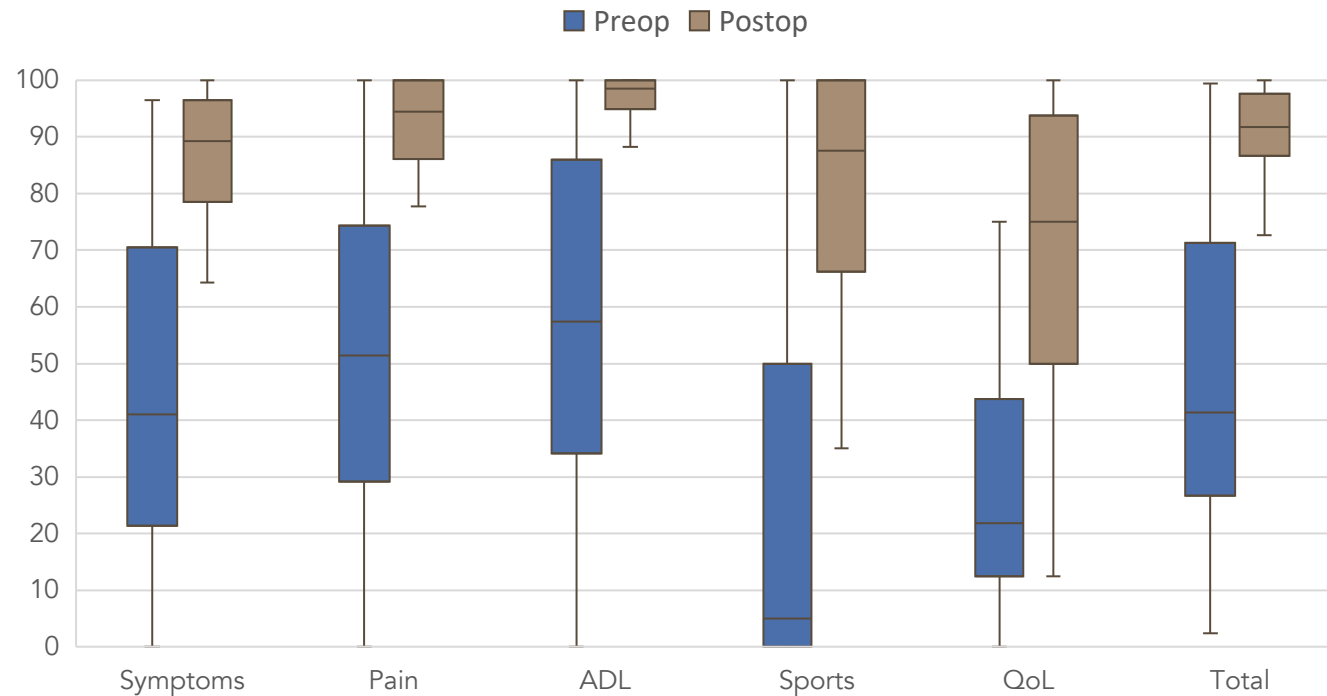


Figure 7. Pre- vs. postoperative KOOS. All $p < 0.001$. Abbreviations: KOOS, Knee Injury and Osteoarthritis Outcome Score; ADL, activities of daily living; QoL, quality of life.

Category	Scale	Mean \pm SD (preop)	Mean \pm SD (postop)	Delta
Symptoms	0 – 100	44.6 \pm 28.6	84.6 \pm 17.8	40.0 \pm 33.1
Pain	0 – 100	51.5 \pm 27.8	90.9 \pm 13.5	39.6 \pm 31.2
ADL	0 – 100	57.4 \pm 30.2	94.5 \pm 13.9	37.5 \pm 34.8
Sports	0 – 100	24.1 \pm 30.8	80.1 \pm 24.3	53.9 \pm 38.4
QoL	0 – 100	28.6 \pm 23.5	71.6 \pm 23.6	42.7 \pm 33.0
Total	0 – 100	47.7 \pm 27.3	88.6 \pm 15.1	41.0 \pm 32.3

Table 3. Pre- and postoperative KOOS. All $p < 0.001$. Deltas are difference between post- and preoperative values.

- Key findings: (i) marked improvements were observed across all longitudinal outcome measures at long-term follow-up; (ii) the procedure demonstrated a low failure rate of 11%; (iii) the procedure was able to improve symptoms and knee function and achieved a high degree of patient satisfaction.
- Our findings provide long-term evidence at an average follow-up of over 7 years and align well with the current literature. Muench et al.¹¹ evaluated 40 patients with a similar average age (32.0 ± 11.5 years) and observed a mean IKDC score of 82.8 ± 13.8 at final follow-up, as well as an average Lysholm score of 77.4 ± 24.8 . This compares to values of 81.4 ± 16.9 and 87.7 ± 15.9 in our cohort, respectively. They also report a clinical healing rate of 83.3%, compared to our clinical survival rate of 89.0%. However, the average follow-up duration was much shorter than our cohort (51.8 ± 14.3 months).
- Similarly, Thauinat et al.¹² analysed 96 patients who underwent medial meniscus bucket handle tear repair and found a mean Lysholm score at final follow-up of 91.53 ± 11.6 , as well as a mean Tegner score of 6.79 ± 1.47 prior to injury and 6.11 ± 1.75 at last follow-up. Our cohort exhibited a mean pre- and postoperative Tegner scores of 3.1 ± 2.4 (after injury) and 5.0 ± 1.9 , respectively, with a mean pre-injury score of 6.3 ± 1.9 . The authors also observed a failure rate of 19%. However, the average follow-up duration was only 35.2 ± 9.8 months.
- Importantly, these findings indicate, that good clinical results after arthroscopic bucket handle tear repair remains stable even at longer follow-up intervals.

- Patients undergoing arthroscopic repair of large meniscus bucket handle tears showed significantly improved clinical outcome measures and patient satisfaction with an acceptable failure rate (11%) at an average 7-year follow-up.
- These results support the hypothesis that arthroscopic repair is viable even in large posterior horn and pars intermedia bucket handle tears using a hybrid technique with all-inside and outside-in sutures.
- The procedure was able to improve function, reduce symptoms, and increase patient satisfaction and should therefore be considered when treating large bucket-handle tears.

1. Logerstedt DS, Snyder-Mackler L, Ritter RC, Axe MJ. Knee pain and mobility impairments: meniscal and articular cartilage lesions. *J Orthop Sports Phys Ther.* Jun 2010;40(6):A1-a35. doi:10.2519/jospt.2010.0304
2. Fairbank TJ. Knee Joint Changes After Meniscectomy. *The Journal of Bone and Joint Surgery British volume.* 1948;30-B(4):664-670. doi:10.1302/0301-620x.30b4.664
3. U J, S S-H, F L, A R. Long-term follow-up of meniscectomy in athletes. A prospective longitudinal study. *The Journal of Bone and Joint Surgery British volume.* 1987;69-B(1):80-83. doi:10.1302/0301-620x.69b1.3818740
4. Christoforakis J, Pradhan R, Sanchez-Ballester J, Hunt N, Strachan RK. Is there an association between articular cartilage changes and degenerative meniscus tears? *Arthroscopy.* Nov 2005;21(11):1366-9. doi:10.1016/j.arthro.2005.08.031
5. Vautrin M, Schwartz C. Future of 34 meniscectomies after bucket-handle meniscus tear: a retrospective study with a follow-up over 22 years. *Eur J Orthop Surg Traumatol.* May 2016;26(4):435-40. doi:10.1007/s00590-016-1754-2
6. Irrgang JJ, Anderson AF, Boland AL, et al. Development and validation of the international knee documentation committee subjective knee form. *Am J Sports Med.* Sep-Oct 2001;29(5):600-13. doi:10.1177/03635465010290051301
7. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)--development of a self-administered outcome measure. *J Orthop Sports Phys Ther.* Aug 1998;28(2):88-96. doi:10.2519/jospt.1998.28.2.88
8. Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. *Clin Orthop Relat Res.* Sep 1985;(198):43-9.
9. Mitsou A, Vallianatos P, Piskopakis N, Maheras S. Anterior cruciate ligament reconstruction by over-the-top repair combined with popliteus tendon plasty. *J Bone Joint Surg Br.* May 1990;72(3):398-404. doi:10.1302/0301-620x.72b3.2341436
10. Flandry F, Hunt JP, Terry GC, Hughston JC. Analysis of subjective knee complaints using visual analog scales. *Am J Sports Med.* Mar-Apr 1991;19(2):112-8. doi:10.1177/036354659101900204