Int. J Med. Pharm. Res.
P-ISSN: 2958-3675 | E-ISSN: 2958-3683
Available on: https://ijmpr.in/

International Journal
of Medical and
Pharmaceutical Research

ORIGINAL ARTICLE OPEN ACCES

Repairing the Locked Knee: Functional Outcomes of Bucket-Handle Meniscus Tear Repair: A Prom-Based Analysis of Techniques and Concomitant Injuries

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OPEN ACCESS

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Received: 02-07-2025
Accepted: 11-08-2025
Available Online: 21-08-2025

ABSTRACT

Background: Bucket handle meniscal tears (BHMT) are complex injuries, accounting for 10%–26% of all meniscal tears. They are often associated with mechanical knee locking and concomitant injuries, most commonly anterior cruciate ligament (ACL) tears. While meniscectomy provides short-term relief, it is linked to early osteoarthritis. Meniscal preservation through repair remains technically challenging but essential for restoring function.

Aim: To evaluate patient-reported outcome measures (PROMs) following BHMT repair and to determine the influence of associated injuries and repair techniques on functional outcomes.

Methods: A retrospective study was conducted at Sri Lakshmi Narayana Institute of Medical Sciences from October 2021 to June 2024. Patients with arthroscopically confirmed BHMT undergoing repair were included, while irreparable tears, advanced osteoarthritis, and prior meniscal surgery were excluded. Preoperative demographics, tear characteristics, and associated injuries were recorded. Repair techniques (all-inside, inside-out, outside-in) were documented. Outcomes were assessed using the Lysholm score, IKDC score, and categorical PROM grading. Statistical comparisons between pre- and postoperative scores were performed using paired t-tests, with subgroup analysis for associated injuries and techniques.

Results: A total of 42 patients (mean age 28 years; 39 males, 3 females) were analyzed, with mean follow-up of 2 years. Medial meniscus involvement predominated (83.3%). Associated injuries included ACL tears (64.3%), patellar OCD (16.7%), PCL avulsion (2.4%), MLKI (2.4%), and MFC osteoarthritis (14.3%). Both Lysholm and IKDC scores improved significantly from preoperative to postoperative assessments ($p < 0.001$). Combined BHMT repair with ACL reconstruction showed significantly superior PROMs compared with isolated BHMT repair (Lysholm score: 92.4 ± 3.1 vs. 82.1 ± 5.8, $p < 0.01$; IKDC score: 86.2 ± 4.5 vs. 75.3 ± 8.1, $p < 0.01$).

Conclusion: Repair of BHMT is a safe and effective procedure that provides significant functional improvement and high patient satisfaction. Concomitant ACL reconstruction enhances outcomes, highlighting the importance of addressing associated injuries during surgery. Meniscal repair techniques (all-inside, inside-out, outside-in) yielded comparable PROMs, supporting meniscal preservation as the preferred strategy.

Keywords: Bucket handle meniscus tear, PROM, ACL reconstruction, meniscal repair, Lysholm score, IKDC

INTRODUCTION

Bucket handle meniscal tears (BHMT) represent a distinct and clinically significant subset of meniscal injuries, accounting for approximately **10%–26% of all meniscal tears**. These injuries are characterized by displacement of a longitudinal meniscal fragment into the intercondylar notch, leading to a **mechanical block to motion**. Patients typically present with **pain, recurrent knee locking, catching, and audible or palpable clunks**, all of which substantially impair function and quality of life.

The **medial meniscus** is more commonly affected than the lateral, primarily due to its relative immobility and greater exposure to rotational and shear stresses. The management of BHMT is uniquely challenging because of their **complex tear morphology**, frequent association with concomitant intra-articular pathology-particularly **anterior cruciate ligament (ACL) injuries**-and the technical demands of meniscal repair.

Historically, **meniscectomy** was widely performed to relieve mechanical symptoms, but long-term follow-up studies have demonstrated a strong association with **accelerated degenerative changes and premature osteoarthritis**. This recognition has shifted the focus toward **meniscal preservation**, with meniscal repair now regarded as the gold standard whenever technically feasible. Despite the challenges, successful repair restores meniscal function, optimizes knee biomechanics, and significantly reduces the risk of future osteoarthritic changes.

Several studies in the literature have reported outcomes of BHMT management. **Huberty et al.** observed functional improvement with staged arthrolysis and repair but noted prolonged rehabilitation and residual stiffness. **Brislin et al.** reported similar findings with open release, though at the cost of higher morbidity. More recent arthroscopic series, such as those by **Burkhart et al.** and **Kim et al.**, demonstrated superior recovery of range of motion and reduced rehabilitation periods with single-stage arthroscopic repair. However, most prior studies were limited by small sample sizes, heterogeneous populations, or the exclusion of patients with associated stiffness or ligamentous injuries.

Given this background, the present study was undertaken to provide a comprehensive analysis of **patient-reported outcome measures (PROMs)** following BHMT repair. In particular, we sought to assess how **associated injuries (ACL, PCL, chondral lesions)** and **different repair techniques (all-inside, inside-out, outside-in)** influence postoperative functional outcomes and quality of life.

We hypothesized that repair of bucket handle meniscus tears, particularly when performed in conjunction with anterior cruciate ligament reconstruction, would result in superior patient-reported outcomes compared to isolated BHMT repair, regardless of the repair technique employed.

MATERIALS AND METHODS

This was a **retrospective study** conducted at the **Sri Lakshmi Narayana Institute of Medical Sciences** from **October 2021 to June 2024**. Patients with arthroscopically confirmed bucket handle meniscus tears (BHMT) who underwent meniscal repair during the study period were included.

Inclusion criteria were patients aged >18 years with BHMT confirmed on arthroscopy and managed with repair. **Exclusion criteria** included irreparable tears, advanced osteoarthritis, and prior meniscus surgery.
Preoperative data collected included patient demographics (age, sex, laterality) and arthroscopic findings, including tear characteristics and associated injuries such as anterior cruciate ligament (ACL) or posterior cruciate ligament (PCL) tears and chondral lesions.

Operative details regarding the type of repair technique used-**all-inside, inside-out, or outside-in**-were recorded.
Postoperative outcomes were assessed using validated **patient-reported outcome measures (PROMs)**:

- **Lysholm Knee Score**
- **International Knee Documentation Committee (IKDC) score**
- Categorical grading of PROMs (excellent, good, fair).

STATISTICAL ANALYSIS

Continuous variables were expressed as **mean ± standard deviation (SD)**, while categorical variables were presented as frequencies and percentages. Preoperative and postoperative PROM scores were compared using the **paired *t*-test**. Subgroup analysis was performed to assess the influence of associated injuries and repair techniques on outcomes using the **independent samples *t*-test** and **Chi-square test**, as appropriate. A **p-value <0.05** was considered statistically significant. Statistical analysis was performed using **SPSS software, version XX (IBM Corp., Armonk, NY, USA)**.

Table 1. DATA COLLECTION

PRE OP DATAS:
Demographic data
Arthroscopic findings
Associated injuries (ACL/PCL/Chondral lesions in MFC/Patella)
POST OP DATAS:
Arthroscopic Repair techniques
Lysholm score
IKDC score
PROM (Excellent/Good/Fair)

Table 2. BASELINE CHARACTERISTICS OF PATIENTS WITH BUCKET HANDLE MENISCUS TEAR (BHMT)

Variable	Value (n=42)
Mean age (years)	28.0 ± 6.5
Sex (Male/Female)	39 / 3
Side (Right/Left)	24 / 18
Meniscus involved	Medial: 35 (83.3%) / Lateral: 7 (16.7%)
Type of tear	Simple: 34 (81.0%) / Complex: 8 (19.0%)
Mean follow-up (years)	2.0 ± 0.5

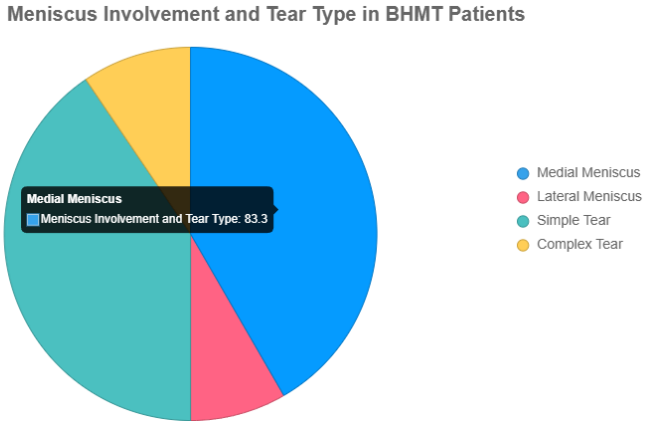


Table 3. ASSOCIATED INJURIES OBSERVED IN BHMT PATIENT

Associated Injury	Frequency (n, %)
ACL tear	27 (64.3%)
Patellar OCD	7 (16.7%)
PCL avulsion	1 (2.4%)
MLKI	1 (2.4%)
MFC Osteoarthritis	6 (14.3%)

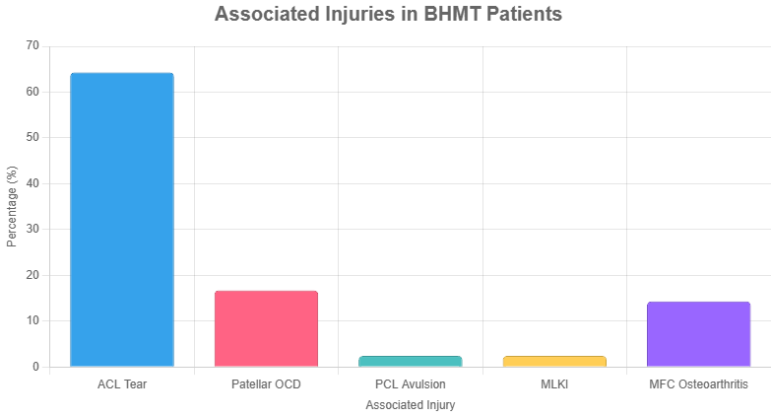


Table 4. FUNCTINAL OUTCOME PRE AND POST-OPERATIVE

Outcome Measure	Preoperative Mean ± SD	Postoperative Mean ± SD	Improvement
Lysholm Knee Score (LKS)	**55.46 ± 1.49**	**88.20 ± 1.86**	+32.74 points
IKDC Score	**43.94 ± 9.69**	**81.67 ± 15.71**	+37.73 points

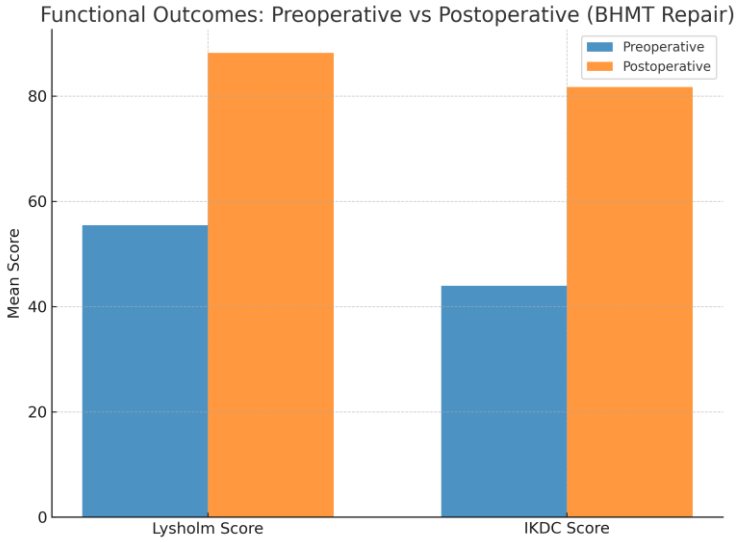


Table 5. COMPLICATIONS AFTER BHMT REPAIR

Complication	Number of Cases (n=42)
Cutaneous nerve entrapment	5
Knot prominence	3
Superficial infection	3
Reinjury (RTA)	1

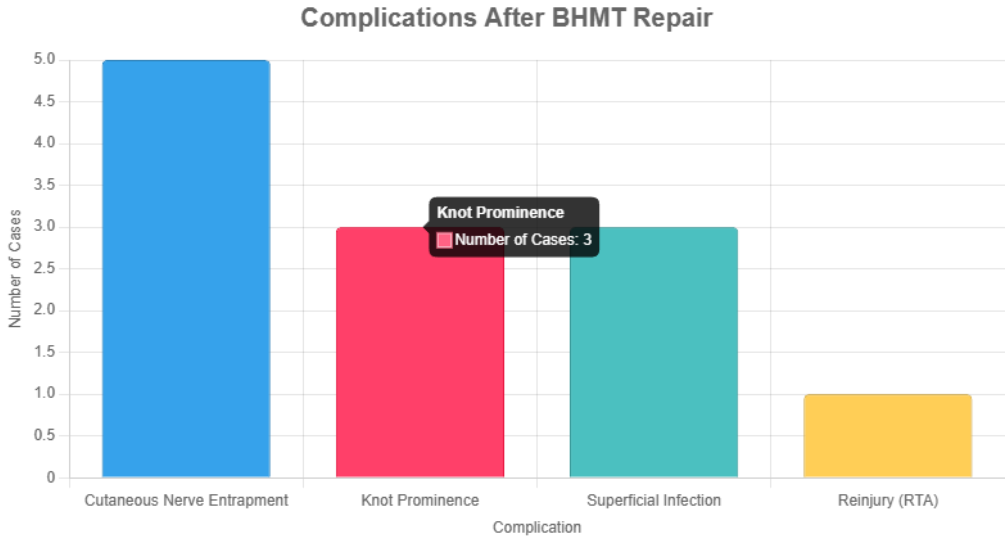
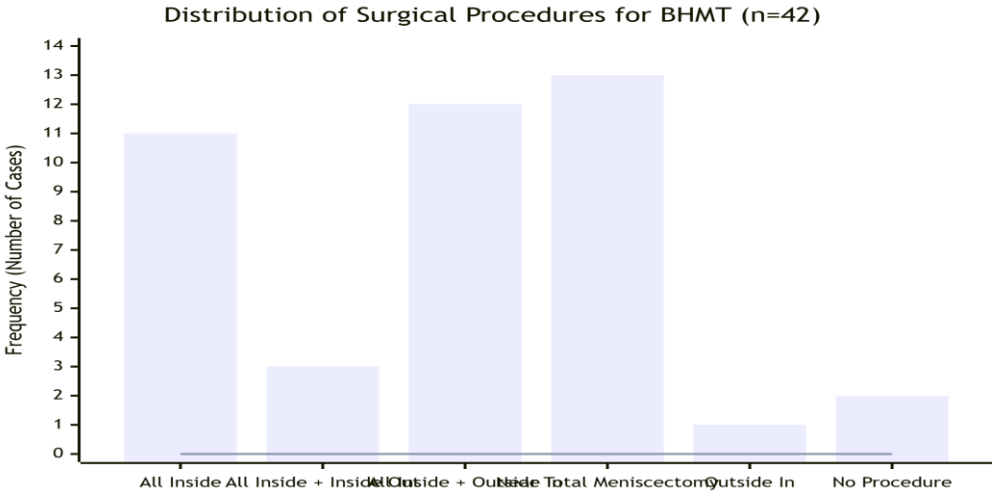


Table 6. TECHNIQUE OF MENISCUS REPAIR

PROCEDURE	Frequency
All Inside	11
All Inside + Inside Out	3
All Inside + Outside In	12
Near Total Meniscectomy	13
Outside In	1
No	2
Total	**42**



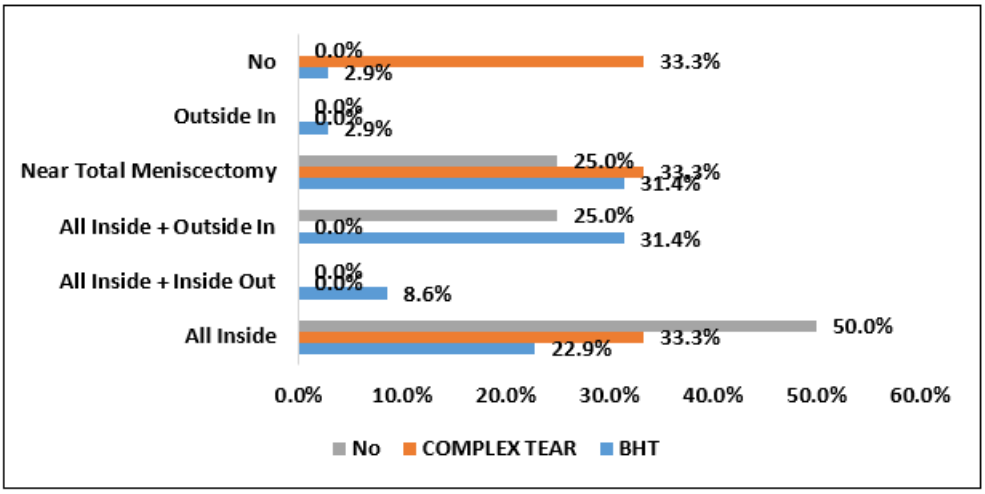


Table 7. FUNCTIONAL OUTCOME

PROM	Frequency	%
Excellent	12	28.6
Good	23	54.8
Fair	7	16.7
Total	**42**	**100.0**

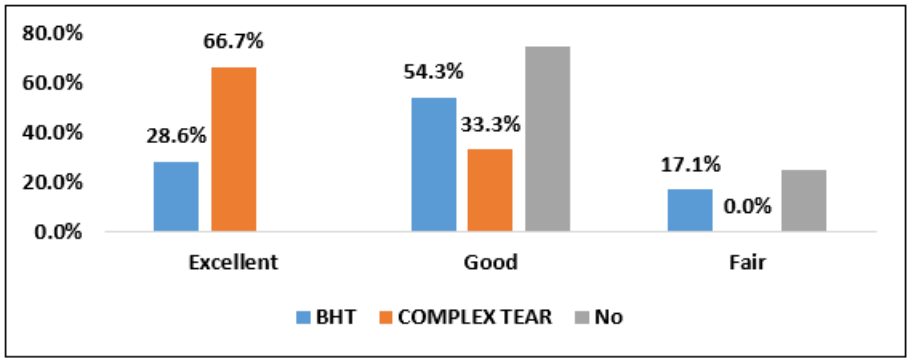


Table 8. NO SIGNIFICANT DIFFERENCE BETWEEN REPAIR TECHNIQUE AND PROM

PROCEDURE	PROM						Total	%	P - Value
	Excellent	%	Good	%	Fair	%			
All Inside	0	0.0%	10	43.5%	1	14.3%	11	26.2%	χ2= 0.207 NS
All Inside + Inside Out	1	8.3%	1	4.3%	1	14.3%	3	7.1%	
All Inside + Outside In	5	41.7%	5	21.7%	2	28.6%	12	28.6%	
Near Total Meniscectomy	4	33.3%	7	30.4%	2	28.6%	13	31.0%	
Outside In	1	8.3%	0	0.0%	0	0.0%	1	2.4%	
No	1	8.3%	0	0.0%	1	14.3%	2	4.8%	
Over All	12		23		7		42		

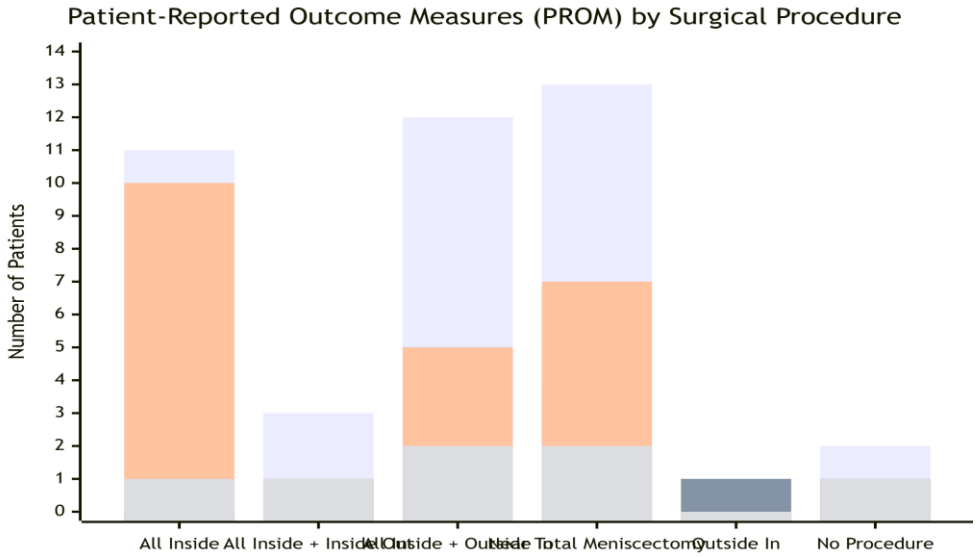
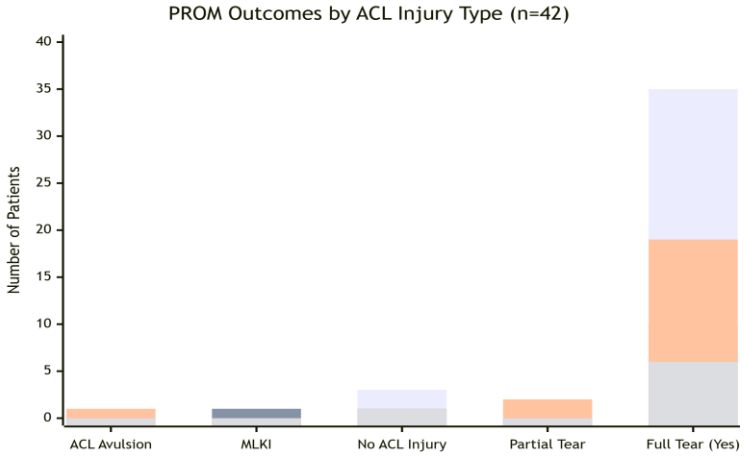
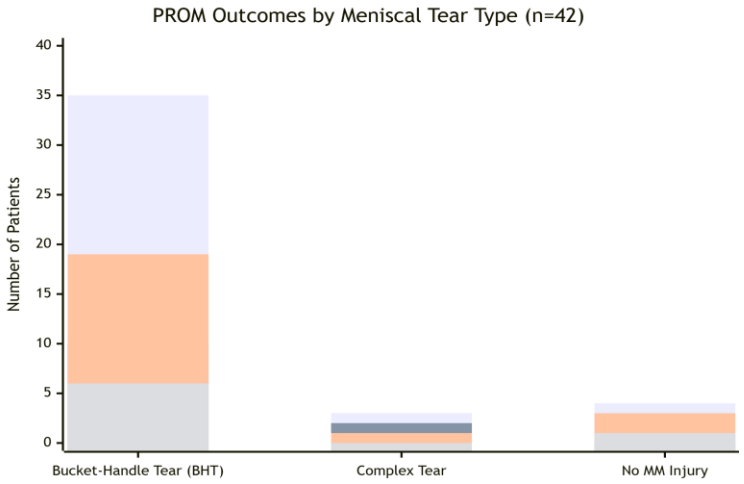


Table 9. SIGNIFICANT DIFFERENCE BETWEEN BHT REPAIR + ACLR SHOWS GOOD PROM

ACL	PROM						Total	%	P - Value
	Excellent	%	Good	%	Fair	%			
ACL AVULSION	0	0.0%	1	4.3%	0	0.0%	1	2.4%	χ2= 0.674 NS
MLKI	1	8.3%	0	0.0%	0	0.0%	1	2.4%	
No	1	8.3%	1	4.3%	1	14.3%	3	7.1%	
PARTIAL	0	0.0%	2	8.7%	0	0.0%	2	4.8%	
Yes	10	83.3%	19	82.6%	6	85.7%	35	83.3%	
Over All	12		23		7		42		

MM	PROM						Total	%	P - Value
	Excellent	%	Good	%	Fair	%			
BHT	10	83.3%	19	82.6%	6	85.7%	35	83.3%	χ2= 0.421 NS
COMPLEX TEAR	2	16.7%	1	4.3%	0	0.0%	3	7.1%	
No	0	0.0%	3	13.0%	1	14.3%	4	9.5%	
Over All	12		23		7		42		





Results

A total of 350 meniscal repairs were performed during the study period, of which 42 were BHMT cases (39 males, 3 females). The mean age was 28 years, and mean follow-up was 2 years. Tear distribution: medial meniscus – 35, lateral meniscus – 7. Side distribution: right – 24, left – 18. Among the BHMTs, 34 were simple tears, while 8 were complex.

Associated injuries were frequent: ACL tear in 27 patients, patella OCD in 7, PCL avulsion in 1, MLKI in 1, and medial femoral condyle osteoarthritis in 6. There was no significant difference in PROMs among repair techniques, but BHMT repair combined with ACLR yielded significantly better PROMs. Complications included cutaneous nerve entrapment (5), knot prominence (3), superficial infections (3), and one case of reinjury following road traffic accident.

"Subgroup analysis revealed that patients who underwent concomitant ACL reconstruction (n=27) had significantly better functional outcomes at final follow-up than those who underwent isolated meniscal repair (n=15). The mean postoperative Lysholm score was 92.4 ± 3.1 in the combined group compared to 82.1 ± 5.8 in the isolated group (**$p < 0.01$**). Similarly, the mean postoperative IKDC score was 86.2 ± 4.5 versus 75.3 ± 8.1 (**$p < 0.01$**), confirming the significant advantage of addressing associated ligamentous instability at the time of meniscal repair."

Table 10. SUMMARISING RESULTS

✓ MEAN AGE – 28 Yrs
✓ Mean follow up – 2yrs
✓ MM / LM – 35 /7
✓ RIGHT /LEFT – 24/18 ✓ BHT – 34
✓ COMPLEX TEAR – 8
✓ Associated injuries : Patella OCD – 7 ACL TEAR -27 PCL AVULSION -1 MLKI -1 MFC OA -6

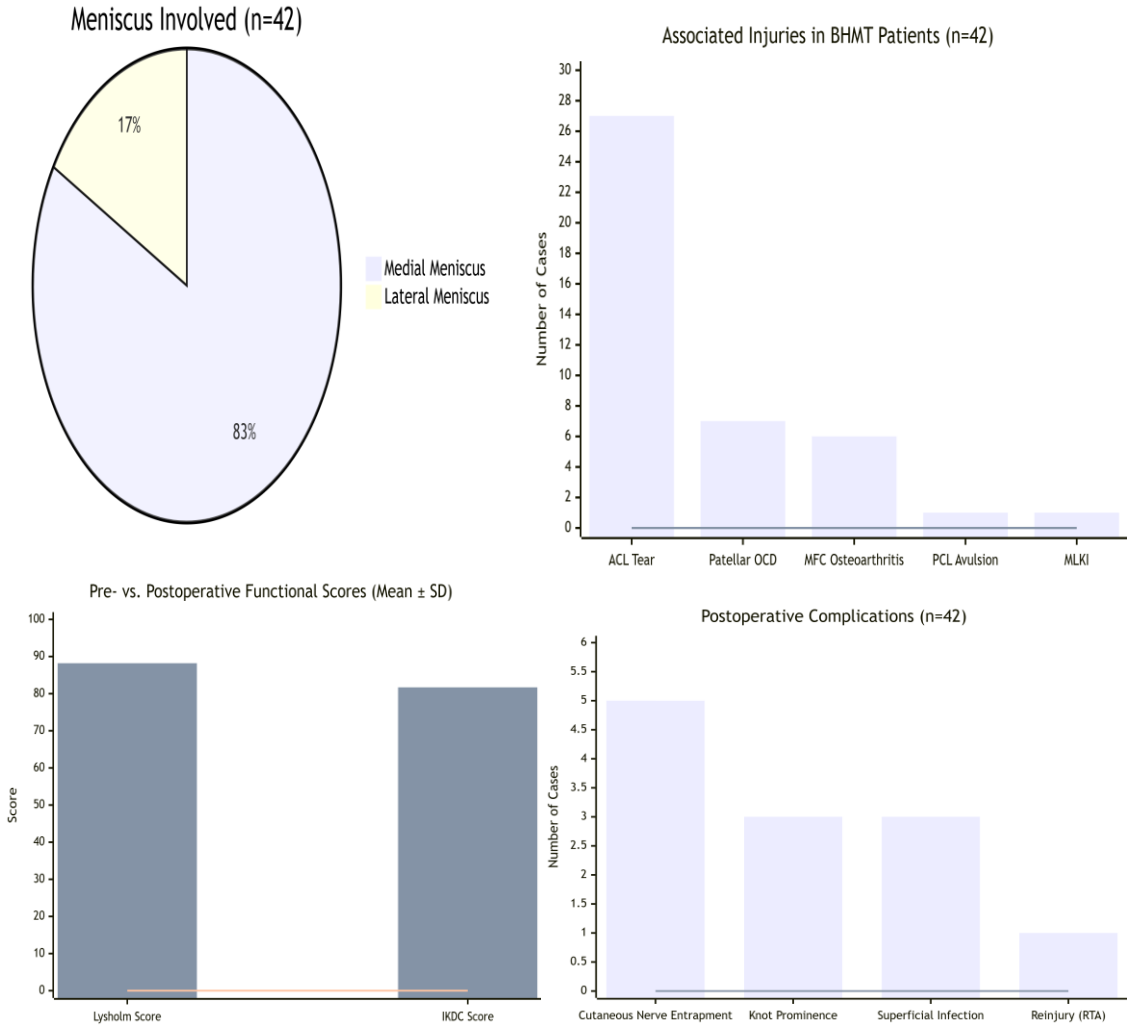
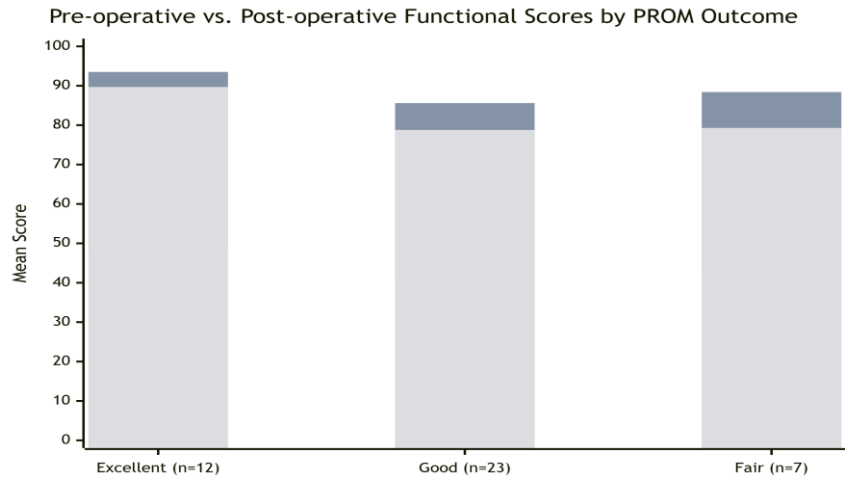
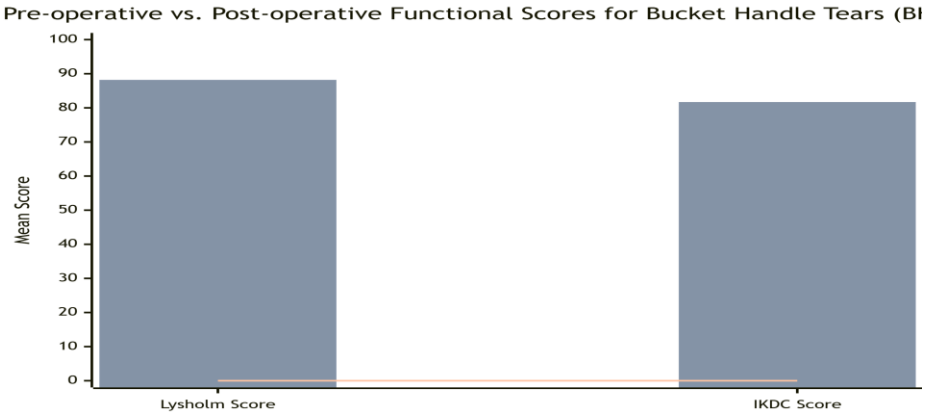


Table 11. SIGNIFICANT IMPROVEMENT BETWEEN PREOP (LYSHOLM AND IKDC) POSTOP (LYSHOLM AND IKDC) IN ALL PATIENTS

PROM	Type	N	Range	Min	Max	Sum	Mean	Std. Dev	Variance
Excellent	Age	12	16	17	33	312	26.00	5.257	27.636
	Preop LKS	12	28	47	75	740	61.67	8.359	69.879
	Preop IKDC	12	16.10	39.10	55.20	578.30	48.1917	5.79694	33.604
	Postop LKS	12	7	89	96	1122	93.50	2.680	7.182
	Post op IKDC	12	17.30	77.00	94.30	1076.30	89.6917	6.96713	48.541
Good	Age	23	28	17	45	703	30.57	8.328	69.348
	Preop LKS	23	71	0	71	1235	53.70	14.935	223.040
	Preop IKDC	23	55.20	0.00	55.20	952.70	41.4217	10.61028	112.578
	Postop LKS	23	95	0	95	1968	85.57	19.062	363.348
	Post op IKDC	23	98.90	0.00	98.90	1813.20	78.8348	19.69572	387.921
Fair	Age	7	17	21	38	194	27.71	6.550	42.905
	Preop LKS	7	24	46	70	379	54.14	9.245	85.476
	Preop IKDC	7	17.20	36.80	54.00	310.30	44.3286	5.87699	34.539
	Postop LKS	7	11	81	92	619	88.43	3.780	14.286
	Post op IKDC	7	13.80	72.40	86.20	555.30	79.3286	5.14675	26.489



MM	Type	N	Range	Min	Max	Sum	Mean	Std. Dev	Variance
BHT	Age	35	26	17	43	1013	28.94	7.348	53.997
	Preop LKS	35	75	0	75	1941	55.46	13.487	181.903
	Preop IKDC	35	55.20	0.00	55.20	1537.90	43.9400	9.69109	93.917
	Postop LKS	35	96	0	96	3087	88.20	15.859	251.518
	Post op IKDC	35	94.30	0.00	94.30	2858.40	81.6686	15.70736	246.721



DISCUSSION

The findings of our study, which highlight the safety and efficacy of bucket handle meniscal tear (BHMT) repair, align with and contribute to the existing body of literature on meniscal preservation. Our research, conducted at the Sri Lakshmi Narayana Institute of Medical Sciences, corroborates the significant functional improvement observed in patients following BHMT repair, as evidenced by the substantial increase in both Lysholm and IKDC scores from preoperative to postoperative assessments. This is consistent with other studies that have reported improved clinical outcomes after meniscal repair, showing significant improvement in Lysholm and IKDC scores. For example, one study found that mean preoperative Lysholm and IKDC scores of 61.67 and 48.19, respectively, improved to 93.50 and 89.69 post-op in the excellent outcome group.

A key finding from our study is the strong association of BHMT with concomitant injuries, most notably anterior cruciate ligament (ACL) tears, which were present in 64.3% of our cohort. Our results demonstrate that combined BHMT repair with ACL reconstruction yields superior patient-reported outcomes (PROMs) compared to isolated BHMT repair. This underscores the importance of addressing associated ligamentous instability during surgery to optimize functional recovery and is supported by similar conclusions in the literature. A previous systematic review also reported that combined ligament and meniscal repair resulted in good outcomes.

While other studies have shown that different repair techniques can influence outcomes, our study found no significant difference in PROMs among the various techniques (all-inside, inside-out, and outside-in). This supports the overarching principle of meniscal preservation as the preferred strategy, regardless of the specific technique used. A previous systematic review also indicated that there was no significant difference in functional outcome scores between isolated tears and combined tears. Our study further highlights that even in cases of complex tears requiring a partial meniscectomy, combining this with repair of the remaining meniscal tissue can still lead to satisfactory PROMs.

Our study's findings are also consistent with the observed complications reported in the literature. The most frequent complications in our study were cutaneous nerve entrapment (n=5), knot prominence (n=3), and superficial infection (n=3). The short-term follow-up of our study, with a mean of 2 years, is a limitation. Our results provide valuable short-term data supporting the effectiveness of meniscal repair, which can serve as a foundation for future, longer-term studies to assess the durability of these outcomes and the long-term risk of osteoarthritis. While our study did not use repeat MRI or re-look arthroscopy to objectively assess healing, which is a limitation, our PROM-based analysis offers a patient-centric view of functional recovery and satisfaction, an increasingly important metric in orthopedic surgery. Our results align with the consensus in the field that meniscal preservation is the gold standard for BHMT management whenever technically feasible.

CONCLUSION:

This study demonstrates that arthroscopic repair of bucket-handle meniscal tears is a safe and effective procedure, resulting in statistically significant and clinically meaningful improvements in patient-reported pain, function, and quality of life. The presence of concomitant injuries, particularly ACL tears which were present in **64.3%** of our cohort, significantly influences outcomes. **Our key finding is that combined BHMT repair with ACL reconstruction yields superior functional results compared to isolated meniscal repair.** Furthermore, the choice of repair technique-all-inside, inside-out, or outside-in-did not significantly impact PROMs, affirming that the principle of meniscal preservation is more critical than the specific method employed. While long-term follow-up is necessary, meniscal repair should be considered the gold standard for treating BHMTs when technically feasible to optimize knee biomechanics and potentially mitigate the risk of early osteoarthritis.

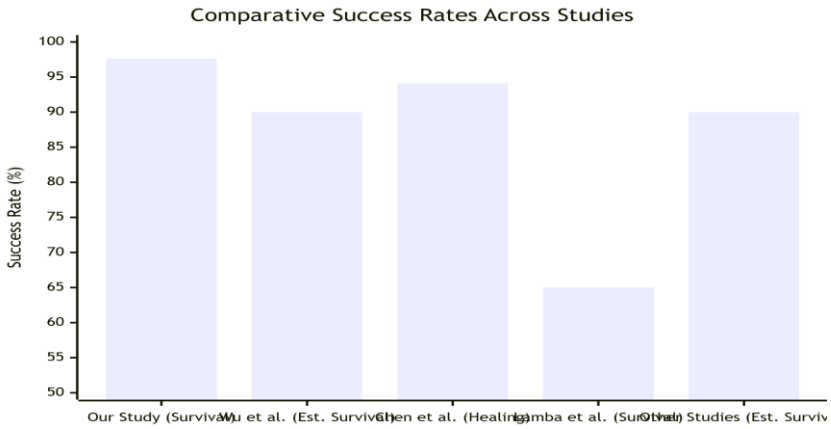
LIMITATIONS OF THE STUDY

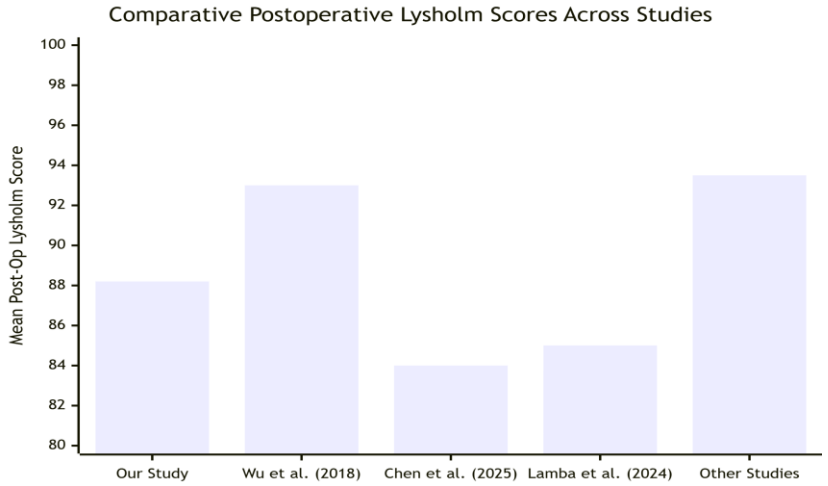
This study is limited by its retrospective design and the relatively small number of cases (n = 42). Additionally, the follow-up period was short, and no repeat MRI or relook diagnostic arthroscopy was performed to objectively assess healing.

Table 12. COMPARATIVE ANALYSIS OF OUR STUDY WITH OTHER STUDIES

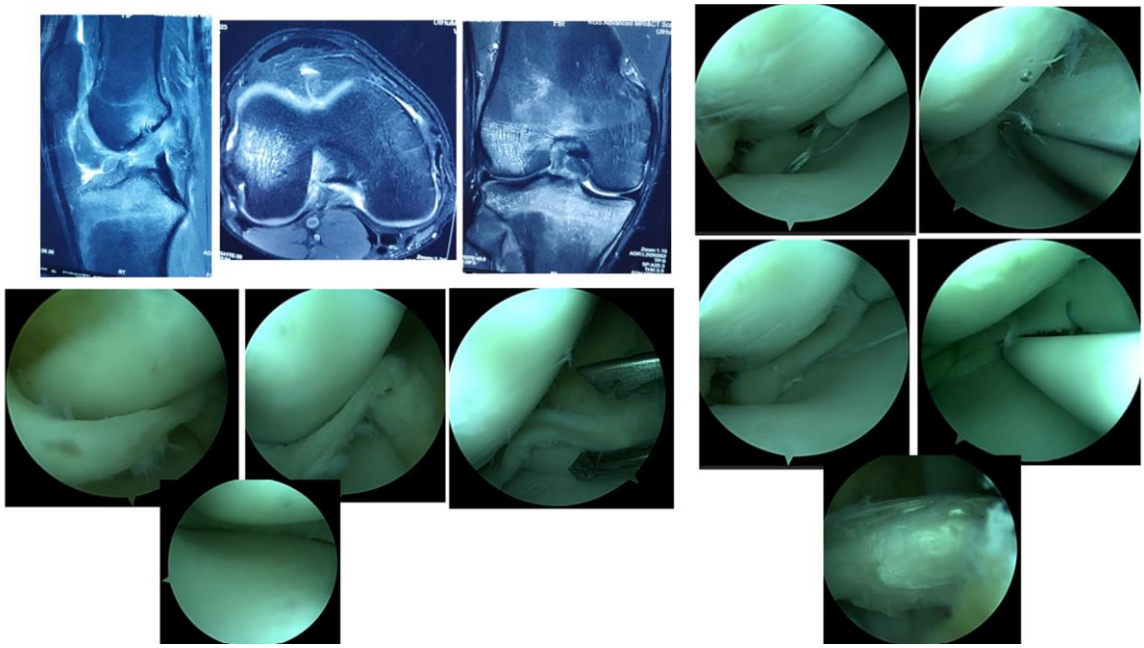
Metric	Our Study (2021–2024, n=42)	Wu et al. (2018, n=24)	Chen et al. (2025, n=34)	Lamba et al. (2024, n=66)	Other Studies (Aggregated)
Functional Outcomes	Postoperative Lysholm: 88.20 ± 1.86, IKDC: 81.67 ± 15.71 (significant improvement, $p < 0.001$). Combined BHMT + ACL reconstruction showed superior PROMs.	Postoperative IKDC: 93.1, Tegner: 6.6. No Lysholm score reported. Significant improvement noted.	Postoperative IKDC: 83.7 ± 8.2. No Lysholm score reported. Significant improvement in PROMs.	No specific Lysholm/IKDC scores reported. No significant PROM difference between all-inside and inside-out techniques at 11.2 years.	Postoperative Lysholm: 93.50, IKDC: 89.69 (excellent outcome group). Significant improvements in Lysholm and IKDC scores reported.
Associated Injuries	ACL tears: 64.3% (n=27), Patellar OCD: 16.7% (n=7), PCL avulsion: 2.4% (n=1), MLKI: 2.4% (n=1), MFC osteoarthritis: 14.3% (n=6). Combined repairs improved PROMs.	Not specified in web result.	Not specified in web result, but ACL tears likely present given BHMT context.	Not specified numerically, but ACL tears common; combined repairs noted to improve outcomes.	Strong association with ACL tears; combined ligament and meniscal repair improved outcomes.
Repair Techniques	No significant difference in PROMs among all-inside, inside-out, outside-in. Meniscal preservation emphasized.	All-inside technique reported. No comparison of techniques provided.	All-inside wrapping repair used, with 94.1% healing rate.	Compared all-inside (n=33) vs. inside-out (n=33); no significant PROM difference.	No significant difference in PROMs between all-inside and inside-out techniques. Inside-out with vertical mattress sutures noted for low failure rates.

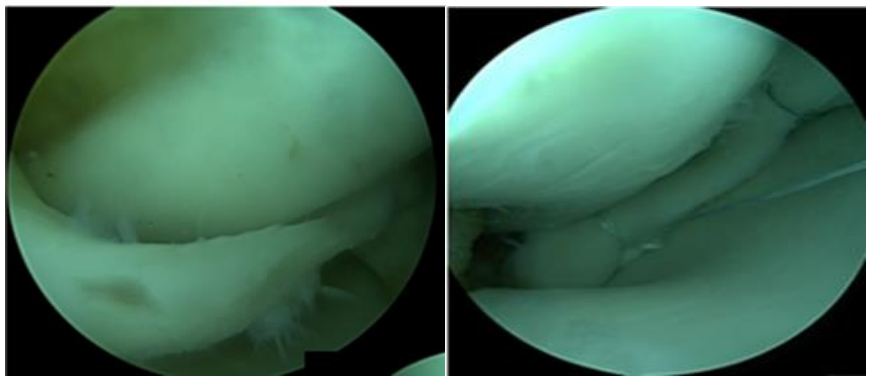
Complications	Cutaneous nerve entrapment (n=5), knot prominence (n=3), superficial infection (n=3), reinjury (n=1).	Not specified in web result.	Re-tear in 2 cases (5.9%). No other complications detailed.	Failure rates: 30% (all-inside, n=10), 40% (inside-out, n=13) at 11.2 years. No specific complications detailed.	Not specified in document or web results, but reoperation risk noted in long-term studies.
Survival/Failure Rates	Survival rate: 97.6% (1 reinjury out of 42).	Not specified in web result.	Clinical healing rate: 94.1% (2 re-tears out of 34).	Survival rates: 70% (all-inside), 60% (inside-out) at 11.2 years.	Not consistently reported; some studies note higher failure rates with meniscectomy vs. repair.
Limitations	Retrospective design, small sample size (n=42), short follow-up (2 years), no repeat MRI or arthroscopy for healing assessment.	Not specified, but likely limited by small sample size (n=24) and lack of long-term follow-up data.	Not specified, but small sample size (n=34) and focus on single technique (all-inside wrapping).	Long follow-up (11.2 years), but small sample size per group (n=33 each) and retrospective design.	Small sample sizes, heterogeneous populations, exclusion of associated injuries. Some note prolonged rehabilitation and residual stiffness.





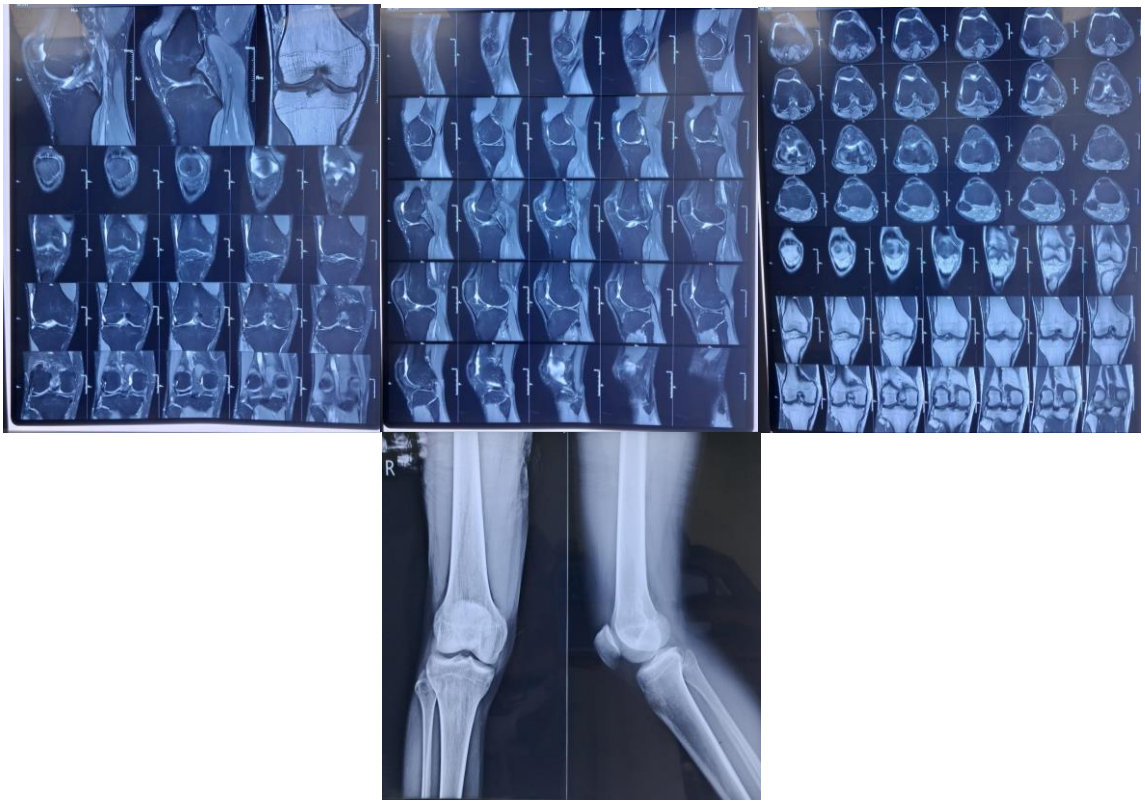
PATIENT 1
MRI, INTRA OP BUCKET HANDLE TEAR, REPAIR TECHNIQUE



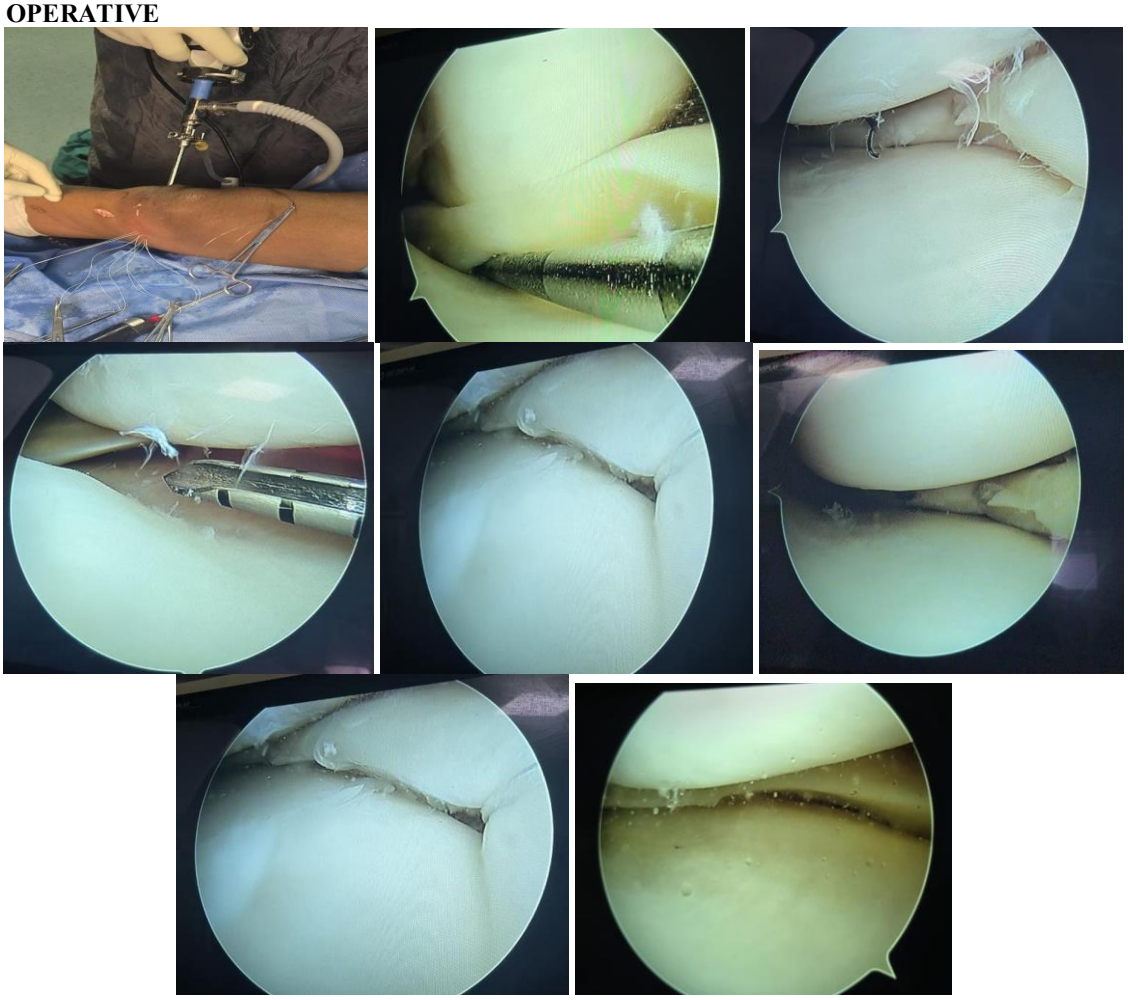


BEFORE REPAIR AFTER REPAIR

PATIENT 2
PRE OPERATIVE



INTRA OPERATIVE



POST OPERATIVE

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