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Functional outcome of arthroscopic all-inside meniscal repair: A single-centre prospective observational study

Jishnu S[1], Shyam Roy[1], Binoy S[1], and Shibu R[1,*]

[1]Department of Orthopaedics, Government Medical College, Thiruvananthapuram, Kerala 695011, India

Abstract

Background: Meniscus repairs enhance the knee function, increase activity levels, slow the course of osteoarthritis and improve functional outcome compared to partial meniscectomy. Although various methods are available, the optimal technique for meniscal repair remains under investigation. This study examines the functional outcomes and the factors influencing the outcomes of arthroscopic all-inside meniscus repair.

Materials and methods: Eighty-seven patients who had arthroscopic all-inside repair were included in a prospective observational study. One year after surgery, the patients' functional outcomes were assessed using international knee documentation (IKDC), Tegner score and Lysholm knee scores.

Results: The mean pre-operative Lysholm score was 61.7±18.8 and post-operative score one-year post-surgery was 87.4±6.42 (p<0.001). The mean pre-operative Tegner score was 3.43±2.07 and post-operative score 7.25±1.46 (p<0.001). The mean pre-operative IKDC score was 53.4 ±11.7 and post-operative score 86.7±5.93 (p<0.001). Longitudinal tears after one year of repair had a mean IKDC score of 91.71, Tegner score of 8.45 and Lysholm score of 90.15. Horizontal tears showed IKDC score of 89.19, Tegner score of 7.55 and Lysholm score of 92.55; and flap tears had a mean IKDC score of 72.56, Tegner score of 4.85 and Lysholm score of 75.65.

Conclusion: With the best results shown in horizontal and longitudinal tears, the arthroscopic all-inside meniscal repair showed significant efficacy across a range of tear patterns. This surgical approach worked well for regaining knee stability and function and allowed patients to return to normal physical activity after the procedure.

Keywords: meniscus tear; arthroscopy; all-inside repair; functional outcome

Introduction

The medial and lateral menisci are two fibrocartilaginous structures situated between the femoral condyles and the tibial plateau. Both menisci are wedge-shaped in cross-section, which is crucial for their function in load distribution and joint stabilization. The meniscal tissue comprises of dense collagen fibers arranged in a circumferential pattern, providing tensile strength. This arrangement allows the menisci to withstand compressive loads and maintain joint stability. The vascular supply of the menisci is critical to their function and healing. The outer one-third of the meniscus, known as the red-red zone, is well vascularized, which aids in healing [1]. The middle one-third, or red-white zone, has a limited blood supply, while the inner one-third, the white-white zone, is avascular, making injuries in this area less likely to heal [1, 2].

Meniscal tears are a common knee injury and can result from a normal force acting on a degenerative meniscus or from an excessive force applied to a normal meniscus. A twisting injury on a semi-flexed limb through a weight-bearing knee is the most frequent mechanism

***Corresponding author:** Dr. R. Shibu, Associate Professor, Department of Orthopaedics, Government Medical College, Thiruvananthapuram, Kerala 695011, India. Email: drshibur@gmail.com

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of damage. Injuries to other ligaments, usually the anterior cruciate ligament (ACL) may also be linked to it [3, 4]. Orthopaedic surgeons are now encouraged to do arthroscopic repair of torn menisci whenever possible, despite the fact that partial or complete meniscectomies were once thought to be the standard of care. Meniscus repair has been demonstrated to enhance knee function, increase activity levels, slow the course of osteoarthritis and improve long-term functional outcome compared to partial meniscectomy [4-6].

There are various techniques for meniscal repair like in-side-out, outside-in and all-inside methods. Although various methods are available, the optimal technique for meniscal repair remains under investigation. All-inside repair method has gained popularity due to its minimally invasive nature and reduced risk of neuro-vascular injuries [7, 8]. All-inside meniscus repair involves the use of specialized devices that allow surgeons to repair meniscal tears from within the joint capsule. This technique avoids the need for accessory incisions, which are required in inside-out and outside-in repair methods [9-11]. This study examines the functional outcomes and the potential factors that may influence the outcomes associated with all-inside meniscus repair.

The primary objective was to estimate the functional outcome of arthroscopic all-inside method of meniscal repair in patients with meniscal injuries. The secondary objectives were to compare the outcome in various tear pattern of meniscus repaired by all-inside method, and to assess the sociodemographic factors associated with good functional outcome.

Materials and methods

The study was conducted as a prospective observational study at the Department of Orthopaedics, Government Medical College, Thiruvananthapuram, from March 2023 to August 2024, after IEC approval. Eighty-seven consecutive patients of age group 18 to 60 years, undergoing arthroscopic all-inside meniscal repair in Government Medical College, Thiruvananthapuram, were included in the study. Patients with isolated meniscal injuries and meniscal injuries associated with cruciate ligament injuries were included. The exclusion criteria were patients who underwent a previous meniscal surgery, patients having features of knee arthritis during arthroscopy, patients with meniscal injuries in the white-white region of menisci, patients undergoing hybrid repair of menisci, patient who doesn't give consent, patients with previous septic arthritis of the knee and patients with fractures around the knee joint.

Surgical technique

With the patient supine, diagnostic arthroscopy was done to identify the meniscal tear. The tear is prepared with a meniscal rasp or arthroscopic motorized shaver, creating a vascular bed conducive to tissue healing. The all-inside suture device [FiberStitch™ Implant, Arthrex] is inserted protected by a skid. The device's tip is brought to the desired site on the meniscus and penetrated to the predetermined depth. Pulling back on the trigger deploys the first suture bundle behind the capsule. The device is then brought out of the tissue and inserted into the second desired location. Pulling the trigger again deploys the second suture bundle. The stitch is tensioned and cut. Sutures are added depending on the size of tear. Touch-down weight bearing with walker and physiotherapy started the next day. Full weight bearing is allowed after six weeks.

Data was collected from the study subjects using the subjective IKDC knee scoring system, Tegner's activity scale, and Lysholm knee scoring scale, before the procedure and on follow up at one year after repair. Subjective IKDC scoring system grades the symptoms, sports activities and functional status of the knee. Tegner's activity scale grades activity based on work and sports activities from 0 to 100. Lysholm knee scoring scale is a 100-point scoring system for examining a patient's knee specific symptoms and this score combine objective physician assessed clinical data with subjective functional data obtained from patient.

Statistical analysis

Data was entered in MS excel & analysed using SPSS Statistics V26 (Chicago, USA) software. Categorical variables were expressed as percentages and continuous variables were expressed as mean and standard deviation. Associations of the factors were tested using tests of significance (chi-square/ t-test).

Results

Eighty-seven patients were included in the study. Majority of the patients (40.2%) were within the 21-30 years age group, followed by 33.3% in the 31-40 years age group (Table 1). The mean age of the patients was 32.5 ±8.9 (19 – 55) years. Out of the total participants, 52 (59.8%) were male, while 35 (40.2%) were females (Table 2). Pre-operatively, patients had knee pain (94.3%), limping (80.5%), locking (70.1%), instability (74.7%) or knee swelling (60.9%). The McMurray test was positive in 79 (90.8%) patients. Associated ACL injury was seen in 78 (89.7%) patients (Table 3). Thirty-nine (44.8%) patients had horizontal tear, while 22 (25.3%) had longitudinal tears (Table 4).

Table 1: Distribution of patients based on age.

Age group (Years)	*Frequency*	*Percentage*
≤ 20	6	6.9
21-30	35	40.2
31-40	29	33.3
41-50	16	18.4
51-60	1	1.2

Table 2: Analysis based on age.

	N	*Mean*	*SD*	*Range*	*Minimum*	*Maximum*
Age	87	32.5	8.9	36	19	55

Table 3: Analysis of pre-operative data.

Data	*Level*	*Count*	*Total*	*Proportion*
Gender	Male	52	87	0.598
	Female	35	87	0.402
Pain	Present	82	87	0.943
	Absent	5	87	0.057
Limping	Present	70	87	0.805
	Absent	17	87	0.195
Locking	Present	61	87	0.701
	Absent	26	87	0.299
Instability	Present	65	87	0.747
	Absent	22	87	0.253
Swelling	Present	53	87	0.609
	Absent	34	87	0.391
McMurray +ve	Present	79	87	0.908
	Absent	8	87	0.092
ACL injury	Present	9	87	0.103
	Absent	78	87	0.897

Table 4: Meniscal tear types.

Level	*Count*	*Proportion*
Horizontal	39	0.4483
Bucket handle	12	0.1379
Longitudinal	22	0.2529
Radial	13	0.1494
Flap tears	1	0.0115

Longitudinal tears after one year of repair demonstrated a mean IKDC score of 91.71, Tegner score of 8.45 and Lysholm score of 90.15. Horizontal tears showed mean IKDC score of 89.19, Tegner score of 7.55 and Lysholm score of 92.55 one year after repair (Table 5). Flap tears had a postoperative mean IKDC score of 72.56, Tegner score of 4.85 and Lysholm score of 75.65.

Table 5: Comparison of outcomes after 12 months based on tear pattern.

Type of meniscal tear	*Post-op IKDC score*	*Post-op Lysholm score*	*Post-op Tegner score*
Horizontal	89.19	92.55	7.55
Longitudinal	91.71	90.15	8.45
Bucket handle	79.58	82.14	5.11
Radial	83.38	84.44	5.95
Flap	72.56	75.65	4.85

The mean Lysholm score of outcomes with meniscal tears associated with ACL injuries was 90.78, Tegner score was 8.11 and IKDC scores was 89. The mean Lysholm score, Tegner score and IKDC score of outcomes with isolated meniscal tears was 87.06, 7.45 and 86.49 respectively, but not statistically significant (Table 6).

Table 6: Comparison of outcomes based on ACL injury.

	ACL	*N*	*Mean*	*SD*	*p value*
Lysholm score	A	78	87.06	6.294	0.155
	P	9	90.78		
Tegner score	A	78	7.45	1.234	0.076
	P	9	8.11		
IKDC score	A	78	86.49	5.923	0.253
	P	9	89.00		

The mean pre-operative Lysholm score was 61.7 (±18.8; range 30-85) and the mean post operative score one-year post-surgery was 87.4 (±6.42; range 20-99) with a statistically significant p-value of <0.001 (Table 7 & 8). The mean pre-operative Tegner score was 3.43 (±2.07; range 0-7) and the mean post operative score one-year post-surgery was 7.25 (±1.46; range 2-9) with p-value <0.001. The mean pre-operative IKDC score was 53.4 (±11.7; range 33-69) and the mean post operative score one-year post-surgery was 86.7 (±5.93; range 79-96) with p-value <0.001.

Discussion

Majority of the patients treated using this method experienced substantial improvements in knee function, as measured by the Lysholm, Tegner, and IKDC scoring systems, with marked progress noted at 12-month postoperative interval. The Lysholm score, which measures knee function and stability, demonstrated significant improvement following meniscal repair using the all-inside method. The mean preoperative Lysholm score was 61.7 ± 18.8, with a maximum of 85 and a minimum of 30, indicating moderate knee function

Table 7: Pre-op and 1-year post op scores.

	Lysholm		*Tegner*		*IKDC*	
	Pre-op	*Post op*	*Pre-op*	*Post op*	*Pre-op*	*Post op*
N	87	87	87	87	87	87
Mean	61.7	87.4	3.43	7.25	53.4	86.7
Std. error mean	2.02	0.688	0.222	0.156	1.26	0.636
95% CI mean lower bound	57.7	86.1	2.98	6.94	50.9	85.5
95% CI mean upper bound	65.7	88.8	3.87	7.56	55.9	88
Median	67	87	3	8	56	86
Standard deviation	18.8	6.42	2.07	1.46	11.7	5.93
Range	55	20	7	7	36	17
Minimum	30	79	0	2	33	79
Maximum	85	99	7	9	69	96

prior to surgery. One year postoperatively, the mean Lysholm score increased substantially to 87.4 ± 6.42, with a maximum of 99 and a minimum of 79 solidifying the long-term benefits of the surgical intervention. The results are statistically significant with a p-value of <0.001.

Table 8: P-value of Lysholm, Tegner & IKDC – preop & postop scores.

Pre-op	*1 year post op*		*statistic*	*df*	*p*
Lysholm	Lysholm	Student's t	-12	86	<.001
Tegner	Tegner	Student's t	-12.5	86	<.001
IKDC	IKDC	Student's t	-23.5	86	<.001

The mean preoperative Tegner score was 3.43 ± 2.07, indicating a reduced level of physical activity due to meniscal injury, with a maximum score of 7 and a minimum of 0. By 12 months, the mean Tegner score improved to 7.25 ± 1.46, with scores ranging from 2 to 9, reflecting a return to higher levels of physical activity. The results are statistically significant with a p-value of <0.001.

The International Knee Documentation Committee (IKDC) score, which is a standardized measure of knee symptoms and function, showed considerable improvement postoperatively. The mean preoperative IKDC score was 53.4 ± 11.7, with a maximum of 69 and a minimum of 33, indicating severe knee dysfunction pre-surgery. At 12 months, with the mean score reaching 86.7 ± 5.93, and scores ranging from 79 to 96, reflecting significant functional recovery. The results are statistically significant with a p-value of <0.001. Mean postoperative IKDC score was 88.19 (range: 64.37-98.95) in the study by Laurendon et al [12]. In their study bucket handle tears showed poor prognosis contrary to flap tears in present study.

Longitudinal tears showed better outcomes after one year with a mean IKDC score of 91.71, Tegner score of 8.45 and Lysholm score of 90.15; followed by horizontal tears with mean IKDC score of 89.19, Tegner score of 7.55 and Lysholm score of 92.55 (Table 5). Longitudinal and horizontal tears exhibited the most favourable outcomes. Patients with radial and bucket handle tears also showed considerable recovery, although these types presented more challenges, leading to slightly lower success rates and slower recovery. The outcomes for flap tears were less predictable, with patients demonstrating the least improvement (postoperative mean IKDC score of 72.56, Tegner score of 4.85 and Lysholm score of 75.65), reflecting the complexity of these tears and the inherent difficulties in achieving optimal surgical results. These findings underscore the efficacy of the all-inside method for a range of meniscal injuries while highlighting the variability in outcomes based on tear type.

The mean Lysholm, Tegner and IKDC scores of outcomes with tears associated with ACL injuries was greater than that with meniscal tears alone (90.78 v/s 87.06, 8.11 v/s 7.45, 89 v/s 86.49 respectively), but the results are not statistically significant. None of the patients had instability, numbness, effusion or infection postoperatively.

Rufina Ali et al [13]; in their study showed that the mean age of patients was 26.31±7.11 and 89.75 were males. In present study the mean age was 32.5 ±8.9 and 59.8% were males. The mean Lysholm score was 90.03 ± 8.85 in their study compared to 87.4 ± 6.42 in the present study. The mean Lysholm score with anterior

cruciate ligament tear was 89.64 ± 9.44 and with isolated meniscal tear was 92.50 ± 2.88, which was not significant (p-value = 0.831), in their study. The results were similar to the present study. ACL restoration combined with meniscal repair produced positive functional and clinical outcomes and consistently high meniscal healing rates according to a study by Pathak et al [14]. Lysholm Tegner score at final follow up was 88.42±9 in the study by Singh et al [15].

The IKDC scores in the all-inside repair was 93.26±4.45 and Tegner score 95.33±2.45 in a study by Malhotra et al [16], comparable to present study. They had 2 cases of knee stiffness. Study by Ciapini et al., concluded that even for patients over 40, the all-inside suture approach may be a good and dependable option for suturable meniscal injuries [17]. Panchal et al: concluded that the mean IKDC and Lysholm scores were 81.72 ± 14.23 and 93.32 ± 14.63, respectively after all-inside repair [18]. In terms of functional outcomes, the all-inside approach had improved Lysholm scores than inside-out, although both approaches had similar IKDC and Tegner scores as concluded in a meta-analysis by Elmallah et al [9].

The Lysholm score which measures knee function and stability, the Tegner score, which assesses the level of physical activity, the IKDC score, which is a standardized measure of knee symptoms and function all demonstrated significant improvement following meniscal repair using the all-inside method.

Conclusion

With the best results shown in horizontal and longitudinal tears, the all-inside approach to meniscal repair showed significant efficacy across a range of tear patterns. Flap tears were the most difficult to achieve the best results, whereas radial and bucket handle tears were difficult but still demonstrated significant improvement. All things considered, this surgical approach worked well for regaining knee stability and function and allowed patients to return to normal physical activity after the procedure. Future research should focus on long-term follow-up and the development of enhanced techniques to address the challenges associated with more complex tear patterns.

Conflicts of interest

Authors declare no conflicts of interest.

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