

E-ISSN: 2395-1958  
P-ISSN: 2706-6630  
IJOS 2023; 9(2): 135-141  
© 2023 IJOS  
<https://www.orthopaper.com>  
Received: 06-02-2023  
Accepted: 08-03-2023

**Dr. Sharad Parmar**  
BJ Medical College, Asarwa,  
Ahmedabad, Gujarat, India

**Dr. Sanyam Panchani**  
BJ Medical College, Asarwa,  
Ahmedabad, Gujarat, India

**Dr. Samarth Patel**  
BJ Medical College, Asarwa,  
Ahmedabad, Gujarat, India

**Dr. Amay Khara**  
BJ Medical College, Asarwa,  
Ahmedabad, Gujarat, India

**Corresponding Author:**  
**Dr. Sharad Parmar**  
BJ Medical College, Asarwa,  
Ahmedabad, Gujarat, India

## Outcomes and management of acute and chronic medial meniscus injury

**Dr. Sharad Parmar, Dr. Sanyam Panchani, Dr. Samarth Patel and Dr. Amay Khara**

DOI: <https://doi.org/10.22271/ortho.2023.v9.i2b.3362>

### Abstract

This study aims to identify various criteria which can affect the Functional outcome of acute and chronic medial meniscus repair done by arthroscopic surgery and study the associated knee injuries seen with damage to the medial meniscus. This is a retrospective study done in Civil Hospital Ahmedabad for patients operated in 2016-2017 calendar year, inclusion and exclusion criteria's have been listed. Assessment is done using the Tegner Lysholm score.

**Keywords:** Joint articular cartilages, arthroscopic surgery, chondral injury, Sports injuries

### Introduction

The knee joint has two menisci. Each meniscus is a crescent-shaped fibro cartilage which divide partly a joint cavity. They are crucial to the healthy knee. They are responsible for load transmission across the knee, increasing the conformity between the particular surfaces while reducing the joint contact pressure. They are shock absorbers and they are involved in stabilization, proprioception, lubrication and nutrition for the joint articular cartilages.

Each meniscus has two insertions, an origin and an attachment. These 4 strong ligaments in clinical practice are referred as roots and they link this moon shaped cartilages to the articular surface of the tibial bone, also called tibial plateau. Menisci are essential for maintaining the ability to convert axial loads into circumferential tension. Participation in sports and recreational activities are risk factors for knee injury. Often unrecognized, when a menisci tears, the knee cartilages are exposed to increased stress. These are severe meniscal injuries that predispose the knee joint to degenerative changes and early osteoarthritis. Moreover, injuries to the menisc. It can also lead to meniscal extrusion, decreased contact surface, and ultimately articular degeneration.

These lesions can occur in two different settings: (i) acute and ii) chronic. Acute menisci tears usually take place in acute knee traumas; they can usually be seen as sport injuries. Chronic tears instead are mainly seen in degenerative diseases where the knee is involved.

Meniscal tears are classified as longitudinal, vertical (transverse), or horizontal. Bucket-handle tears are classified as longitudinal tears that eventually separate and may cause locking of the joint. The parrot-beak tear is a pedunculated tag tear located on the posterior horn. MRI has a fair accuracy rate for detecting medial (88%) and lateral (88%) meniscal tears. According to Gelb *et al.*, MRI has a sensitivity of 82% and a specificity of 87% for an isolated meniscal lesion <sup>[1]</sup>.

Common clinical symptoms are knee pain, joint line tenderness and mechanical symptoms such as locking, giving away and catching. Although, these symptoms can vary greatly among patients, ranging from undetectable to very severe.

Management is variable based upon many factors like the injury itself, its timing and the baseline conditions. It spans from a non-operative and conservative approach to complete surgical interventions if the former becomes refractory and fails. There is an increased awareness of meniscal perseveration. In long-term studies, meniscectomy has clinically been shown to result in an increased incidence of radiological signs of arthritis. As early as 1948, Fairbank radiographically demonstrated degenerative changes in knees after total meniscectomy <sup>[2]</sup>.

Meniscal repair aims to achieve meniscal healing, avoiding the adverse effects of meniscectomy. Meniscal repair techniques largely depend on the type of tear, presupposing precise pre- and intra-operative assessment. The present paper does not deal with results or indications, including the essential choice between abstention, repair and meniscectomy. Suffice it to say that attitudes need inverting the paradigm, considering the possibility of meniscal preservation before even partial meniscectomy. In adults, the blood supply to the menisci of the knee reaches the outer 10% to 33% of the body of the menisci. This portion of the menisci is capable of inflammation, repair, and remodeling. Anterior cruciate ligament (ACL) ruptures are commonly associated with meniscus tears. The prevalence of associated meniscus injuries in patients with ACL ruptures has been found to be 65% in acute injuries and 90% in chronic injury of ACL [3, 4]. Meniscus repair performed simultaneously with ACL reconstruction can give additional stability to the knee joint [5]. The healing rate of repaired meniscus associated with ACL reconstruction is 92%, compared to only 63% in meniscus tears not associated with ACL reconstruction [6-8]. Generally, the treatment of a meniscus tear combined with an ACL rupture is repair rather than a meniscectomy because the bleeding and debris from the ACL reconstruction starts an inflammatory reaction that helps the meniscus' healing phase [9, 11]. The other reason that repair is preferred, is that the healed meniscus can help add stability to the knee joint [11]. The arthroscopic meniscus repair method can be categorized as all-inside, outside-in, or inside-out. Inside out or outside-in repair techniques require additional skin incisions and can cause neurovascular injury and soft tissue irritation [12-15]. All-inside repair with meniscal implants and devices has been popularly used because of its advantages, such as its ease of use and shorter repair time [16, 17]. However, it has some disadvantages such as implant breakage, failure of repair, infection, and Chandra injury [18, 19].

### Aims and Objectives

#### This study was carried out to:

1. Evaluate the midterm functional outcome of arthroscopic medial meniscus repair.
2. To evaluate influence of various parameters on medial meniscus repair such as age and sex of patient, cause of tear, side affected, associated procedures and techniques.
3. To find out the associated knee injuries related to medial meniscus tear.

### Material and Methods

This a retrospective study conducted in B.J Medical College and Civil Hospital, Ahmedabad from January 2021 to May 2021. There were 100 patients included in our study of which 78 patients (78%) were male and 22 (22%) were female. 56 patients (56%) had right side injury while 44 (44%) had injury to the left knee. The patients were followed up for an average duration of 4.2years with minimum follow up of 3years and maximum follow up of 5years. All young and middle age patients presenting with unilateral knee complaints and history of trauma to the knee in the Orthopaedic emergency and outpatient departments in B.J Medical College And Civil Hospital, Ahmedabad were evaluated by a thorough general and local examination of the knee. In a relaxed patient and in supine position, the uninjured knee was examined first to establish ligament and menisci excursions after which the affected knee was examined. Patients were examined for joint line tenderness, signs of effusion and any complains of

locking of knee joint. The following specific tests were performed for diagnosing meniscus tear:

1. McMurray's Test
2. Thessaly Test

### Injuries to the associated structures were assessed by performing the following clinical tests.

1. Valgus/ varus stress test (for collateral ligaments)
2. Anterior Drawer test, Lachman's Test and Pivot shift Test (for Anterior Cruciate Ligament)
3. Posterior drawer test (for posterior cruciate ligament)

Routine radiographs of both knees in standing position in anteroposterior view and lateral view of the affected knee were taken. MRI of the knee was done in all Medial meniscus Tear cases for confirmation.

### Inclusion criteria

#### The following patients were included

- Clinical /MRI evidence of symptomatic individuals with a medial meniscus tear treated with meniscus repair.
- Patients between ages 20 to 50yrs (skeletal matured patients).
- Associated with ACL and PCL injuries.
- A normal contralateral knee.

### Exclusion criteria

- Clinical /MRI evidence of symptomatic individuals with a medial meniscus tear treated with meniscectomy.
- Patients with systemic diseases compromising their pre-anesthetic fitness.
- Age > 50yrs.
- Patient with osteoarthritis knee.
- Associated Grade 3 and 4 MCL and LCL injuries.
- Patients with associated fracture of tibial plateau.
- Patients with local skin infections.
- Patients requiring revision surgery or second look surgery.
- History of previous surgery in the knee.
- Associated pre-existing chondromalacia patellae or associated chondral injury.

### Pre-operative work up

Patients with medial meniscus tear proven clinically and radiologically is admitted in Department of Orthopedics, Civil Hospital, and Ahmedabad. Routine investigations like hemoglobin, total and differential counts, platelet count, Reactive status, chest X-Ray, ECG were taken and anesthetic assessment for regional and general anesthesia was done.

### Pre-operative Rehabilitation

1. Pre-operative strength and range of movement of knee joint were measured and documented
2. Static and dynamic quadriceps exercise were taught to patients while awaiting surgery.
3. All patients were enlightened on post-operative rehabilitation.

### Functional outcome assessment

All patients were subjected to post-operative anteroposterior and lateral radiographs to determine the tunnel placement and position of end button and interference screw with associated ACL repair. Patients were followed at 6 weeks, 6 months and 1 year and 4years functional outcomes assessed.

**The International Knee Documentation 2000 score (IKDC)**

The Subjective IKDC scale was evaluated by summing the scores for the individual items and then transforming the score to a scale that ranges from 0 to 100. To calculate the final subjective IKDC score simply add the score of each item and divide by the maximum possible score which was 87.

Subjective IKDC score =  $[\text{Sum of items} / \text{Maximum possible score}] \times 100$

The score is interpreted as a measure of function such that higher scores represent higher levels of function and lower levels of symptoms. A score of 100 is interpreted to mean no limitation with activities of daily living or sports activities and the absence of symptoms.

The Tegner Lysholm Knee Scoring Scale consists of eight parameters for evaluation. The parameters evaluated are

1. Limping
2. Aided walking
3. Episodes of knee locking
4. Knee instability
5. Knee pain
6. Knee swelling
7. Climbing of stairs
8. Squatting

The individual parameters were allotted specific scores depending on the patient’s functional ability. The maximum possible knee score was 100. Based on the outcome scores they were divided into Excellent, Good, Fair and Poor.

- Excellent – 95-100.
- Good – 84-94.
- Fair – 65-83.
- Poor – 64 or less.

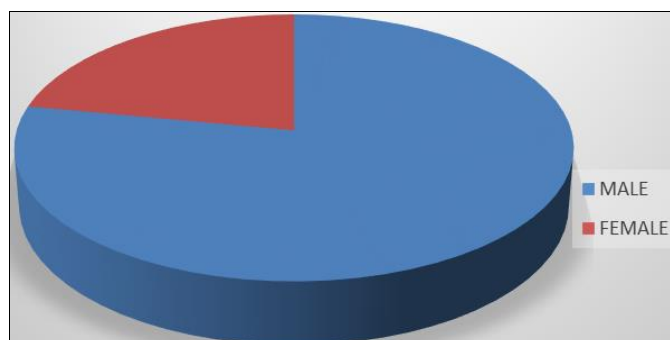
The IKDC knee score and Lysholm knee score forms are attached as annexure I and II respectively.

**Observations & results**

Hundred cases of arthroscopic medial menisci repair were regularly followed for an average period of 4.2yrs in B.J Medical College, Ahmedabad (from January 2021 to May 2021).

**Sex**

	No. of Patients
Male	78
Female	22



The 100 patients included in our study, 78 (78%) were Male

patients and 22 (22%) were female.

**Side Involvement**

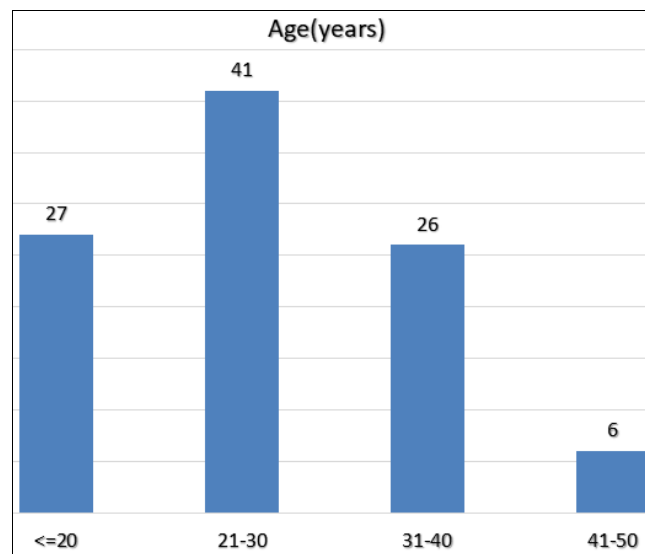
	No. of Patients
Right	56
Left	44



In this study, the right side was more commonly injured (56%) than the left side (44%)

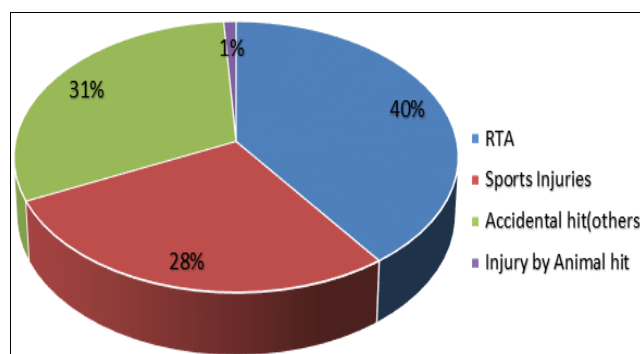
**Age distribution**

Age (in years)	No. of Patients
<= 20	27
21-30	41
31-40	26
41-50	6



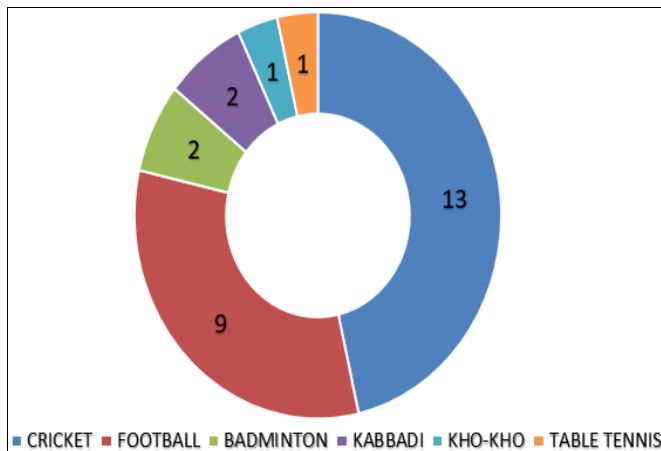
Most of the patients (41%) were in the age group of 21 to 30 years followed by 27% in the age group of <=20 years.

**Mode of trauma**



The most common mode of injury in our study was Road Traffic Accidents (40%) followed by accidental fall (31%). The other modes of injury in our study were sports injury and hit by animal.

**Sports injuries**

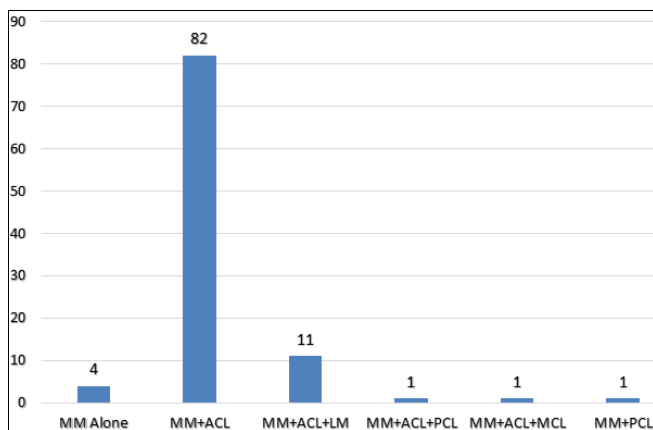


In this study, Cricket was the most common sport causing injury to the medial meniscus.

**Associated knee injuries**

	Percentage
MM ALONE	4
MM+ACL	82
MM+ACL+LM	11
MM+ACL+PCL	1
MM+ACL+MCL	1
MM+PCL	1

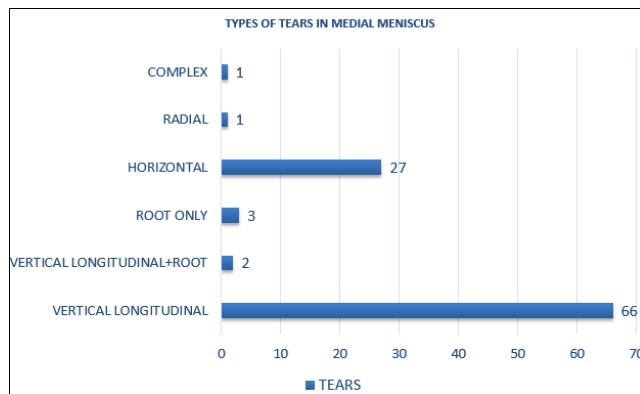
**Associated knee injuries with medial meniscus tear**



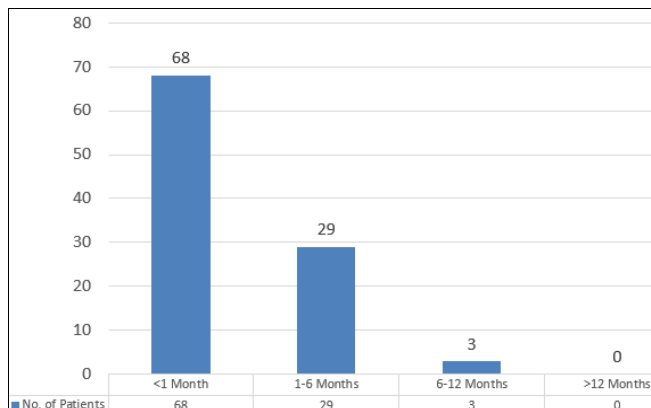
In our study, there was associated ACL injury in 95% of patients. Isolated MM tear was present in 4 patients (4%).

**Types of tears**

	No. of Patients
Vertical longitudinal	66
Vertical longitudinal+ root	2
Root only	3
Horizontal	27
Radial	1
Complex	1



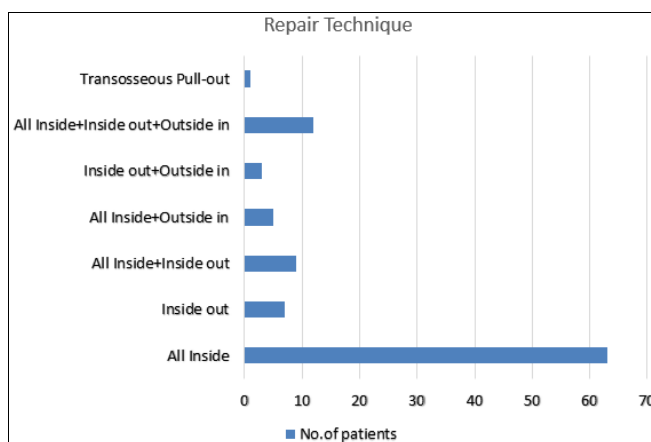
**Injury to Operation Duration**



In our study, most of the patients (68%) presented within 1 month after injury

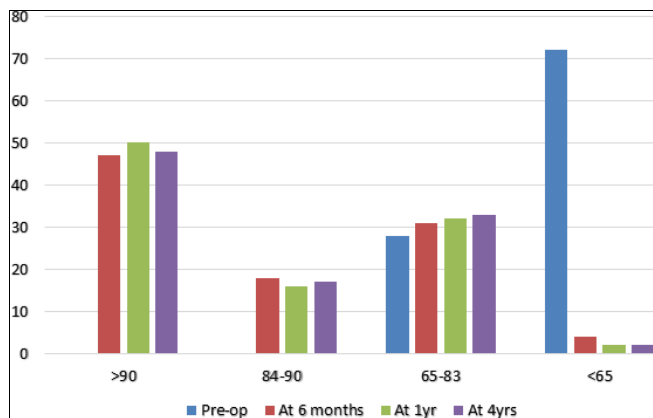
**Types of Technique used**

	No. of patients
All Inside	63
Inside out	7
All Inside Inside out	9
All Inside Outside in	5
Inside out+Outside in	3
All Inside+Inside out+Outside in	12
Tran osseous Pull-out	1



The most common technique employed for repair was all-inside (63%) while all the techniques (All-inside, Inside out and Outside in) together were used in 12 patients to achieve satisfactory results.

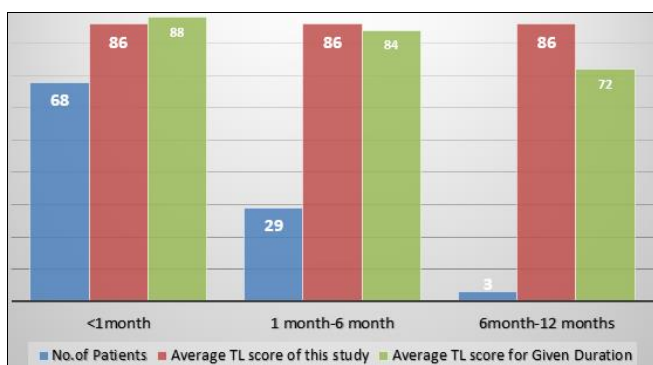
**Tegner Lysholm Score**



Tegner Lysholm Score		Pre-op	At 6 months	At 1yr	At 4yrs
> 90	Excellent	0	47	50	48
84-90	Good	0	18	16	17
65-83	Fair	28	31	32	33
<65	Poor	72	4	2	2

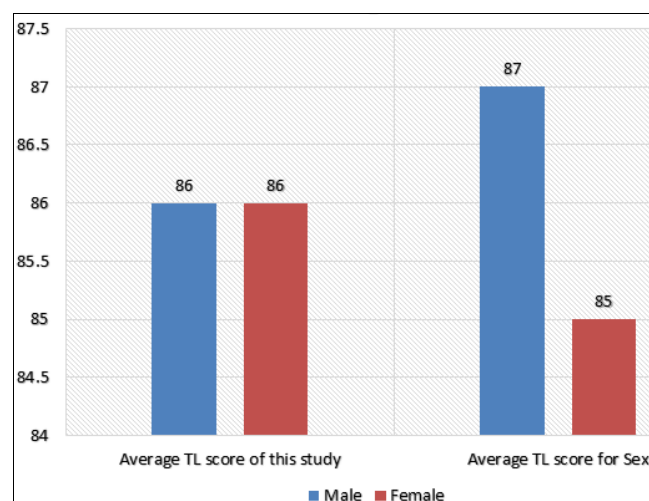
Functional Outcomes Scores average	Pre-op	At 6 months	At 1yr	At 4yrs
IKDC Score	45.34	86.24	87.20	87.41
Tegner Lysholm score	45.09	86.27	87.18	87.37

**Comparison of Tegner Lysholm Score with Injury to operation Duration**



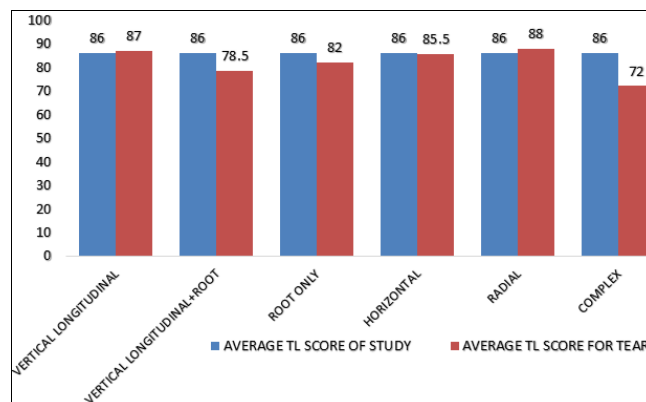
From the above findings it was seen that as the duration of injury increases the Tegner Lysholm Score decreased. The patients that presented early i.e. within 1 month had better functional outcome than that presenting within 6-12 months.

**Tegner Lysholm Score with sex**



From the above findings it was seen that Sex is not the factor responsible altering the fictional outcome of Medial Menisci repair.

**Tegner Lysholm score with type of tear**



The Functional outcome shows a great amount of variation with the type of tear.

Complex tears had the worst functional outcome followed by vertical longitudinal with root tear when repaired while other showing nearly same functional outcome when repaired

**Post-operative complications**

1. 6 patients in our study had superficial infection at the donor site with ACL reconstruction simultaneously done which settled with intravenous antibiotics.
2. One patient developed deep infection of the donor site with gaping of the wound. The patient underwent wound debridement and secondary closure and was given intravenous antibiotics. The wound healed well and sutures were removed after 10 days.
3. Two patient developed fixed flexion deformity of 10 degrees with range of movements ranging from 10 to 90 degrees. The patient had poor compliance to the rehabilitation protocol.

**Discussion**

The menisci were previously thought to have little function and to be a vestigial remnant of a muscle within the knee. We now know this is incorrect, with the menisci having important roles in joint loading, stability, proprioception, and lubrication. For these reasons, we have an aggressive approach to repairing meniscal tears. Due to the increased occurrence of Road Traffic Accidents and increased number of persons participating in sports activities, the number menisci repair being done has been increased. Arthroscopic menisci repair is one of the common procedures done in orthopaedics and thus it has been extensively studied and outcomes of menisci repair have gained considerable attention. With the advent of newer techniques and modern instruments menisci preservation is considered more and more over meniscectomy.

Our study is to evaluate the midterm functional outcome of arthroscopic medial menisci repair. This retrospective study was conducted in B.J medical college and Civil Hospital, Ahmedabad to clinically evaluate the clinical results of medial menisci repair. These patients were operated in year 2016-2017. This study group comprised of 113 patients with thirteen patients lost to follow up. In our study, the most common mode of injury was Road Traffic Accident followed by Sports injuries. One of the patients had an injury due to kick by an

animal. Among the sports injuries, Cricket was the most common cause of medial menisci tear. Male predominance was found in our study. 78 (78%) patients were males and 22 (22%) were females. The Right knee was involved in 56 (56%) of patients and left knee in 44 (44%) patients.

Patients with a concomitant ACL reconstruction interestingly had a better chance of a successful meniscal repair, than patients without an ACL rupture. It is thought that the hemarthrosis generated during ACL reconstruction provides serum factors and fibrin clots that aid meniscal healing. Furthermore, the meniscal repair has been postulated to be protected from abnormal shear stresses by the increased joint stability. In our study, there was associated ACL injury in 95% of patients. Four patients in our study had isolated medial menisci injury and the patients with concomitant ACL repair had better functional outcome as compared to isolated medial menisci repair.

Some series have found no effect of age on healing rate. In this study, meniscal repairs done in younger patients had a significantly higher success rate. This is probably a consequence of the better healing potential of the meniscus at a younger age. Average age of patients at the time of surgery in the present study was 26 years whereas that of Johan et al., D Choudhary *et al.*, Riley *et al.*, Maher *et al* and Kumar *et al.* Were 26, 27, 33, 24 and 27 years respectively. Most of the patients were in the age group of 21-30 years (41%).

Most of the patients had Vertical Longitudinal tear 68(68%) out of which 55 patients came to us with Bucket Handle Tear followed by Horizontal tears 27 out of which 2 patients developed Flaps. For the location of tears 99 patients (99%) had Posterior Horn Involvement. Location of the meniscus tear has been shown to be one of the most important factors influencing healing rates of meniscus repairs because of the quantity of blood supply to the meniscus. Therefore the zone of tears when seen intraoperatively maximum patients had tear with RED-RED zone thus having good Tegner Lysholm score & IKDC score. More recently, with the introduction of reliable all-inside techniques for meniscal repair, we now use a hybrid technique with all-inside sutures for the most central parts of the posterior horn tears. In our study 63 patients (63%) were operated with all inside technique. With Average number of sutures being 4.4 with highest being 9 and lowest being 1.No patients had intron complications.

Although some investigators did not observe any correlation between chronicity of a meniscal tear and failure to heal, others have demonstrated higher healing rates in acute tears. This study also suggests that repairs were better performed within 6 week of the initial injury. Thus, 68% of patients (n=68) underwent medial menisci repair within 1 month after injury. The patients operated within January 2016 to December 2017 were included in the study. Functional midterm (4-5yrs) outcome was assessed in the form of IKDC Score and Tegner Lysholm Score at 6 months, 1year and 4years.

Limitations of the study were the retrospective nature of this investigation, lack of a control group and the non-random nature of this cohort. In our study, we used a clinical result rather than arthroscopic evaluation to determine our success rate. We acknowledge that this is an indirect evaluation of meniscal healing and that this is a limitation of our study. However, based on some studies, we believe that the meniscus of an asymptomatic patient after meniscal repair is completely or at least partially healed. A further limitation of our study is that we have maximum patients with concomitant ACL injury with less patients having isolated Medial Menisci

tear. Hence the results couldn't be compared between them. Nevertheless our results demonstrate that meniscal repair in the young patients and presenting early i.e. with 1 month of duration of Injury appears to be successful in the midterm, with most patients able to return to their daily activity. This subgroup of patients places a very high demand on their knees, and so one would expect failed meniscal healing to be symptomatic in the majority of subjects. We believe an aggressive approach with repair of most meniscal tears in a young, active, high-demand population is the correct clinical approach. With a meticulous suture technique, good results can be achieved.

### Conclusion

The main goal of the current study was to retrospectively identify key factors that may enhance the success ratio of meniscal repairs in the future. Significantly better results were found in acute repairs of the meniscus and in younger patients. In addition, concomitant ACL reconstruction significantly improved healing of a meniscal repair. Furthermore, superior clinical outcomes were seen in these patients with successful meniscal repairs. Meniscal tears can be treated by meniscectomy, either partial or total, and with many meniscal repair techniques, the last ones with much better clinical outcomes. Meniscal repair is a well-established procedure, mainly concerning peripheral longitudinal vertical tears in vascularized zones technical progress, especially in the form of hybrid implants, has improved results, which are good in terms of healing, function and cartilage protection, with a low rate of secondary meniscectomy. Received wisdom thus needs turning on its head: seek preservation before meniscectomy. Other indications have emerged, with specific techniques; results have been promising, even over the long-term. Save the meniscus!

### Conflict of Interest

Not available

### Financial Support

Not available

### References

1. Fairbank TJ. Knee joint changes after meniscectomy. *J Bone Joint Surg.* 1948;30B:664-670.
2. Gelb HJ, *et al.* Magnetic resonance imaging of knee disorders. *American Journal of Sports Medicine.* 1996;24:99-103.
3. Demavend KE. Diagnosis of acute knee injuries with hemarthrosis. *Am Sports Med.* 1980;8(1):9-14.
4. Warren RF, Marshall JL. Injuries of the anterior cruciate and medial collateral ligaments of the knee: a long-term follow-up of 86 cases: Part II. *Clin Orthop Relate Res.* 1978;136:198-211.
5. De Girolamo L, Galleria E, Valhi P, *et al.* Why menisci show higher healing rate when repaired during ACL reconstruction? Growth factors release can be the explanation. *Knee Surg Sports Traumatol Arthrosc.* 2015;23(1):90-6.
6. Horibe S, Shino K, Nakata K, Maeda A, Nakamura N, Matsumoto N. Second-look arthroscopy after meniscal repair: review of 132 menisci repaired by an arthroscopic inside out technique. *J Bone Joint Surg Br.* 1995;77(2):245-9.
7. Kocabay Y, Tetik O, Isbell WM, Atay OA, Johnson DL. The value of clinical examination versus magnetic

- resonance imaging in the diagnosis of meniscal tears and anterior cruciate ligament rupture. *Arthroscopy*. 2004;20(7):696-700.
8. Murrell GA, Maddali S, Horovitz L, Oakley SP, Warren RF. The effects of time course after anterior cruciate ligament injury in correlation with meniscal and cartilage loss. *Am J Sports Med*. 2001;29(1):9-14.
  9. Shelbourne KD, Gray T. Results of anterior cruciate ligament reconstruction based on meniscus and articular cartilage status at the time of surgery: five- to fifteen-year evaluations. *Am J Sports Med*. 2000;28(4):446-52.
  10. Warren RF. Meniscectomy and repair in the anterior cruciate ligament-deficient patient. *Clin Orthop Relate Res*. 1990;(252):55-63.
  11. Ahn JH, Wang JH, Yoo JC. Arthroscopic all-inside suture repair of medial meniscus lesion in anterior cruciate ligament: deficient knees: results of second-look arthroscopies in 39 cases. *Arthroscopy*. 2004;20(9):936-45.
  12. Rodeo SA. Arthroscopic meniscal repair with use of the outside-in technique. *Instr Course Lect*. 2000;49:195-206.
  13. Johnson D, Weiss B. Meniscal repair using the inside-out suture technique. *Sports Med Arthrosc*. 2012;20(2):68-76.
  14. Vinyard TR, Wolf BR. Meniscal repair: outside-in repair. *Clin Sports Med*. 2012;31(1):33-48. Kang *et al*. The Results of All-Inside Meniscus Repair Clinics in Orthopaedics Surgery 7, No. 2, 2015 • [www.ecios.org](http://www.ecios.org)
  15. Kang HJ, Chun CH, Kim SH, Kim KM. A ganglion cyst generated by non-absorbable meniscal repair suture material. *Orthop Traumatol Surg Res*. 2012;98(5):608-12.
  16. Gunes T, Bostan B, Erdem M, Asci M, Sen C, Kelestemur MH. Biomechanical evaluation of arthroscopic all-inside meniscus repairs. *Knee Surg Sports Traumatol Arthrosc*. 2009;17(11):1347-53.
  17. Pujol N, Tardy N, Boisrenoult P, Beaufils P. Long-term outcomes of all-inside meniscal repair. *Knee Surg Sports Traumatol Arthrosc*. 2015;23(1):219-24.
  18. Hagino T, Ochiai S, Watanabe Y, *et al*. Clinical results of arthroscopic all-inside lateral meniscal repair using the Meniscal Viper Repair System. *Eur J Orthop Surg Traumatol*. 2014;24(1):99-104.
  19. Kurzweil PR, Tifford CD, Ignacio EM. Unsatisfactory clinical results of meniscal repair using the meniscus arrow. *Arthroscopy*. 2005;21(8):905.
  20. Starke C, Kopf S, Petersen W, Becker R. Meniscal repair. *Arthroscopy*. 2009;25(9):1033-44.
  21. Fukuda Y, Takai S, Yoshino N, Murase K, Tsutsumi S, Ikeuchi K, *et al*. Impact load transmission of the knee joint influence of leg alignment and the role of meniscus and articular cartilage. *Clin Biomech (Bristol, Avon)*. 2000;15:516-521.
  22. Verdonk R, Volpi P, Verdonk P, Van der Bracht H, Van Laer M, Almqvist KF, *et al*. Indications and limits of meniscal allografts. *Injury*. 2013;44:S21-S27.
  23. Verdonk PC, Forsyth RG, Wang J, Almqvist KF, Verdonk R, Veys EM, *et al*. Characterisation of human knee meniscus cell phenotype. *Osteoarthritis Cartilage*. 2005;13:548-560.
  24. Rath E, Richmond JC. The menisci: Basic science and advances in treatment. *Br J Sports Med*. 2000;34:252-257.

**How to Cite This Article**

Patel ZM, Parmar S, Patel S, Patel S, Khara A. Outcomes and management of acute and chronic medial meniscus injury. *International Journal of Orthopaedics Sciences*. 2023;9(2):135-141.

**Creative Commons (CC) License**

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.