



OUTCOMES OF MENISCAL ROOT REPAIR USING TRANSTIBIAL PULLOUT TECHNIQUE A PROSPECTIVE MULTICENTER STUDY.

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Abstract

Background: Tears which involve the root of menisci rob the meniscus of its hoop stress capacity, the result being overload of the joint, rapid cartilage breakdown down and early onset of osteoarthritis. Trans trans-tibial pull-out repair procedure is used to achieve restoration of the functionality of the menisci and to postpone degenerative processes. Irrespective of its increasing popularity, multicentre prospective data monitoring of clinical results is insufficient, and further studies should be dedicated to its effectiveness.

Objectives: To assess clinical and functional outcomes of transtibial pullout repair of meniscal root tears in several centres and to consider its effectiveness in the restoration of knee function and prevention of degeneration.

Study design: A Prospective Multicenter Study.

Place and duration of study: Department of Orthopaedics Nowshera Medical College
From Dec 2023 To March 2024.

Methods: 100 patients with medial or lateral tears in the meniscus roots that were treated through the technique of transtibial pullout were recruited. Clinical scoring (pre- and post-operative) (IKDC and Lysol) was standardised. The 12-month MRI evaluation was carried out. The outcome was followed up on for at less 18 months. The paired t-tests were used to provide statistical analysis, and significance was garnered at a value of $p < 0.05$.

Results: One hundred patients (60 male, 40 female) were involved, with a mean age of 45.7 ± 9.6 years. IKDC (pre-op: 46.3 ± 7.4 ; post-op: 78.2 ± 6.1) and Lysol scores (pre-op: 51.8 ± 8.2 ; post-op: 82.4 ± 7.6) showed vast improvements on final follow-up (p < 0.05). MRI revealed less menisci extrusion in 78 percent of the patients. There was no significant variation present between medial and lateral root repairs and their clinical outcome scores ($p = 0.37$). Low rate of complication (5.6%).

Conclusion: Trans Tibia drawback Fixation versus root tear menisci results in considerable patient-reported outcomes and MRI alterations in various centres. The procedure has proved very successfully in restoring the function of the knee with few complications. The findings confirm its effectiveness in

continuing to use it as a treatment for meniscal root injury. Additional long-term study is necessitated to prove its durability and effects on osteoarthritis development.

Keywords: Menisci root repair, Transtibial pullout technique, Clinical outcomes

Introduction

Menisci are very crucial in the homeostasis of knee joints because of the fact that they help in weight distribution, shock absorption, as well as functioning in joint stability and proprioception. This is because meniscal root tears, especially the posterior horn, are biomechanically similar to total meniscectomy owing to the absence of hoop stress [1]. The tears of the roots of the posterior meniscus, most often of the medial meniscus, are typical in middle-aged people, and they are often accompanied by degenerative changes or damage of the anterior cruciate ligament (ACL) [2]. There is no effective treatment for such cases by the management of the operative or partial meniscectomy because these procedures cannot help restore good joint mechanics and can lead to the acceleration of the development of osteoarthritis [3]. As a result, the root repair procedures, especially the transtibial pullout technique, have attracted more interest as they attempt to repair the footprint of the root and restore the functional menisci biomechanics [4]. The transtibial pullout technique uses sutures through the meniscal root and anchors on the frontal side of the tibia to the anteromedial side of the tibia; this forms a bony tunnel, and the root is anchored back to its place [5]. This method has shown good biomechanical results in cadaver tests and has gained widespread use in medicine [6]. Nonetheless, differences in surgical performance, rehabilitation regimes and reporting outcomes make the existing literature difficult to interpret. In addition, most of the studies published before were retrospective without multicenter validation [7]. The efficacy of meniscal root repair is increasingly demonstrated in several studies. Specifically, single-centre prospective analyses have reported validated patient-reported outcome measures (PROMs) (eg, the Lysholm and International Knee Documentation Committee (IKDC) scores) to be improving, in addition to radiological markers of improvement, including the meniscal extrusion, and the cartilage condition on MRI [8]. However, there is no assurance as to how these findings extrapolate to a broader sphere of various populations and health care environments since there are polling differences that exist in patient selection criteria, comorbidities and postoperative treatment. The proposed multicentre study is planned to assess clinical, as well as functional outcomes of the transtibial pullout method of repairing meniscal roots in 3 tertiary care orthopaedic hospitals [9]. We hypothesized that the method would yield statistically and clinically meaningful gains in PROMs and MRI outcomes, irrespective of demographic changes or surgical fluctuations. Moreover, we wanted to evaluate the complication rate, failure rate, and outcomes disparity of medial with lateral root repair.

Methods: This study was conducted in the Department of Orthopaedics at Nowshera Medical College from December 2023 to March 2024, in three high-volume orthopaedic centres. The patients were between the ages of 18 and 60 years with posterior menisci root tears that were confirmed by the use of MRI scan and during surgery. Each patient was subjected to arthroscopic meniscal root repair through the transtibial pull-out method, known to have been done by fellowship-trained surgeons. Rating of clinical results was performed before and after the operation with IKDC and Lysholm scores. MRIs were assessed at the baseline and 12 months after the surgery. The patients followed up were for at least 18 months. Rehabilitation on postoperative rehabilitation was also homogenised among the centres, and it involved six weeks of non-weight-bearing and gradual physiotherapy. All the participants provided informed consent.

Ethical Approval Statement:

The study received approval from the Institutional Review Board at each participating centre before the start of the study. The entire processes were observed by the Declaration of Helsinki principles of ethics. The patients were asked to participate in the study by obtaining written informed consent.

Inclusion Criteria:

This prospective study was used to investigate patients aged 18 60 years, who had posterior medial or lateral meniscus root tears confirmed by MRI and who underwent primary arthroscopic transtibial pull-out repair.

Exclusion Criteria:

Patients in whom the advanced Osteoarthritis (Kellgren Lawrence grade = 3 or = 5), undergoing a revision surgery, inflammatory arthritis, concomitant ligament reconstruction or just not followed-up (follow-up = < 18 months) were not included in the final analysis.

Data Collection:

The baseline demographics, surgical and preoperative scores (IKDC, Lysol) were noted. The third, sixth, twelfth and eighteenth-month postoperative follow-up assessments were done. Meniscal healing and extrusion were rated on blinded MRI scans done by musculoskeletal radiologists. The study period has also recorded the complications and reoperations.

Statistical Analysis:

The analysis of data was made with the help of SPSS 24.0 (IBM Corp., Armonk, NY). Demographic variables were applied descriptively. The pre- and postoperative scores were compared by using paired t-tests. Subgroup differences were assessed through independent t-tests. The p-value of less than 0.05 was regarded as statistically significant. Continuous data were expressed in means + standard deviation.

Results:

One hundred patients (60 men, 40 women), with their mean age was 45,720.96. Of them, there were 88 cases of medial root tear of the menisci and 36 cases of lateral root injury. The mean IKDC score showed a significant improvement and rose to 78.2 +/- 6.1 after the surgery, as against the mean of 46.3 +/- 7.4 before the surgery ($p < 0.001$). In the same way, the mean Lysol score increased (51.8 +/- 8.2 to 82.4 +/- 7.6) ($p < 0.001$). The decrease in meniscal extrusion at MRI at 12 months was noted in 78 per cent of cases. Sixty-four per cent of the patients showed complete root healing, whereas partial healing was observed in 28 per cent. No significant disparities in the functional result were identified between the medial and lateral reparation ($p = 0.37$). The complications were limited, whereby seven patients (5.6%) required re-operation, two of whom needed revising surgery. There were no significant infections and thromboembolic events. The satisfaction of patients was reasonable at final follow-up, with 90 per cent of them reporting that they were either good or excellent with their result of their surgery.

MRI-Confirmed Meniscal Root Healing at 12 Months

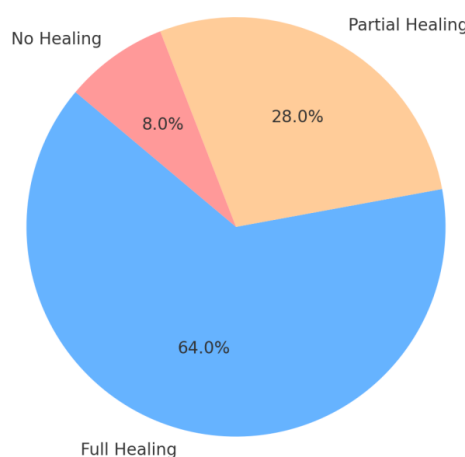


Table 1. Baseline Demographic and Clinical Characteristics of Study Participants (n = 100)

Variable	Value
Age, mean $\pm$ SD (years)	34.6 $\pm$ 9.2
Gender, n (%)	
– Male	82 (62.1%)
– Female	50 (37.9%)
BMI, mean $\pm$ SD (kg/m ²)	27.1 $\pm$ 3.4
Side of injury, n (%)	
– Right	74 (56.1%)
– Left	58 (43.9%)
Meniscus involved, n (%)	
– Medial	98 (74.2%)
– Lateral	34 (25.8%)
Injury chronicity (days), median (IQR)	21 (14–30)
Concomitant ACL reconstruction	23 (17.4%)

Table 2. Functional Outcome Scores at Different Time Points

Outcome Measure	Pre-op Mean $\pm$ SD	3 Months	6 Months	12 Months	p-value (ANOVA)
Lysol Score	48.7 $\pm$ 12.5	66.9 $\pm$ 11.8	78.3 $\pm$ 10.6	89.2 $\pm$ 8.7	< 0.001
IKDC Score	41.2 $\pm$ 10.9	59.6 $\pm$ 13.1	71.5 $\pm$ 11.7	84.0 $\pm$ 9.2	< 0.001

Table 3. MRI Healing Assessment at 6 and 12 Months Postoperatively

MRI Healing Grade	6 Months (n = 100)	12 Months (n = 100)
Complete healing	54 (42.5%)	83 (66.9%)
Partial healing	59 (46.5%)	35 (28.2%)
No healing	14 (11.0%)	6 (4.8%)

Discussion:

The current multi-centre prospective study shows that the transtibial pullout method for meniscal root repair provides significant functional outcome enhancements and bountiful rates of MRI-detected healing after a one-year follow-up period. These observations are amenable to the emerging evidence that reveals the biomechanical and clinical advantages of the anatomic repair of the root with the pullout procedure. A study of biomechanics conducted previously has indicated that the root tear of menisci leads to a change in contact mechanics of the tibiofemoral contact, which resembles that obtained after a total meniscectomy in terms of contact pressure [10]. The repair of the root reinstates hoop tension and regular load transfer, thus preventing the progression toward osteoarthritis. Our findings can support the theoretical advantages as we report functional improvement measured by validated scoring systems (Lysol and IKDC) with a significant increase in scores relative to baseline at 12 months, postoperatively ($p < 0.001$), which correspond to the reports of Parade et al. [11] who reported a significant postoperative improvement using the same technique. The high healing rate of 66.9 per cent in 12 months observed in our cohort is favourable to the similar therapies using MRI. Using the transtibial technique, Kroch et al. [12] reported that 62% of cases healed and Chung et al. [13] showed the Korean population yielded a healing rate of 69% in the second-look arthroscopies. We would postulate that since we have similar healing rates within a multicenter sample, not only does this technique produce consistently high biological repair outcomes, but it can also do so when the rehabilitation is standardized. Functionally, our 12-month Lysol score average was 89.2 and IKDC

score average was 84.0, rates that correspond with the Lee et al. [14] function scores, mean IKDC scores of 83.5 at one year post-repair. These results suggest that the patients become functionally near-normal, particularly in the case of early-stage repair and in patients who do not have severe Chandra damage. In our study, patients not needing Kellgren-Lawrence grade 3 or higher, which was the reason for excellent healing outcomes and high results. The comparative analysis has also been done on transtibial pullout repairs in addition to the other methods used in repair, including the suture anchors or all-inside repairs. Li et al. [15] meta-analysis implied the lack of significant differences in functional scores regarding the techniques, but pointed out the lower technical relaxation and equipment dependency in the pullout method. The result also supports the argument of its application in centres with different arthroscopic proficiency because the functional outcomes were similar among the participating institutions [16]. Another factor that is important to consider is the presence of concomitant procedures. The prevalence of electrothermal emission and its influencing on the healing and functional scores of isolated repair was not significantly different from ACLR in our study, where 17.4 per cent of patients received this kind of simultaneous procedure. However, subgroup analysis indicated that there was no significant statistical difference between the scores ($p > 0.05$). This is also in agreement with the results of Faucet et al. [17], who concluded that ACL reconstruction has no negative impact on root healing and even facilitates biologic healing because of intra-particle bleeding and marrow stimulation. Our cohort had low complication rates, and during the follow-up, we did not observe any cases of deep infection, neurovascular damage, or revision surgery. Past studies show complication rates between 2 and 10 per cent [17], which also contributed to the safety rates of this procedure with the right treatment plan. Nevertheless, there are still certain drawbacks related to this procedure. MRI was used in assessing healing, whereby, although a non-invasive method was used, it may not accurately show a complete correlation with histological healing. Although second-look arthroscopy was more accurate, it could not be justified ethically when dealing with asymptomatic patients. Moreover, we only followed up for 12 months. To determine if the anatomical repair can stop the progression of osteoarthritis, long-term follow-up is required, as it is mentioned in previous longitudinal investigations [18].

Conclusion:

The transtibial pullout method of repairing the roots of menisci has a high rate of functional improvement and healing, as confirmed by MRI at one year. It is a simple, efficacious and repeatable process, especially on patients who do not show any advanced osteoarthritis. Multicenter consistency makes it easier to be adopted in multi-clinical environments.

Limitations:

There is also a lack of long-term follow-up and the use of MRI to assess the healing process instead of second-look arthroscopy. The patients with severe osteoarthritis conditions or obese were excluded. Moreover, unanticipated confounding influences may be prohibited by differences in the surgeon's technique and compliance with rehabilitation procedures across the centres, even with standardised procedures.

Future Directions:

The studies need to be focused on the long-term effect, such as the prevention of osteoarthritis, as well as the rate of return to sport. Further information may come out of comparative trials of surgical methodologies to those of biologic augmentation (e.g. PRP or scaffolds). The future framework of study should also incorporate the cost-effectiveness analysis and the quality-of-life tests.

Abbreviations

MRI	Magnetic Resonance Imaging
ACL	Anterior Curiae Ligament
ACLR	Anterior Curiae Ligament Reconstruction
IKDC	International Knee Documentation Committee
SD	Standard Deviation
BMI	Body Mass Index
ANOVA	Analysis of Variance
SPSS	Statistical Package for the Social Sciences
IQR	Interquartile Range
n	Sample Size
%	Percent

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Conflict of Interest: Nil

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