

# Functional outcomes after re-insertion of posterior root tear of medial meniscus using a simple economic technique

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## Background

Root avulsions of the meniscus cause loss of hoop stresses and therefore loss of the meniscal function. This in return is associated with increased peak contact stresses and risk of osteoarthritis. Root repair is therefore crucial to preserve normal biomechanics and kinematics. Many techniques have been used and expensive fancy equipment made the procedure easier, however, cost is of great importance.

## Aim

To demonstrate the results and functional outcomes after root re-insertion using simple economic tools.

## Patients and methods

Between March 2022 and May 2023, 25 patients with root tears were operated upon and followed-up for a mean of 12 months. Patients with acute traumatic tears, degenerative tears with grade 1–2 osteoarthritis, associated genu varum less than 5° and a BMI less than or equal to 35 were included in the study. All patients underwent diagnostic arthroscopy as part of the procedure. Pie-crusting of the medial ligament was performed routinely to facilitate visualization and instrumentation in the medial compartment. Bed preparation was performed using a motorized shaver. This was followed by passing polydioxanone suture (PDS) shuttling sutures through a grey cannula and into the posterior root meniscal tissue, this was then used to shuttle heavy poly-braided nonabsorbable suture material. A tunnel was created through the anterior tibial cortex using the anterior cruciate ligament (ACL) guide. The sutures are then tied over a post (4.5 mm screw). Lysholm, International Knee Documentation Committee (IKDC), and Tegner activity scores were used to evaluate the patients at 6 and 12 months.

## Results

The mean Lysholm score improved from 50.16 ± 12.51 preoperative to 82.08 ± 12.90 postoperative. The mean IKDC score improved from 51.24 ± 11.06 to 84.36 ± 10.18. The mean Tegner activity score improved from 3 ± 1.32 ranging from 1 to 5 to 5.20 ± 1.53. Traumatic tears showed greater improvement as compared with degenerative tears.

## Conclusion

Simple outside techniques can be used to perform adequate reliable root repair. This yields comparable results to other techniques described in the literature.

## Keywords:

economic, meniscus, out-in, re-insertion, root tears, simple

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## Introduction

Meniscal root injuries are considered a functional loss and are associated with increased peak contact stresses at the tibio-femoral joint causing osteoarthritis [1,2].

Although partial meniscectomy improves pain [3], root re-insertion has been proven to reduce the risk of osteoarthritis [4]. Many techniques have been described to place sutures in the meniscal root; meniscal knee scorpion, lasso suture passer, and different fixation methods were described; suture anchors, surface button fixation or tying over a bony bridge. The aim of this study is to demonstrate that simple economic tools to perform outside-in meniscal root repair are

effective and yield good functional outcomes. The null hypothesis is that simple economic outside-in meniscal repair is reliable, effective, reproducible and yields good functional outcomes.

## Patients and methods

Between March 2022 and May 2023, 25 patients were operated upon and followed-up for a period of

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12 months. The mean operative time was 61.5 min ranging from 43 to 80 min. Patients with traumatic tears, painful degenerative tears, and signs of medial compartment overload and associated genu varum less than 5° were all included in the study. Patients with advanced medial compartment osteoarthritis (severe narrowing of the medial joint space on radiography), obese patients with BMI greater than 35, severe genu varum greater than 5°, were all excluded from the study. All patients signed a consent for to participate in the study. The ethical committee approval was obtained with an IRB number MD-170-2022.

**Pre-operative**

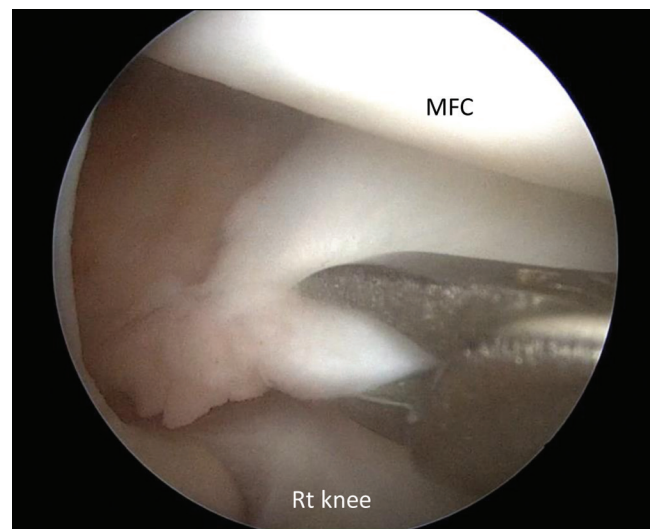
All patients were assessed using the Lysholm score. Preoperative MRI was done to establish the diagnosis. A ghost meniscus seen on the first sagittal cut medial to the PCL, root tear seen on the posterior coronal cuts, and meniscal extrusion are all signs of root tears. Radiography of both lower limbs' long films were used to asses frontal plane mal-alignment.

**Operative**

Informed consent was obtained from all patients. All patients were operated upon in the supine position under general or spinal anesthesia and tourniquet control. All procedures started with diagnostic knee arthroscopy (DKA) through standard anterior portals to evaluate the cartilage condition, meniscal reduction, and associated lesions (Fig. 1). This was followed by medial ligament release using pie-crusting technique to open the medial compartment of the knee and facilitate instrumentation.

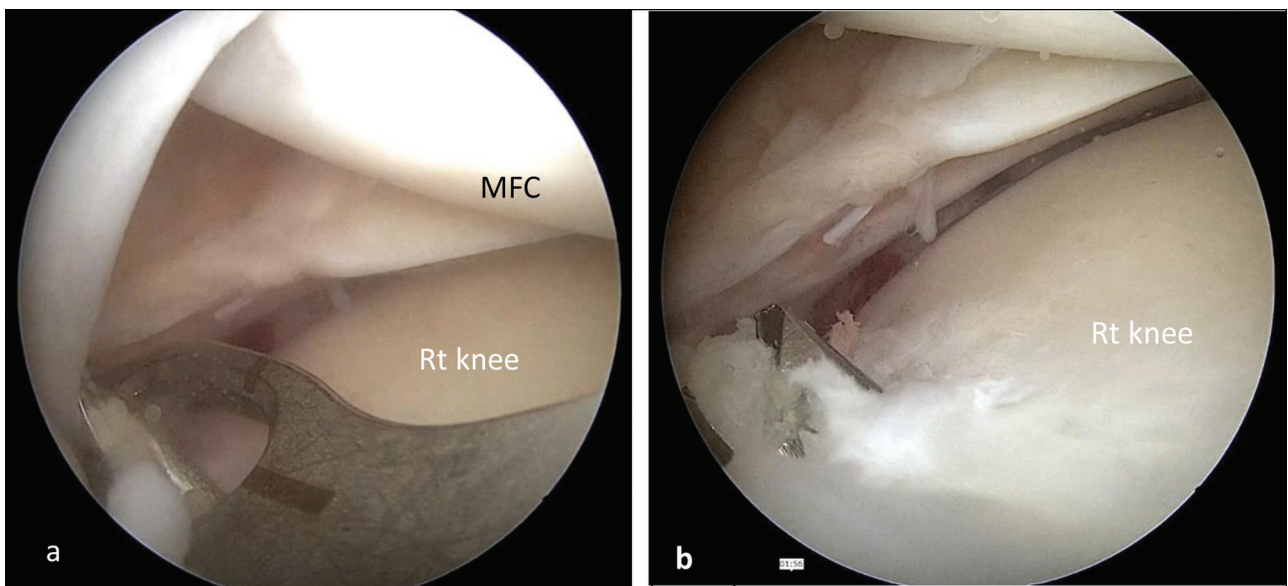
The bed of the root was then prepared using a motorized shaver. An anterior cruciate ligament (ACL) C-guide was then used to drill a 4.5 mm tunnel at the center of the root bed (Fig. 2). A grey cannula loaded with number 1 polydioxanone suture (PDS) was passed in outside in technique into the posterior root meniscal tissue and retrieved using suture grasper through an anteromedial portal (Fig. 3). Looped heavy poly-braided suture was then shuttled over the PDS with the two ends at the anterior portal. The looped end was then retrieved through the anterior portal, then the two free ends were passed into the loop to create

**Figure 1**



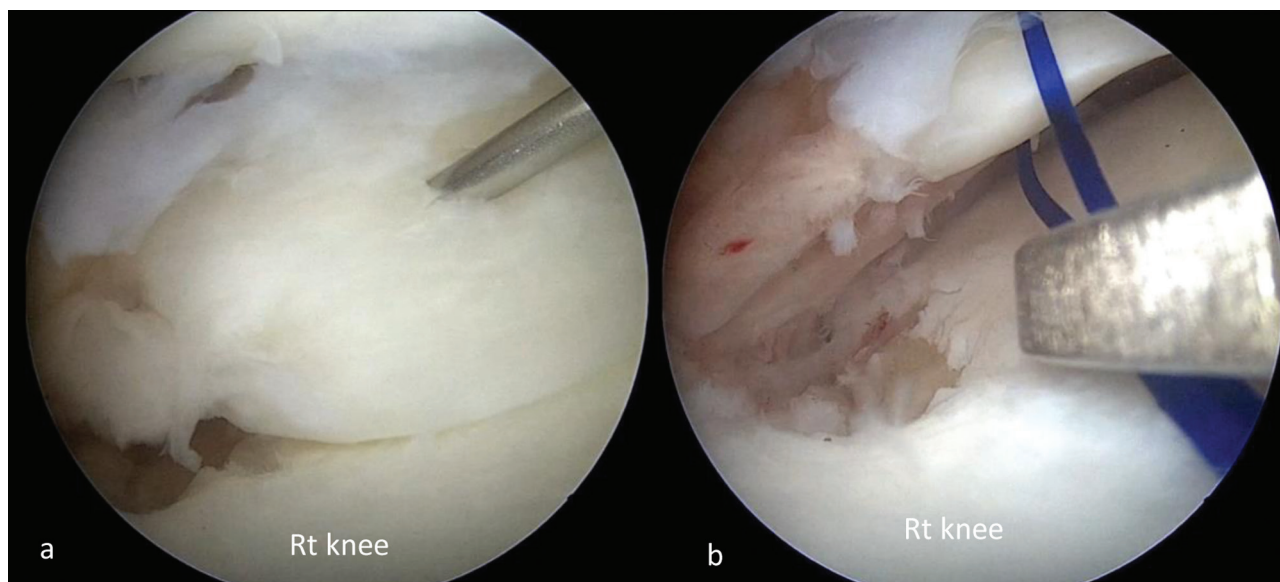
Root tear after medial release, a picture showing tissue grasper checking reducibility of the meniscus.

**Figure 2**



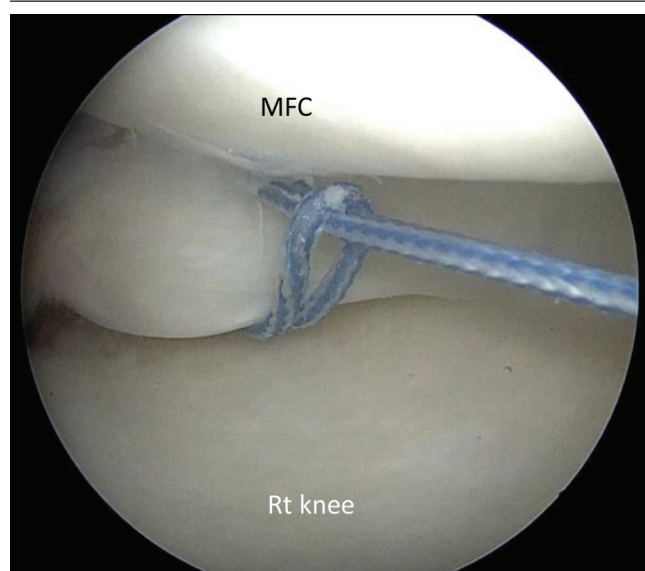
a: showing use of ACL C-guide to introduce the guide pin in the bed of the root. b: a 4.5 mm drill bit is used to create a tunnel at the bed of the root. ACL = anterior cruciate ligament.

Figure 3



a: showing grey cannula loaded with PDS passed in an outside fashion supra-meniscal and used to penetrate the root in the desired position. b: PDS suture material passed through the cannula and a ring suture retriever is used to retrieve both ends from the anteromedial portal. PDS = polydioxanone suture.

Figure 4



Cinch configuration of the heavy poly-braided suture material after being shuttled over the PDS. PDS = polydioxanone suture.

a Cinch configuration (Fig. 4). The same steps were repeated creating another Cinch suture. Number 1 looped PDS was passed into the tunnel and used to shuttle Cinch sutures into the tunnel (Fig. 5). Sutures were then tightened over a 4.5 mm cortical screw post.

#### Postoperative

All patients were sent home on the same day or were admitted no more than one night. A single dose of IV antibiotic was given postoperatively. Cryotherapy was started on the same day of surgery. Patients were placed in a knee immobilizer and were kept strictly

nonweight-bearing for 6 weeks. Range of motion exercises were allowed out of the immobilizer from full extension to 90° of knee flexion. Static quadriceps exercises were started immediately. Anticoagulation either oral anticoagulants or low molecular weight heparin were given for the entire nonweight-bearing period.

Patients started weight-bearing after 6 weeks; at which time the immobilizer was discarded and physiotherapy was commenced. Full flexion was allowed only after 3 months. The assessment was made at 6 weeks, 3, 6, and 12 months postoperatively. But scores were only taken at 6 and 12 months using the Lysholm knee score, IKDC score and Tegner activity score.

#### Statistical methods

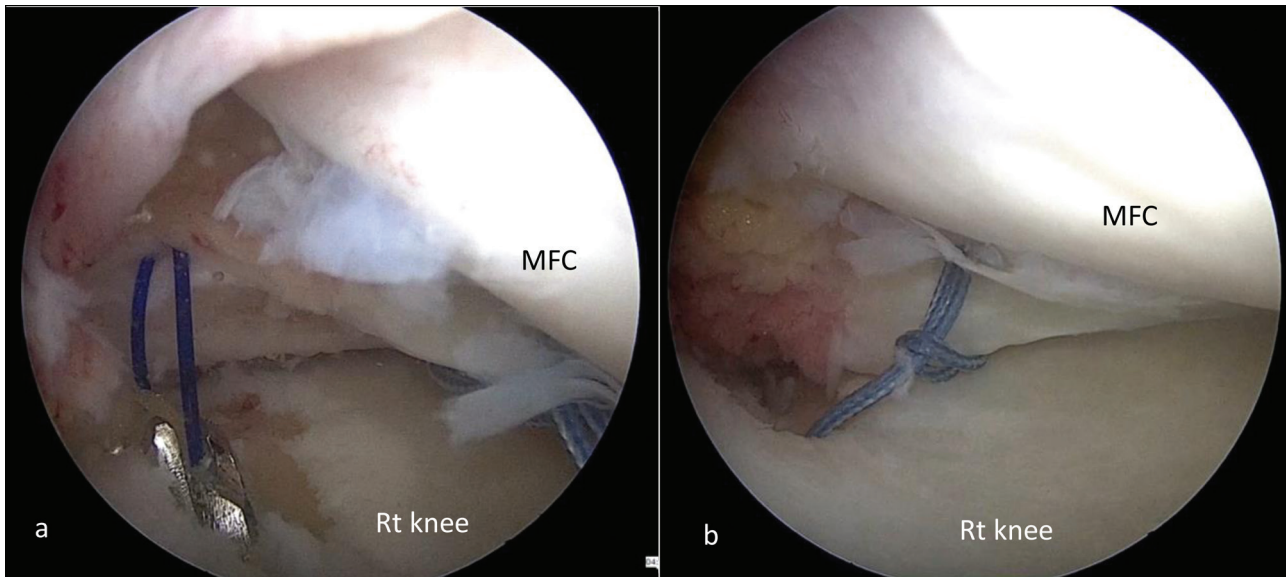
Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). Data was summarized using mean and standard deviation in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. For comparison of serial measurements within each patient, repeated measures ANOVA was used (Chan) [5]. *P* values less than 0.05 were considered statistically significant.

#### Results

A total of 25 patients were operated upon and followed-up for a mean period of 12 months. Twenty-one were females and four were males. The mean age was  $48.4 \pm 8.35$ . Thirteen patients had traumatic tears while 12 had degenerative tears.



Figure 5



a: PDS passed through the tunnel and is then retrieved through the anterior medial portal. b: The Cinch suture is shuttled over the PDS into the tunnel pulling the root and holding it against the bed. PDS = polydioxanone suture.

Fourteen patients had no arthroscopic evidence of osteoarthritis, while 11 had some osteoarthritis on arthroscopic evaluation, of which seven were grade 1 and four were grade 2

The mean preoperative Lysholm score was  $50.16 \pm 12.51$  ranging from 30 to 70. The mean preoperative IKDC score was  $51.24 \pm 11.06$  ranging from 34 to 70. The mean preoperative Tegner activity score was  $3 \pm 1.32$  ranging from 1 to 5. Ten patients participated in sports activities, and all of them played light sports leisurely. While 15 patients did not play sports, eight had office-based jobs and seven were involved in more physically demanding occupations, out of which one was a laborer. All 25 patients suffered posteromedial knee pain and medial joint line tenderness on examination. Mc-Murray's test was positive in 10 patients only.

The mean postoperative Lysholm score at 12 months was  $82.08 \pm 12.90$  ranging from 42 to 96. This shows a significant improvement compared with the preoperative score with a  $P$  value of less than 0.001 (Fig. 6). The mean IKDC score at 12 months postoperatively was  $84.36 \pm 10.18$  ranging from 56 to 96, this showed a significant improvement compared with the preoperative score with a  $P$  value of less than 0.001 (Fig. 7). The mean postoperative Tegner score at 12 months was  $5.20 \pm 1.53$  ranging from 2 to 7 showing a great improvement compared with preoperative score, with a  $P$  value of less than 0.001 (Fig. 8). The mean visual analog score for pain was 4.5 at the final follow-up ranging from 1 to 8

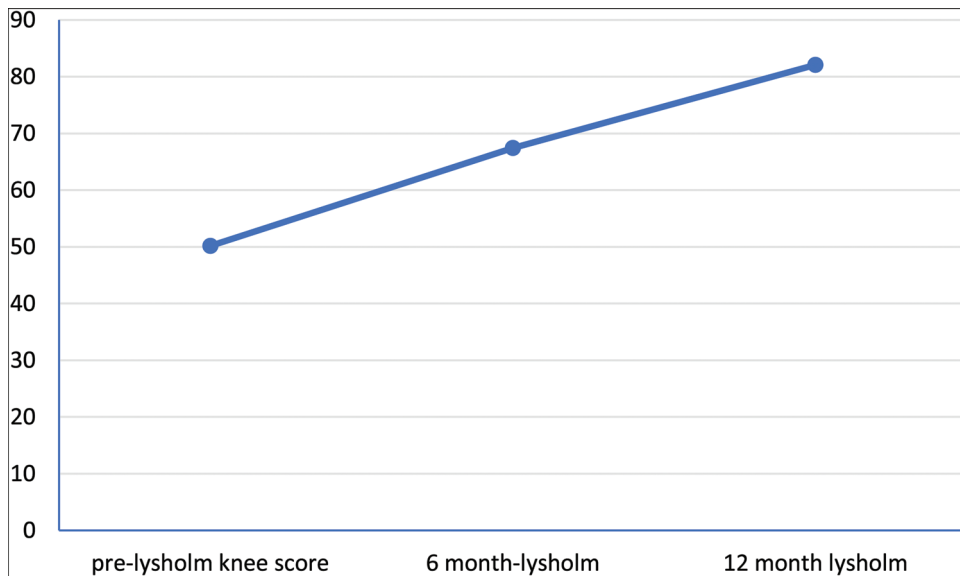
Fifteen patients were able to return to preinjury level of activity. Out of which six returned to playing sports, the other nine patients returned to their work, five had an office job and four return to physically demanding work. The remaining 10 patients reported that they had not fully returned to their preoperative level of activity, four of which could not return to the same level of sports activity. The other six patients still struggled at work, out of which one was a laborer and five were office-based females with a slightly higher BMI (average 32).

According to the linear regression model, patients with higher levels of activity had better Lysholm scores at the final follow up but this was not statistically significant, and negative correlation could not be established ( $P$  value 0.24) (Fig. 9). When we compared male and female patients, we found slightly better results in male patients as compared with female counterparts. However, this was not statistically significant,  $P$  value 0.5. Applying linear regression model, increasing age was associated with nonsignificantly inferior results ( $P$  value 0.102) (Fig. 10).

## Discussion

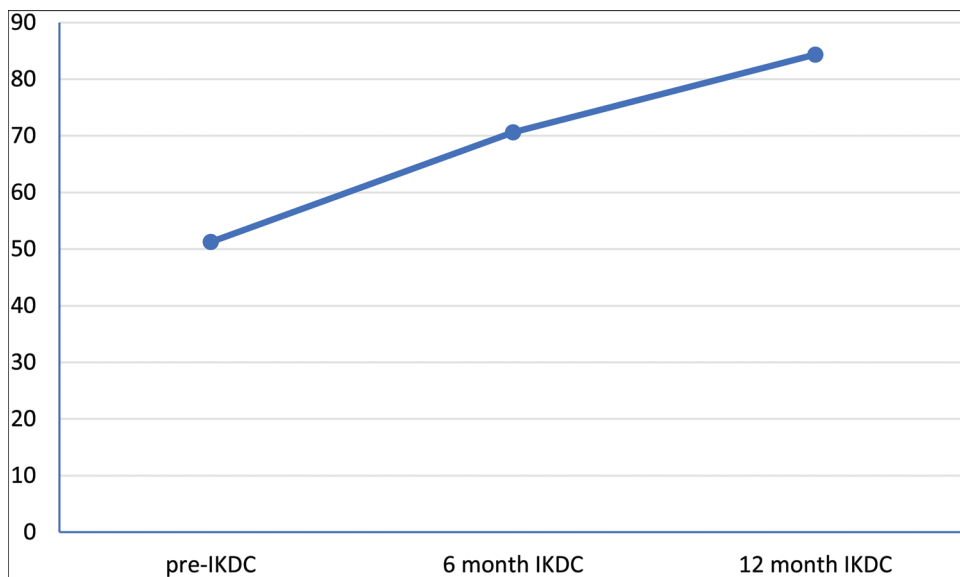
The most important finding of this study are that meniscal root repair significantly improves a patient's symptoms and performance. It demonstrated significant improvement in all functional scores. Although male patients showed better Tegner scores and return to pre-injury activity; there was no significant difference in results according to gender. Increasing age was associated with significantly inferior results. The null

Figure 6



Shows the pre and postoperative Lysholm score.

Figure 7



Pre and postoperative IKDC score. IKDC = International Knee Documentation Committee.

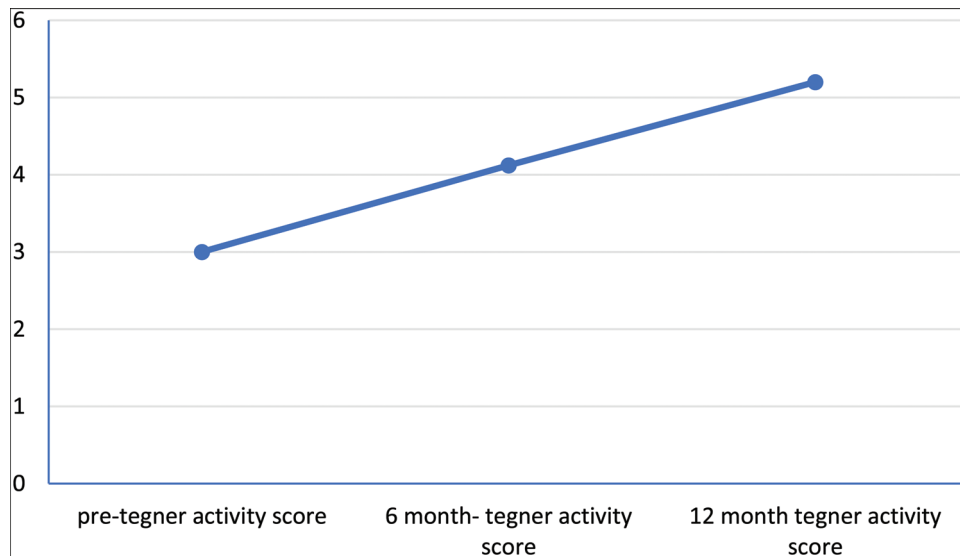
hypothesis was proved; a simple economic outside-in technique for root repair yields good functional outcomes and overall patient satisfaction.

In this study on 25 patients, postoperative Lysholm score showed significant improvement as compared with pre-operative score. This matches the findings of Seo *et al.* [6]. To the author's knowledge, this study is the first to compare Lysholm score of patients based on level of activity. Patients with higher levels of activity had better Lysholm scores. This is believed to be because of better muscle bulk and lower BMI.

Seo and colleagues objectively assessed root healing using second-look arthroscopy. This is believed to be a point of strength in their study. They studied 21 patients, many of which had an associated intra-articular pathology. They performed second-look arthroscopy on only 11 patients. Associated intra-articular pathology is believed to be a source of bias in the results [6].

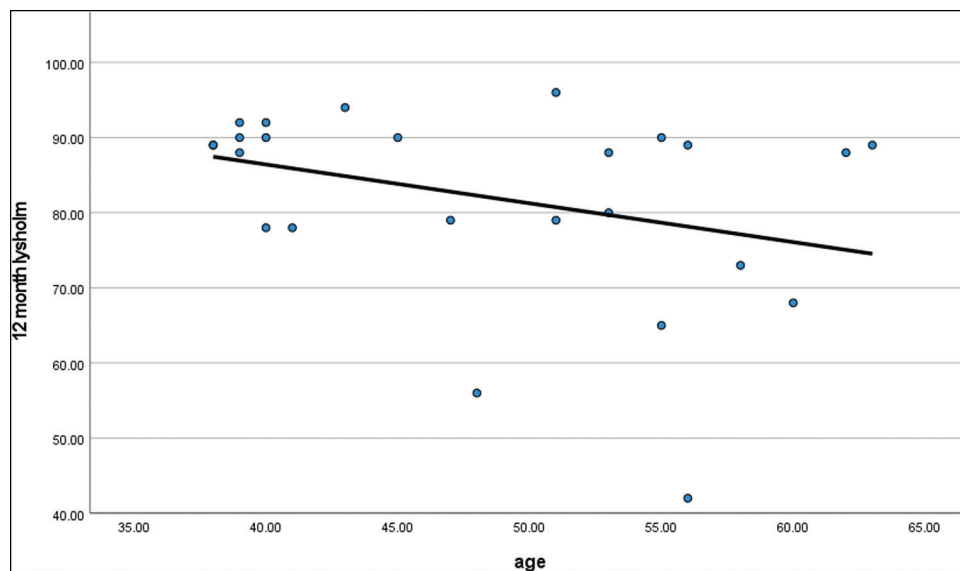
Jung and colleagues studied 13 patients. They relied on a posteromedial portal for root bed preparation and root re-insertion using suture anchors. They report

Figure 8



Pre and postoperative Tegner activity score.

Figure 9



Linear regression model between age and 12-month Lysholm score.

that avoiding tibial tunnels and sutures tied over the anterior cortex, reduces the risk of failure of repair or having a lax repair [7]. In this study simple suture passage using a grey cannula was more economic and, less time consuming and less technically demanding compared with posteromedial portal. Furthermore, to avoid a lax repair and risk of failure; suture limbs retrieved from the tibial tunnel were tied over a 4.5 mm cortical screw. Despite the fact the technique used in this study was different from Jung and colleagues functional outcomes were comparable.

They assessed meniscal extrusion using MRI and found that meniscal extrusion was not reduced postoperatively

[7]. This might have been because in their technique; no tibial tunnel was used. When the tibial tunnel is used, part of the meniscus is driven into the tunnel helping in reducing the extrusion. Furthermore, In the technique used in this study; double sutures are taken in the meniscus allowing for the distribution of forces and better reduction. Yet the reduction of meniscal extrusion is greatly affected by the chronicity of the injury, and the location of placement of tunnel or anchors in the root bed while the fixation technique might have less impact on meniscal centralization.

In a metanalysis and systemic review by Perry *et al.* in 2023 (Examining the Efficacy of Medial Meniscus

Figure 10

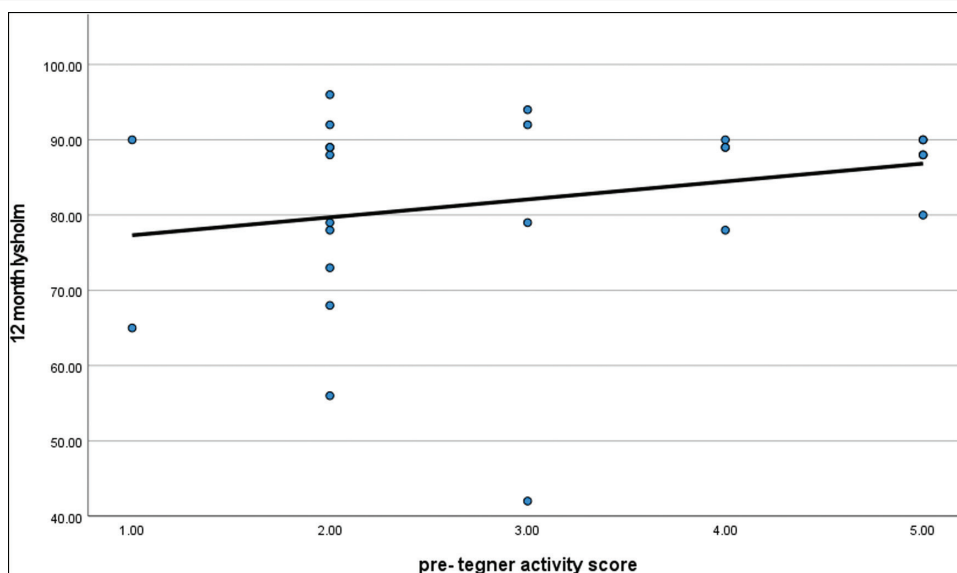


Diagram showing the relationship between 12 months Lysholm and Preinjury Tegner score.

Posterior Root Repair), 11 studies did not show a significant reduction in root extrusion, while only one study showed a significant reduction in root extrusion [8].

In this study, postoperative MRI was not done routinely to assess meniscal reduction. It could be a useful tool to objectively assess the reduction of meniscal extrusion. If indicated (e.g. for arthroscopic lysis or another pathology); a second look arthroscopy would be very useful to assess meniscal reduction and healing.

The same metanalysis compared the suture configuration used, the study by Krych *et al.* found that the Cinch stitch configuration was more superior to the locking loop stitch, in terms of less cyclical displacement [9]. Mitchell *et al.* however, reported that the locking loop suture showed higher load to failure [10]. Other studies compared the fast-fix modified Mason Allen (MMA) technique with two simple stitches and trans-tibial pull-out sutures and found no statistically significant differences regarding patient reported outcomes [11,12]. Lee *et al.* however, found that MMA stitch resulted in reduced meniscal extrusion.

Perry *et al.* reported that across the different studies, they included in their metanalysis and systematic review; patients showed significant improvement in patient scores at an average of 27.7 months. They did not compare patient outcomes with those managed conservatively or with partial meniscectomy. This is similar to the results of this study, significant improvement in Lysholm, IKDC, and visual analog score were seen but an average of 12 months. Minimal improvement in Tegner score is probably due to the higher age of patients and more

were female gender, who are less physically active. It is important to compare the results of root repair with conservative management and partial meniscectomy.

In this study, MRI was not used to assess meniscal extrusion and reduction. This is different from the series of Moon and colleagues who measured reduction of the meniscal extrusion. Surprisingly, despite of 90% healing rate, according to their study root repair failed not only to reduce meniscal extrusion but also to prevent further extrusion [13]. In contrast, Kim *et al.* demonstrated that root repair was successful in reducing the extruded meniscus and preventing further extrusion [14].

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All authors have contributed significantly to the study, including study design, operating upon and following patients, collection of data, writing and revising the manuscript.

This study has received approval of the ethical committee with reference number.

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Nil.

#### Conflicts of interest

There are no conflicts of interest.

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