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Posterior root tear medial meniscus repair with pullout sutures

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***Abstract*---**Objective: This current study was conducted to evaluate clinical, radiographic, and functional data, as well as complications associated with the repair of medial meniscus posterior root tears (MMPRT) using pullout sutures technique. Materials & Methods: the current study started in January 2014 till June 2016, including 27 patients with MMPRT who underwent arthroscopic pullout suture repair surgery. Of these, 25 patients were analyzed, clinical results by using Lysholm score and international knee documentation committee (IKDC) and magnetic imaging resonance (MRI) were evaluated, as a preoperative state as well as at the last follow-up visit. Results: Improving mean value of Lysholm score in all patients from the poor score in 15 patients as well as a fair score in 10 patients preoperatively to good score in 19 patients and an excellent score in 6 patients the last follow-up visit. IKDC men value become much better it changed from 43.36 ±5.35 preoperatively to 81.89 ± 8.48 at the final follow-up ($P < 0.001$). MRI showed complete healing in 15 patients and failure in 10 patients, meniscal extrusion (ME) was >3 mm in 22 patients and ≤ 3 mm in 3 patients preoperatively improved to 13 patients ≤3 mm and 12 patients > 3 mm postoperatively. Conclusion: Arthroscopic pullout suture repair provides favorable clinical

results for patients with MMPRT in the short term that seems to be repairable and concomitant with grade III degenerated articular cartilage.

Keywords---Posterior root- Root tear, Pullout suture repair, Radiographic.

Introduction

Diagnosis of symptomatic MMPRT necessitates a high level of clinical speculation focused on the patient's medical history, symptoms, physical examination, MRI scan assessment, as well as diagnostic arthroscopy (Carreau et al., 2017). While the conservative method of treatment fails to reestablish the native anatomical structure, which could cause arthritic changes with time, arthroscopic partial meniscectomy or repair has become the mainstay of treatment for MMPRT (Hein et al., 201, Maher et al., 2020). On the other hand, Conservative treatment may be helpful in treating certain individuals properly (Bhatia et al., 2014), Also, the clinical outcomes of conservative treatment have been documented to be competent when early diagnosis and suitable treatment procedures are used (Shelbourne et al., 2011, Lim et al., 2010). However, if the conservative method of treatment fails to treat MMPRT, patients may miss a good opportunity for proper meniscus repair, but also their pain, as well as arthritic changes may worsen(LaPrade et al., 2015, Krych et al., 2017).

Meniscus root tear (MRT) repair is receiving more and more attention, and as a consequence, a variety of procedures have been proposed (Krych et al., 2017, Englund et al., 2009, Choi et al., 2008). A variety of clinical publications using arthroscopic MRT pull-out repair have expressed positive clinical and radiological outcomes (Lee et al., 2009, Seo et al., 2009). The chondroprotective impact of repair, particularly, looks to be promising (Kim et al., 2011). Since the number of research undertaken on the subject was limited, definitive evidence on clinical and MRI findings after MRT repair is difficult to come by. Furthermore, no prognostic markers for successful repair have been identified (Magee et al., 2004). Therefore, this study set out to report the clinical outcomes and MRI findings after repairing MRT by arthroscopic pull-out surgical technique, as well as to determine the factors and characteristics linked to poor prognosis.

Materials and Methods

The study was conducted on 30 patients who suffered MMPRT it started in January 2015 till June 2016 presented to Level I Trauma Centre at Kasr Al-Ainy hospital and was managed by the pullout sutures. The mean follow-up duration was one year, 2 patients were followed for only 6 weeks with no data about the radiological or functional outcome, and 3 patients were failed due to the degenerated meniscus and suture cut through, these 5 patients were excluded in the final results.

Patients with isolated MMRT or associated with torn ACL, and aged from 20-50 years were incorporated in the current study. While we excluded patients who had

severe osteoarthritis from the study. After history taking, all patients were assessed clinically (localized tenderness, skin condition, swelling, range of motion, and neurovascular examination), radiologically (standing X-ray, and MRI), and functionally (Lysholm score and IKDC).

Implants: Endobutton, no. 2 non absorbable sutures ethibon or no. 2-0 fibrewire.

Surgical technique:
All of the patients were anesthetized by spinal anesthesia. Patients were positioned on their backs in a supine position. A full arthroscopic evaluation of the knee joint was conducted. Under visualization through the antero-medial portal, the anterior cruciate ligament tibial aiming guide with a short tip was inserted into the body via the anterolateral portal. The tip of the guide with 40˚ to 45˚ was placed at the decorticated footprint of the MMPR. Through a 2 cm vertical incision, the guide's sleeve was attached to the anterolateral cortex of the proximal tibia distal to Gordy's tubercle. The tibial anterolateral cortex's entrance point was just below Gerdy`s tubercle on the lateral aspect of the tibia. Using a guide pin and a 4.5 mm drill bit, a tibial tunnel is created from the anterolateral aspect of the proximal tibial cortex towards the footprint of the MMPR. A knee scorpion suture passer loaded with No.2-0 suture material was inserted through the anteromedial portal. In a vertical orientation, the detached root section of the medial meniscus posterior horn was pierced out from the tibial to the femoral aspect of the meniscus. Then the No.2 fibre wire suture was shuttled on no. 2-0 suture through the meniscus posterior root. No. 2-0 suture material was passed in the same manner in a more peripheral site to the prior suture, a ring grasper was used to retrieve the two upper limbs of both fibre wire suture and no 2-0 suture material then the fibre wire was shuttled into the meniscus root using the no. 2-0 suture material. This suture is working as a tension suture, a ring grasper was advanced through the tibial tunnel, the tensioned suture was retrieved through the tibial tunnel to the tibial surface. Another 2-0 suture material was loaded, passed half centimeter medial to the tensioned suture then no 2 fiber wire was shuttled into the meniscus. Again, no 2-0 is passed in the peripheral zone of the meniscus in line with the second fiber wire. A ring grasper was used to retrieve the two inferior limbs of both the fiber wire and no. 2-0 suture material then the fiber wire is shuttled into the meniscus using the no. 2-0 suture to form a reduction suture. A ring grasper was advanced through the tibial tunnel, the reduction suture was retrieved through the tibial tunnel to the tibial surface. The MMPR could be reduced and fixed with proper tension by pulling the ends of the suture material under tension. The fibre wire suture fabric was post-tied to and fastened with a titanium endo button on the lateral surface of the tibial cortex with sufficient tension and reduction. Sutures were used to seal the subdermal skin with 2-0 or 3-0 absorbable sutures. A 2-0 suture was used to seal the skin in a running or interrupted pattern, making sure to evert the skin edges. Finally, a compressing dressing was used.

Postoperative follow-up:
Patients visited the outpatient clinic one week postoperative for dressing, two weeks postoperative for stitches removal, 6 weeks postoperative for follow up of a range of motion then monthly visit till 6 months postoperative. Follow up MRI scan was done at 6 months postoperative.

Statistical analysis of the data:
The data was coded and entered using the statistical program SPSS (Statistical Package for the Social Sciences) version 24. The standard deviation, mean, median, maximum, and minimum were used to sum quantitative data, whereas frequency (count), as well as relative frequency, as well as relative frequency, were used to sum categorical data (percent). The paired t-test was used to compare quantitative factors measured before and after**.** To assess categorical data, The Chi-square ($\chi 2$) was utilized. Also, the exact test was used instead when the expected frequency was less than 5. A P-value of less than 0.05 was considered statistically significant.

Results

The patient aged from 23 to 50 years with a mean age of 41.63± 5.75 years. There were 11 males (36.7%) and 19 females (63.3%). Ten patients had injuries in the right knee (33.3%), 20 cases had injuries in the left knee (66.7%). Two patients had associated ACL injury, one patient had medial femoral condyle ulcer and varus knee.

Thirty patients with thirty MMPRTs were included in this study, 27 patients underwent meniscal repair with pullout sutures, three patients were failed at repair due to degenerated meniscus, and suture material was cut through and had partial meniscectomy. Two out of 27 patients were followed for 6 weeks only with no available data about the radiological and functional outcome, 25 patients were followed for 6 months with MRI and functional assessment at the end of follow-up.

In the postoperative period limp, support, tenderness (pain), swelling, instability, locking, squatting and stair–climbing, were all monitored. Moreover, ostoperative data showed, all patients had no limp, no support, never gave way, and had no locking or catching sensation. Only slight pain was prescribed by all patients. Ten patients had no swelling at all while 15 patients had swelling on severe exertion. In addition, 6 patients had no problems in stair-climbing and 19 were slightly impaired. Besides, six patients had no problems on squatting and 19 patients were slightly impaired (Table 1).

Table 1

Limp		Preoperative limp			Postoperative limp		
		None	Slight	Severe	None	Slight	Severe
	Count	12	13	0	25	0	0
	Percent	48.0 %	52.0 %	0.0 %	100.0 %	0.0 %	0.0 %
		Count			Percent		
Support	Preoperative	5			20.0 %		
	Postoperative	0			0.0 %		
					Count	Percent	
Pain	Preoperative	None			0	0.0 %	
		Slight			0	0.0 %	
		Marked on severe exertion.			3	12.0 %	

		Marked on walking > 2 Km.	1	4.0 %
		Marked on walking < 2 Km.	17	68.0 %
		Constant.	4	16.0 %
	Postoperative	None	0	0.0 %
		Slight	25	100.0 %
		Marked on severe exertion.	0	0.0 %
		Marked on walking more than 2 Km.	0	0.0 %
		Marked on walking less than 2 Km.	0	0.0 %
		Constant.	0	0.0 %
			Count	percent
Instability	Preoperative	Never giving way.	4	16.0 %
		Rarely during severe exertion.	5	20.0 %
		Frequently during severe exertion.	15	60.0 |%
		Occasionally in daily activities.	1	4.0 %
		Often in daily activities.	0	0.0 %
		Every step.	0	0.0 %
	Postoperative	Never giving way.	25	100.0 %
		Rarely during severe exertion.	0	0.0 %
		Frequently during severe exertion.	0	0.0 %
		Occasionally in daily activities.	0	0.0 %
		Often in daily activities.	0	0.0 %
		Every step.	0	0.0 %
			Count	Percent
Locking	Preoperative	No locking and no catching sensations	0	0.0%
		Catching sensation but no locking	25	100.0%
		Locking occasionally	0	0.0%
		Frequently	0	0.0%
		Locked joint on examination	0	0.0%
	Postoperative	No locking and no catching sensations	25	100.0%
		Catching sensation but no locking	0	0.0%
		Locking occasionally	0	0.0%
		Frequently	0	0.0%
		Locked joint on examination	0	0.0%
			Count	Percent
Swelling	Preoperative	None	6	24.0 %
		On severe exertion	7	28.0 %
		On ordinary exertion	9	36.0 %
		Constant	3	12.0 %
	Postoperative	None	10	40.0 %
		On severe exertion	15	60.0 %
		On ordinary exertion	0	0.0 %
		Constant	0	0.0 %
			Count	Percent
Stair-climbing	Preoperative	No problems	0	0.0 %
		Slightly impaired	18	72.0 %
		One step at a time	7	28.0 %
		Impossible	0	0.0 %
	Postoperative	No problems	6	24.0 %

		Slightly impaired	19	76.0 %
		One step at a time	0	0.0 %
		Impossible	0	0.0 %
			Count	Percent
Squatting	Preoperative	No problems	0	0.0 %
		Slightly impaired	5	20.0 %
		Not beyond 90◦	20	80.0 %
		Impossible	0	0.0 %
	Postoperative	No problems	6	24.0 %
		Slightly impaired	19	76.0 %
		Not beyond 90◦	0	0.0 %
		Impossible	0	0.0 %

Preoperative and postoperative Lysholm scores are shown in Table 2. After repair, 6 patients had excellent scores and 19 patients had good scores. IKDC improved postoperatively by a mean ± SD of 81.89 ± 8.48 vs 43.36 ± 5.35 preoperatively (Table 2). Preoperative and postoperative meniscal extrusion is illustrated in Figure 1.

Six months postoperative follow-up MRI showed that 15 (60.0%) patients had completed healing (Figure 2) and 10 (40.0%) patients showed incomplete or no healing. As regards complications, one patient had postoperative DVT, and three patients had partial meniscectomy.

Table (2)
Preoperative and postoperative Lysholm score

		Count	Percent
Preoperative	Poor	15	60.0 %
	Fair	10	40.0 %
	Good	0	0.0 %
	Excellent	0	0.0 %
Postoperative	Poor	0	0.0 %
	Fair	0	0.0 %
	Good	19	76.0 %
	Excellent	6	24.0 %

Table (3)
Preoperative and postoperative IKDC

	Mean	Standard Deviation	Median	Minimum	Maximum	P value
Preoperative IKDC SCORE	43.36	5.35	41.10	28.70	51.70	< 0.001
Postoperative IKDC SCORE	81.89	8.48	81.60	70.10	94.30	

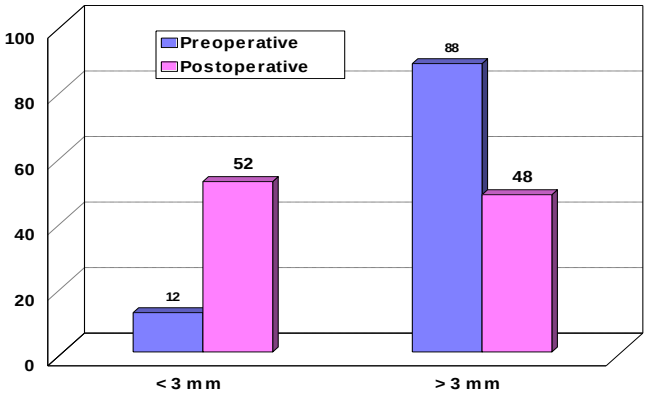

Figure 1. Preoperative and postoperative meniscal extrusion (ME)

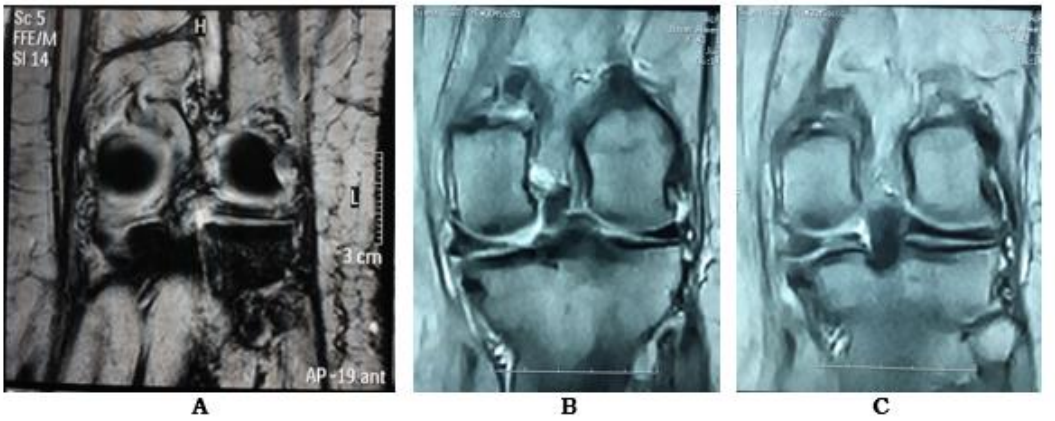

Figure 2. 42 years old female patient presented with left knee pain, tender joint line, and MRI was done revealed PRTMM. Preoperative Lysholm score was poor and IKDC was 39.1, while postoperative Lysholm score improved to good and postoperative IKDC improved to 70.1 **(a)** Photograph of MRI showing PRTMM lesion, (b&c) Photograph of 6 months postoperative MRI showed healed meniscus root in a good reduction and anatomical position

Discussion

Several clinical studies involving the repair of MRT by arthroscopic pull-out technique have indicated positive clinical outcomes and radiographical findings (Lee et al., 2009, Magee et al., 2004). On the other hand, since the number of research undertaken on the subject was limited, definitive evidence on clinical and MRI findings after MRT repair is difficult to come by. Furthermore, no prognostic markers for successful repair have been identified (Magee et al., 2004).

Therefore, this study set out to report the clinical outcomes and MRI findings after repairing MRT by arthroscopic pull-out surgical technique, as well as to determine the factors and characteristics linked to poor prognosis. Prior to arthroscopic surgery, all participants had MRI tests that indicated MMPRTs. The

Lysholm knee and IKDC ratings were used to assess clinical findings either preoperatively or during the final follow-up visits.

Thirty patients underwent repair with pullout suture, 3 patients were failed at repair due to degenerated meniscus and suture cut through and 2 patients were lost in follow up, 25 patients were followed up to 6 months and were included in this study.

Following surgery, all clinical outcome parameters improved significantly. according to Lysholm score 15 patients (60%) had poor score preoperative and 10 patients (40%) had a fair score, postoperative 19 patients (76%) had a good score and 6 patients (24%) had excellent score. the mean IKDC score increased from 43.36 ± 5.35 to 81.89 ± 8.48 ($P < 0.001$). postoperative MRI showed complete healing in 15 (60.0%) patients and failure in 10 (40.0%) patients. preoperative ME was > 3 mm in 22 (88.0%) patients and ≤3mm in 3 (12.0%) patients, improved postoperative to 13 (52.0%) patients ≤ 3mm and 12 (48.0%) patients > 3mm .

In the same regard, The Lysholm score improved significantly from 56.8 to 85.1, according to Kim et al. (2011), While the mean Lysholm knee score improved from 57.0 to 93.1, according to Lee et al.(2009). Furthermore, the average Lysholm score increased from 48.3 preoperatively to 83.2 postoperatively, according to Moon et al. (2012).

Kim et al. (2011) study Between September 2003 and August 2007, 58 patients with MMPRT who subgrouped into (M group, n 28) underwent partial meniscectomy or (R group, n 30) pullout repair. On plain radiographs, the cases were assessed using the, IKDC, Lysholm knee score, Kellgren-Lawrence grade, and joint space narrowing. On MRI medial meniscal extrusion, as well as the condition of the meniscus plus articular cartilage, were evaluated. For both groups' precise clinical data were improved. In addition, The Lysholm knee score significantly improved in the R group (P-.001), going from 56.8 (44 - 70) to 85.1 (77- 94), as well as in the M group from 56.1 (47 - 66) to 81.7 (75 - 89). (P- 0.001). Furthermore, IKDC score significantly improved in both groups, going from 42.6 (30 - 53) to 77.2 (68 - 92) in the R group (P-.001) and 42.3 (30 - 53) to 74.1 (70 - 83) in the M group (P- .001). 3 patients in the M group developed advanced osteoarthritis (OA) with considerable pain, but at a mean of 17.8 months following meniscectomy, they received total knee replacement arthroplasty (10.7 percent).

A systemic review conducted by Feucht et al.(2015) there were 172 patients in total in 7 trials who matched the inclusion criteria. They aged around 55.3 years, and 83 percent of them were female. All Lysholm scores of the participants were recorded before and after surgery. The Lysholm score increased postoperatively changed from 52 to 85.9 after a mean follow-up duration of 30.2 months. The conventional radiological assessment revealed, 64 of 76 patients (84%) showed no Kellgren-Lawrence grading advancement. In 84 of 103 patients (82%), MRI revealed no advancement of cartilage deterioration and improved extrusion of medial meniscal in 34 of 61 individuals (56 percent).137

In Chung et al.(2016) In MMPRT, 40 patients had been monitored for more than 5 years following management by pullout fixing technique. The average period of follow-up was 71.1 months. Preoperatively and during final follow-up, clinical outcomes such as Lysholm score and IKDC score, as well as radiographic results such as Kellgren-Lawrence (K-L; 0/1/2/3/4) grade and medial joint space width, were assessed. The Lysholm score (average increased from 52.1-8.8 to 83.8-11.9) and IKDC score (average increased from 40.1- 7.6 to 73.3-10.9) both improved significantly (P.001). The width of medial joint space (from 4.8-1.1 to 3.9-1.1) and K-L grade (from 6/25/9/0/0 to 0/11/20/9/0) significantly worsened on assessed radiographs (P.001). Generally, K-L grade progression was seen in 28 of 40 patients (70 percent). Despite this, no patient's K-L grade increased to 4, or the procedure was converted to total knee arthroplasty. In the follow-up MRI, 18 (45%) of the patients had complete healing, whereas 22 (55%) had partial healing.

After patients' follow-up of at least 5 years, Chung et al.(2015) compared clinical and radiological results in the MMRT repair cohort study and in the partial meniscectomy cohort study, finding that the repair group had significantly improved Lysholm and IKDC scores than scores in the partial meniscectomy group. Chung et al. documented improvements that were statistically significant in postoperative subjective clinical scores in comparison to the preoperative state after MMRT repair, however, arthrosis development was not avoided and extrusion of meniscus extrusion was not minimized.

In Ozkoc et al. (2008) retrospective study at a mean follow-up time of 4.7 years, patients with MMPRT underwent partial meniscectomy. Lysholm scores improved considerably after surgery, while degenerative alterations as measured by Kellgren-Lawrence radiological grade worsened.

Technical pearls and pitfalls

Technical pearls and pitfalls in the current study were that using knee scorpion was much easier and less time-consuming, some patients with tight medial compartments we did outside in pie crusting to the medial collateral ligament.

Limitations

The limitations in our study were that patients with degenerated meniscus were at a higher risk for suture cut-through and hence partial meniscectomy we didn't follow these patients to assess their outcome. Also, good reduction may be difficult if patients had a delayed repair. Finally, we couldn't assess accurate meniscal extrusion due to lacking standardization in MRI, so we considered extrusion 3 mm which is normal as a basic standard.

Conclusion

MRT resulted in a change in biomechanics and the progression of osteoarthritis in the knee. Pullout repair is an arthroscopic surgical procedure for repairing MRT and restoring the meniscus' circumferential hoop strength. Patient-reported functional results have improved following surgical repair of the posterior MRT. In patients who do not have severe osteoarthritis, it is advised that posterior MRT be

repaired. Arthroscopic pullout suture repair provides favorable short-term clinical outcomes for patients with MMPRT that seems to be repairable and concomitant with grade III degenerated articular cartilage that was detected in terms of radiographic studies.

Ethical approval:
This study was approved by an Cairo University ethics committee

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No competing interests exist.

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