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Evaluation of the Relationship Between Clinical Findings and Magnetic Resonance Imaging Findings of Patients with Arthroscopic Meniscus Repair

Bekir Karagoz[1](ID), Hasan Bombaci [2](ID)

[1]Adiyaman University Training and Research Hospital Department of Orthopaedics and Traumatology, Adıyaman, Turkey
[2]Health Science University Haydarpasa Numune Training and Research Hospital Department of Orthopaedics and Traumatology, Istanbul, Turkey

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Abstract

Objective: In this study, the relationship between clinical findings and magnetic resonance imaging (MRI) findings in patients undergoing arthroscopic meniscus repair was investigated.

Methods: Seventy patients with a mean age of 29.3 ± 9.2 (range; 18-54) were included in the study. The clinical evaluation of the meniscus repairs was made according to the criteria described by Barret. MRI results were evaluated according to the classification made by Crues et al. In addition, the clinical healing and satisfaction of the patients were evaluated with preoperative and postoperative the Lysholm functional scoring. Both clinical and MRI results were compared based on age, time to surgery, type of tear, localization of the ruptured meniscus, combination with anterior cruciate ligament reconstruction.

Results: While the results of 58 (83%) patients were successful in the clinical evaluation, the number of cases that recovered according to the MRI results was found to be 39 (55.7%). The mean Lysholm functional score, which was 62.64±19.73 preoperatively, increased to 90.93±9.58 at the final follow-up. Consistency between improvement in MRI according to Kappa analysis and success or failure according to clinical evaluation was found to be insignificant. In this analysis, the sensitivity coefficient was 52.86% and the Kappa value was calculated as 0.123.

Conclusion: No correlation was found between clinical evaluation and MRI results in the statistical analysis. According to the results of this study, clinical evaluation and Lysholm functional scoring help the clinician more in case follow-up and the success of the surgery compared to the MRI results.

Key words: Meniscus repair, Lysholm, Barret criteria, Magnetic resonance

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Address for correspondence/reprints:

Bekir Karagoz

Telephone number: +90 (545) 646 89 14

E-mail: drbkr71@gmail.com

Introduction

Meniscus are anatomical formations in the fibrous cartilage structure between the tibia and femur in the knee joint (1). Its main duties are to provide load transfer with its shock absorbing feature, to increase the joint surface contact area, to contribute to joint stability and proprioception (2,3). Direct traumas, coercive movements and repetitive overloads can cause meniscus tears.

In the historical process, different surgical methods have come to the fore at different times in the treatment of meniscal tears. Among the factors that are effective in deciding the surgical technique in meniscus tears; the patient's complaint, age, the size of the tear, the morphology of the tear, the structure of the meniscus, time after injury and accompanying additional pathologies are included (1). Partial meniscectomy has been shown to cause irreversible damage to articular cartilage in the long term (4,5). Since the 1980s, arthroscopic techniques have been developed and with the recognition of the blood supply properties of the meniscus, repair has come to the fore in appropriate tears.

For the postoperative follow-up of the meniscus repair, there are various evaluations in the literature such as clinical evaluation, "secondary look" arthroscopy and magnetic resonance imaging (MRI) after meniscus repair (6-8). However, "second look" arthroscopy is not preferred because it is an invasive method. In some studies, comparing clinical evaluation and MRI results, it has been suggested that clinical evaluation has higher success rates (9). However, controversy continues regarding the congruence of MRI findings with clinical outcomes.

The aim of this study is to evaluate the relationship between clinical and MRI findings in patients who underwent arthroscopic repair due to meniscal tears. In addition, it was aimed to evaluate the success rate of the treatment method applied.

Methods

After obtaining approval from the ethics committee of our institution, patients who underwent arthroscopic meniscal tear repair between January 2011 and December 2018 were included in our study. By examining the files of the patients in the hospital archive, examination forms at the first application and functional evaluation scores used in follow-up were obtained. Inclusion criteria of the patients in the study: (1) being in the age range of 18-55 years, (2) having only meniscus tear with meniscus or anterior cruciate ligament (ACL), (3) having meniscus tear due to trauma or sports injury, (4) ACL reconstruction with hamstring tendon autograft, (5) at least six months of follow-up and regular follow-up visits, (6) patients' compliance with the standard rehabilitation process. As exclusion criteria; (1) being under the age of 18 and over 55, (2) having a history of any previous operation for the knee joint, (3) having a follow-up period of less than 6 months, (4) not following the rehabilitation process, not having regular controls. 28 of the 98 patients who underwent meniscus repair, determined from the hospital records, were not included in the study because they had exclusion criteria.

Seventy patients with inclusion criteria were included in the study. Of the cases included in the study, 57 (81.4%) were men and 13 (18.6%) were women. Average age is 29.3 ± 9.2 (range; 18-54). The mean time from trauma to surgery in patients was 12.2 ± 15.8 (range, 1-82) months, and the mean follow-up time was 35.8 ± 23.3 (range; 8-108) months. It was operated on the right side of 38 (54.3%) and the left side in 32 (45.7%). Fifty (71%) patients had medial meniscus, 15 (21%) patients had lateral meniscus, 5 (8%) patients had both medial and lateral meniscus tears. It was found that 15 of the patients (21.4%) had a complex tear with a longitudinal component, 20 (28.6%) had a bucket handle and 35 (50%) had a longitudinal tear.

Surgical Technique

All patients were operated by an orthopedic and traumatologist experienced in arthroscopic surgery. Operations were performed with a 30° slop arthroscope from Karl Storz (Karl Storz Hopkins®; Germany). In the arthroscopic technique, in addition to standard anteromedial and anterolateral portals, anterior transpatellar portal was used in some cases. After the tear area was rasped, the sutures were sent from the portal that provides the most appropriate angle to the tear line and applied horizontally, vertically or obliquely according to the shape of the tear. Two types of sutures were used in meniscus repair: Polydioxanone suture (Biomet, Warsaw; USA) was used as suture material in the inside-out technique. Meniscus was repaired completely from inside, with the help of a device, using vertical suture in the all-inside technique. Fast-fix® (Smith & Nephew, Inc. Andover, MA; USA), Maxfire (Biomet, Warsaw; USA) meniscus suture equipments were used as suture in the all-inside technique. ACL reconstruction was performed with meniscus repair in 40 of the 70 patients. Endobuttons were used for fixation on the femoral side, while an interference screw and stapler were used on the tibial side.

Rehabilitation Program

The same rehabilitation programs were applied to all patients in the postoperative period. Patients were mobilized with support from the 2nd week to the 6th week by giving partial weight. Isometric quadriceps and hamstring exercises were started on the 1st postoperative day. Full extension and flexion up to 60° were allowed for 0-2 weeks postoperatively. While maintaining the muscle strength and full extension gained between 2-4 weeks, it was tried to achieve a 90° flexion by increasing the range of motion. It was aimed to have full range of motion between 4-6 weeks. Angle adjusted brace was removed at the end of the sixth week. While the patient was allowed to have full range of motion, squatting, jumping and turning movements were not allowed before 3 months. Return to sports and training was provided with straight running for 4-6 months. In patients without ACL injuries, it was enabled to switch to contact sports between six and eight months. Patients with ACL injuries were rehabilitated according to the meniscus protocol for the first 2 months and then the ACL rehabilitation protocol was adhered to. Contact sports were allowed after 10 months.

Clinical Evaluation

Barret's criteria were checked on physical examination in all patients (10). According to Barret's criteria, the meniscus was deemed to be healed in the absence of joint tenderness, effusion, locking in the knee with meniscus repair and negative McMurray test. If one or more of these criteria were found, the result was accepted as clinical failure. In addition, Lysholm functional scoring was evaluated preoperatively and at sixth month postoperatively.

MRI Evaluation

Radiological healing of the meniscal tear was evaluated by MRI of the knee joint at the sixth month postoperatively. MRI scans were performed with a protocol for the knee joint, which is routinely used in our clinic, using a 1.5T MR imaging device (GE Healthcare: Optima MR450w) in all cases. No special preparation was made for the patients before the procedure. MRI images were evaluated by a radiologist experienced in musculoskeletal diseases. The classification made by Crues et al. was used to evaluate the MRI results (11). In this classification, meniscus healing in MRI results was divided into 4; Grade 0: Normal, Grade 1: Increased signal in the intrameniscal area, Grade 2: Intrameniscal linear or wedge-shaped signal intensity, Grade 3: Linear or spherical signal intensity extending to the joint surface. Results reported as Grade 0–1–2 whose signal intensity did not reach the joint surface were considered to be healed, while results reported as Grade 3 that reached the joint surface were considered unhealed. Both clinical and MRI results were compared based on age, tear type, number of sutures used, combination with ACL reconstruction.

Statistical analysis

Demographic and clinical characteristics of the participants who underwent meniscus repair in the study were evaluated using descriptive methods such as percentage, mean, and standard deviation. Pearson Chi-Square Analysis was used for proportional comparisons among categorical data. In addition, Fisher's Exact Chi-Square Analysis was preferred for proportional comparisons with data below 5%. "Independent groups t test" was used when comparing the average data between the groups met the normal distribution hypothesis, and the Mann Whitney U test was used if it was not met. "t test for dependent samples" was used to measure the change of preoperative and postoperative Lysholm functional scoring values. Kappa Analysis was used to measure the consistency between clinical evaluation and MRI findings. IBM SPSS 22.0 program was used to evaluate the analyzes. The level of significance was set as $p < 0.05$ for all statistical analyzes.

Results

In the clinical evaluation performed according to Barret's criteria, there was at least one physical examination finding in all patients (100%) before surgery, while this rate was found to be 17.1% after surgery. In the statistical analysis performed, this rate of healing in physical examination findings after meniscus repair was found to be statistically significant ($p < 0.05$).

Preoperative Lysholm score mean was 62.64 ± 19.73, postoperative Lysholm score mean was 90.93 ± 9.58. It was found that the Lysholm scoring mean significantly changed after treatment ($p < 0.001$).

In comparison made according to demographic characteristics; the mean postoperative Lysholm functional scores was found to be statistically significantly higher under 30 years of age than 30 years and over ($p = 0.002$). In addition, it was found that the postoperative Lysholm functional scores of the cases that were successful in the clinical evaluation made according to the Barret's criteria were statistically significantly higher than the cases without success ($p = 0.001$).

The success status of the operated patients according to the MRI results was evaluated according

to the classification by Crues et al (11). According to this evaluation, healing in MRI was detected in 39 (55.7%) patients (Grade 0-1-2), and there was no healing in 31 (44.3%) patients (Grade 3).

According to the comparison between the two groups under the age of thirty and over the age of 30, it was found that the recovery rates in MRI were not statistically significantly different (p = 0.126) among the cases who underwent meniscus repair. In addition, according to the clinical evaluation, it was observed that the success rates in treatment were not statistically significantly different than the comparison between the two groups (p = 0.743).

According to the tear patterns (complex with longitudinal component, bucket handle, longitudinal), the rates of those with healing on MRI (Grade 0-1-2) were not found to be statistically significantly different (p = 0.521). According to the MRI results, 9 (60%) of the cases with complex tear with a longitudinal component, 9 (45%) of the cases with bucket handle tear, and 21 (60%) of the cases with longitudinal tear had healed. In addition, statistical analysis performed according to clinical evaluation revealed that there was no statistically significant difference between tear patterns (complex with longitudinal component, bucket handle, longitudinal) in terms of success rates (p = 0.363) (Table 1).

In the MRI results, the mean number of sutures in non-healed (Grade 3) participants with respect to the size of the tear were found to be statistically significantly lower than the mean of those with healed (Grade 0-1-2) (p = 0.030). It was found that the success rate in clinical evaluation and the mean number of sutures were not statistically significantly different (Table 2) (p = 0.406).

It was found that the rates of cases with isolated meniscus repair and combined surgery with ACL reconstruction were statistically significantly different (p = 0.019) (Table 3). Healing was found in the MRI results in 14 (46.7%) of the cases with isolated meniscus repair, and in 25 (62.5%) of the cases who underwent combined surgery with ACL reconstruction. According to the clinical evaluation using Barret's criteria, it was found that the rates of cases with isolated meniscus repair and combined surgery with ACL reconstruction were not statistically significantly different (p = 0.363).

Statistical analysis was performed to evaluate the consistency between recovery status according to MRI results and success according to clinical assessment. According to this analysis, the sensitivity coefficient was calculated as 52.86% and the kappa value as 0.123 (Table 4). With this result, it was determined that the concordance between the improvement in MRI and success in clinical evaluation was insignificant.

Table 1. Comparison of clinical evaluation and magnetic resonance imaging results according to tear type in patients

		Tear Type						X2	p
		Complex tear		Bucket handle tear		Longitudinal tear			
		n	%	n	%	n	%		
Magnetic Resonance Imaging Result	Unsuccessful	6	40	11	55	14	40	1,302	0,521
	Successful	9	60	9	45	21	60		
Clinical Evaluation	Successful	14	93,3	17	85,0	27	77,1	2,03	0,363
	Unsuccessful	1	6,7	3	15,0	8	22,9		

Table 2. Comparison of the number of sutures according to radiological and clinical evaluation results

	Magnetic Resonance Imaging Result		
	Unsuccessful (n=31)	Successful (n=39)	p
Number of sutures	5,07±2,22	4,00±1,79	0,030
	CLINICAL EVALUATION		
	Successful (n=58)	Unsuccessful (n=12)	p
Number of sutures	4,40±2,09	4,83±1,85	0,406

Table 3. Comparison of clinical evaluation and magnetic resonance imaging results between patients with isolated meniscus repair (M) and those with combined meniscus repair and ACL reconstruction (M+ACL).

		M		M+ACL			
		N	%	N	%	X2	p
Magnetic Resonance Imaging Result	Unsuccessful	16	53,3	15	37,5	7,97	0,019
	Successful	14	46,7	25	62,5		
		N	%	N	%	X2	p
Clinical Evaluation	Successful	25	83,3	33	82,5	2,03	0,363
	Unsuccessful	5	16,7	7	17,5		

Table 4. Comparison of success between clinical evaluation and magnetic resonance imaging findings

		Magnetic Resonance Imaging Result		Total	Kappa value
		Successful	Unsuccessful		
Clinical Evaluation	Unsuccessful	9	3	12	0,123
	Successful	30	28	58	
Total		39	31	70	

Kappa <0: No consistency
Kappa between 0.00 and 0.20: Insignificant
Kappa between 0.21 and 0.40: Low
Kappa between 0.41 and 0.60: Moderate
Kappa between 0.61 and 0.80: Important
Kappa between 0.81 and 1.00: Nearly perfect

Discussion

The results of this study showed that the Barret's criteria and Lysholm functional scoring to evaluate the results of meniscus repair successful results in the follow-up and evaluation phase. When the MRI results were examined, it was found that it was not as successful as clinical evaluation in determining recovery after repair. While making a repair decision in meniscus tears; the age of the patient, the location of the tear, the pattern of the tear, the size of the tear, the stability of the knee joint, the time elapsed after the trauma, the quality of the meniscus tissue and the experience of the surgeon are factors that should be evaluated (1). The importance of these factors has been examined in many different studies (13-15).

Various evaluation methods such as clinical evaluation, "secondary look" arthroscopy and MRI have been reported in the literature after meniscus repair. "Secondary look" arthroscopy is the gold standard method for evaluating meniscus healing (16). However, its being an invasive method makes it difficult to use in routine practice (17). Miao et al. compared clinical evaluation, " secondary look " arthroscopy and MRI. The success rates of the clinical evaluation were found to be higher than the evaluation made by MRI and " secondary look " arthroscopy. Although it is an indirect method, it has been suggested that clinical evaluation with patient history and physical examination is more successful in evaluating postoperative recovery (9). In clinical evaluation, the experience of the surgeon comes to the fore, and it can be performed without any invasive procedure (16). In our study, the clinical results of meniscus repair were evaluated by physical examination methods. Physical examination was based on clinical criteria determined by Barrett et al. while there was at least one physical examination finding in all patients (100%) preoperatively, this rate was found to be 17.1% after surgery. In the statistical analysis, this healing was found significant in physical examination findings after meniscus repair. Lysholm functional scoring is one of the most used scorings for knee joint functional evaluation. It is mainly used for patients with knee ligament injury (18). All patients in our study were evaluated with preoperative and postoperative Lysholm functional scoring. It was observed that there was a statistically significant increase in the postoperative period compared to the preoperative period.

According to many studies, the most reliable imaging method for evaluating healing after meniscus repair is MRI or computed tomography arthrography (16,19,20). However, the disadvantages of both methods are that they are invasive. The fact that MRI is both noninvasive and easily accessible has increased its usability in evaluation after meniscus repair. Miao et al. combined several sequences of MRI in the radiological evaluation of meniscal healing reported 92% sensitivity and 99% specificity (21). However, edematous and fibrous tissue that occurs during the recovery period can be perceived as a pathological signal (22). When we look at the

literature, although conventional MRI is an accurate method for the diagnosis of meniscal irregularities, there are studies showing that it is less reliable in the postoperative evaluation of meniscus repairs in the short and medium term (6,23). Eggli et al. reported that tears were reported on MRI images in 24 (96%) of 25 menisci with successful healing and conventional MRI was not safe (24). Hantes et al. evaluated the healing process of meniscal repair by MRI 3, 6, and 12 months after surgery (8). Postoperative signal changes were detected in each of the 20 patients participating in the study at postoperative 3 months. There was a significant decrease in these signal changes between 3 and 12 months. However, the signal change did not disappear completely.

In our study, the radiological healing of the cases with meniscus repair was evaluated with MRI. The classification described by Crues et al. was used to evaluate the degree of signal in the repaired area. According to the classification made by Crues et al. the healing rate was found to be 55.7%. At the end of this study, our opinion; clinical evaluation and scoring method is more advantageous than MRI evaluation in postoperative follow-up, both economically and noninvasively. Negative aspects of MRI in postoperative follow-up; the presence of signal changes in MRI evaluations even after a very long postoperative follow-up period, the possibility of misleading the clinician in the follow-up of these visible signal changes, the lack of criteria for evaluating the MRI results that have yet to be clearly established in the postoperative follow-up, the high cost of the MRI method and the lack of consistency between MRI results and clinical evaluation can be counted as.

The weaknesses of our study are that male-female, internal-external meniscus subgroups were not high enough to make comparisons, meniscus sizes could not be documented in more detail, cartilage damage was not evaluated, and the number of patients included in the study was not high. Its strengths include the average follow-up period of the cases included in the study, approximately 3 years, and being operated by a single surgeon

Conclusions

According to these results, it has been determined that non-invasive and cost-free clinical evaluation gives more accurate results than MRI in the follow-up of the patients with meniscus repair. In this respect, we think that Barret's criteria and Lysholm functional scoring are effective methods to evaluate recovery. However, the long-term effects of this inconsistency in clinical evaluation and MRI findings may be a separate research topic.

Ethics Committee Approval: Ethics committee approval was received for this study from the Health Sciences University Haydarpaşa Numune Training and Research Hospital Clinical Research Ethics Committee (ethics committee date and no: 22/07/2019- HNEAH-KAEK 2019/82)

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