

A Longer Duration from Injury to Surgery is Associated with Preoperative Deterioration of an Isolated Meniscal Tear in Patients Aged 40 Years or Older

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Research Article

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Abstract

Background: It remains unclear what percentage of isolated meniscal tears deteriorates before surgery, especially in older patients. We aimed to evaluate the preoperative deterioration of an isolated meniscal tear in patients aged 40 years or older, and whether time from injury to surgery is associated with worsening of a meniscal tear.

Methods: Patients aged 40 years or older who underwent arthroscopic surgery for isolated meniscal tear between 2014 and 2019 were retrospectively reviewed. The diagnostic magnetic resonance imaging (MRI) findings and arthroscopic findings were compared to evaluate the deterioration of meniscal tears. Predictors of the development of meniscal tears; patient demographic factors, duration from injury to surgery (injury to MRI and MRI to surgery), and image findings were assessed.

Results: A total of 58 patients (58 knees) were included (mean age, 55.9 ± 8.5 years; male/female, 31/27). An isolated meniscal tear deteriorated in 28 (48.3%). In comparison of patients with and without deteriorated meniscal tear, significant differences were found in the MRI grade of meniscal tear ($p = 0.03$), duration from injury to MRI (164.2 ± 167.9 vs. 45.2 ± 48.7 days, $p < 0.001$), and from MRI to surgery (148.8 ± 91.1 vs. 67.6 ± 56.7 days, $p < 0.001$). A multivariate regression analysis showed that the duration from injury to MRI (odds ratio [OR], 1.03; $p < 0.001$) and from MRI to surgery (OR, 1.02; $p < 0.001$) were independent predictors of worsening of a meniscal tear.

Conclusions: Approximately 50% of isolated meniscal tears deteriorated preoperatively in patients aged 40 years or older. The duration from injury to MRI and from MRI to surgery were independent predictors of the preoperative worsening of an isolated meniscal tear in this cohort.

Background

A meniscal tear is the most common knee injury [1, 2], with an incidence of 23.8/100,000 per year [1]. Meniscal injury is often associated with knee ligamentous injuries, such as anterior cruciate ligament (ACL) injury [3-5]. Numerous studies have reported that there is a high risk of worsening or newly developing meniscal injuries in cases of ACL-deficient knee because of the anterior and rotational instability of the knee [5-8]. Stone et al. reported that delayed ACL reconstruction (ACLR) for more than 1 year was associated with an increased risk of medial meniscal injury (odds ratio, 3.47; $p < 0.002$) [9]. ACLR should be performed within three months to prevent subsequent meniscal injuries, according to a recent systematic review [8]. However, to the best of our knowledge, no studies have evaluated whether or not an isolated meniscal tear deteriorates when surgery is delayed. Evidence regarding the association between the duration from injury to surgery and worsening of the isolated meniscal tear, is scarce. To prevent deleterious effects of meniscectomy on the development of osteoarthritis (OA), the "meniscus preservation concept" has been mentioned [10, 11]. It was reported that 320% increase of the meniscal repair was found while 21.4% reduction of the meniscectomy, from 2005 to 2017 in France [12]. A similar trend in meniscal surgeries in the United States was also reported [13]. In the previous studies, less

favorable outcomes of meniscal repair were reported in the older population [14, 15]. However, Poland et al. showed that an age > 40 years old was not associated with an increased risk of meniscal repair failure at 5 years after surgery [16], which was supported by a systematic review by Everhart et al. [17]. Considering the increased number of aged populations all over the world, further studies are needed for this cohort.

A recent systematic review reported that a short time from injury to surgery, Outerbridge scores below grade 3 were significant predictors of better patient-reported outcome measures (PROMs) after arthroscopic meniscal repair [18]. However, the majority of the included studies (78%) were level 4 case series, that were unable to draw a definitive conclusion regarding predictors for better results after arthroscopic meniscal repair. In order to achieve more favorable clinical results following meniscal repair for older patients as well as young patients, it may be valuable to clarify the preoperative factors associated with worsening of an isolated meniscal tear at the time of surgery. Some authors have reported that acutely repaired meniscus tears obtained superior results compared to chronically repaired tears [19-21]. However, it remains unclear why acutely repaired tears result in better outcomes. It was hypothesized that delayed surgery may result in the deterioration of an isolated meniscal tear before surgery. Especially in the aged population, preoperative deterioration of meniscal tear would occur due to poor quality and vascularity of the meniscus [22, 23]. If an isolated meniscal tear develops before surgery, it may affect the surgical procedures and postoperative clinical outcomes. The present study was performed to answer the following two questions by comparing the findings of magnetic resonance imaging (MRI) that was performed as a diagnostic examination, and the arthroscopic findings at surgery: (1) " Does an isolated meniscal injury deteriorate between the injury and surgery in patients aged 40 years old or older ? ", and (2) " If an isolated meniscal tear deteriorates preoperatively, is the duration from injury to surgery associated with worsening of the meniscal tear ? "

Methods

A single institutional retrospective analysis of prospectively collected data was performed. Institutional review board approval was obtained before the initiation of data collection. All procedures were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Declaration of Helsinki of 1975, as revised in 2013. From January 2014 to December 2019, patients \geq 40 years old who underwent arthroscopic surgery for the treatment of isolated meniscal tear were identified and included in the study. The diagnosis of an isolated meniscal tear was made by a combination of physical examinations, including the McMurray test, Apley test and tenderness to the joint space, and MRI findings [24-26]. The final diagnosis was made by the arthroscopic evaluation at the time of surgery. Exclusion criteria were patients who had (1) a history of surgery for the operated knee, (2) a meniscal tear associated with knee ligamentous injuries, (3) a discoid meniscus, (4) not undergone MRI as a diagnostic examination for the meniscal tear, (5) the timing of the meniscal injury that could not be determined from the medical records. Our indications for arthroscopic meniscal surgery included patients who had locking of the knee joint due to meniscal injury and who failed the conservative treatment for more than 3 months. Patient charts were individually reviewed to

obtain the patient data, including age, sex, body mass index (BMI), injury mechanism, Tegner activity scale before the injury, side of the affected knee (right vs. left), date of the MRI scan and surgery, and duration from injury to surgery that was divided into time from the injury to MRI and from MRI to surgery. The severity of knee OA was radiographically evaluated by the preoperative whole-leg radiograph in the standing position, according to the Kellgren Laurence (KL) classification. The deterioration of the meniscal tear was confirmed by comparing the findings of MRI performed as a diagnostic examination and those of the arthroscopic evaluation at surgery.

The evaluation of the MRI findings

The findings of MRI that were performed as a diagnostic examination of the meniscal tear were evaluated by two of the authors who are consultant orthopaedic surgeons, and have been involved in knee arthroscopic surgeries for more than 10 years. Both examiners were blinded to the patient information. The side (medial meniscus, MM vs. lateral meniscus, LM, or bilateral menisci), segment (anterior horn, middle horn, posterior horn, anterior or posterior roots), and grade of the affected meniscus were evaluated. The grade of the meniscal tear was documented according to the classification by Guenther et al. [27]. Due to this classification system, meniscal injuries were graded on a scale from 1 to 4: grade 1, trivial tear, very short, peripheral; grade 2, substantial tear but undisplaced; grade 3, displaced portion or involvement of meniscal root; and grade 4, bucket handle meniscal tear. The two raters independently assessed the MRI findings. In the case of discrepancy in the assessment of the grade of meniscal injury between the examiners, a third senior orthopaedic surgeon resolved it.

The evaluation of the arthroscopic findings

All meniscal surgeries were arthroscopically performed with the patient in the supine position by one of four experienced arthroscopists who are specialized in knee arthroscopic surgeries. A tourniquet was applied over the operated thigh at an average of 250mmHg. The arthroscopic diagnosis was made using an 30° arthroscope via standard anterolateral and anteromedial portals. Information regarding the site, segment, and grade of the meniscal tear, as mentioned above in the section on the evaluation of MRI findings, was obtained from the operative records and arthroscopic videos.

Deterioration of the isolated meniscal tear

The MRI findings and arthroscopic findings at surgery were compared to evaluate the deterioration of the isolated meniscal tear. In addition to the grading system by Guenther et al. [27], enlargement of the meniscal tear was evaluated by comparing the involved segment of the tear between the MRI findings and arthroscopic findings. Patients were classified into two groups depending on the results: Group A, patients whose grade and segment of the meniscal tear had not change by surgery; Group B, patients whose meniscal tear had deteriorated by surgery. The deterioration of the meniscal tear was defined as

- (1) progressed grade of the meniscal tear at surgery, (2) enlargement of the meniscal tear at surgery and
- (3) newly identified tears at surgery in addition to the lesions on MRI.

Statistical analysis

All statistical analyses were performed using the SAS software program (JMP Pro ver. 15.2.0; SAS Institute, Cary, NC, USA). Descriptive statistics are presented for both group (subjects with and without worsening of the meniscal tear) in the form of the number of occurrences and percentage or as the mean, standard deviation (SD), and extrema. P values less than 0.05 were considered significant. The Shapiro-Wilk method was used to test whether or not the data were normally distributed. Student t tests were performed for continuous variables when the data showed a normal distribution, otherwise, the Mann-Whitney U test was performed. The categorical variables were compared using the Chi-square or Fisher's exact test. All tests were two-tailed. Variables included in the bivariate analyses were the sex, age, BMI, injury mechanism, Tegner activity scale before the injury, side of the affected knee, duration from injury to MRI (days), duration from MRI to surgery (days), KL grade, and the side (MM vs. LM vs. bilateral menisci) and MRI grade of the meniscal tear. A logistic regression analysis was performed to assess the impact of potential predictors on the deterioration of the isolated meniscal tear. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. Finally, Spearman's rank correlation coefficient was used to assess the relationship between (1) the duration from injury to MRI and continuous variables, and (2) the duration from MRI to surgery and continuous variables. The strength of the correlation of the rank coefficients was defined as follows: strong, 0.70–1.0; moderate, 0.40–0.69; weak, 0.20–0.39 [28]. The relationship between the duration from injury to surgery (injury to MRI and MRI to surgery) and categorical variables was evaluated using the Student t test or Mann-Whitney U test.

Results

A total of 75 patients who underwent arthroscopic surgery for an isolated meniscal tear were identified in the study period. Of these patients, 17 were excluded for the following reasons: discoid meniscus (n = 5), history of the knee surgery (n = 10), and revision surgery of the meniscus tear (n = 2). As a result, a total of 58 patients (58 knees) were finally included and evaluated in this study. The arthroscopic evaluation did not identify any ligamentous injuries, such as ACL or posterior cruciate ligament (PCL) injuries. The mean age of the sample population was 55.9 ± 8.5 (range, 40-81) years old, and males were 31 (53.4%). The mean BMI was 25.5 ± 4.6 (range, 19.5-40.1) kg/m^2 . The side of the injured knee was right in 31 (53.4%), and no patient injured both sides. The KL grade were 1 in 23 (39.7%), and 2 in 35 (60.3%). The mean time from injury to MRI was 102.6 ± 134.8 (range, 1-727) days, and that from MRI to surgery was 106.8 ± 85.1 (range, 7-365) days.

Deterioration of the isolated meniscal tear

Of the 58 patients, deterioration of the isolated meniscal tear was detected in 28 patients (48.3%, Group B). The details of the MRI and arthroscopic findings in Group B are shown in Table 1. Of the 28 patients, grade of the tear progressed in 21 (75%). Two patients (7.1%) showed enlargement of the tear (Case 9, 28), and new meniscal tears were arthroscopically identified in 5 (17.9%) (Case 8, 16, 24, 25, 32).

Due to the comparison of the patients with and without worsening of the meniscal tear, there were significant difference in the MRI grade of the meniscal tear ($p = 0.03$), duration from injury to MRI (164.2 ± 167.9 vs. 45.2 ± 48.7 days, $p < 0.001$), and duration from MRI to surgery (148.8 ± 91.1 vs. 67.6 ± 56.7 days, $p < 0.001$). There were no significant differences in other evaluated factors (Table 2).

In the multivariate regression analysis, the duration from injury to surgery (OR: 1.031, 95%CI: 1.015-1.047, $p < 0.001$) and that from MRI to surgery (OR: 1.024, 95%CI: 1.013-1.035, $p < 0.001$) were identified as statistically significant independent predictors (Table 3).

Correlation between the duration from injury to surgery and included variables

Regarding the correlation between the duration from injury to MRI and the included continuous variables, there were no correlation detected in the age ($R = 0.181$), BMI ($R = 0.186$), Tegner activity scale ($R = 0.059$), and MRI grade of the meniscal tear ($R = 0.194$). Regarding the correlation between the duration from MRI to surgery and the included variables, there were also no correlation identified in the evaluated factors (Table 4-A).

There were no significant associations between the duration from injury to surgery (injury to MRI and MRI to surgery) and evaluated categorial variables (Table 4-B).

Discussion

The most important findings of the present study were that an isolated meniscal tear deteriorated from the injury to surgery in 48.3% (28/58) of patients ≥ 40 years old, and the duration from injury to MRI (OR, 1.031, $p < 0.001$) and that from MRI to surgery (OR, 1.024, $p < 0.001$) were independent predictors of worsening of an isolated meniscal tear at the time of surgery.

Many previous studies have demonstrated an increased incidence of meniscal tears with delayed ACLR in pediatric and adult patients [5-9, 27, 29, 30]. Recurrent episodes of instability in the ACL-deficient knee could cause displacement or enlargement of the already-torn meniscus [31]. However, in the present study the deterioration of the meniscal tear was confirmed in nearly one-third of the patients with ACL-intact knees. Many authors have demonstrated the role of the meniscus, especially the medial meniscus, as an important restraint for anterior tibial translation in the ACL-deficient knee [32, 33]. However, the influence of isolated meniscal tear on knee stability still remains controversial, because few studies have investigated this issue. It was reported that a meniscal tear developed during screw-home mechanism (0-

30° flexion) and ascent from a squatting position (120-60° flexion) [34]. Kedgley et al. showed that the stress distribution on the meniscal tear surface under weight-bearing differed depending on the tear pattern and tear location, according to a finite element analysis [35]. They showed that differences in the stresses across the tear surfaces were greater for the LM than for the MM in longitudinal tear samples. In addition, they found that only the posterior segment of the LM was compressed throughout the range of knee flexion (0-30°). In the present study, there was not significant difference in the rate of worsening of the tear of the MM or LM between the Group A and Group B ($p = 0.22$). The deterioration of the meniscal tear in our study was assessed using the grading system reported by Guenther et al. [27]. This grading method did not consider the morphology of the meniscal tear. Furthermore, the majority of tear locations in this study population were in the middle to posterior segments of the meniscus. Therefore, the influence of the morphology and/or location of the tear on the development of isolated meniscal tear was not evaluated in this study. However, the present study was the first, to the best of our knowledge, to evaluate the development of an isolated meniscal tear from injury to surgery in the clinical setting, demonstrating the worsening of the tear in a half of patients ≥ 40 years old. It was speculated that activities under weight bearing between the injury and surgery might cause the enlargement of the torn meniscus or the development of a new meniscal tear, suggesting that patients with an isolated meniscal tear may benefit from early surgical treatment if indicated for the surgery in older patients. Cannon et al. reported a superior success rate in patients who underwent meniscal repair acutely (within 2 weeks from the onset) in comparison to those who received it chronically (88% vs. 79%) [19]. Noyes et al. found better results in the acutely repaired meniscal tear group (within 10 weeks from the injury) than in the chronically repaired group (success rate: 90% vs. 85%) [21]. Tengrootenhuisen et al. also reported better results in the acutely treated group (within 6 weeks of injury) compared with the chronically treated group (success rate, 83% vs. 52%) [36]. However, why the early surgical group had better clinical results than the delayed surgical group remains unclear. The worsening of the isolated meniscal tear before surgery may be a factor associated with worse clinical outcomes in the delayed surgical group. Future studies are needed to clarify whether or not the development of a meniscal tear in the ligament-intact knee affects the surgical results.

In the treatment for an isolated meniscal tear, conservative or surgical treatment is selected depending on the clinical setting. Many factors, such as tear stability, length, morphology, segment and vascularity were reported to be considered for the suitability of conservative treatment [37]. If conservative treatments fail, preservation of the meniscus, by meniscal repair or left *in situ*, is recommended as the clinical and radiological outcomes are worse after partial meniscectomy [10, 11, 38]. Based on the 2019 European Society for Sports Traumatology, Knee Surgery and Arthroscopy (ESSKA) meniscus consensus, preservation of the meniscus should be the first line of treatment whenever possible, regardless of the age, BMI, tear size, or tear location [38]. Several authors demonstrated favorable clinical results of meniscal repair performed in patients who were 40 years and older [16, 17, 21]. However, patient's age and radiographic findings (KL grade) could become a bias to clinicians when evaluating the cause of knee pain, which may result in a delayed decision to perform MRI to evaluate meniscal tears in middle-aged or elderly patients with radiographically OA knee. However, Englund et al. reported that meniscal

tears on knee MRI were detected in 35% of persons > 50 years old, and two-thirds of those tears were asymptomatic [39]. Therefore, it is not appropriate to make a diagnosis of a meniscal tear in aged patients using only MRI findings [24, 25]. All patients in the present study had a history of the sudden onset of knee pain, and individuals whose onset of meniscal tear could not be identified were not included in order to exclude cases of incidental meniscal tears detected on MRI. With increased age, the vascular supply to the meniscus is decreased [40]. Furthermore, the meniscus of patients with OA knee is more degenerative and sensitive to minor injury than in patients without OA knee, implying more easily worsening of the tear after an injury in OA knee patients. In order to prevent the development of meniscal tear after the injury, it is recommended to consider performing MRI at an early stage in middle-aged or elderly patients suspected of having a traumatic meniscal tear. This will decrease the rate of worsening of the meniscal tear, which may lead to better clinical results after meniscal repair in such populations. The avoidance of preoperative deterioration of the meniscal tear may result in performing meniscal repair rather than meniscectomy. However, the purpose of the present study was to evaluate whether or not an isolated meniscal tear deteriorates before surgery, and it was beyond the scope of this study to assess the differences in surgical outcomes or procedures between subjects with and without worsening of the meniscal tear at surgery. Further prospective studies will be required to investigate the influence of preoperative deterioration of the meniscal tear on surgical procedures and surgical results.

The current study has several limitations. First, patients who did not undergo surgery were not evaluated in this study. Therefore, the presence or absence of worsening of an isolated meniscal tear in patients treated conservatively could not be described. Second, MRI is the most commonly performed diagnostic imaging modality in the diagnosis of meniscal tear [41]. However, the sensitivity and specificity of MRI for medial meniscal tear are 89% (95% CI, 83%-94%) and 88% (95% CI, 82%-93%), respectively, and those for the lateral meniscal are 78% (95% CI, 66%-87%) and 95% (95% CI, 91%-97%), respectively [42]. Therefore, the accuracy of the evaluation of meniscal tear by MRI could affect the results of the present study. Third, as mentioned in the discussion, the grading system of the meniscal tear used in this study was unable to evaluate the morphology of the tear. Furthermore, the length of the meniscal tear was not evaluated using a probe at surgery. Therefore, the detailed measurement of the tear length was not performed. Fourth, due to the retrospective study design, the patient activities from the injury to surgery were not completely evaluated. However, all subjects had knee pain that limited their preoperative activity level, therefore the activity level was not high. Finally, young patients and patients with severe OA-knee (KL 3 or KL 4) were not identified in the study population. Therefore, preoperative worsening of meniscal tears in these cohorts was not evaluated.

Conclusions

Approximately 50% of isolated meniscal tears deteriorated preoperatively in patients aged 40 years and older. The durations from injury to MRI and from MRI to surgery were independent predictors of the worsening of isolated meniscal tear at surgery.

Abbreviations

MRI, magnetic resonance imaging; ACL, anterior cruciate ligament; ACLR, anterior cruciate ligament reconstruction; OA, osteoarthritis; PROM, patient-reported outcome measure; BMI, body mass index; KL, Kellgren Laurence; MM, medial meniscus; LM, lateral meniscus; SD, standard deviation; OR, odds ratio; CI, confidence interval; PCL, posterior cruciate ligament; ESSKA, European Society for Sports Traumatology, Knee Surgery and Arthroscopy

Declarations

Ethics approval and consent to participate

Ethical approval of this study was obtained from the institutional review board at Miyazaki University Graduate School of Medicine (Approval No. O-0817). This study was performed in accordance with the Declaration of Helsinki. Written informed consent was obtained from all subjects.

Consent for publication

Not applicable.

Availability of data and materials

All data are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

TY and TT conceptualized this study. TY collected data. TY mainly drafted the manuscript, and TT, NY, YM and EC supervised it. All authors had complete access to all data used in this study and take responsibility for its accuracy. All authors have read and approved the final manuscript.

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Tables

Table 1

Details of the MRI findings and arthroscopic findings in patients with deteriorated meniscal tear (n = 28)

MRI findings				Arthroscopic findings		
Case	M or L	Segment	Grade*	M or L	Segment	Grade*
1	M	P	2	M	P	3
2	M	P	2	M	P	3
3	M	P	1	M	P	2
4	M	M	1	M	M	2
5	M	M/P	2	M	M/P	3
6	M	M	2	M	M	3
7	M	P	1	M	P	3
8	M	P	2	M/L	M/P(M), M/P(L)	3(M), 3(L)
9	M	P	2	M	M/P	2
10	M/L	M/P	2	M/L	M/P(M), M/P(L)	2(M), 4(L)
11	L	A	1	L	A/M/P	2
12	M	M	1	M	M/P	2
13	L	A/M	2	L	A/M	3
14	M	P	2	M	P	3
15	M	P	2	M	P	3
16	M	P	2	M/L	P(M), A/M(L)	2(M), 3(L)
17	M	P	2	M	P	3
18	L	M/P	2	L	A/M/P	4
19	M	M/P	2	M	M/P	3
20	L	M/P	2	L	M/P	4
21	M	M	1	M	M	3
22	M/L	M/P	1	M/L	M/P(M), M/P(L)	2(M), 1(L)
23	M	P	2	M	P	3
24	M	P	2	M/L	P(M), M(L)	3(M), 2(L)
25	M	P	2	M/L	P(M), M(L)	3(M), 2(L)

26	L	P	2	L	P	3
27	L	M	2	M/L	P(M), M(L)	2(M), 2(L)
28	M	P	3	M	M/P	3

* Grade 1, trivial tear (very short, peripheral); Grade 2, substantial tear but undisplaced;

Grade 3, displaced portion or involvement of meniscal root; Grade 4, bucket handle tear

M, medial meniscus; L, lateral meniscus; M/L, medial and lateral menisci

A, anterior segment; M, middle segment; P, posterior segment;

A/M, anterior and middle segment, continuous; M/P, middle and posterior segment, continuous;

A/M/P, the whole segment, continuous

Table 2

Comparison of patients with and without the deterioration of the isolated meniscal tear

Variables	All patients (n = 58)	Non-deteriorated group (n = 30)	Deteriorated group (n = 28)	P value
Age, years	55.9 ± 8.5	55.2 ± 8.5	56.8 ± 8.5	0.30
Sex				0.79
male	31 (53.4)	17 (56.7)	14 (50.0)	
female	27 (46.6)	13 (43.3)	14 (50.0)	
BMI	25.5 ± 4.6	26.6 ± 5.4	24.3 ± 3.3	0.16
Side of the injured knee				0.61
right	31 (53.4)	15 (50.0)	16 (57.1)	
left	27 (46.6)	15 (50.0)	12 (42.9)	
Injury mechanism				0.18
daily activities	39 (67.2)	17 (56.7)	22 (78.6)	
working	11 (19.0)	8 (26.7)	3 (10.7)	
sports activities	8 (13.8)	5 (16.7)	3 (10.7)	
Tegner Activity Scale	3.5 ± 1.0	3.7 ± 1.0	3.6 ± 1.0	0.30
Kellgren-Laurence grade				0.29
grade 1	23 (39.7)	14 (46.7)	9 (32.1)	
grade 2	35 (60.3)	16 (53.3)	19 (67.9)	
Side of the meniscal tear				0.22
medial meniscus	39 (67.2)	23 (65.2)	16 (57.1)	
lateral meniscus	10 (17.2)	5 (31.9)	5 (17.9)	
medial and lateral menisci	9 (15.5)	2 (2.9)	7 (25.0)	
MRI grade of the meniscal tear				0.03
grade 1	14 (24.1)	7 (23.3)	7 (25)	
grade 2	33 (56.9)	13 (43.3)	20 (71.4)	
grade 3	8 (13.8)	7 (23.3)	1 (3.6)	

grade 4	3 (5.2)	3 (10.0)	0 (0)	
Duration from injury to MRI, days	102.6 ± 134.8	45.2 ± 48.7	164.2 ± 167.9	< 0.001
Duration from MRI to surgery, days	106.8 ± 85.1	67.6 ± 56.7	148.8 ± 91.1	< 0.001

Age, BMI, Tegner activity scale, duration from injury to MRI and that from MRI to surgery are shown as mean ± standard deviation.

Other variables are shown as a number and percentage in the parenthesis.

BMI, body mass index; MRI, magnetic resonance imaging.

Bold shows statistically significant (p < 0.05)

Table 3

Multivariate analysis of the predictors for deterioration of the isolated meniscal tear

Variables	B	SE	OR	95% CI	P value
Duration from injury to MRI	0.030	0.008	1.031	1.015-1.047	< 0.001
Duration from MRI to surgery	0.024	0.006	1.024	1.013-1.035	< 0.001

B, regression coefficient; SE, standard error; OR, odds ratio; 95% CI, 95% confidence interval

MRI, magnetic resonance imaging.

Table 4

Correlations between the duration from injury to surgery (injury to MRI and MRI to surgery) and variables.

(A) Continuous variables		
Variables	Duration from injury to MRI	Duration from MRI to surgery
Age	R = 0.181 (p = 0.17)	R = -0.022 (p = 0.87)
BMI	R = 0.186 (p = 0.16)	R = 0.001 (p = 0.99)
Tegner activity scale	R = 0.059 (p = 0.66)	R = 0.171 (p = 0.20)
MRI grade of the meniscal tear	R = 0.194 (p = 0.14)	R = 0.173 (p = 0.18)
Duration from injury to MRI	N/A	R = 0.166 (p = 0.21)
BMI, body mass index; MRI, magnetic resonance imaging; N/A, not applicable.		
(B) Categorical variables		
Variables	Duration from injury to MRI	Duration from MRI to surgery
Sex		
male	127.2 ± 157.6	90.0 ± 69.8
female	74.5 ± 98.1	126.2 ± 97.6
P value	0.14	0.10
Side of the injured knee		
right	102.7 ± 121.5	101.7 ± 83.9
left	102.5 ± 151.0	112.7 ± 87.7
P value	0.64	0.59
Kellgren-Laurence grade		
grade 1	87.2 ± 113.1	106.3 ± 99.9
grade 2	112.8 ± 147.9	107.1 ± 75.4
P value	0.38	0.43
Side of the meniscal tear		
medial meniscus	108.6 ± 140.6	112.7 ± 87.9
lateral meniscus	85.5 ± 136.0	99.0 ± 85.4
P value	0.58	0.52

Values are shown as mean ± standard deviation.

MRI, magnetic resonance imaging.