

# Which Factors Are Associated With the Prevalence of Meniscal Repair?

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## Research article

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# Abstract

## Purpose

To investigate the potential factors associated with the prevalence of meniscal repair

## Methods

Patients who received partial meniscectomy or meniscal repair in our institution from Jan 2015 to Dec 2019 were included in current study. The inclusion criteria were (1) meniscus tear treated using meniscectomy or repair, (2) with or without concomitant anterior cruciate ligament reconstruction, (3) not multiligamentous injury. Demographic data, including sex, age, body mass index (BMI), injury-to-surgery interval and intra-articular factors such as the location of injury, medial or lateral, ACL rupture or not and the option of procedure (partial meniscectomy or repair) were documented from medical records. Univariate analysis consisted of chi-square. Multivariate logistic regression was then performed to adjust for confounding factors.

## Results

592 patients including 399 males and 193 females with a mean age of 28.7 years (range from 10 to 75 years) were included in current study. In the univariate analysis, male ( $p=0.002$ ), patients aged 40 years or younger ( $p<0.001$ ), increased weight ( $p=0.010$ ), Posterior meniscus torn ( $0.011$ ), concurrent ACL rupture ( $p<0.001$ ), lateral meniscus ( $p=0.039$ ) and early surgery ( $p<0.001$ ) were all associated with the prevalence of meniscal repair. However, After adjusting for confounding factors, we found that age (OR, 0.35; 95% CI, 0.17 - 0.68,  $p=0.002$ ), ACL injury (OR, 3.76; 95% CI, 1.97 - 7.21,  $p<0.001$ ), side of menisci (OR, 3.29; 95% CI, 1.43 - 7.55,  $p=0.005$ ), site of tear (OR, 0.15; 95% CI, 0.07 - 0.32,  $p<0.001$ ), and duration of injury (OR, 0.46; 95% CI, 0.28 - 0.82,  $p=0.008$ ) were associated with the prevalence of meniscus repair.

## Conclusions

Meniscal tear in aged patients especially those with concomitant ACL injury is likely to be repaired. Additionally, in order to increase the prevalence of repair and slow down progression of OA, the surgical procedure should be performed within two weeks after meniscus tear especially when the tear is located at lateral meniscal posterior.

## Study Design

Case-control study; level of evidence, 3.

# Introduction

Meniscus is a vital intra-articular structure to maintain knee stability, consequently slow down the progression to osteoarthritis (OA)[1, 2]. It also paly an important role in load transmission, shock

absorption and joint lubrication[3, 4]. With the development of diagnostic techniques for meniscal injury, the volume of arthroscopic procedures to treat injured meniscus dramatically increased in recent years. Patial menisctomy has been widely used for patients who underwent a failure of nonoperative treatment in early years[5, 6]. However, with deep understanding of the biomechanical function of meniscus, surgeon realized that menisctomy procedure can improve pain and knee function at short-term follow up, but the loss of meniscal tissue also lead to the onset of early osteoarthritis at the long term[7, 8]. Comparing with menisctomy, meniscal repair can preserve its tissue, thus restore its biomechanical function reducing the risk of developing knee OA in the future. In the above setting, a consensus has been reached that meniscal tissue should be preserved as much as possible[9–11].

The decision as to whether to repair the injured meniscus was made by surgeon. The indication for repair that surgeon usually consider include (1) the location of meniscal tear, whether vascularity is adequate enough to enhance the healing rate of meniscus; (2) the severity of meniscal injury, whether the remaining meniscal tissue is adequate, so that repair is viable[12]. However we cannot give them an accurate answer, when patients consult about the surgical plan before operation as the severity and the vascularity of meniscus can only be evaluated precisely under the arthroscope. Thus, we performed this study to investigate the potential factors associated with the choice of repair procedure. So that we can counsel patients about the options and expectations preoperatively. Additionally, identifying these factors can increase the prevalence of patients undergoing meniscal repair.

## Method

Institutional review board approval was waived. 592 patients who received menisectomy or repair in our institution from Jan 2015 to Dec 2019 by three high experienced surgeons were included in current study. The inclusion criteria were (1) meniscus tear treated using menisctomy or repair, (2) with or without concomitant anterior cruciate ligament reconstruction, (3) not multiligamentous injury.

Demographic data, including sex, age, body mass index (BMI), injury-to-surgery interval and intra-articular factors such as the location of injury, medial or lateral, ACL rupture or not and the option of procedure (partial menisctomy or repair) were documented from medical records. Age was divided into older group (> 40) and younger group ( $\leq$  40), BMI was classified into three groups ( $\leq$  24Kg/m<sup>2</sup>, 24–27 Kg/m<sup>2</sup>, and  $\geq$  27 Kg/m<sup>2</sup>) the duration from injury to surgery was defined as delayed group ( $\leq$  2weeks) and early group (> 2weeks).

The meniscal injury was determined by clinical examination, magnetic resonance imaging (MRI) and intraoperative findings. Surgical procedure were performed by three experienced surgeons and the procedure is uniform. Anterolateral and anteromedial knee portals were utilized for all patients. Under arthroscopy, the meniscus tear patterns, the site and the potential vascularity were directly seen by the surgeons. Then they will determine a suitable procedure for each patient based on their experience and judgement. Meniscal repair was implemented through all-inside technique using meniscal repair device (Fast-Fix; Smith & Nephew). According to the length of tear, one to seven sutures were needed. When

repair is not viable, injured meniscus will be trimmed until a stable peripheral rim was achieved. In the case of a concurrent ACL injury, the ACL reconstruction will be performed firstly by using peroneal longus tendon as graft.

## **Statistical analysis**

Statistical analyses were performed with SPSS, version 23.0 (SPSS Inc., Chicago, IL, USA). In the univariate analysis, we used the chi-squared test to describe the associations between categorical variables and the prevalence of partial meniscectomy procedure. Risk factors with a p value less than 0.1 in the univariate analysis were used in the multivariate analysis. In the multivariate analysis, we used binary regression to determine the independent risk factors for meniscal partial resection. Odds ratios and 95% confidence intervals (CIs) were reported. A p value less than 0.05 indicated statistical significance.

## **Results**

From Jan 2015 to Nov 2019, 592 patients including 399 males and 193 females with a mean age of 28.7 years (range from 10 to 75 years) were included in current study. Of these patients, 368 patients underwent concomitant ACL reconstruction, 224 patients underwent isolated meniscal surgery. Partial meniscectomy was performed on 346 patients, the remaining 246 patients received meniscus repair operation. Those demographic baseline data were shown in Table1.

Table 1  
Demographic baseline data

	Partial meniscetomy	repair	P-value
Gender			0.002
male	216	183	
female	130	63	
Age			< 0.001
≤40	213	212	
>40	133	34	
Weight			0.010
≤60	75	38	
60–90	246	176	
≥90	20	29	
BMI			0.544
≤24	170	112	
24–27	104	74	
≥27	67	56	
Site of tear			0.011
Multiple	40	32	
Anterior	23	7	
Body	43	19	
Posterior	114	106	
ACL injury			< 0.001
Yes	160	208	
No	186	38	
Duration of injury			< 0.001
≤2weeks	59	91	
>2weeks	287	155	
Side of meniscis			0.039

	Partial meniscetomy	repair	P-value
Lateral	170	119	
Medial	132	78	
Both	44	49	
Surgeons			0.211
1	141	100	
2	75	56	
3	130	90	

Table 2  
Multivariable analysis of factors associated with the prevalence of meniscal repair

	Regression coefficient	95%CI	P-value
Gender	1.14	0.67 to 1.96	ns
Age	0.35	0.17 to 0.68	0.002
Weight	1.03	0.55 to 1.93	ns
Site of tear	0.15	0.07 to 0.32	p < 0.001
ACL injury	3.76	1.97 to 7.21	< 0.001
Duration of injury	0.46	0.28 to 0.82	0.008
Side of meniscis	3.29	1.43 to 7.55	0.005

In the univariate analysis, seven variables were found to be associated with the prevalence of meniscus repair. 183/399(45.9%) repair surgery was performed on male versus 63/199 (31.7%) on female (p = 0.002). Age was a significant predictive factor for performing meniscus repair, with 212/425 (49.9%) patients aged 40 years or younger underwent repair versus 34/133 (20.4%) in patients aged older than 40 years (p < 0.001). BMI did not affect surgeon's decision on operation options but weight will, the percentage of patients undergoing repair increased with the increasing of body weight (36.9% vs 41.7% vs 59.2%, respectively; p = 0.010). Posterior meniscus torn and multiple site torn is likely to be repaired comparing with anterior and body meniscus injury (48.2% and 44.4% vs 23.3% and 30.6%; p = 0.011). 208/368 (56.5%) patients with concurrent ACL rupture underwent repair which is significant higher than those suffered isolated meniscal tear (38/224, 17.0%; p < 0.001). When operations were performed within two weeks after injury, patients tend to have a meniscal repair compared with performing surgery two weeks later after injury(91/150 vs155/442, p < 0.001). 41.2% patients with isolated lateral, 37.1% patients

with isolated medial torn and 52.7% patients with both sides injury underwent meniscus repair ( $p = 0.039$ ).

After adjusting for confounding factors, we found that age (OR, 0.35; 95% CI, 0.17–0.68,  $p = 0.002$ ), ACL injury (OR, 3.76; 95% CI, 1.97–7.21,  $p < 0.001$ ), side of menisci (OR, 3.29; 95% CI, 1.43–7.55,  $p = 0.005$ ), site of tear (OR, 0.15; 95% CI, 0.07–0.32,  $p < 0.001$ ), and duration of injury (OR, 0.46; 95% CI, 0.28–0.82,  $p = 0.008$ ) were associated with the prevalence of meniscus repair.

## Discussion

In this study, we found that younger age, early arthroscopic surgery (< 2 weeks), lateral meniscus tear, posterior horn tear and accompanying with ACL injury were associated with the prevalence of meniscal operation.

The clinical outcomes between partial meniscectomy and meniscal repair has been hotly debated in recent years. In a study performed by Kyu et al[13], they observed the difference of patients-reported outcomes among patients who have underwent meniscectomy or repair for at least 10 years follow-up and claimed that meniscal repair have a superior clinical outcomes. Stein et al[14] evaluated the rate of return to sports in athletes and found that patients underwent meniscal repair have a higher rate of return to sports (96.15%) comparing with those underwent partial meniscectomy (50%) at 8.8-year follow-up. While the re-operation rates of meniscal repair is likely to be higher than that of meniscectomy at short-term follow-up. Nevertheless, given the increased risk of partial meniscectomy predisposing patients to early onset degenerative changes, preservation of meniscal tissue should be attempted whenever possible[9–11]. However, to our knowledge, no study was conducted to assess the potential factors associated with the prevalence of meniscal repair. In this setting, we performed this study.

The influence of age on the clinical outcomes after arthroscopic meniscal repair have been widely reported in previous literature. Mike et al[15] found that younger age can improve the knee function and enhance the healing rate of repaired meniscus significantly which is consistent with another study[16]. However, substantial articles also shown an opposite conclusions. In a respective cohort study with 16-years follow-up, Steadman et al[17] found that the failure rate of meniscus repair, knee function and patient satisfaction were not significant in patients who are 40 years or younger and older than 40 years. Their findings are supported by Sarah et al[18] and Shane et al[19]. In current study, surgeons tend to perform meniscus repair for younger patients ( $\leq 40$  years). This may be explained by that most patients still worry the negative effect of age on meniscal healing as the cells, collagens, and proteoglycans in aged meniscus become disrupted and vulnerable[20]. Additionally, the high possibility of an early onset of OA when meniscal tissue is resected totally or partially also makes surgeons worried.

In our study, 472/512 (84.5%) traumatic meniscus tear are accompanied by a concurrent ACL rupture which is similar to other articles' results[21]. We found that ACL injury is the most important factor associated with the prevalence of meniscal repair. Many articles have reported a higher healing rate in patients undergoing a concomitant ACL reconstruction compared with those receiving isolated meniscus

surgery[21–23]. They claimed that the intra-articular growth factors in bleeding from tunnels create an ideal environment for meniscus healing[24, 25]. Besides, most of these meniscus tears accompanying with ACL injury are sports-related which is more common among younger patients. The above two reasons may be explained for the popularity of meniscus repair in patients having ACL injury concomitantly.

Nonoperative treatment was commonly recommended to patients with degenerative meniscal injury. When meniscal symptoms, including pain and knee locking cannot be relieved after two weeks nonoperatively in our institution, meniscectomy and meniscus repair will be performed. Haroon et al[21] found that the failure rate of meniscal repair is lower if meniscus are repaired within 6 weeks in those patients accompanying by ACL injury. However, we found that when arthroscopic surgery was delayed to two weeks later after injury, the ratio of undergoing meniscal repair will be reduced significantly. Meniscus is the second knee stabilizer. The meniscus tear will become more and more serious, when meniscal surgery was postponed especially when ACL deficient[26, 27]. We speculated that the severely damaged meniscus may influence surgeons' decisions on meniscal repair as its poor healing potential.

As we all know, meniscus are classified as three zones, that is the white-white zone, white-red zone and red-red zone according to the vascularity[28]. Theoretically, tears within the vascular zone have a higher healing rate comparing with those in avascular zone[21, 28, 29]. This is a vital factor that may affect surgeon's treatment options. However, in our study, we did not evaluate the influence of tear zones on the prevalence of repair as they were not recorded. Some authors believed that the posterior horn root tear should be repaired whenever possible, because detachment of posterior root can disrupt continuity of the circumferential fibers and lead to loss of hoop tension[13, 30]. We also observed that surgeons tend to repair meniscal posterior horn.

No consensus being reached on whether the side of repair has differential influence on the clinical outcomes and the failure rate[29]. Some studies found lateral meniscal repair has a higher success rate[30], some other articles hold an opposite opinion, while much more literature shows that the failure rate is not associated with the side of repair[29]. In current study, those patients with lateral meniscus tear and both sides injury are more likely to receive meniscal repair.

Despite many factors have been studied and shown to be associated with the high failure rate of meniscal repair or partial meniscectomy, whether they can affect surgeons' decision on treatment options and which will affect have not yet been evaluated. In current study, we found that aged patients especially those with concomitant ACL injury are more likely to receive meniscal repair. Additionally, in order to increase the prevalence of repair and slow down progression of OA, the surgical procedure should be performed within two weeks after meniscus tear. Lateral meniscal posterior horn injury has a higher opportunity for meniscus repair.

However, our study has some limitations. Firstly, tear zone of meniscus should be an important predictive factor for treatment options, but we failed to assess it because of data loss. More study is needed, in the future, to investigate whether meniscal tear within the red-red zone is more likely to be repaired compared with those within white-white zone. Secondly, this study was conducted based on the

data in single medical center in China. We are not sure whether our findings can be generalized to general orthopaedic population in other hospital. Nevertheless, we hope this study can provoke people's attention and thinking about what are associated with the prevalence of meniscal repair and performed more related study. Finally, all arthroscopic meniscal surgery were performed by three different high experienced surgeons, thus option bias may exists, however, we believed this can reflect the realistic clinical issue.

## **Conclusion**

Meniscal tear in aged patients especially those with concomitant ACL injury is likely to be repaired. Additionally, in order to increase the prevalence of repair and slow down progression of OA, the surgical procedure should be performed within two weeks after meniscus tear especially when the tear is located at lateral meniscal posterior.

## **Abbreviations**

ACL: Anterior cruciate ligament

BMI: Body mass index

MRI: Magnetic resonance imaging

## **Declarations**

### **Ethics approval and consent to participate**

No patients' private information is involved. Therefore ethics approval is not needed from our Research Ethics Committee and consent for participation was waived.

### **Consent for publication**

Not applicable

### **Availability of data and material**

The datasets used and/or analyzed during the current study will be available from author XXS on a reasonable request and no material or illustrations have been previously published

### **Competing interests**

The authors declare that no benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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NO

## Author contributions

XXS participated in the design of the study, wrote the manuscript and performed the study, CWX and XXS collected and analyzed the data. DYC and QJ and XSQ designed and supervised the entire study. XXS was a major contributor in writing the manuscript. All authors read and approved the final manuscript.

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