

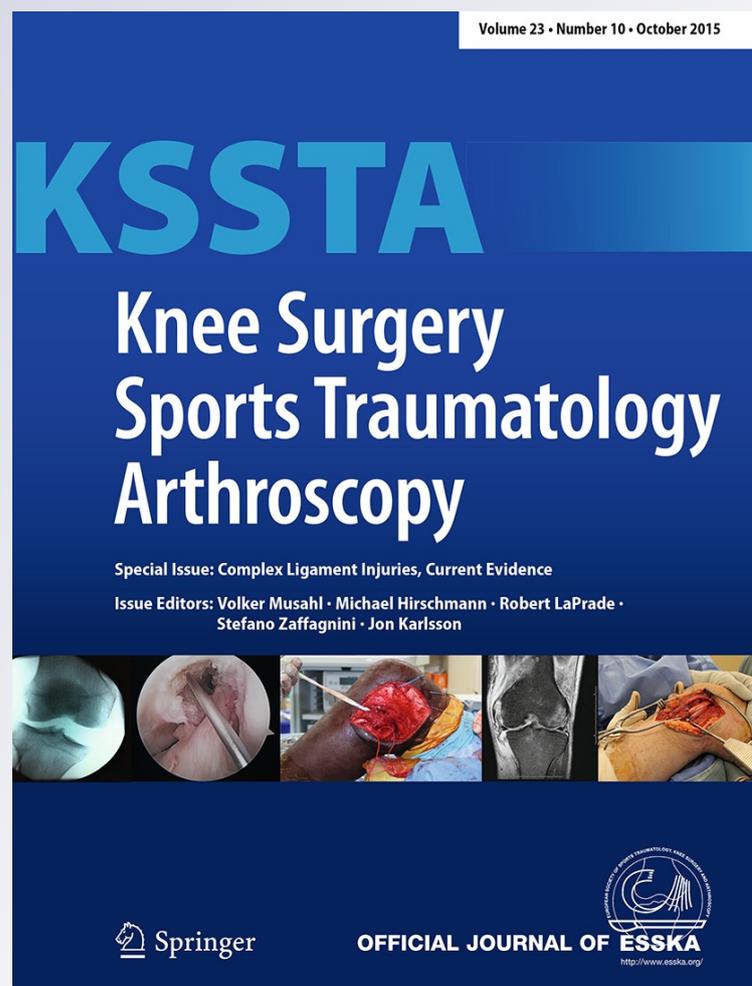
Posterior meniscus root tears: associated pathologies to assist as diagnostic tools

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Posterior meniscus root tears: associated pathologies to assist as diagnostic tools

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Abstract

Purpose The purpose of this study was to investigate associated pathologies identified at arthroscopy in patients with meniscus root tears.

Methods This study was Institutional Review Board approved. All patients who underwent arthroscopic knee surgery where a complete meniscus root tear was identified were included in this study. Concurrent ligament tears and articular cartilage changes \geq Outerbridge grade 2 were recorded and stored in a data registry.

Results Fifty patients (28 males, 22 females) [mean age = 36.5 years (range 17.1–68.1 years)] who were diagnosed with a medial or lateral meniscus root tear at arthroscopy were included in this study out of 673 arthroscopic surgeries (prevalence 7.4 %). Twenty-three (46 %) patients had a medial meniscus root tear, 26 (52 %) patients had a lateral meniscus root tear and one (2 %) patient had both. Thirty-four per cent of patients ($n = 17$) underwent partial meniscectomy, while 60 % ($n = 31$) underwent suture repair. During arthroscopy, 60 % ($n = 30$) of patients were diagnosed with an anterior cruciate ligament (ACL) tear. Patients with lateral meniscus root tears were 10.3 times (95 % CI 2.6–42.5) more likely to have ACL tears than patients with medial meniscus root tears ($p = 0.012$). Patients who had medial meniscus root tears were 5.8 times (95 % CI 1.6–20.5) more likely to

have chondral defects than patients who had lateral meniscus root tears ($p = 0.044$).

Conclusion In this study, patients' preoperative functional scores and activity levels were low. Patients with lateral meniscal root tears were more likely to have an ACL tear. Patients with medial meniscal root tears were more likely to have a knee articular cartilage defect with an Outerbridge grade 2 or higher chondral defect. This study confirms the importance of comprehensive assessment of concurrent injuries to properly diagnose meniscus root tears.

Level of evidence IV.

Keywords Meniscus root tear · Posterior horn · Articular cartilage · Anterior cruciate ligament · Risk factors

Introduction

Each year, approximately 1 million people in the USA undergo surgery to treat a meniscus tear [7, 15]. Although meniscus injuries are common, it has been reported that many meniscus root tears often go unrecognized initially [2–4, 8, 10]. A meniscus root tear has been described as a radial tear or avulsion at the posterior horn attachment to bone for either the medial or lateral meniscus [11, 15, 23, 24, 27]. The meniscus roots are responsible for meniscal stability, which is necessary to preserve proper meniscal function. Without the meniscus root attachments, the meniscus would be inherently unstable [19]. Specifically, meniscal root tears have been shown to result in a loss of hoop stress, as well as functional load distribution, exposing the articular cartilage to abnormal forces that are comparable to those following total meniscectomy [2–4, 23–25, 27, 28].

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If left untreated, meniscal root tears may lead to early onset arthritis, meniscal extrusion, joint-space narrowing, long-term knee dysfunction and degenerative joint disease [10, 16, 26]. It is important to identify these injuries as soon as possible in order to provide early treatment to attempt to repair the root tear and prevent the sequelae of arthritis. By determining concomitant pathologies that are associated with meniscus root tears, these complex tears may become more easily identified. The purpose of this study was to investigate associated pathologies identified at arthroscopy in patients with meniscus root tears.

Materials and methods

All patients who had a meniscus tear diagnosed at time of arthroscopy were identified from a prospective data registry. From this group, all patients who underwent arthroscopic knee surgery where a complete meniscus root tear was identified were included in this study. A meniscus tear was considered a root tear if the tear was within 9 mm of the meniscal root upon arthroscopic probing. There were no age restrictions for patients to be included in this study. Patients who had degenerative changes or chronic injuries were not excluded from this study. At initial presentation, all patients underwent a clinical examination and a magnetic resonance imaging scan. All data including demographic, surgical findings and subjective data were prospectively collected and stored in a data registry. Only patients 18 years or older completed a subjective questionnaire to determine decreased function preoperatively. Three patients were under the age of 18, with a mean age of 17.5 years (range 17.1–17.8 years). The Lysholm score [20] was collected on all patients, and activity level was measured using the Tegner activity scale [29]. Both scores have been validated for documenting outcomes following meniscus injuries of the knee [5]. At the time of arthroscopy, all ligament tears and articular cartilage defects \geq Outerbridge [22] grade 2 were recorded. This study was Institutional Review Board (IRB) approved by the Vail Valley Medical Center IRB, number 2002-03.

Statistical analysis

All data, except for the Tegner activity scale, were normally distributed as tested by the one-sample Kolmogorov–Smirnov test. Comparison of continuous variables for binary categorical variables was performed using the independent samples *t* test. Statistical analysis was performed using PASW (version 18.0, IBM, Armonk, NY, USA) software package. All reported *p* values are two-tailed with an α level of 0.05 indicating statistical significance.

Results

There were 1,857 patients who underwent arthroscopic knee surgery for various pathologies from April 2011 to February 2013. Of these patients, 673 (36.2 %) had a meniscus tear identified at arthroscopy. Concomitant pathologies are listed in Table 1. Of the 673 patients, 50 (7.4 %) (28 males, 22 females) with a mean age of 37 years (range 17–68 years) were diagnosed with a complete root tear of the medial or lateral meniscus at arthroscopy and were included in this study. The prevalence of a complete meniscus root tear in patients who had a meniscus tear in this study was 7.4 and 2.7 % of overall patients who had arthroscopic knee surgery. Patients had a mean body mass index (BMI) of 25.0 (17.2–34.1). The majority of patients reported the mechanism of injury as sport participation (Table 2), with alpine sports as the most commonly reported (Fig. 1).

Mean time from injury to arthroscopy was 8.8 months (2 days–14 years). Thirty-one (62 %) patients underwent surgery within 3 months of initial injury. Twenty-three (46 %) patients had a medial meniscus root tear, 26 (52 %) patients had a lateral meniscus root tear and one (2 %) patient had both medial and lateral meniscus root tears. Thirty-four per cent of patients ($n = 17$) underwent partial meniscectomy, while 60 % ($n = 31$) underwent in situ suture repair. Three patients (6 %) did not have any meniscal treatment at time of initial surgery because they had a cruciate ligament tunnel bone grafting procedure initially with a planned future-staged procedure for repair of the meniscus root tear at the time of the revision ACL reconstruction. Nineteen patients underwent previous surgery on

Table 1 Concomitant pathologies documented at index surgery for the all patients who had a meniscus tear diagnosed at time of arthroscopy

| Concomitant pathology | Total ($n = 673$) |
|--|---------------------|
| Anterior cruciate ligament tear | 243 (36 %) |
| Posterior cruciate ligament tear | 20 (3 %) |
| Fibular collateral ligament tear | 42 (6 %) |
| Medial collateral ligament tear | 48 (7 %) |
| Chondral defect (Outerbridge grade 2 or greater) | 357 (53 %) |

Table 2 Mechanism of injury for all patients with meniscal root tears

| Mechanism of injury | Percentage of patients (%) | <i>n</i> |
|---------------------|----------------------------|----------|
| Sport participation | 75 | 37 |
| No specific injury | 10 | 5 |
| Slip and fall | 8 | 4 |
| Auto accident | 6 | 3 |
| Twisted knee | 1 | 1 |

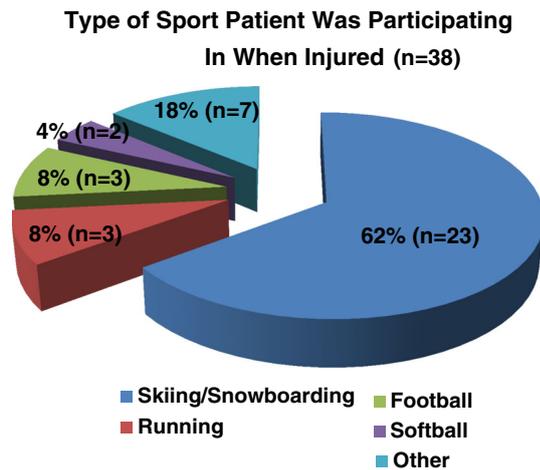


Fig. 1 Type of sport patient was participating in when meniscus root tear was sustained

Table 3 Surgical procedures for patients who underwent previous surgery on the injured knee (*n* = 19)

| Previous surgical treatment | Percentage of patients (%) | <i>n</i> |
|---|----------------------------|----------|
| Anterior cruciate ligament reconstruction | 18 | 9 |
| Meniscus repair/meniscectomy | 8 | 4 |
| Anterior cruciate ligament and meniscus repair/meniscectomy | 4 | 2 |
| Chondroplasty | 4 | 2 |
| Arthroscopy (loose bodies and scar tissue removal) | 4 | 2 |

the injured knee (Table 3). During arthroscopy, 60 % of patients were diagnosed with an anterior cruciate ligament (ACL) tear (*n* = 30). Four (13 %) of the 30 patients had a torn ACL graft from a previous ACL reconstruction. Concomitant pathologies were documented at surgery (Table 4). Lateral meniscus root tears were 10.3 times (95 % CI 2.626–42.501) likely to occur with an ACL tear than medial meniscus root tears (*p* = 0.001). Medial meniscus root tears were 5.8 times (95 % CI 1.622–20.455) more likely to occur with a chondral defect of the knee than lateral meniscus root tears (*p* = 0.021)

Patient assessment

Forty-seven patients who had a posterior meniscus root tear were eligible to report their preoperative functional scores due to age (≥ 18 years). The average preoperative Lysholm score was 54 (range 22–98), and the median preoperative Tegner activity scale was 2 (range 0–8). The median Tegner activity scale prior to injury was 7 (range 3–10), while the median desired Tegner activity scale was 7 (range 4–10), with all patients indicating a desire to return

Table 4 Concomitant pathologies documented at index surgery for the total patient population and subdivided by medial and lateral tear types. One patient was excluded from the table due to concomitant medial and lateral root tears within the same knee

| Concomitant pathology | Total (<i>n</i> = 49) | Medial meniscus root tears (<i>n</i> = 23) | Lateral meniscus root tears (<i>n</i> = 26) | <i>p</i> value |
|--|------------------------|---|--|----------------|
| Anterior cruciate ligament tear | 29 (59 %) | 8 (35 %) | 21 (81 %) | 0.001* |
| Posterior cruciate ligament tear | 5 (10 %) | 3 (13 %) | 2 (8 %) | n.s. |
| Fibular collateral ligament tear | 8 (16 %) | 3 (13 %) | 5 (19 %) | n.s. |
| Medial collateral ligament tear | 4 (8 %) | 1 (4 %) | 3 (12 %) | n.s. |
| Chondral defect (Outerbridge grade 2 or greater) | 27 (55 %) | 17 (74 %) | 10 (43 %) | 0.021* |

* <0.05 Indicates level of significance

Table 5 Preoperative scores and demographics for patients who had a meniscus body tear diagnosed at time of arthroscopy

| | <i>n</i> = 510 ^a |
|------------------------------|--------------------------------|
| Gender | 212 females, 298 males |
| BMI | 25.1 (range 11.1–42.5) |
| Mean age | 42.1 years (range 11–83 years) |
| Mean Lysholm score | 55 (range 7–100) |
| Median Tegner activity scale | 2 (range 0–10) |

^a Not all patients had preoperative scores available

to pre-injury level or greater. For patients who had a meniscus tear (*n* = 673), preoperative functional scores and demographic data are listed in Table 5.

Discussion

The most important finding of this study was that while patients in this study had low preoperative function and limited activity as represented by the Lysholm and Tegner activity scales, these scores were similar to those scores of patients in general with other meniscal tears. Thus, one must utilize other means to diagnose meniscal roots tears in addition to their functional scoring. Using the gold standard of arthroscopic verification, this study found that patients who had a lateral meniscus root tear were more likely to

have an ACL tear, while patients with a medial meniscus root tear were more likely to have concomitant chondral defects. The prevalence of meniscus root tear in this patient population was 7.4 % for all patients who had a meniscus tear and 2.7 % for all patients who underwent arthroscopic surgery.

This study found an association between the presence of medial meniscus root tears and articular cartilage defects of the knee with an Outerbridge grade 2 or greater changes. Patients with a medial root tear were approximately five times more likely to also have an articular cartilage defect of the knee with an Outerbridge grade 2 score or higher. Several studies have reported that medial meniscus root tears can lead to early and rapid chondral degeneration of the knee [1–4, 12, 25]. Hwang et al. [14] conducted a study in order to determine risk factors for medial meniscus root tears. They found that patients who had greater varus alignment and a higher Kellgren–Lawrence grade were at a higher risk of a medial root tear than other types of tears [14]. Although Hwang et al. reported an association between Kellgren–Lawrence grade and medial meniscus root tears, the compartment of chondral damage was not reported. In addition, Hwang et al. [14] reported increased age and BMI as risk factors for medial root tears. Our study did not identify BMI as a risk factor; however, this may be due to the patient population which had an average BMI within normal limits. Another recent study reported on medial meniscus tear morphology and the severity of articular cartilage lesions. Their findings revealed medial meniscus root tears were associated with significantly more cartilage lesions in the medial compartment as compared to other types of tears [13]. These associations may be due to the anatomical differences in medial and lateral menisci and increased load on the knee when meniscus root tears are present [25].

Previous literature has documented the importance of being able to accurately detect meniscus root tears for the longevity and overall health of the knee joint. To the authors' knowledge, this study was the first to document the presence of meniscal root tears and associated pathology via the gold standard of arthroscopy, as well as for prospectively collected data. This is important because recent studies have reported that meniscus root tears are commonly undetected during MRI and arthroscopy unless they are specifically being evaluated [9, 20]. Untreated meniscal root tears have been documented to produce devastating and lasting effects, such as early osteoarthritis and functional disability [16, 26]. Meniscal root tears, in particular, have been reported to be often missed during the initial clinical examination and even through the progression of treatment [9, 21]. And although a few previous studies have reported high sensitivity and specificity for the diagnosis of meniscus root tears on MRI scans, these studies are difficult to interpret because of various methodologies and unclear data collection methods [6, 7,

19]. The time from MRI to arthroscopy ranged from 1 day to 18 months in one study [6] and 0 days–13 months [19] for another study, which may be a confounding factor in MRI interpretation. Various strengths of MRI were also used, ranging from 1.0 to 3.0 Tesla, creating inconsistency among studies [6, 7, 19]. Also, these studies were not conducted prospectively, and the methods, in which the data were collected, during both arthroscopy and MRI, were unclear, making it difficult to accurately interpret the results. Furthermore, the presence of meniscus root tears on MRI was not confirmed arthroscopically for many patients, making it challenging to confirm the presence of root tears [6, 7, 19]. So while previous studies have reported MRI to be useful in meniscus root tear detection, these studies also demonstrate the importance of determining other factors that may be associated with meniscus root tears, such as concomitant pathologies, in order to aid physicians in the diagnostic process.

In this study, patients with posterior meniscus root tears had an average preoperative Lysholm score of 54 and a median Tegner activity scale of 2. Patients who had a meniscus tear, but not a root tear, had an average preoperative Lysholm score of 55 and a median Tegner activity scale of 2. These scores were extremely similar for these groups. Various studies have reported on preoperative function and activity level in patients with root tears of the meniscus. The Lysholm and Tegner activity scale have previously been validated for patients with various meniscus injuries [5]. Unfortunately, the scores of patients with posterior meniscus root tears in this study were extremely similar to those of patients with meniscus body tears, as well as scores previously reported in other studies for meniscus body tears [3, 17, 18, 26]. Briggs et al. conducted a study that looked at meniscus injuries in approximately 500 knees, which were then separated into groups based on injury type, worker's compensation status, patient-assessed preoperative activity level and patient-assessed preoperative knee function. Mean preoperative Lysholm score for all groups ranged between 47 and 61, with the majority of groups having a preoperative Lysholm score in the mid-50s [5]. These findings are similar to those of this study. Other studies have also reported median preoperative Tegner activity scale scores from 1.9 to 4.0, which are also similar to the present study [17]. The results of our study and these previous studies demonstrate that these functional outcomes assessment scales may not be helpful to differentiate between a complete posterior horn root tear and a posterior horn body tear of the meniscus. Therefore, this study supports that it is critical to identify other factors, such as concomitant pathologies, that can aid in the accurate diagnosis of meniscus root tears. As the vital importance of the integrity of the meniscal roots becomes more apparent and their diagnosis becomes more

recognized, it is imperative to identify associated injuries to assist with the diagnosis of meniscal root tears.

There were some limitations to this study. This study was retrospective in nature; however, all data were collected prospectively. This study was conducted at a tertiary referral clinic, which may not be representative of the general population and may introduce selection bias. These results may be useful in future diagnosis and identification of meniscus root tears, which will help to improve treatment and outcomes.

Conclusions

In this study, patients' preoperative functional scores and activity levels were low, but essentially identical to scores reported in patients with meniscal body tears. This study also found that patients who had lateral meniscal root tears were more likely to have an ACL tear and patients who had medial meniscal root tears were more likely to have an articular cartilage defect of the knee with an Outerbridge grade 2 or higher chondral defect. This study confirms the importance of a comprehensive assessment of concurrent injuries in order to properly diagnose meniscus root tears at initial presentation in order to avoid a delay in treatment, which has shown to be detrimental to patient outcomes.

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