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Anamnestic prediction of bucket handle compared to other tear patterns of the medial meniscus in stable knees

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ABSTRACT

Objective: The aim of this study was to analyze and compare the preoperative anamnestic details between patients with an arthroscopic diagnosis of bucket handle and other tear patterns of the medial meniscus in stable knees.
Methods: A total of 204 patients (mean age 49.3 ± 13 years) were included in the study. The mean age was 49.3 ± 13 years. The study group included 65 patients (63 males, 2 females) with an arthroscopic diagnosis of bucket handle tear and the control group included 139 patients (90 males, 49 females) with non-bucket handle tear patterns. The preoperative clinical assessments of the two groups were analyzed retrospectively. Anamnestic prediction for the diagnosis of a bucket handle tear was based upon various medical history parameters. Multivariate logistic regression was carried out to identify independent anamnestic factors for predicting isolated bucket handle tears of the medial meniscus compared to non-bucket handle tears.
Results: Analysis of the multivariate logistic regression yielded 3 statistically significant independent anamnestic risk factors for predicting isolated bucket handle tears of the medial meniscus: male gender (OR, 9.7; 95% CI, 1.1–37.6), locking events (OR, 4.6; 95% CI, 1.8–11.3) and pain in extension (OR, 6.9; 95% CI, 2.5–23.7). Other preoperative variables such as age, BMI, activity level, comorbidities, duration of symptoms, pain location, preceding injury and its mechanism had no significant effect on tear pattern.
Conclusions: Preoperative strong clues for bucket handle tears of the medial meniscus in stable knees are male gender, locking events and limitation in extension.
Level of evidence: Level III, Diagnostic study.

Introduction

Arthroscopic surgery to treat meniscal tears is usually performed in active patients who failed to improve with non-operative treatment.[1] In addition to various patients' related factors, it is important to consider the tear pattern in decision making since the timing for intervention is often crucial for the repair of bucket handle tears.[2] In daily practice the clinical diagnosis of meniscal tears is verified by magnetic resonance imaging (MRI); however, the utility of MRI is limited by cost and availability which amplify the importance of clinical evaluation. Therefore, accurate evaluation of patients' symptoms and signs in order to differentiate bucket handle from other tear types is imperative for early intervention. Prior studies have focused on the accuracy of various meniscal signs on physical examination but few have evaluated anamnestic details.[3,4] The purpose of the current study was to analyze and compare the preoperative anamnestic details between patients with an arthroscopic diagnosis of bucket handle and other tear patterns of the medial meniscus. The hypothesis was that there are significant differences in patients' demographics and symptoms description.

Patients and methods

The study was conducted in a regional referral center for arthroscopic surgery. Patients that were included had knee arthroscopy between 2012 and 2013 for a preoperative diagnosis of

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torn medial meniscus. Excluded procedures were cruciate ligament reconstruction, concurrent osteotomy, patellar realignment, surgery for synovial disease or ipsilateral previous knee surgery. Additional exclusion criteria were patients with varus or valgus clinical deformity and moderate to severe arthritic signs on preoperative weight bearing radiographs (i.e. Kellgren–Lawrence grade >1[5]).

There were two groups of isolated medial meniscal tear. The study group included patients with an arthroscopic diagnosis of bucket handle tear and the control group were those with a diagnosis of other non-bucket handle tear patterns (i.e. oblique, flap and complex). The preoperative clinical assessments of the two groups were analyzed retrospectively and included demographic details, detailed patient history, Tegner activity scale and Lysholm knee scoring questionnaire.[6]

Anamnestic prediction for the diagnosis of a bucket handle tear was based upon the following variables.

Demographic variables: age, gender, limb side, body mass index (BMI).

Clinical variables: comorbidities (defined by the American Society of Anesthesiologists (ASA) level of physical status), Tegner activity scale, preceding injury and its mechanism, duration of preoperative symptoms, visual analogue score (VAS), pain location, knee symptoms (derived from the Lysholm knee score).

Pain location was documented as non-specific, medial, lateral, anterior or combined.

Knee symptoms (derived from the Lysholm knee score) were swelling, locking events, pain or limitation in bending, pain or limitation in extending, limping episodes, pain on stair climbing.

All preoperative evaluations and operations were undertaken and reported by 3 senior, orthopedic surgeons who work together in an academic knee arthroscopy regional referral center. The indication for knee arthroscopy in the case of diagnosed meniscal tear was an unresolved knee pain and activity limitation for at least 8 weeks. A shorter period to arthroscopy was noted for locked knees. All candidates had plain radiography and magnetic resonance imaging (MRI) of the knee prior to surgery.

Surgery was done under general anesthesia with the patient in a supine position. Standard anterolateral and anteromedial knee portals were used. Diagnostic arthroscopy with a 30-degree 4-mm scope was performed to evaluate abnormal findings of menisci, ligaments and cartilage. In this study bucket handle type tears involved the posterior horn and mid-portion of the meniscus, while other types involved the posterior horn.

Statistical analysis

Continuous variables were expressed by mean and standard deviation with an accuracy of one decimal place. Categorical variables were reported as count and percentages. Multivariate logistic regression was carried out to identify independent anamnestic factors for isolated bucket handle tears of the medial meniscus. The goal of logistic regression was to find the best fitting model to describe the relationship between the dichotomous characteristic of interest (dependent variable = bucket handle or non-bucket handle tear type) and a set of independent (predictor or explanatory anamnestic details) variables. Meniscal tear type (the categorical dependent variable) was modeled as a function of the above predictor demographic and clinical independent variables. All variables were initially included in the multivariate models, and elimination of non-significant factors was performed using a stepwise backward elimination approach. Level of significance, odds ratios (OR), and 95% CIs were calculated for each variable. A p value less than 0.05 was considered statistically significant.

Results

Overall, there were 204 patients eligible for inclusion, 65 of the bucket handle tear group (63 males, 2 females) and 139 of the non-bucket handle tear group (90 males, 49 females). The mean age was 49.3 ± 13 years. The mean body mass index (BMI) was 27.6 ± 4.4 kg/m^2. The demographic differences between groups are presented in Table 1. The differences in patients' symptoms are presented in Table 2. Pain (particularly located medially), limping and difficulties in stair climbing were very common in both groups. More patients in the bucket handle tear group reported on preceding injury, locking events and limitation in extension. The mechanism of injury was rotational in all of the bucket handle tear patients (23 of 65). In the non-bucket handle tear patients the mechanism of injury was rotational in 8, acute flexion in 4 and direct blow in 6 of 139 patients.

Analysis of the multivariate logistic regression yielded 3 statistically significant variables (Table 3). An odds ratio greater than 1 signified an increased probability of association with a bucket handle tear. Independent anamnestic risk factors for isolated bucket handle tears of the medial meniscus were male gender (OR, 9.7; 95% CI, 1.1–37.6), locking events (OR, 4.6; 95% CI, 1.8–11.3) and pain in extension (OR, 6.9; 95% CI, 2.5–23.7). Other preoperative variables such as age, BMI, activity level, comorbidities, duration of symptoms, pain location, preceding injury and its mechanism had no significant effect on tear pattern.

Discussion

Historically, several investigators have shown that clinical diagnosis of meniscal tear is approximately 70% accurate.[7,8] Unfortunately, no single symptom or physical sign correlates well with meniscal tears.[1–3,8] A true mechanical locking of the knee is often attributed to bucket handle tears, usually of the medial meniscus.[9] If a patient does not have locking, the diagnosis of a torn meniscus is more complex even for the most astute surgeon. The current study focused on the anamnestic differentiation between the diagnosis of medial meniscal bucket handle and other tear types in patients with stable knees. Of the various anamnestic variables, three were significantly associated with bucket handle tears: male gender, locking events and limitation in extension. Moreover, other preoperative factors such as age, BMI, activity level, comorbidities, duration of symptoms, pain location, preceding injury and its mechanism had no significant effect on tear pattern.

Unfortunately, while several studies have evaluated the accuracy of various physical maneuvers,[3,4,8] few studies have measured the accuracy of the clinical history in patients with suspected torn meniscus. These studies found that the history can heighten clinical suspicion but is of little value in distinguishing between meniscal and ligamentous injury or in pinpointing which one has sustained damage.[10,11] In a prospective study of 145 patients, Abdon et al[12] found a history of mechanical locking, patient's localization of pain to the joint line, and a decreased ability to participate in

Table 1
Demographic details of the two study groups.

	Bucket-handle tear	Non-bucket-handle tear
Patients	65	139
Male: female	63:2	90:49
Age	37.9 ± 11.8	51.3 ± 12.2
Body mass index	26.4 ± 4.2	27.8 ± 4.4
ASA level of physical status	1.6 ± 0.5	1.5 ± 0.6
Tegner activity scale	4.4 ± 2.3	3.5 ± 1.8
Smokers	37 (56%)	42 (30%)

Table 2
Clinical symptoms of the two study groups.

	Bucket-handle tear	Non-bucket-handle tear
Preceding injury	23 (36%)	18 (13%)
Duration of symptoms (months)	3 ± 1	7 ± 2
Pain intensity (VAS)	6.5 ± 2.8	6.3 ± 2.5
Medial knee pain	44 (68%)	96 (69%)
Swelling	28 (44%)	68 (49%)
Locking events	31 (48%)	4 (3%)
Pain or limitation in bending	60 (92%)	114 (82%)
Pain or limitation in extending	34 (52%)	26 (19%)
Limping episodes	52 (80%)	97 (70%)
Pain in stair climbing	52 (80%)	107 (77%)

Table 3
Statistically significant anamnestic variables to determine bucket-handle from non-bucket-handle medial meniscal tears.

	Odds Ratio	95% Confidence Interval	p Value
Male gender	9.7	1.1–37.6	0.04
Locking events	4.6	1.8–11.3	0.001
Pain or limitation in extension	6.9	2.5–23.7	0.04

sporting activities associated with meniscus tears. Pain at rest, sick leave, and medial patellar tenderness were all negatively correlated with a meniscus tear. Corea et al[13] reported more than 50% of patients with meniscal tears had mechanical symptoms and recurrent effusions. To our knowledge few previous studies have examined the value of detailed history taking on the diagnosis of bucket handle tears. Metcalf and Barrett[14] reported on 1485 meniscal tear patterns in patients with stable knees. Similar to our findings, among the factors that were associated with peripheral tear were gender of male and loss of extension while factors such as age and chronicity of symptoms were not significant. Dervin et al[15] have found that history features were not helpful when analyzing the accuracy of unstable meniscal tears diagnosis; however, in contrary to our study population, their patients had osteoarthritis.

A recent study by Yan et al[16] compared history and physical examination with MRI findings in order to predict the probability of meniscal tears. They have used similar methodology as in our study with logistic regression analysis and found that giving way, locking and McMurray's test are independent clinical diagnostic factors for the diagnosis of meniscal tears. Snoeker et al[17] developed a clinical prediction rule for meniscal tears in primary care based on a cross-sectional multicenter study with 121 participants. According to their results higher prediction points should be given to male gender and older age. In contrast to our analysis both of the above studies did not evaluate specific tear patterns. Feucht et al[18] have looked at associated tears of the lateral meniscus in ACL injuries. In 215 patients a multivariate logistic regression was carried out to identify independent risk factors for minor and major lateral meniscal tears and to calculate odds ratios. The results showed that male patients, patients <30 years, and particularly patients who sustained a contact injury have a high risk for an associated major lateral meniscus tear. In contrast to our study they included ACL injuries and evaluated lateral meniscal tears.

The common assumption is that vertical bucket handle tears are the result of a traumatic event in a young and active patient.[9] This is true for combined injuries involving the anterior cruciate ligament (ACL); however, in the current study where ACL tears were excluded, many of the tears were not related to trauma and preceding injuries did not significantly determined tear patterns. This may explain the insignificance of age or activity level in predicting tear types. In addition, the mechanism of injury was exclusively rotational in patients with bucket-handle tears while it varied in the few injured patients with non-bucket handle tears. The mechanism did not influence tear patterns probably because of the negligible number of injuries in patients with non-bucket handle tears.

The strengths of this study are the use of detailed anamnestic variables array and the focus on isolated bucket handle tears of the medial meniscus without lateral meniscus or ligament involvement in knees without axial deformity and unremarkable radiographs. For the purpose of regression analysis a comparison was made to a non-bucket handle tear group of patients. The main limitation of this study is its retrospective design. Although accurate clinical diagnosis can be useful in identifying patients who may be at risk for having a tear in the peripheral zone and therefore may be more amenable to repair, this study results show that patients demographics and symptoms are not sufficiently accurate in predicting isolated bucket handle tears of the medial meniscus except for strong clues such as male gender, locking events and limitation in extension. Future studies should evaluate the accuracy of these anamnestic clues in combination with physical findings to differentiate meniscal tear types.

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