ORIGINAL ARTICLE

Assessment Of Pain, Balance, Functional Performance, And Quality Of Life In Patients With Meniscus Lesions: A Cross-Sectional Study

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ABSTRACT

INTRODUCTION: This study aimed to compare pain, balance, functional performance, and quality of life between individuals with meniscal injury and healthy controls. To evaluate the differences in pain, balance, functional performance, and quality of life between individuals with meniscal injury and healthy controls. **MATERIALS AND METHODS**: Seventy participants were enrolled, including 35 patients with MRI-confirmed meniscal injury and 35 age- and sex-matched healthy controls. Pain was measured using the Visual Analog Scale (VAS), balance and mobility with the Berg Balance Scale (BBS) and Timed Up and Go Test (TUG), functional performance with the Five Times Sit to Stand Test (5TSTS), and quality of life with the Western Ontario Meniscal Evaluation Tool (WOMET). Muscle strength and range of motion (ROM) were also assessed. **RESULTS**: Compared with healthy controls, individuals with meniscal injury reported higher pain levels and demonstrated poorer functional performance and quality of life ($p<0.05$). The meniscal tear group reported higher pain levels ($p<0.001$) and demonstrated worse functional mobility (longer TUG and 5TSTS times) and quality of life (higher WOMET scores, $p<0.05$). A significant correlation was found between VAS and WOMET outcomes in the meniscal tear group ($p<0.05$) and between VAS and both WOMET and BBS outcomes in the control group ($p<0.05$). **CONCLUSION**: This study emphasizes the need for rehabilitation strategies addressing both physical recovery and quality of life for individuals with meniscal injuries. Future research should explore targeted pain management and rehabilitation programs to improve patient well-being.

Keywords
Meniscus tear, pain, muscle strength, balance, quality of life

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INTRODUCTION

Meniscal injury are common knee injuries affecting a broad population, from young athletes to the elderly. They often result from sports trauma or age-related degeneration. [1] These injuries not only cause local damage but also impact pain perception, balance, function, and overall quality of life.[2,3] Despite advances in diagnosis and treatment, the broader functional effects of meniscal injury —especially concerning objective evaluations— remain underexplored. The meniscus plays a key role in knee stability, shock absorption, and load distribution.[3,4] Damage can lead to biomechanical alterations, reduced stability, and increased osteoarthritis risk.[4–7]

While prior studies have primarily focused on treatment strategies, fewer have assessed daily functional implications such as postural control and fall risk.[8] To our knowledge, this study evaluates pain, balance, functional performance, and quality of life in individuals with meniscal injury using a comprehensive combination of VAS, BBS, TUG, 5TSTS, and WOMET, which have

mostly been reported individually or partially in previous studies. This comprehensive approach provides a multidimensional analysis, differing from previous studies that focus on isolated measures. The inclusion of predominantly female and older participants also adds to understanding this condition in underrepresented groups. This study aims to evaluate the functional and quality-of-life impacts of meniscal injury by comparing objective measures between patients and healthy controls. We hypothesize that patients will report higher pain, poorer function, and reduced quality of life, and that pain levels will correlate with balance and functional limitations.

MATERIALS AND METHODS

A total of 70 participants were enrolled: 35 patients with MRI-confirmed meniscal injury and 35 healthy controls. Sample size was calculated using G-Power (effect size = 0.8, power = 95%).[9]

Inclusion criteria – Meniscus group: Participants aged 18 –60 years with MRI-confirmed meniscal tear who were willing to participate and had no systemic or neurological conditions affecting assessment. All participants were evaluated during conservative (non-operative) management prior to any surgical decision. Both traumatic and degenerative meniscal tears, involving different morphologies and locations, were included without restriction on tear type.

Inclusion criteria – Control group: aged 18–60, no neurological, orthopedic, or systemic issues, and willing to participate. For the control group, individuals with no history of knee pain, trauma, surgery, or known musculoskeletal disorders were included. Participants had no current or previous knee-related symptoms and no clinical findings suggestive of meniscal pathology on physical examination. Therefore, routine radiographic (X-ray or MRI) screening was not performed, as there were no clinical indications requiring imaging.

Exclusion criteria: recent lower extremity fracture or knee surgery within the past year, autoimmune/inflammatory diseases, or recent knee rehabilitation (within 6 months).

Physical and Sociodemographic Data

Collected data included age, sex, height, weight, occupation, dominant limb, and physical activity levels, as well as symptom duration and affected side.

Pain and Range of Motion

Pain intensity was assessed using the Visual Analog Scale (VAS) during activity, rest, and at night. Knee range of motion (ROM) was measured with a goniometer, with the pivot placed on the lateral femoral condyle, using standard anatomical alignment for flexion and extension. Participants were assessed in the prone position.

Muscle Strength

Quadriceps and hamstring strength were tested using manual muscle testing (MMT) on a 5-point scale. For flexion testing, participants lay prone; for extension, they sat with hips and knees at 90°. Resistance was applied at the ankle. Pelvic stabilization was ensured during flexion, and a towel supported the thigh during extension.[10] A single experienced physiotherapist conducted all tests to ensure consistency.

Balance

Balance was assessed with the Berg Balance Scale (BBS), a 14-item tool with scores ranging from 0 to 56, where higher scores indicate better balance. Its Turkish version has been validated. [11]

Functional Performance

Functional performance was evaluated using the Timed Up and Go Test (TUG)[12] and Five Times Sit to Stand Test (5TSTS).[13] For TUG, participants stood from a chair, walked 3 meters, turned, and returned to sit; time was recorded. For 5TSTS, they rose and sat five times with arms crossed, and the total time was noted.

Quality of Life

Quality of life was assessed using the Western Ontario Meniscal Evaluation Tool (WOMET), validated in Turkish. It consists of 16 items across three subdomains: physical symptoms, emotional impact, and lifestyle/

work.[14]

Assessment of Quality of Life

The Western Ontario Meniscal Evaluation Tool was used to assess the quality of life in people with meniscus pathology (WOMET). This validated tool in Turkish consists of 16 questions divided into three categories: physical symptoms, emotional impact, and lifestyle/work. Together, these questions provide a thorough evaluation of the individual's well-being.[14]

Statistical Analyses

Data were analyzed using IBM SPSS v27.0.1.0. Categorical data were reported as counts and percentages; continuous variables as means ± standard deviation. The Chi-square test was used for group comparisons of categorical variables. The Mann-Whitney U test was used for non-normally distributed continuous variables. Spearman's correlation assessed relationships between variables. A p-value <0.05 was considered statistically significant.

RESULTS

Seventy subjects, comprising 35 with meniscus injury and 35 healthy individuals, were included in the study. Descriptive data for the participants are shown in Table 1. No statistically significant difference was found between the demographic characteristics of the groups (p>0.05).

Table I: Comparison of the physical characteristics of individuals

		Study Group	Control Group	
Variable		n (%)	n (%)	p
Sex	Female Male	24 (68.57%) 11 (31.43%)	26 (74.29%) 9 (25.71%)	0.597
Dominant Side	Right Left	5 (14.29%) 30 (85.71%)	1 (2.86%) 34(97.14%)	0.198
Age (years)		45.2 ± 9.9	44.3 ± 10.1	0.715
Height (cm)		164.6 ± 10.6	166.3 ± 8.8	0.286
Weight (kg)		79.2 ± 13.5	76.4 ± 14.0	0.455
BMI (kg/m2)		29.4 ± 4.8	27.7 ± 5.0	0.092

cm: Centimeter, kg: Kilogram, m: meter, n: sample size, Significant values $p<0.05$

The distribution of the dominant side, education level, smoking, and alcohol consumption was compared between the study group and control group. The majority of individuals in both groups were right-handed, with 85.71% in the study group and 97.14% in the control group. Education levels varied, with the largest portion of the study group having completed primary education (62.86%), while the control group showed a more diverse educational background, including a higher percentage of participants with bachelor's degrees (34.29%). Smoking habits were less common in both groups, with 80% of the study group and 71.43% of the control group not engaging in smoking. Alcohol consumption was also low among participants, with the vast majority not consuming alcohol at all (91.43% in the study group and 94.29% in the control group). However, the differences between groups in these categories were not statistically significant, indicating similar demographic and lifestyle characteristics among participants.

Regarding meniscal tear characteristics in the study group, 74.3% of patients had medial meniscus injury , while 22.9% had lateral injury and 2.9% had combined medial and lateral involvement. The posterior horn was the most commonly affected location (82.9%), followed by the anterior horn (17.1%). In terms of tear morphology, horizontal injury were the predominant type (80%), whereas other tear types were observed less frequently.

Table II: Comparison of muscle strength and ROM findings between groups

Measurement		Study Group (n=35) +/- SD (Min-Max)	Control Group (n=35)	p-value
Knee Joint Flexion	Right	127.1±10.2 (95-140)	128.5±7.6 (110-140)	0.901
	Left	127.5±9.9 (100-140)	128.0±8.6 (105-140)	0.906
Knee Joint Extension	Right	1.30±2.74 (-10-5)	0.69±1.05 (0-4)	0.009*
	Left	1.77±1.55 (0-5)	0.69±0.96 (0-3)	0.002*
Knee Flexor Strength	Right	4.66±0.48 (4-5)	4.89±0.40 (3-5)	0.012*
	Left	4.60±0.55 (3-5)	4.89±0.47 (3-5)	0.003*
Knee Extensor Strength	Right	4.51±0.66 (3-5)	4.89±0.40 (3-5)	0.003*
	Left	4.49±0.70 (3-5)	4.83±0.38 (4-5)	0.024*

*Mann-Whitney U Test, °: degree, X±SD: Mean ± Standard Deviation, Min-Max: Minimum – Maximum, ROM:Range of motion; n: sample size, Significant values are represented in bold, $p < 0.05$

Knee flexion range of motion did not differ significantly between the meniscus tear group and the control group. However, knee extension range of motion was significantly greater in the meniscus tear group on both sides. In addition, knee flexor and extensor muscle strength were significantly lower in the meniscus tear group compared with healthy controls.

Table III: Comparison of balance, physical performance, and VAS findings between groups.

Variable	Study Group (n=35)	Control Group (n=35)	p-value
BBS Score	54.1 ± 2.0, Range: 47-56	54.3 ± 2.6, Range: 45-56	0.227
TUG Time (seconds)	9.11 ± 1.41 Range: 6.8-12.46	8.53 ± 3.24,Range: 6.38-24.99	0.003*
5TSTS Time (seconds)	11.2 ± 3.0, Range: 7.4-20	10.5 ± 4.7, Range: 7.12-30	0.035*
VAS Rest	2.23 ± 2.04, Range: 0-7	0.49 ± 1.46, Range: 0-6	<0.001*
VAS Activity	5.60 ± 2.26, Range: 0-10	2.00 ± 2.57, Range: 0-7	<0.001*
VAS Night	3.26 ± 3.63, Range: 0-10	0.91 ± 2.15, Range: 0-8	0.001*

BBS: Berg Balance Score; TUGT: Timed Up and Go Test; 5TSTS: Five Times Sit to Stand Test; VAS: Visual Analog Scale

No significant difference was observed between groups in Berg Balance Scale scores. However, individuals with meniscus injury demonstrated significantly longer Timed Up and Go and Five Times Sit to Stand test completion times, indicating reduced functional performance. Furthermore, pain intensity at rest, during activity, and at night was significantly higher in the meniscus tear group.

Table IV: Comparison of WOMET scores.

WOMET	Study Group (n=35)	Control Group (n=35)	p- value
WOMET-A (Physical Symptoms)	Average: 246.9, Range: 20-740, Median: 220	Average: 113.4, Range: 0-420, Median: 70	<0.001*
WOMET-B (Sports/Recreation)	Average: 182.9, Range: 0-400, Median: 180	Average: 69.7, Range: 0 -300, Median: 30	<0.001*
WOMET-C (Emotions)	Average: 99.4, Range: 0-240, Median: 100	Average: 41.1, Range: 0 -180, Median: 0	<0.001*
WOMET Total Score	Average: 529.1, Range: 20-1260, Median: 470	Average: 224.3, Range: 0-750, Median: 150	<0.001*

WOMET: Western Ontario Meniscal Evaluation Tool

Table 4 shows the results of the Western Ontario Meniscal Evaluation Tool (WOMET) which assesses the impact of meniscus injury on physical symptoms, sports/recreation activities, emotions, and overall quality of life. Across all sections (A for physical symptoms, B for sports/recreation, and C for emotions) and the total score, the study group (with meniscus injury) reported significantly higher impacts than the control group. The differences were statistically significant, and the p-values were less than 0.001 across all categories.

VAS scores at rest showed a weak and non-significant correlation with BBS, TUGT, and 5TSTS, suggesting minimal association with balance and physical performance. However, there was a moderate positive correlation with WOMET-B (r=0.341, p=0.045), indicating that higher rest pain levels are associated with worse outcomes in the WOMET-B domain.

Activity-related VAS scores demonstrated moderate to strong positive correlations with all WOMET subscales, particularly WOMET-Total (r=0.613, p<0.001), suggesting that pain during activity significantly impacts all aspects of quality of life as measured by the WOMET. Nighttime VAS scores also showed moderate to strong positive correlations with WOMET-A, WOMET-B, WOMET-C, and WOMET-Total, with the highest correlation observed with WOMET-Total (r=0.630, p<0.001).

DISCUSSION

In our study, we compared individuals with isolated meniscus injury , without additional pathologies, to healthy individuals of similar age groups in terms of pain, balance, functional performance, and quality of life. Pain, ROM, postural control, and fall risk assessed by the Berg Balance Scale (BBS), and bilateral knee joint flexion angles were closely matched between the two groups. However, when evaluating balance and functional performance with the Five Times Sit to Stand Test (5TSTS) and the Timed Up and Go Test (TUGT), as well as quality of life with the Western Ontario Meniscal Evaluation Tool (WOMET) scores, differences were found between the two groups. There is a lack of studies evaluating postural balance, fall risk, functional performance, and quality of life in patients with meniscus lesions.

Meniscus tear risk increases with age.[15] One study reported a mean age of 36,[16] while ours was 48, consistent with literature.[17] Prior studies noted male predominance in meniscal injuries.[18-20] In contrast, 68% of our study group and 74% of controls were female, likely reflecting the patient profile of our clinic.

High BMI is a known risk factor.[21,22] A previous study reported an average BMI of 30.5 kg/m²; [21]our study group had a mean BMI of 29.4 kg/m², with no significant difference between groups.

Horizontal tears are common, often in the posterior horn.[23] Medial tears occur more frequently than lateral ones.[23-25] In one study of 103 cases, horizontal tears were

among the most common.[26] Similarly, 80% of our participants had horizontal tears, mostly posterior (82.9%) and medial (74.3%). This supports the notion that horizontal tears result from age-related degeneration. Knee pain negatively affects daily function.[27] In our study, participants' knee pain was assessed with the Visual Analog Scale (VAS). A total of 102 patients with meniscal injury , treated either surgically or conservatively, were evaluated, and the average pain intensity according to VAS was reported as 5.[28] In another study with 24 participants with radial and bucket-handle meniscus tears, the average pain level during activity was more than 5, and the pain at rest was more than 3.[29] In our study, VAS values were also significantly higher in the study group compared to the control group.

A decrease in the range of motion in flexion is reported in previous studies.[5] We did not find such a difference in our study group and both groups' range of motion in flexion and extension were in the normal range. However, the results for both knee extension movements were significantly different. As restricted motion is associated with acute lesions, our study did not account for the acute and chronic knee pain, which may be an explanation for this difference.

The role of the quadriceps femoris muscle is significant in knee function and joint stability.[30] A significant relationship was found for both parameters, with a 30% decrease in extensor muscle strength and a 17% decrease in flexor muscle strength in the knee with a meniscus tear compared to the healthy knee.[31] Another study found that quadriceps femoris muscle strength following knee injuries was lower in the side with meniscal injury.[32] In our study, the examination of muscle strength in both healthy and patient groups also revealed a significant difference between the knee flexor and extensor muscle groups.

Although BBS is commonly used for balance,[33] we found no group difference. Previous studies reporting poor stability did not use BBS.[34] To our knowledge, this is the first study applying BBS in meniscal tear cases, indicating the need for further research.

A study of 252 patients with osteoarthritis and meniscus tears found that lower extremity muscle strength positively impacted pain and mobility, with TUG time averaging 10 seconds.[35] In our study, the TUG time was significantly longer in the study group (9.11 s) than in controls (8.3 s). 5TSTS results also showed significantly delayed performance in the meniscus tear group.

WOMET assesses the quality of life in meniscal injuries. It consists of 16 questions under 3 main headings to evaluate physical findings (A), lifestyle(B), and mood(C) in individuals with meniscal tears. In a study examining the preoperative symptoms of patients with degenerative meniscal tears, two groups were examined, those with and without mechanical symptoms, and no significant difference was found between the WOMET scores of these groups.[36] WOMET was used to examine the short-term clinical outcomes of arthroscopic partial meniscectomy in terms of quality of life, and preoperative assessment results showed high scores parallel to the VAS score.[37] We also compared the scores of the three main sections and the total scores of the Western Ontario Meniscal Evaluation Tool (WOMET) between groups. In Sections A, B, C, and the overall score, the meniscus tear group outperformed the control group. The meniscus tear group scored considerably higher in Section A, which could be connected to the group's high VAS ratings. Section B, which measures quality of life, and Section C, which analyzes the effect of knee difficulties on mood, again showed a significant difference between the groups, with higher scores in the meniscus tear group. Overall, the data show a significant negative relationship between pain and a decrease in meniscus-related quality of life, as criticized by the WOMET, particularly during physical activity and at night. These results highlight how crucial it is to treat pain in meniscus-related individuals in order to improve their overall quality of life.

We employed multiple objective tools-VAS, BBS, TUG, 5TSTS, WOMET-providing a comprehensive comparison between meniscus patients and healthy controls. To our knowledge, this is the first study combining all these tools in one cohort.

Nonetheless, several limitations should be noted. The lack of proprioception assessment restricts conclusions regarding postural balance. Gender imbalance, with more females than males, may affect generalizability. The wide age range, without subgroup analysis, could have masked age-related effects. Additionally, the absence of MRI in the control group raises concerns about undetected asymptomatic pathology. Although BMI values were relatively high in both groups, radiographic screening for early osteoarthritis was not performed in asymptomatic controls, which should be considered when interpreting the findings. Finally, the observed differences should be interpreted cautiously, as meniscal tear type and time elapsed since injury were not analyzed as separate subgroups. These factors may influence functional performance and pain outcomes and should be addressed in future studies.

CONCLUSİON

Significant differences were observed between groups in pain, joint mobility, muscle strength, functional performance, and quality of life. Pain appeared to negatively influence multiple outcome parameters, highlighting the importance of effective pain management strategies to improve functional capacity and overall well-being in individuals with meniscal injuries. These findings may support the development of exercise-based rehabilitation programs targeting pain reduction. Future research should include long-term follow-up, proprioceptive assessment, broader populations, and comparative analyses between patients receiving structured rehabilitation and those without rehabilitation to further clarify treatment-related outcomes.

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CONFLİCTS OF INTEREST

The authors declare no conflicts of interest.

CONSENT

Written informed consent from the patients was obtained.

INSTITUTIONAL REVIEW BOARD (ETHICS COMMITTEE)

Ethical approval for the study was granted by the Biruni University Ethics Committee for Non-Interventional Clinical Investigations on 27.05.2022, under decision number 2022/70-25, and written informed consent was obtained from all participants

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