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RESEARCH ARTICLE

EVALUATION OF FORCE SENSE, FUNCTIONAL PERFORMANCE, QUALITY OF LIFE, ACTIVITY LEVEL AND KINESIOPHOBIA IN DEGENERATIVE MENISCAL TEARS FOLLOWING PARTIAL MENISCECTOMY

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ABSTRACT

Purpose: The aim of this study was to compare functional performance, force sense of knee joint, kinesiophobia, quality of life, and activity level between patients with partial meniscectomy and healthy peers.
Material and Methods: Twenty patients with partial meniscectomy within 6 months to 3 years postoperatively and 20 healthy peers were included. Maximal voluntary isometric muscle strength of Quadriceps femoris and force sense with the biofeedback device, quality of life with Western Ontario Meniscal Evaluation Tool, functional performance with stair up/down test, physical function with Knee Injury and Osteoarthritis Outcome Score-Physical Function Short Form, activity level with Tegner Activity Level scale, kinesiophobia was evaluated with Brief Fear of Movement Scale.
Results: Range of motion, maximal voluntary isometric muscle strength of M. Quadriceps femoris, and force sense decreased in the operated leg compared with the non-operated leg in meniscectomy group ($p<0.05$). In comparisons between groups maximal voluntary isometric muscle strength of M. Quadriceps femoris, functional performance, force sense, quality of life and physical function were lower in meniscectomy group compared to control group ($p<0.05$). Range of motion, pain severity, kinesiophobia scores, physical activity level was similar in both groups ($p>0.05$).
Conclusion: Considering functional deficiencies following arthroscopic partial meniscectomy, patients need comprehensive assessments focusing deficiencies in proprioception, functional performance, quality of life, muscle strength, and physical function

Keywords: knee, meniscus, meniscectomy, quality of life, proprioception

INTRODUCTION

The meniscus, one of the most important anatomical structures of the knee joint and plays a role in load transmission and distribution, joint lubrication and nutrition, stability, shock absorption, and proprioception. The most injured structure in the knee joint is the menisci. While meniscus tears are usually caused by trauma in young people, they may occur without trauma because of the degeneration of meniscus and decreased elasticity in the elderly. Meniscectomy is one of the surgical methods used in the treatment of meniscal tears. In surgery, all or part of the damaged meniscus is removed. Nowadays, "partial meniscectomy" is preferred due to some reasons such as poor long-term results of total meniscectomy and understanding the functional importance of the meniscus (1).

Meniscectomy is the cause of the decreased knee joint position sense. This reduces the functionality of patients and increases the risk of injury to the knee joint (2). When the studies in the literature were examined, it was observed that proprioception after meniscectomy was evaluated in various methods and most of these studies focused on joint position sense and kinesthesia. Studies have shown that proprioception is not only affected by these two parameters but also the sense of force, which plays an important role in providing neuromuscular control, also affects proprioception. (3). However, there is no study in the literature evaluating the force sense in the knee joint after partial meniscectomy.

Functional performances of individuals decrease after knee injuries. In a study, with individuals who have underwent meniscectomy, it was found that the functional performance decreased in the operated leg compared with the non-operated (4). There are few studies in the literature comparing functional performance between patients with partial meniscectomy and healthy subjects (5).

Studies are showing that patients' quality of life has decreased after meniscectomy. However, the evaluation scales used in these studies are not specific to meniscus injuries and are insufficient to evaluate the disease-specific quality of life (6).

Long-term retrospective studies show that patients' level of physical activity has decreased after meniscectomy (7,8). However, since there is a decrease in physical activity level with aging in the late period, it has not been explained in these studies whether the decrease in physical activity level is related to aging or other factors (9). It is not known whether in the short term after surgery the activity levels of patients differ from healthy peers. This leads to the inability to fully explain the specific effect of meniscectomy on the level of physical activity.

Studies are showing that kinesiophobia increases after knee injuries and this situation affects patients' rehabilitation results negatively. However, many of these studies have been performed in patients with anterior cruciate ligament reconstruction (ACLR), and there have been no studies comparing kinesiophobia with the healthy group after partial meniscectomy (10).

Our hypothesis was that force sense and kinesiophobia level were more affected in patients with partial meniscectomy compared to healthy peers. To clearly demonstrate the functional deficit after meniscectomy, the aim of this study was to compare functional performance, knee joint strength sensation, kinesiophobia, quality of life, and activity levels between patients with partial meniscectomy and their healthy peers.

MATERIAL AND METHODS

Twenty patients with partial meniscectomy within six months to three years postoperatively and 20 healthy were included in this study. Surgeries were performed by the same surgeon. The ethics committee approval required for the study was accepted by Hacettepe University Ethics Committee of Non-Interventional Clinical Investigations with GO 18/462-06 decision number (Date: 12.08.2018). The study was conducted at Hacettepe University Faculty of Physical Therapy and Rehabilitation.

The criteria for inclusion in the meniscectomy group;
- Having undergone arthroscopic partial meniscectomy due to degenerative meniscal tear,
- To be between the sixth month and the third year postop,
- To be between the ages of 40-65,
- To be body mass index between 18 and 30,
- Volunteering to participate in the research,
- Not having received post-operative physiotherapy and rehabilitation in an external center.

The criteria for inclusion in the control group;
- Have not had any knee surgery,
- Meniscus tear, anterior cruciate ligament injury, etc. not have a knee injury,
- Being of the same age and gender as the individuals in the study group,
- Volunteer to participate in the study.

Exclusion criteria from the study;
- Having had additional knee surgery,
- Having had anterior cruciate ligament injury,
- Having had any knee injury in the last six months,
- Having any systemic disease that may affect the evaluation parameters,
- Not being able to cooperate with assessments.

The individuals signed an informed consent form. The flowchart of individuals is shown in Figure 1.

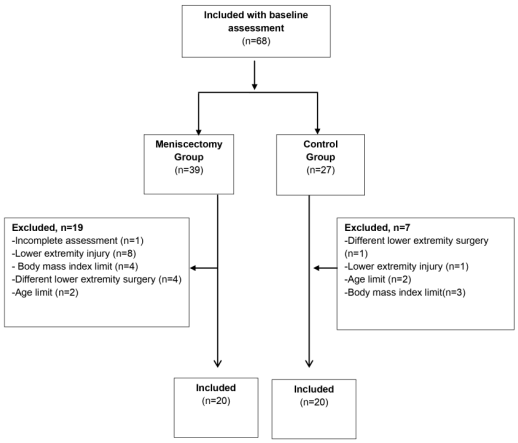

Figure 1. Flowchart of individuals.

Physical Properties and Sociodemographic Assessment

Age, sex, height, body weight, dominant lower extremity, occupation was recorded. In addition, affected extremities, injury, and surgery dates of individuals with meniscectomy were recorded. In order to determine the dominant lower extremity, individuals were asked with which foot they hit the ball.

Pain Severity and Range of Motion Assessment

The pain severity of with a visual analog scale (VAS) and the range of motion of the knee joint was evaluated with a universal goniometer (11,12).

Force Sense Measurement

A biofeedback device (Stabilizer, Chattanooga Group) was used to measure the force sense of the knee joint and maximal voluntary isometric muscle strength of M. Ouadriceps femoris. Participants sat on the treatment bed with their knees fully extended. The device's pressure bag was placed under the knee joint and inflated the cuff to a pressure of 20 mmHg pressure. The participants were instructed to extend the knee joint through a maximum voluntary isometric contraction for 5s. Meanwhile, the highest value seen on the screen of the device was recorded in mmHg as the maximum voluntary isometric muscle strength of the M. Quadriceps femoris. In evaluating the force sense, 50% of this maximum value was recorded for use (13).

Firstly, individuals were instructed to contract the quadriceps femoris muscle to reach the 50% mmHg of the maximum value (target value) using visual and verbal feedback. After this practice, individuals were instructed to reproduce the target force without feedback. As soon as they thought they had reached the targeted value, they were asked to give feedback to the physiotherapist. Then the value on the indicator was recorded. The difference between the value the participants obtained, and the target value was calculated in mmHg. This difference was recorded as the result of the first measurement. This measurement was repeated three times. The arithmetic mean of three measurements was recorded. High deviation scores indicated lower force sense in the knee side (14).

Functional Performance and Activity Level Assessment

Functional performance evaluated with nine stair up/down test. This test is a valid and reliable functional performance test that evaluates an individual's stair climbing activity, dynamic balance, and lower extremity strength. It was stated that before starting the test, individuals had to go up and down 9 steps one by one as soon as possible, and if necessary, they could get support from the stair handrails and use walking aids. (15). Tegner Activity Level scale was used to assess physical activity level and was determined by asking the participants. Tegner Activity Level Scale is a scoring system that rates individuals' activity levels between 0 and 10. 0 points mean quitting activities and 10 points mean being able to do professional sports at the national

team level. (16). The Knee Injury and Osteoarthritis Outcome Score-Physical Function Short Form (KOOS-PS), consisting of seven questions, was used to assess physical function. Higher scores in our study indicated poor physical function (17).

Quality of Life Assessment

Western Ontario Meniscal Assessment Tool (WOMET) scale consisting of sixteen questions specially developed to evaluate the health-related quality of life of patients with meniscal injury was used. The result of the test is between 0 and 1600 points. Lower values indicate more positive outcomes in terms of quality of life (18).

Kinesiophobia Assessment

Brief Fear of Movement Scale was used to assess kinesiophobia. The validity and reliability of the scale has been proven for individuals with osteoarthritis (OA). This scale was created based on the questions in the Tampa Kinesiophobia Scale. The 1, 2, 9, 10, 14, 15th questions of the

Likert scale was used to evaluate the questions (1= strongly disagree, 2= disagree, 3= agree, 4= strongly agree). Individuals were asked to mark the score appropriate for them. The lowest score that can be obtained because of this test is six, and the highest score is 24. Lower scores indicate lower kinesiophobia level in the individuals with OA (19,20).

Statistical Analyses

The number of samples was determined by performing power analysis with the G*Power program. The primary aim of this study was to compare the force sense between patients with partial meniscectomy and healthy. In our study, our hypothesis was established as one-tailed, since it has been shown in the literature that proprioception is adversely affected in patients with meniscectomy. Considering the deviation values in the force sense measurement as the main outcome measurement, it was envisaged to include at least 20 participants in the meniscectomy and control group with a $p<0.05$ significance level and 90% power ratio. Raw data were not modified, and missing data was not completed before statistical analyzes were performed. Post hoc analysis was not performed. Statistical analysis was performed by using IBM SPSS 21.0 package program. The normal distribution of variables was examined by analytical and visually methods. Descriptive statistics were given as mean ± standard deviation for normally distributed variables, the interquartile range and median for non-normally distributed variables. For two-group comparisons, the Mann-Whitney U test was used for non-normal distribution and Independent Samples t-Test was used for normally distributed data. Gender distribution between the two groups was analyzed the Chi-square test. For in group comparisons, the Paired Samples t–Test was used. P-value below 0.05 was considered statistically significant.

RESULTS

The physical properties of participants with meniscectomy and healthy subjects were similar ($p>0.05$) (Table 1). There was not statistically difference between the two groups in terms of gender ($p=0.752$). The post-operative duration of the participants with meniscectomy was 21±11.42 months.

Table 1. Comparison of the physical characteristics of individuals.

Physical Characteristics	Meniscectomy X±SD (n=20)	Control X±SD (n=20)	t	p
Age (year)	54.65±7.10	53.5±6.80	-0.546	0.558
Body weight (kg)	75.20±7.65	72.65±13.80	-0.723	0.474
Height (cm)	169.75±9.88	167.35±11.64	-0.703	0.486
Body Mass Index (kg/m^2)	26.11±1.85	25.81±3.11	-0.361	0.720

Independent sample t-test, X±SD: Mean ± Standard Deviation, cm: Centimeter, kg: Kilogram, m: meter, n: sample size, t: t value, p: Independent samples t-test Significant values $p<0.05$

Pain severity was similar in both groups ($p>0.05$) (Table 2). Knee extension limitation was not found in both groups. Range of flexion motion decreased in the operated leg compared with the non-operated leg ($p=0.002$) (Table 3).

Maximum voluntary isometric muscle strength of M. Quadriceps femoris decreased in the operated leg compared with the non-operated leg, and control group ($p=0.012$, $p=0.003$) (Table 3, Table 4). Force sense decreased in the operated leg compared with the non-operated leg, and control group ($p=0.001$, $p<0.001$) (Table 3, Table 2).

Table 2. Comparison of non-normally distributed data between groups.

	Meniscectomy (n=20)		Control (n=20)		z	p
	Min-Max	Median	Min-Max	Median		
Pain severity (cm)	0-3.3	0	0-3.9	0	-0.436	0.718
Force Sense (mmHg)	1.33-8.67	5.36	0.33-8.67	1.83	-4.076	**< 0.001**
Stair up/down test (sec)	4.50-18.60	10.30	4.20-9.70	5.65	-3.233	**0.001**
KOOS-PS (0-100)	0-37	22	0-31.80	12.65	-2.027	**0.043**
WOMET (0-1600)	70-1100	495	0-370	110	-4.667	**< 0.001**
Tegner Activity Level (0-10)	2-6	3	2-4	3	-0.607	0.602

Mann-Whitney U test, Koos-ps: Knee Injury and Osteoarthritis Outcome Score – Physical Function Short Form, Womet: Western Ontario Meniscal Evaluation Tool, cm: centimeter, n: sample size, mmhg: millimeters of mercury, sec: second min – max: minimum – maximum, Significant values are represented in bold, p<0.05

Table 3. Comparison of the individuals in the meniscectomy group within the group.

Meniscectomy	Operated extremity (n=20) X ± SD Min-Max/Median	Non-Operated extremity (n=20) X ± SD Min-Max/Median	z	p
Range of Motion (°)	127.7±8.49	133.45±6.10	-3.073	**0.002***
Isometric muscle strength M. Quadriceps Femoris (mmHg)	43.30±10.33	50.10±11.90	-2.774	**0.012***
Force Sense (mmHg)	1.33-8.67/5.36	0-6/2.33	-3.221	**0.001****

* Paired Samples t – Test, **Wilcoxon Signed-Rank Test, °: degree, X±SD: Mean ± Standard Deviation, Min – Max: Minimum – Maximum, n: sample size, mmHg: millimeter mercury, Significant values are represented in bold, p < 0.05

Functional performance, quality of life and physical function were lower in meniscectomy group compared to healthy (p=0.001, p<0.001, p=0.043) (Table 2). Kinesiophobia scroes, physical activity level was also similar in both groups (p>0.05) (Table 2, Table 4).

DISCUSSION

Lower functional outcomes in long-term period after partial meniscectomy in patients with degenerative meniscal tears are common. The objective of this study was to investigate functional performance, force sense of knee joint, kinesiophobia and activity level, and quality of life in patients with partial meniscectomy in long term. The results demonstrated that force sense, maximal voluntary isometric muscle strength of M. Quadriceps femoris, physical function, functional performance, and quality of life were lower compared to healthy peers and pain severity and kinesiophobia were still persistent even in long term in patients with partial meniscectomy.

Table 4. Comparison of muscle strength and kinesiophobia findings between groups.

	Meniscectomy (n=20) X ± SD	Control (n=20) X ± SD	t	p
Isometric muscle strength M. Quadriceps Femoris (mmHg)	43.30±10.33	55±14.70	-3.177	**0.003**
Brief Fear of Movement (6-24)	13.35±2.83	11.85±3.03	-1.617	0.114

Independent sample t-test, X±SD: Mean ± Standard Deviation, mmHg: millimeter mercury, n: sample size, Significant values are represented in bold, p<0.05

The knee joint is one of the body regions with the most pain complaints (21). In a study that was examined patients with partial meniscectomy, patients' pain severity has evaluated before, and six weeks after surgery, and a decrease in pain severity was found after meniscectomy (22). The study show that meniscectomy reduces pain severity in the postoperative early period compared to the level before surgery. Our study seems to support the result of these study because in our study pain severity was found similar in both groups. In a study, patients who underwent total meniscectomy with open surgery has compared with the control group 21 years after surgery. Knee pain scores of the patients in the meniscectomy group were higher (23). Different surgical methods applied to patients may have caused the different results between our study, and this study. In addition, meniscectomy causes degenerative changes that cause knee pain in the late period. We assume that different follow-up times after surgery may also cause differences between studies.

M. Quadriceps femoris play critical role in the dynamic function of the knee joint, and stability. In the literature, in studies investigating the consequences of partial meniscectomy on M. Quadriceps femoris muscle strength, significant decrease was found in the quadriceps muscle strength of the operated extremity (24,25,26). In our study, operated leg muscle strength was compared to the non-operated leg, and with the control group, as suggested in the literature, and muscle strength of M. Quadriceps femoris decreased in operated leg compared with non-operated leg, and control group. This result was consistent with other studies. However, in Becker et al.'s study, the fact that meniscectomy individuals had similar muscle strength on the operated and non-operated sides differed from ours and other studies in the literature. It has been stated that this difference may be caused by changes in joint cartilage metabolism on both the affected and unaffected sides as a result of unilateral knee injuries (27,28).

Most of the studies examining proprioception have primarily focused on kinesthesia, or joint position sense, while research on force sense is limited. Our study is the first study evaluating proprioceptive force sense after partial meniscectomy. The force sense is defined as the ability to reproduce a specific target force (14). In a study, the effect of partial medial meniscectomy on joint position sense was examined. In this study, proprioception was evaluated angle reproduction test. It was found that participants with medial meniscectomy have significantly less joint position sense than the before surgery (29). In another study examining the effects of partial meniscectomy, the joint position sense has been evaluated with a continuous passive motion device. As a result of this study, the joint position sense of the operated extremity was found to be less than the non-operated extremity (30) In our study, operated leg muscle strength was compared to the non-operated leg, and with the control group, as suggested in the literature, and muscle strength of M. Quadriceps femoris decreased in operated leg compared with non-operated leg, and control group. Similarly, in our study, the force sense in the operated leg was found to be less than the non-operated leg, and the healthy group. These two results were consistent with the literature. As a result of our study, it has been shown that the force sense is negatively affected in individuals who have undergone meniscectomy. It is known that with the deterioration of proprioception, it becomes difficult to maintain dynamic stability in the joint, and the risk of functional instability and re-injury increases (31). In addition, considering that the force

sense plays an important role in supporting the joint by adjusting the muscle tension level of the individual during weight transfer (14), we think that the evaluation of proprioception after meniscectomy should not only be limited to joint position sense and kinesthesia sense, but also force sense evaluation should be added.

The stair up/down test which is used to evaluate functional performance in musculoskeletal problems. Studies investigating the functional performance of patients with meniscectomy, it was found that the functional performance of the operated extremity was impaired compared to the non-operated extremity (4,15). In our study, it was found that participants with meniscectomy had a higher time to go up and down the stairs compared to the control group. The lower functional performance of individuals with meniscectomy compared to healthy peers may have caused by insufficient muscle strength, decreased sense of confidence to the knees of the patients, and impaired balance. When the studies were examined, it was observed that the functional performance increased as the time elapsed after surgery increased. The postoperative short follow-up period may also have led us to find this result.

Physical activity improves the quality of life and muscle strength, endurance, and flexibility, reduces the risk of early death and chronic disease. In a study conducted to examine the long-term results of partial meniscectomy on athletes, it was found that level of physical activity decreased after surgery (7). Another study included patients with partial and total meniscectomy, and healthy peers. Physical activity level was evaluated before the injury and 14 years after surgery. A decrease in physical activity was found in both groups Thus, it was thought that other factors except meniscectomy were also effective in low the level of physical activity (8). When the studies conducted were examined, it was seen that physical activity was evaluated before and after surgery. In the literature, there is no study comparing the physical activity level of patients who underwent meniscectomy due to degenerative meniscal tear with a control group in the short term after surgery. We assume that it is important to evaluate the physical activity level in the short term after surgery. Because it is known that there is a decrease in the level of physical activity because of aging (9). For this reason, we compared two groups in the short term after surgery and excluded other factors that would cause a decrease in physical activity level as much as possible. In our study, the physical activity level was found similar in both groups. Individuals participating in our study consisted of people who are not professional athletes may have been effective in this result. In addition, there are some advantages of evaluating the level of physical activity in the short term after meniscectomy, and it is a disadvantage that the negative consequences of this surgery that may affect physical activity have not yet emerged. The fact that these effects have not emerged yet may have been effective in finding this result.

We used KOOS-PS to assess physical function. In the literature, in studies investigating the effects of meniscectomy on physical function, preoperative and postoperative evaluations were made, and it was found that physical function decreased after meniscectomy. In some studies, it has been reported that comparing individuals who underwent meniscectomy with healthy individuals is important for the better quality of future studies (17,32). Our study removed this deficiency in the literature and compared the physical function of individuals who underwent meniscectomy with the control group and it was observed that their physical functions were worse. This situation may have been caused by the low physical activity level, muscle strength, and force sense of the patients

Quality of life is defined as individual perception of life, objectives, values, interests, and standards in the framework of culture. In the study by Sihvonen et al., to investigate the effect of meniscectomy compared to placebo, quality of life was evaluated 24 months after surgery, and it was found that the quality of life was not different from the placebo group, and that meniscectomy did not affect the quality of life positively (33). In another study, the quality of life of individuals with meniscectomy were evaluated before, and after surgery, and an increase in the quality of life was found in the postoperative period compared before the surgery (6). In our study it was found that the quality of life of subjects with meniscectomy were lower than the control group. As the studies were examined, it was observed that the patients' quality of life increased in the short term after surgery compared to the pre-surgery period, but the quality of life of individuals with meniscectomy was lower than healthy peers. Factors such as

kinesophobia, pain, and physical disabilities may have caused a decrease in quality of life. Also, considering the study conducted by Sihvonen et al., we assume that the increase in quality of life after surgery may be due to the placebo effect. Studies investigating the quality of life after meniscectomy which compare before and after surgery may be a limitation in determining the effects of meniscectomy on quality of life in all aspects.

Kinesiophobia which is defined as the fear of movement and re-injury causes restriction of activities, leads to a decrease in strength, flexibility, and physical capacity. In the study, to investigating kinesiophobia after ACLR, it was found that patients who were in the short term after surgery had a high level of kinesophobia (10). When the literature is reviewed, no studies are investigating the effect of meniscectomy on kinesophobia. In our study, kinesiophobia scores were found similar in both groups. Given that the increase in pain perception is the basis of kinesiophobia, we assume that individuals with similar pain severity may be effective to be found this result. Also, as it is known that some negative consequences (such as pain) of meniscectomy occur in the late period, the 20-month follow-up period of our study may have been effective in this result. As a result, it is necessary to add the evaluation of kinesiophobia to the evaluations to be made after meniscectomy surgeries and to create rehabilitation programs suitable for these evaluations. The most important limitation of our study is that individuals with meniscectomy could not be evaluated before surgery. Pre-op assessments would have been more effective in comparing the differences following surgery. Another limitation is that individuals aged between 6 months and 3 years after surgery were included in our study. The long time interval may have affected the results. Keeping this interval short may provide more precise results in future studies.

CONCLUSION

In conclusion, lower force sense, muscle strength, quality of life, physical function, functional performance, and higher pain severity, kinesiophobia level are seen in long-term following partial meniscectomy in patients with degenerative meniscal tears. Considering the functional deficit following partial meniscectomy, comprehensive assessment and rehabilitation programs should be established to support the functional recovery of patients with partial meniscectomy in long-term. Further studies are needed to compare patients with degenerative meniscal tears with or without surgery in different stages of postoperative rehabilitation.

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Conflict of interests: None.

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