The effects of partial meniscectomy and meniscal repair on the knee proprioception and function

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Abstract

Purpose: Aim of our study was to compare the effects of partial meniscectomy and meniscus repair on knee proprioception and function. Methods: The study included 46 patients with clinical and radiological diagnosis of meniscal tear and accompanying anterior cruciate ligament (ACL) rupture. The patients were evaluated under two groups: group 1: partial meniscectomy and ACL reconstruction, and group 2: meniscal repair and ACL reconstruction. Proprioceptive and functional evaluation of all patients was performed prior to surgery and on postoperative 12th month. Results: Group 1 consists of 18 male and 1 female patients with an average age of 28.78 ± 3.50. Group 2 consists of 23 male and 4 female patients with an average age of 27.14 ± 3.65. Preoperative evaluation revealed significant differences in knee joint position sense values on wide range of knee motion (15°, 30°, 45°, 60°, and 75°) in both groups. The statistically significant difference was observed in only the range of knee motion of 60° in patients underwent meniscal repair (group 2), whereas in the range of knee motion of 45°, 60°, and 75° in patients underwent partial meniscectomy (group 1) at 12th-month control. According to Lysholm knee scoring system, significantly better results were achieved with meniscal repair compared to the partial meniscectomy at 12th-month control. Conclusion: In case of ACL rupture accompanied by meniscal tear, the meniscal repair should be sutured, if possible, in order to obtain better results in terms of knee function and proprioception.

Keywords

knee proprioception, meniscectomy, meniscal repair, meniscal tear

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Introduction

The proprioceptive feedback is an important factor for functional outcomes as well as a subjective feeling of stability in knees.¹ Proprioceptive mechanism of the knee gives information about joint position and joint motion.²,³ The mechanoreceptors such as Ruffini endings, Pacinian corpuscles, and Golgi tendon organs have a proprioceptive function which are present in the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), and menisci.⁴⁻⁶ They bring the afferent signal to the brain for knee postural changes.⁷

The ruptured ACL causes instability without any correlation to the mechanical instability of the knee.
The reason for this instability was explained with impairment of the proprioceptive mechanism of ACL. The outer and middle third of the meniscus have free nerve endings. Many studies try to explain the correlation between free nerve endings and proprioception of the meniscus. Meniscal tear or meniscectomy could lead to impairment of the proprioceptive mechanism. Very few studies have investigated the correlation between the impairment of the proprioceptive mechanism and meniscal tear or meniscectomy. No studies have investigated the impact of meniscal repair with meniscal suture on the proprioceptive function of the knee.

Aim of our study was to compare the effects of partial meniscectomy and meniscal repair on the knee proprioception and function.

Materials and methods

The study included 46 patients underwent arthroscopic repair, who were diagnosed with meniscal tear and accompanying ACL rupture based on clinical findings and magnetic resonance imaging (MRI) examination between January 2010 and January 2015. Patients with a history of previous surgical intervention, PCL rupture, chondral damage, internal ligament and external collateral ligament injury, diabetes, neurological disease, and opiate use were excluded from the study. The signed consents of patients were obtained after informing the patients about the study. Patients underwent surgical intervention, an average of 8 months after the injury (range, 3–18 months).

The patients were evaluated under two groups:

Group 1: Partial meniscectomy and ACL reconstruction.
Two displaced flap tears, two radial tears in the white–white zone, and nine complex tears in the medial meniscus. Four displaced flap tears and two radial tears in the white–white zone in the lateral meniscus.

Group 2: Meniscal repair and ACL reconstruction.
Ten bucket handle tears, six longitudinal tears, and two horizontal tears in the medial meniscus. Five bucket handle tears, two longitudinal tears, and two horizontal tears in the lateral meniscus.

No patients had both medial and lateral meniscus tears. All surgical procedures were performed arthroscopically by the same surgeon. ACLs were repaired with single-tunnel ACL reconstruction with hamstring tendon autografts from ipsilateral side, while meniscal repair was performed with arthroscopically assisted reconstruction with meniscal suture. The meniscal tears were repaired with inside-out sutures and all-inside sutures.

Postoperative evaluation of all patients was performed by a physiotherapist who was blinded to the operation in a different rehabilitation center. Evaluation of all patients was performed prior to surgery and on postoperative 12th month by the physiotherapist. Knee joint position sense (KJPS) test and Lysholm knee scoring scale were used to evaluate the knee joint proprioception and function, respectively.

KJPS measurement

KJPS measurement was performed with a CPM device. The patient was positioned supine and the knee joint of the tested leg was aligned with the axis of the CPM and the thigh was secured on the ground with a fixation strap (Figure 1). The evaluation of patients was performed with patients wearing shorts to avoid sensory inputs that may occur due to clothing. The CPM constant velocity was set as 2°/s. During this evaluation, the patients were asked to passively position their knees at eight different angles (0°, 15°, 30°, 45°, 60°, 75°, 90°, and 120°). Each measurement was performed three times for these eight different angles and average of three values was taken for statistical evaluation. To compare the results of the patients, these measurements were also applied for the healthy limbs.

Statistical evaluation

SPSS software for Windows (version 11.5) was used for statistical evaluation of the data. Student’s t-test was used.
for statistical evaluation of proprioception. Mann–Whitney U-test was used to compare knee joint functions between the groups. The value of $p < 0.05$ was considered as statistically significant.

### Results

There were no statistically significant differences between the groups according to age, female to male ratio, dominant knee involvement, and preoperative Lysholm knee scoring scale ($p > 0.05$; Table 1).

Preoperative evaluation revealed significantly different KJPS values on wide range of knee motion ($15^\circ$, $30^\circ$, $45^\circ$, $60^\circ$, and $75^\circ$) in the injured knee compared to the healthy knee in both groups ($p < 0.05$; Tables 2 and 3).

KJPS score was evaluated at the postoperative 12th-month follow-up. Proprioceptive function was found to be impaired at $45^\circ$, $60^\circ$, and $75^\circ$ range of motion in patients who underwent partial meniscectomy in group 1 ($p < 0.05$; Table 4). In the second group, meniscus repaired patients had impaired proprioceptive function at only $60^\circ$ range of motion ($p = 0.027$; Table 5).

While analyzing preoperative and postoperative 12th-month average Lysholm knee scoring system, it was found that the patients treated with partial meniscectomy and ACL reconstruction (group 1) had an average preoperative Lysholm knee score of 41.36 ± 11.99, whereas the mean postoperative average Lysholm knee score was

### Table 1. Comparison of preoperative clinical value and descriptive features of the groups.

| Preoperative evaluation | Group 1: Partial meniscectomy | Group 2: Meniscal repair | $p$ |
|-------------------------|-------------------------------|--------------------------|-----|
| Age                     | 28.78 ± 3.50                 | 27.14 ± 3.65             | 0.1345 |
| Man/woman ratio         | 18/1                          | 23/4                     | 0.3870 |
| Dominant/nondominant    | 16/3                          | 14/3                     | 0.6796 |
| Lysholm knee score      | 41.36 ± 11.99                | 47.29 ± 9.67             | 0.3652 |

### Table 2. Mean KJPS values, standard deviation, and $p$ values of both knees (partial meniscectomy + ACL reconstruction and contralateral healthy knee) at eight different degrees.

| Preoperative KJPS | Injury knee | Healthy knee | $p$ |
|-------------------|-------------|--------------|-----|
| 0$^\circ$         | 3.54 ± 4.33 | 1.21 ± 1.92  | 0.200 |
| 15$^\circ$        | 11.52 ± 3.80| 14.63 ± 2.97 | 0.015 |
| 30$^\circ$        | 24.02 ± 7.92| 30.48 ± 4.58 | 0.004 |
| 45$^\circ$        | 32.40 ± 5.70| 43.01 ± 4.80 | <0.0001 |
| 60$^\circ$        | 74.80 ± 12.35| 61.31 ± 3.88 | <0.0001 |
| 75$^\circ$        | 84.45 ± 9.94| 75.90 ± 4.18 | 0.001 |
| 90$^\circ$        | 98.25 ± 7.41| 94.16 ± 7.03 | 0.089 |
| 120$^\circ$       | 116.40 ± 3.98| 117.98 ± 2.17 | 0.135 |

KJPS: knee joint position sense; ACL: anterior cruciate ligament.

### Table 3. Mean KPJS values, standard deviation, and $p$ values of both knees (meniscal repair + ACL reconstruction and contralateral healthy knee) at eight different degrees.

| Preoperative KJPS | Injury knee | Healthy knee | $p$ |
|-------------------|-------------|--------------|-----|
| 0$^\circ$         | 3.14 ± 43.38| 2.12 ± 1.952 | 0.162 |
| 15$^\circ$        | 12.16 ± 4.58| 14.96 ± 2.08 | 0.005 |
| 30$^\circ$        | 26.15 ± 7.61| 30.485 ± 4.18 | 0.006 |
| 45$^\circ$        | 31.92 ± 10.56| 43.72 ± 5.18 | <0.0001 |
| 60$^\circ$        | 75.40 ± 14.47| 61.12 ± 4.39 | <0.0001 |
| 75$^\circ$        | 85.95 ± 10.99| 77.02 ± 7.09 | 0.0008 |
| 90$^\circ$        | 98.95 ± 7.97| 95.75 ± 5.82 | 0.098 |
| 120$^\circ$       | 117.09 ± 3.26| 117.89 ± 2.11 | 0.287 |

### Table 4. Mean KPJS values, standard deviation, and $p$ values of both knees (partial meniscectomy + ACL reconstruction and contralateral healthy knee) at eight different degrees.

| Preoperative 12-month follow-up KJPS | Injury knee | Healthy knee | $p$ |
|--------------------------------------|-------------|--------------|-----|
| 0$^\circ$                            | 1.85 ± 2.22 | 1.56 ± 1.60  | 0.642 |
| 15$^\circ$                           | 14.87 ± 2.96 | 16.18 ± 1.94 | 0.115 |
| 30$^\circ$                           | 27.86 ± 3.70| 30.08 ± 3.11 | 0.053 |
| 45$^\circ$                           | 40.66 ± 4.48| 44.12 ± 3.30 | 0.010 |
| 60$^\circ$                           | 56.75 ± 6.75| 62.66 ± 2.90 | 0.001 |
| 75$^\circ$                           | 80.54 ± 5.47| 75.56 ± 3.57 | 0.002 |
| 90$^\circ$                           | 89.07 ± 5.37| 90.82 ± 2.93 | 0.221 |
| 120$^\circ$                          | 116.85 ± 1.89| 117.59 ± 2.20 | 0.276 |

KJPS: knee joint position sense; ACL: anterior cruciate ligament.

### Table 5. Mean KPJS values, standard deviation, and $p$ values of both knees (second group: meniscal repair + ACL reconstruction and contralateral healthy knee) at eight different degrees.

| Preoperative 12-month follow-up KJPS | Injury knee | Healthy knee | $p$ |
|--------------------------------------|-------------|--------------|-----|
| 0$^\circ$                            | 1.75 ± 2.11 | 1.45 ± 1.77  | 0.569 |
| 15$^\circ$                           | 15.03 ± 4.12| 16.36 ± 2.22 | 0.146 |
| 30$^\circ$                           | 30.05 ± 4.68| 30.88 ± 5.03 | 0.537 |
| 45$^\circ$                           | 41.42 ± 4.06| 43.30 ± 3.14 | 0.063 |
| 60$^\circ$                           | 58.67 ± 3.34| 60.947 ± 2.41 | 0.027 |
| 75$^\circ$                           | 73.36 ± 4.19| 74.61 ± 6.35 | 0.395 |
| 90$^\circ$                           | 89.57 ± 8.83| 90.67 ± 5.11 | 0.575 |
| 120$^\circ$                          | 117.58 ± 2.25| 117.62 ± 1.95 | 0.948 |

KJPS: knee joint position sense; ACL: anterior cruciate ligament.
90.56 ± 6.20. Patients treated with meniscal repair and ACL reconstruction (group 2) had an average preoperative Lysholm knee score of 47.29 ± 9.67, whereas average postoperative Lysholm knee score was 95.06 ± 5.70. Statistically significantly better results were achieved with meniscal repair compared to the partial meniscectomy (p < 0.05).

Discussion

The meniscus is important for anteroposterior stabilization, lubrication, shock absorption, load transmission, and proprioception in the knee joint. The knee proprioception is important for the function of the knee. ACL and meniscal tears can cause deterioration of proprioception that can play an important role in the stability of the knee. Meniscal tear causes significant proprioceptive deficit when compared to healthy contralateral knee.

In a study, arthroscopic partial meniscectomy improves the knee outcome scores, and it does not improve knee proprioception. In contrast to this study, in addition to knee outcome scores, we found improvement in knee proprioception in our study. However, this improvement was more limited range of motion with the partial meniscectomy than with the meniscal repair group.

The proprioceptive functions of the patients were evaluated who had undergone a total meniscectomy at 30° and 70° knee flexion angle. A remarkable deficit was found at total meniscectomy group.

In another study, the patients who underwent partial meniscectomy to the posterior horn of the medial meniscus were compared retrospectively with the healthy control group. There was difference at 60° and 75° knee flexion angle. The limited aspect of this study was that the proprioceptive deficit was identified at only 60° of flexion in patients underwent partial meniscectomy. Whereas the proprioceptive deficit was identified at 45°, 60°, and 75° of flexion in patients underwent partial meniscectomy. Statistically significantly better results were achieved in terms of knee function (Lysholm score) in patients underwent both meniscal repair than those underwent partial meniscectomy.

Conclusion

As a result, a significant increase has been achieved in both knee proprioception and Lysholm score in patients with both meniscal repair and partial meniscectomy group patients after surgical intervention (p < 0.05). In addition, when compared the treatment approaches including partial meniscectomy and meniscal repair, it was found that both approaches provided significant improvement in knee proprioception, although proprioceptive deficit, although proprioceptive deficit was identified at 45°, 60°, and 75° of flexion in patients underwent partial meniscectomy.

On the other hand, when we compare between the groups in terms of functional results, statistically significantly better results were achieved with meniscal repair compared to the partial meniscectomy.

In the cases of ACL rupture accompanied by meniscal tears, the meniscal tear should be sutured, if possible, to obtain better results in terms of knee function and proprioception, and is important for the patient satisfaction.

Declaration of conflicting interests

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