A Comparative Study of Meniscectomy and Nonoperative Treatment for Degenerative Horizontal Tears of the Medial Meniscus

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Background: It is still debated whether a degenerative horizontal tear of the medial meniscus should be treated with surgery.

Hypothesis: The clinical outcomes of arthroscopic meniscectomy will be better than those of nonoperative treatment for a degenerative horizontal tear of the medial meniscus.

Study Design: Randomized controlled trial; Level of evidence, 1.

Methods: A total of 102 patients with knee pain and a degenerative horizontal tear of the posterior horn of the medial meniscus on magnetic resonance imaging were included in this study between January 2007 and July 2009. The study included 81 female and 21 male patients with an average age of 53.8 years (range, 43-62 years). Fifty patients underwent arthroscopic meniscectomy (meniscectomy group), and 52 patients underwent nonoperative treatment with strengthening exercises (nonoperative group). Functional outcomes were compared using a visual analog scale (VAS) for pain, Lysholm knee score, Tegner activity scale, and patient subjective knee pain and satisfaction. Radiological evaluations were performed using the Kellgren-Lawrence classification to evaluate osteoarthritic changes.

Results: In terms of clinical outcomes, meniscectomy did not provide better functional improvement than nonoperative treatment. At the final follow-up, the average VAS scores were 1.8 (range, 1-5) in the meniscectomy group and 1.7 (range, 1-4) in the nonoperative group ($P = .675$). The average Lysholm knee scores at 2-year follow-up were 83.2 (range, 52-100) and 84.3 (range, 58-100) in the meniscectomy and nonoperative groups, respectively ($P = .237$). In addition, the average Tegner activity scale and subjective satisfaction scores were not significantly different between the 2 groups. Although most patients initially had intense knee pain with mechanical symptoms, both groups reported a relief in knee pain, improved knee function, and a high level of satisfaction with treatment ($P < .05$ for all values). Two patients in the meniscectomy group and 3 in the nonoperative group with Kellgren-Lawrence grade 1 progressed to grade 2 at the 2-year follow-up.

Conclusion: There were no significant differences between arthroscopic meniscectomy and nonoperative management with strengthening exercises in terms of relief in knee pain, improved knee function, or increased satisfaction in patients after 2 years of follow-up.

Keywords: medial meniscus; degenerative horizontal tear; arthroscopic meniscectomy; nonoperative treatment

Horizontal tears of the meniscus are known as degenerative tears and are more common in late middle age.[4,6] The posterior horn is relatively immobile compared with other parts of the medial meniscus, and it is vulnerable to tears.[35] Therefore, horizontal tears of the posterior horn of the medial meniscus are the most typical and basic components of degenerative tears in the meniscus. They usually begin at the inner margin of the meniscus and extend toward the periphery, producing 2 leaves: 1 superior and 1 inferior. Deciding how and when to manage such tears is difficult because of the surgical requirement for resection when the tear extends deep into the capsule and the high rate of revision surgery related to residual symptoms after partial meniscectomy.[31] Moreover, resection inevitably leads to consequences such as subtotal or total meniscectomy, which causes osteoarthritis (OA)

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TABLE 1
Baseline Characteristics of Patients[a]

	Meniscectomy Group (n = 50)	Nonoperative Group (n = 52)	*P* Value
Sex, male/female, n	9/41	12/40	.666
Age at surgery, y	54.9 ± 10.3	57.6 ± 11.0	.083
Body mass index	25.0 ± 2.5	26.4 ± 1.9	.338
Mechanical axis[b]	−0.9 ± 1.3	−1.1 ± 1.4	.358
Maximal flexion, deg	139 ± 6.9	141 ± 10.3	.227
VAS score	5.2 ± 1.8	4.9 ± 1.5	.366
Lysholm score	64.0 ± 11.2	65.2 ± 10.8	.275

[a]Values are expressed as mean ± standard deviation unless otherwise indicated. VAS, visual analog scale.
[b]A negative number represents varus deformity.

because of its effect on the weightbearing regions of articular cartilage.[1,24]

According to previous studies, early OA development is more likely to occur after meniscectomy than after nonoperative treatment.[20,29] However, there is often a poor correlation between objective data and subjective complaints, making studies on outcomes difficult to perform.[19] In addition, few comparative studies have been reported for degenerative horizontal tears in the medial meniscus in a prospective study.[13,14]

The purpose of the present investigation was to compare the clinical results of arthroscopic meniscectomy and nonoperative treatment for degenerative horizontal tears in the posterior horn of the medial meniscus. Our hypothesis was that the clinical outcomes of arthroscopic meniscectomy would be better than those of nonoperative treatment for a degenerative horizontal tear of the medial meniscus.

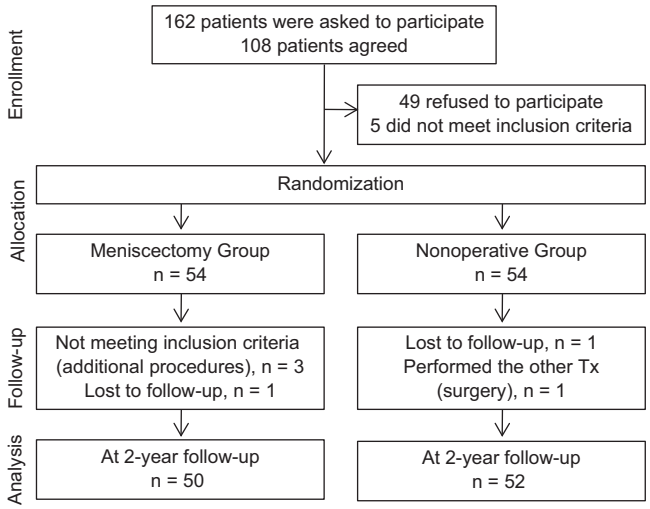

Figure 1. CONSORT flow diagram.

MATERIALS AND METHODS

Patients

The study protocol was approved by the institutional review board of our institution (CNUHHIRB 2006-32). Patients with a degenerative horizontal tear of the posterior horn of the medial meniscus on magnetic resonance imaging (MRI), who were referred to the Center for Joint Disease at our institution between January 2007 and July 2009 for the treatment of nontraumatic knee pain, were asked to participate in this study. The inclusion criteria included daily knee pain on the medial side with mechanical symptoms affecting daily living activities despite management at a primary clinic during the previous month. The exclusion criteria included a history of definite trauma, previous knee surgery, ligament deficiency, systemic arthritis, and osteonecrosis. In addition, patients showing a marked degenerative change with grade ≥2, according to the Kellgren-Lawrence classification,[18] were excluded. Of the 162 eligible patients, 108 agreed to participate. Subsequent treatment was decided by randomization using a closed-envelope technique and dividing the participants into 2 different groups. At the 2-year follow-up, 4 patients in the meniscectomy group and 2 patients in the nonoperative group had dropped out (Figure 1). There were 81 women and 21 men, and the average age was 56.8 years (range, 43-62 years). Each participant provided written informed consent. Patient demographics and preoperative status of the knee are presented in Table 1.

Management of the Nonoperative Group

The mean symptom duration of patients who underwent nonoperative management was 8.2 months (range, 2-81 months). All patients in the nonoperative group were prescribed drugs, such as analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs), or muscle relaxants, depending on clinical symptoms for the first 2 weeks. In addition, they underwent scheduled physical exercise to improve muscle strength, endurance, and flexibility for 60 minutes per session, 3 times weekly, for 3 weeks under the supervision of a physical therapist. After an early, intensive, supervised rehabilitation program to strengthen muscles during the first 3 weeks, all patients were provided with a home exercise program, which they conducted unsupervised for 8 weeks. The home exercise program consisted of daily isometric and isotonic muscle exercises (Table 2). Patients were instructed to perform the exercises

TABLE 2
Home Exercise Program

Times per Week	Exercise	Frequency (3 Times per Day)
0-8	Stretching of knee extensors and flexors	1 min/muscle group
0-8	Knee extension in sitting position	3 × 10 repetitions
0-8	Knee flexion in sitting position	3 × 10 repetitions
0-8	Stationary bicycling	Gradual increase every 15 min
5-8	Half squats with <45° of flexion with weights	3 × 10 repetitions
5-8	Squats with full flexion with weights	3 × 10 repetitions

with some strain but almost pain free and not adversely influencing the affected knee.

Management of the Meniscectomy Group

Arthroscopic meniscectomy was performed on patients at an average of 8.4 months (range, 6 weeks to 123 months) after the onset of symptoms. Surgery was carried out by a single experienced orthopaedic surgeon, using a 5.5-mm, 30° arthroscope and a pressure-controlled irrigation system. The procedure in each case was limited to resection with limited debridement of the articular surface lesion. Patients who underwent additional procedures, such as curettage, abrasion arthroplasty, or subchondral drilling for any articular lesions, were excluded from this study (n = 3) (Figure 1). No patient underwent total meniscectomy or peripheral meniscal repair. All patients were discharged on the day after surgery. Subsequently, patients were permitted to use co-interventions, such as analgesics or NSAIDs, within 2 weeks. All patients were then provided with a home exercise program, which was conducted unsupervised, using the same protocol as the nonoperative group for 8 weeks.

Assessments

Magnetic resonance imaging was used to visualize cartilage injuries at the femoral distal or tibial medial condyles of lesion sides before the surgery, and teleoroentgenography was used to measure the preoperative mechanical axes in the lower extremities.[12] Clinical results were evaluated with a visual analog scale (VAS) for pain, which consisted of a horizontal line that was 10 cm in length, based on symptoms (defined as pain related to specific activities, such as stair climbing, squatting, and standing up and sitting down); the Lysholm knee score[21]; and the Tegner activity scale.[34] Degrees of relief from pain, according to the VAS, were categorized as "complete relief" (0 or 1 point), "improved" (>2-point decrease), or "persistent" (changes within 2 points); patient subjective satisfaction with management, based on knee joint condition and degree of interference with everyday life, was rated as "very satisfied" (treatment met patient expectations), "satisfied" (treatment helped, and patient would undergo this treatment option), or "dissatisfied" (patient was the same or worse than before). Osteoarthritic changes, observed by roentgenography (anteroposterior, lateral, and Merchant views), were graded using the Kellgren-Lawrence classification.[18] Patients with grade ≥2 arthritis (definite osteophytes or definite narrowing of the joint space on plain radiography) with clear osteophytes were defined as having OA (Figure 2). Clinical outcome measures and physical examinations were conducted by independent authors (J.-I.C. and M.-C.K.) not involved in the treatment at 3 months, 1 year, and 2 years in the outpatient consulting room.

Figure 2. Kellgren-Lawrence grade 2: definite osteophytes and definite narrowing of the joint space.

Statistical Analysis

An a priori power analysis was performed. The sample size was calculated based on the data obtained from the 30

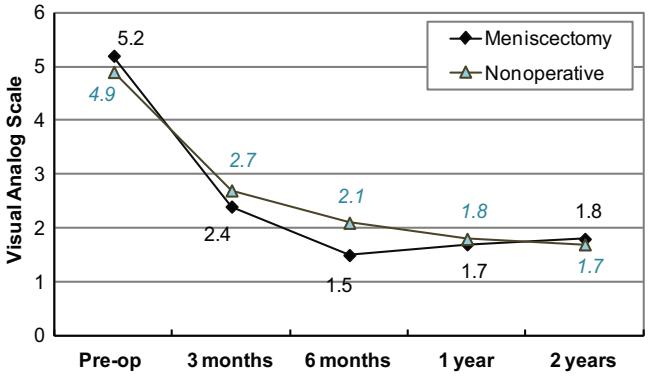

Figure 3. Mean changes in visual analog scale scores during follow-up examinations.

TABLE 3
Pain Relief Ratings at 2-Year Follow-up[a]

Rating	Meniscectomy Group (n = 50)	Nonoperative Group (n = 52)
Complete	34 (68)	35 (67)
Improved	13 (26)	12 (23)
Persistent	3 (6)	5 (10)

[a]Values are expressed as n (%). Statistical analysis between the 2 groups: $P = .652$.

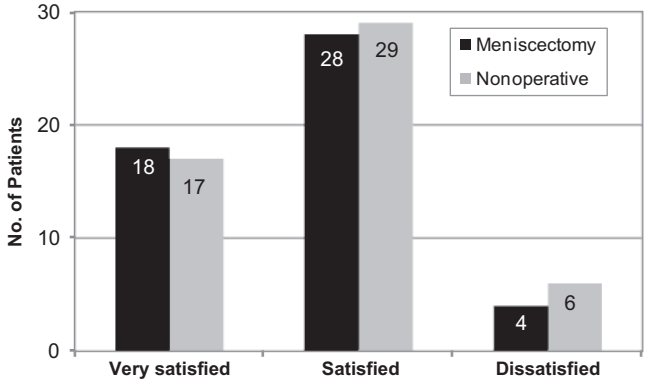

Figure 4. Patient satisfaction rates after 2 years of follow-up.

cases in an earlier series of this study at our institution. The end point was the Lysholm knee score. As was observed in 30 patients, the standard deviation was approximately 18. Given that we wanted to test the difference in the minimal clinical relevance of 10 between the 2 groups with 80% power and a significance level of $P < .05$, these values were estimated with 54 patients in each group. The Student t test was used to analyze the numeric data and the χ^2 test to analyze the nonnumeric data. The analysis was performed with SPSS software (SPSS for Windows v 18.0, SPSS Inc, Chicago, Illinois), and significance was accepted at the 95% level.

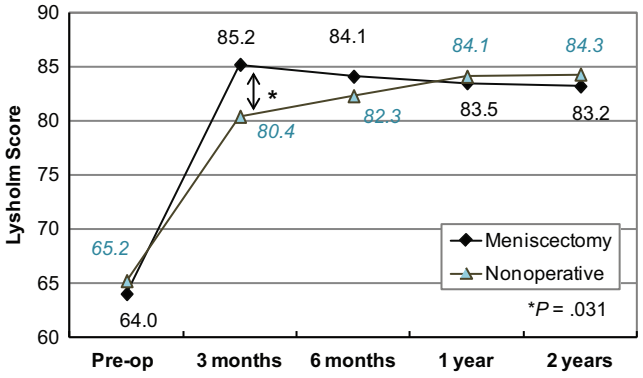

Figure 5. Mean changes in Lysholm knee scores after follow-up examinations.

RESULTS

The main symptoms before management were pain at a high flexion (94 patients, 92%) and tenderness at the posteromedial joint line (86 patients, 84%). At the 2-year follow-up, the average VAS scores were 1.8 (range, 1-5) and 1.7 (range, 1-4) in the meniscectomy and nonoperative groups, respectively, which were not significantly different ($P = .675$) (Figure 3). In the meniscectomy group, symptom improvement, according to the mean VAS score after surgery, had continued for 6 months, and in the nonoperative group, the symptoms remained longer than in the meniscectomy group after starting management. Knee pain with mechanical symptoms in the meniscectomy and nonoperative groups was completely relieved in 34 and 35 patients, improved in 13 and 12 patients, and persisted in 3 and 5 patients, respectively, at the 2-year follow-up, and no significant difference was observed between the 2 groups (Table 3).

In the meniscectomy group, 18 were very satisfied, 28 were satisfied, and 4 were dissatisfied with surgery at the 2-year follow-up, and in the nonoperative group, 17 patients were very satisfied, 29 were satisfied, and 6 were dissatisfied ($P = .357$) (Figure 4). The average Lysholm knee scores were 83.2 (range, 52-100) and 84.3 (range, 58-100) at the 2-year follow-up in the meniscectomy and nonoperative groups, respectively, which were also not significantly different ($P = .237$). The Lysholm knee scores had improved when evaluated at the follow-up relative to before treatment in both groups, and the only significant intergroup difference was observed at 3 months (Figure 5). Similarly, the average Tegner activity scale scores had been restored at the 2-year follow-up from 4.2 (range, 0-6) to 5.1 (range, 0-8) in the meniscectomy group and from 4.1 (range, 0-6) to 4.9 (range, 0-8) in the nonoperative group ($P = .522$). According to the Kellgren-Lawrence classification, 2 patients in the meniscectomy group (aged 59 and 62 years) and 3 in the nonoperative group (aged 57, 67, and 74 years) showed OA progression by >1 grade over the study period (Table 4).

TABLE 4
Kellgren-Lawrence Grade for Osteoarthritis at the Initial Visit and 2-Year Follow-up

Kellgren-Lawrence Grade	Initial Visit[a]		2-Year Follow-up[b]	
	Meniscectomy Group	Non-operative Group	Meniscectomy Group	Non-operative Group
0	39	35	33	31
1	11	17	15	18
2	0	0	2	3
3	0	0	0	0

[a] $P = .482$.
[b] $P = .440$.

DISCUSSION

Horizontal meniscal tears occur frequently and may be asymptomatic.[4,6,26] This tear type can give rise to a flap tear but is usually mechanically stable. Although traditionally medial meniscal tears have been treated by arthroscopic meniscectomy, there is no scientific evidence to support its efficacy for degenerative changes, which include horizontal tears of the medial meniscus. Hence, we evaluated the effect of partial meniscectomy and nonoperative management in patients with degenerative medial meniscal tears. In this study, an arthroscopic procedure for degenerative horizontal tears in the posterior horn of the medial meniscus did not provide superior outcomes when compared with nonoperative management. The only time point at which the meniscectomy group had a significantly higher Lysholm knee score was after 3 months. Roos et al[30] reported that arthroscopic partial meniscectomy, as the only intervention, showed improvements after 3 months. This finding was similar to that of the present study in which the mean Lysholm knee scores significantly improved at only 3 months postoperatively. At the 2-year follow-up, no significant difference between the 2 groups was observed. However, in a previous study by Desai and Ackroyd,[5] the prevalence of degenerative meniscal tears was 60% in elderly patients who were analyzed postmortem[27]; thus, arthroscopic resection of degenerative lesions of menisci was considered to be of little value in the long term. On the basis of the analysis conducted in this study, we can only assume that resection of a degenerative horizontal tear in the posterior horn of the medial meniscus would have an outcome similar to that of nonoperative management. These results might be because a horizontal tear generally does not disrupt the functional continuity of the circumferential fibers, and the meniscal functions were largely preserved.[17,24]

In addition, we would like to examine whether arthroscopic surgery is better for knee pain with mechanical symptoms.[2] The VAS, pain relief, and patient satisfaction for subjective symptoms were assessed in this study, but no significant differences were observed between the 2 groups. The possible explanation of the lack of significant difference may be that the symptoms, including mechanical pain of patients with degenerative horizontal tears, can improve with time regardless of treatment modality. Christoforakis et al[4] reported that complex and horizontal tears are associated with more severe cartilage degeneration than other types of meniscal tears. In addition, Bolano and Grana[3] reported that patients with horizontal cleavage, degenerative, or complex tears were significantly more likely to report unsatisfactory results (44%) than patients with bucket-handle, flap, or radial tears (3%) ($P < .05$) after arthroscopic partial meniscectomy. However, Higuchi et al[15] reported no significant difference in functional results between horizontal, bucket-handle, and complex tears. Matsusue and Thomson[22] found no significant difference in patient outcomes between degenerative and nondegenerative tears, with 79% and 88% reporting excellent or good results, respectively ($P = .517$).

Although there are often poor correlations between objective data and subjective complaints, making studies on outcomes difficult to perform,[9,19] there is a prevailing concern that the meniscus-deficient knee is at risk for the development of premature chondral damage that leads to an accelerated and severe course of knee OA. Englund et al[8] reported that degenerative tears are significantly more associated with symptomatic OA than are acute tears. In that study, radiographic OA was also seen at a significantly higher rate (29%) in the operative patient's contralateral knee ($P = .039$) when compared with the control group (9%). In the current study, the OA score of 5 patients (5%) increased by >1 grade, based on the Kellgren-Lawrence classification,[18] with our smaller incidence possibly reflecting the 2-year follow-up duration and limited exclusion criteria (Kellgren-Lawrence grade ≥2). Furthermore, many studies showed that increasing age predisposed the patient to have radiographic signs of OA at follow-up.[3,7,28] Even if the relationship between age and the incidence of OA was not evaluated in the present study because of the short follow-up duration for the development of OA, the mean age of these patients was 59.6 years, which was greater than the mean age (56.8 years) of all patients.

The present study aimed to compare the modalities used to treat nontraumatic horizontal tears of the medial meniscus. In the nonoperative group, after 3 weeks of supervised exercise, patients exercised at home while unsupervised for 8 weeks. The majority of previous scientific publications have examined only rehabilitation after arthroscopic surgery, which was performed in this study.[11,23,25,32,33,36] Herrlin et al[13,14] reported not only great improvements in the 2 groups but also showed no differences in clinical outcomes, as in the current study. After critically reviewing clinical trials, Goodwin and Morrissey[10] failed to find sufficient evidence to support the use of physical therapy after arthroscopic surgery with respect to functional improvements, and they recommended a home exercise program. In another study, Jokl et al[16] concluded that a well-planned, unsupervised home exercise rehabilitation program can produce results as good as a supervised physical therapy program. Therefore, in the present study, we used a supervised exercise program, followed by a relatively longer home exercise program, to improve compliance and reduce costs.

The 2 groups were highly comparable, which means that the internal validity of the study was high. The risk that a prognostic variable influenced the treatment results in the 2 groups was very low. Although all patients in the

meniscectomy group were not prescribed supervised physical exercise, it probably would not affect the outcomes of the 2-year follow-up. However, the other major limitation of this study is that the clinical results were obtained using questionnaires to measure parameters of pain, swelling, and various activities of daily living or with an available knee scoring system (only checked by the Lysholm knee score, not the others), and objective evaluations such as MRI and strength testing using an isokinetic device were not performed.[33] In addition, there were some drop-outs of patients (4 in the meniscectomy group and 2 in the nonoperative group), and patients were not evaluated over an extended period of time.

CONCLUSION

Horizontal tears of the posterior horn of the medial meniscus of the knee joint are mainly related to degenerative changes, and as the present study shows, partial meniscectomy and nonoperative management both provide satisfactory clinical results. However, we found that arthroscopic meniscectomy for the treatment of a degenerative horizontal tear of the medial meniscus did not provide any significant advantage, relative to nonoperative management with strengthening exercises, in terms of the relief of knee pain, improved knee function, or increased satisfaction of patients after 2 years.

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