

# Traumatic and non-traumatic isolated horizontal meniscal tears of the knee in patients less than 40 years of age

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## Abstract

**Purpose** The aim of this study is to analyze the characteristics of isolated horizontal meniscal tears in young patients and compared traumatic and non-traumatic isolated horizontal meniscal tear without other type of meniscal tear.

**Methods** Forty patients who underwent partial meniscectomy with isolated horizontal meniscal tears and followed up for more than 2 years were divided into two groups according to the presence of distinct previous traumatic events (defined as contusion or sprain) to the knees. Analyzed variables included in this descriptive statistics were involved side of knee and location of meniscus, physical examinations (joint line tenderness and McMurray's testing), subjective International Knee Documentation Committee (IKDC) criteria, and Lysholm functional questionnaires.

**Results** Twenty-two of the forty patients (55 %) had distinct previous traumatic events. Fourteen cases (63.6 %) in traumatic group and 14 cases (77.8 %) in non-traumatic group are involved non-dominant knees during locomotion or playing sports. Twenty patients (90.9 %) in traumatic group and eight patients (44.4 %) in non-traumatic group presented with tear in the midportion of the medial meniscus on arthroscopic findings ( $p < 0.01$ ). Six patients

(60.0 %) in traumatic group and twelve patients (85.7 %) in non-traumatic group had meniscal cysts on arthroscopic findings at the time of surgery ( $p < 0.01$ ). There was no statistic difference between the two groups with respect to physical examinations, subjective IKDC scores, and Lysholm functional scores.

**Conclusions** Isolated horizontal meniscal tears in young patients predominantly involved non-dominant knees and medial meniscus. Anterior aspect of medial meniscus was more frequently involved in traumatic group. Meniscal cysts were more frequently showed in non-traumatic group.

**Keywords** Knee joint · Meniscus · Horizontal tear · Young patients

## Introduction

A tear pattern of the meniscus is generally based on the analysis of clinical history, magnetic resonance imaging (MRI) studies, and gross morphology of the meniscus under arthroscopic findings. The patterns of the meniscus can be classified into two main distinct types: traumatic and degenerative [8, 10]. Traumatic lesions usually occur in younger active individuals because of a distinct knee trauma to a previously healthy joint (No past history of diagnosis and treatment of meniscal injury and fractures). The meniscus often splits vertically and parallel to the circumferentially oriented collagen fibers (longitudinal tear) or occasionally perpendicular to the circumferential fibers (radial tear). Degenerative lesions, described as horizontal cleavages, flap (oblique), or complex tears or meniscal maceration or destruction are, in contrast, mostly associated with older age and pre-existing or incipient osteoarthritic disease. Among these tear patterns, horizontal

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meniscal tear that is beginning in the inner margin and extending peripherally is described as degenerative type of meniscal lesion in old population and leads to arthroscopic partial meniscectomy. Isolated horizontal tears in young patients are described rarely in the literature. But, we frequently experience horizontal tears in young patients. The purpose of this retrospective study was to analyze the characteristics of isolated horizontal meniscal tears in young patients and compared traumatic and non-traumatic isolated horizontal meniscal tears.

## Methods

This study was approved by the Institutional Review Board at our institution.

Among 131 patients who were diagnosed with isolated meniscal tear that had only horizontal component of tears from October 2002 to July 2008 at our Institution, forty patients (40 meniscectomies) were included in this study. Inclusion criteria for the study group were patients who (1) had a diagnosis of either only longitudinal or oblique horizontal tears on the MRI findings and arthroscopic findings, (2) underwent partial meniscectomy for meniscal tears, (3) age <40, and (4) followed up for more than 2 years. Exclusion criteria were the following: (1) horizontal tears with discoid meniscus or osteoarthritic change on preoperative MRI (32 patients), (2) horizontal tears with concomitant surgical procedures other than partial meniscectomy (47 patients), and (3) follow-up loss (52 patients).

Arthroscopic partial meniscectomy for all cases was performed by the senior author (J.H.Kim). Patients were divided into two groups according to the presence of previous trauma history. Clinical information and follow-up data were obtained from their medical records and then analyzed retrospectively. Before the operation, all the patients were asked to complete a standardized questionnaire regarding demographic information, involved side of knee, duration of symptom, and level of sports activities. Comprehensive physical examinations including joint line tenderness and McMurray test were performed and the findings were recorded on a data collection sheet by orthopedic surgeons at our institution.

We also reviewed preoperative MRI findings, intraoperative arthroscopic images and the operation records.

MRI scans were performed on the patients with two 1.5 T superconducting magnets (Magenetom Vision and Sonata, Siemens Medical System, Erlangen, Germany) using quadrature extremity coils. The MR protocol incorporated the following sequence: fat-suppressed intermediate-weighted images in the axial plane, T1-weighted images and fat-suppressed dual-echo T2-weighted images in the sagittal plane, and dual-echo T2-weighted images in

the coronal plane. The MR images were reviewed by two experienced musculoskeletal radiologists with 14 and 8 years of experience, in a blind fashion using Picture Archiving and Communication System (PACS) workstations (Marosis, Infinitti, Seoul, Republic of Korea).

Assessment consisted of evaluation using the subjective International Knee Documentation Committee (IKDC) criteria, and Lysholm functional questionnaires preoperatively and minimum of 2 years after surgery. *T* test for continuous variables and chi-square test for discrete variables were used comparing both groups with significance determined to be  $p < 0.05$ . The SPSS software package (version 19.0, SPSS Inc, Chicago, Illinois) was used for all statistical analyses.

## Results

Patients who had a history of distinct previous trauma (defined as contusion or sprain) to the knees (Traumatic group) were 22 cases (55 %) and patients who did not have a history of distinct previous trauma (Non-traumatic group) were 18 cases (45 %).

The mean age of the patients was 34.2 years (range from 28 to 40) in traumatic group and 32.7 years (range from 16 to 39) in non-traumatic group. The study included eight male patients (36.4 %) in traumatic group and eight male patients (44.4 %) in non-traumatic group. Fourteen cases (63.6 %) in traumatic group and 14 cases (77.8 %) in non-traumatic group are involved non-dominant knee during locomotion or playing sports. The mean duration of symptom was 5.4 months in traumatic group, 7.7 months in non-traumatic group. On physical examinations, 20 patients (90.9 %) in traumatic group and all patients in non-traumatic group had tenderness on the joint line. McMurray tests were positive on 16 patients (72.7 %) in traumatic group and 14 patients (77.8 %) in non-traumatic group (Table 1).

On MRI and arthroscopic findings, 20 patients (90.9 %) of medial meniscus and two patients (9.1 %) of lateral meniscus were involved in traumatic group. And 14 patients (77.8 %) of medial meniscus and four patients (22.2 %) of lateral meniscus were involved in non-traumatic group. Medial to lateral menisci involvement was at a ratio of 10:1 in traumatic group and 7:2 in non-traumatic group. Five patients (25.0 %) in traumatic group and only one patient (7.1 %) in non-traumatic group presented with tear in the anterior horn of the medial meniscus ( $p = 0.28$ ) (Table 2).

Nineteen patients (85.0 %) in traumatic group and six patients (42.9 %) in non-traumatic group presented with tear in the midportion of the medial meniscus ( $p < 0.01$ ). Six patients (30.0 %) in traumatic group and twelve

**Table 1** Comparisons of the demographics between groups

	Traumatic group (n = 22)	Non-traumatic group (n = 18)	p value
Age (years)	34.2 ± 5.9 (28–40)	32.7 ± 15.1 (16–39)	0.67
Sex (M:F)	8:14	8:10	0.60
Involved side (D:Non-D <sup>a</sup> )	8:14	4:14	0.33
Duration of symptoms (month)	5.4 ± 4.1 (0–12)	7.7 ± 9.2 (1–24)	0.33
Regular sports activities	5	2	0.34
Physical examinations			
Joint line tenderness	20	18	0.19
Mcmurray testing	16	14	0.71

<sup>a</sup> D: Dominant; Non-D: Non-dominant. Measurements are expressed as mean ± standard deviation and ranges in parentheses

**Table 2** Comparisons of the MRIs and arthroscopic findings on medial meniscus between groups

	Traumatic group (n = 20)	Non-traumatic group (n = 14)	p value
Location of meniscal tear			
Anterior horn	5	1	0.28
Midbody	19	6	<0.01
Posterior horn	19	13	0.32
Parameniscal cysts	6	12	<0.01
Chondromalacia (G 1:2:3:4)			
Tibia plateau	4:2:2:0	2:2:2:0	0.94
Femoral condyle	0:4:0:0	0:3:2:0	0.28

patients (85.7 %) in non-traumatic group had meniscal cysts ( $p < 0.01$ ) (Table 2).

There was no statistic difference between two groups with respect to meniscal degeneration and chondromalacia under arthroscopic findings (Table 2; Figs. 1, 2).

The preoperatively and at the last follow-up, average subjective IKDC scores improved from 58.1 to 84.6 in traumatic group, and 59.1 to 85.1 in non-traumatic group, and Lysholm scores improved from 61.1 to 85.5 in group 1, and 62.2 to 86.1 in group 2 ( $p > 0.05$ ) (Table 3).

**Discussion**

The most important findings of the study are that isolated horizontal meniscal tears which is rare in young patients



**Fig. 1** A sagittal T2-weighted MRI shows horizontal tear (white arrow) at the anterior horn of lateral meniscus in a 33-year-old woman who had a history of distinct previous trauma



**Fig. 2** A sagittal T2-weighted MRI shows horizontal tear (white arrow) at the posterior horn of medial meniscus in a 31-year-old man who did not have a history of distinct previous trauma

**Table 3** Comparisons of the clinical outcomes between preoperative and postoperative Subjective International Knee Documentation Committee (IKDC) system and Lysholm scores

	Subjective IKDC scores		Lysholm scores	
	Preoperative	Postoperative 2 years	Preoperative	Postoperative 2years
Traumatic group	58.1 ± 2.2	84.6 ± 1.3	61.2 ± 2.8	85.5 ± 2.5
Non-traumatic group	59.1 ± 2.8	85.1 ± 1.5	62.2 ± 1.6	86.1 ± 2.1
<i>p</i> value	0.22	0.29	0.15	0.41

were involved predominantly at non-dominant knees and medial meniscus.

Horizontal cleavages lesions of the meniscus are associated with older age and osteoarthritic disease [7, 8, 10]. In the study by Dandy [4], 75 % of the medial meniscal tears were vertical and 23 % horizontal, with the vertical tears occurring most often in the fourth decade and horizontal tears in the fifth decade of life. Similar findings have been made in necropsy cases, where 60 % of patients who had osteoarthritic change of knee had a horizontal cleavage lesion [8]. Report of isolated horizontal tears in young patients less than 40 is rare. Terzidis et al. [16], in an evaluation of 378 isolated meniscal tears in young athletes, found 22.5 % of tears to be horizontal. To our knowledge, there is no published previous report that describes characteristics of traumatic and non-traumatic isolated horizontal tears in young patients less than 40.

The horizontal meniscal tear is one of the patterns of failure related to shear forces [11]. Cleavages between the superior and inferior portions of the meniscus generally begin in the inner tip of the meniscus and extend toward the periphery for a variable distance. The path of least resistance with these tears is between the circumferential collagen fibers. Although radial tie fibers are thought to prevent traumatic longitudinal tearing of the meniscus, they actually may predispose the meniscus to horizontal tears by separating the circumferential collagen fibers more often than violating fibers [14]. In this study, more anterior aspect of the meniscus occurs at traumatic tears than non-traumatic. It is conceivable that the disruption of the radial tie fibers after traumatic events vulnerable to extend the cleavages toward an anterior aspect of meniscus.

The frequency of medial meniscal tears compared with lateral meniscal tears has been known to be at a ratio of 2:1 [3]. This side-to-side difference and location in tear occurrence is usually attributed to the anatomical and functional differences that exist between the two menisci [9, 17]. However, in this study, we have to focus only on medial meniscus because the rate of lateral meniscal tears is low.

Medial meniscal tears are located more frequently at the posterior aspect of the meniscus [6], lesion of the anterior horn and meniscal cyst on medial meniscus is rare [15].

Anterior horn of the medial meniscus is less important in the load-bearing function and, therefore, produces fewer clinically significant symptoms as compared with tears of the middle zone or posterior horns [1, 13]. Perhaps it is related to injury mechanism at traumatic event in traumatic group. On the other hand, it is conceivable that it is related to Asian population who could spend a lot of time in a kneeling position in non-traumatic group.

Concerning the meniscal cysts, a history of trauma is usually recorded in around 50 % of the cases [12], as well as a strong association with horizontal meniscal tears [2]. The true etiology of meniscal cysts remains unclear, the most common theory is a combination of trauma with degenerative changes in the meniscus that produces a horizontal tear which provides an access point to the synovial fluid and the motion of the knee acts as a “pump” to drive synovial fluid into the tear [5]. In this study, meniscal cysts were more frequently presented in non-traumatic group. Perhaps this is related to the repeated minor trauma within the substance of the meniscus, without a single episode of serious injury, which leading to mucoid degeneration.

Although long-term follow-up is required to evaluate the function results, in this study, we demonstrated good functional results in both groups at the final follow-up regardless of traumatic event. It is conceivable that partial meniscectomy lead to prevent further damage of meniscus.

This study has some weakness. First, this study was a retrospective design. Second, the number of patients was small. Third, longitudinal horizontal oblique meniscal tears were not differentiated. Last, only cases that needed surgical treatments were included.

In conclusion, this study showed several interesting characteristics of isolated horizontal meniscal tears in young patients, which were different from previous reports. Isolated horizontal tears in young patients predominantly involved non-dominant knees and medial meniscus. Anterior horn and midbody of medial meniscus were more frequently involved in traumatic group. Parameniscal cysts were more frequently showed in non-traumatic group. On the physical examinations and functional results, there was no statistic significant difference between the two groups.

**Conflict of interest** The authors did not receive and will not receive any benefits or funding from any commercial party related directly or indirectly to the subject of this article.

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