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Hypermobility Syndrome and Proprioception In Patients With Knee Ligament Injury

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ABSTRACT

The aim of this prospective controlled study was to determine the effect of hypermobility on proprioception and knee ligament injuries in a young patient population.
20 cases diagnosed as knee ligament injury (patient group) and 17 healthy individuals (control group) were included in this controlled study. Beighton scores (BS) were obtained from each patient. Cybex NORM dynamometer (770 Norm, Lumex Inc. Ronkonkoma, NY USA) were used for proprioception testing. Measurements were recorded for three times in both flexion and extension of the knees and mean values were noted.
The frequency of hypermobility was higher in the patient group than the control group with a statistically significance ($p<0.05$). When the proprioception measurements were evaluated, the increase in average absolute angle error values for extension to flexion and for flexion to extension was higher in patient group than control group (4.86 ± 3.39 vs 3.78 ± 3.85 and 4.61 ± 4.18 vs 4.26 ± 1.90); but this difference was not statistically significant ($p>0.05$). The increase in average absolute angle error values for extension to flexion and for flexion to extension was higher in patients with hypermobility for both groups but this difference was not statistically significant ($p>0.05$)
Hypermobility and knee ligament injury are conditions which contributes to proprioception deficits; hypermobility can more likely lead to knee ligament injuries. Further studies with randomized controlled design are needed.

Key Words: Hypermobility, knee ligament injury, proprioception

Introduction

Knee proprioception is required for protection against excessive movements, and coordination of movements (1). Also, it plays role for stabilization of static posture (1). Decrease in the muscle tone and reduction of the tense power of tendons leads to deficits in proprioception (2). On the other hand degeneration of ligaments contribute to proprioceptive feedback loss (2,3). Impairment in proprioception was defined in Benign joint hypermobility syndrome (BJHS) cases (4,5). Proprioceptive deficit has been reported in patients with increased joint hypermobility; also in a systematic review it was shown that people with BJHS demonstrate poorer lower limb joint proprioception sense with statistically different results from those without joint hypermobility (6). There are some hypotheses for proprioception deficits in people with BJHS. One of this hypotheses is reception damage; this damage can be caused by excessive joint mobility (4, 7). Excessive joint mobility can lead to knee ligament injury and contribute to this vicious circle. Also it was mentioned that it is required to investigate this condition in children and young people with BJHS. Thus the aim of this prospective controlled study was to determine the effect of hypermobility on proprioception and knee ligament injuries in a young patient population.

Materials and Methods

Study Design: This controlled trial with a blind assessor was conducted in the Physical Medicine and Rehabilitation Department of the Başkent University Faculty of Medicine. The study protocol was approved by the Institutional Review Board of Başkent University. The Declaration of Helsinki protocols were followed. All participants were informed about the study and signed written informed consent before interventions. The study was carried out from May 2012 through August 2012.

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Table 1. Demographic characteristics of patient and control groups

	Patient Group (n=20)	Control Group (n=17)	p
Age (median/min-max)	28.5 (17-55)	22.5 (20-29)	0.009*
Sex (Female/Male)	7/13	11/6	0.07**
BMI (Ort±Ss)	25.68±4.68	22.16±3.11	0.014***

*Mann Whitney U Test, ** Ki-square test , *** Student's t Test

Table 2. Comparison of hypermobility frequency between patient and control groups

		Group			
		Control	Patient	Total	p
Hypermobility	Beighton score ≤3	13	6	19	
Criteria	Beighton score >4	4	14	18	0.008
Total		17	20	37	

*Chi Square Test (Fisher's Exact Test)

Table 3. Comparison of proprioceptive sensory measurements between patient and control groups

	Mean ± Standard Deviation	p
Absolute angle error value for extension to flexion in injured knee (n=20)	4.86 ± 3.39	0.158*
Absolute angle error value for extension to flexion in healthy knee (n=17)	3.78 ± 3.85	
Absolute angle error value for flexion to extension in injured knee (n=20)	4.61 ± 4.18	0.232*
Absolute angle error value for flexion to extension in healthy knee (n=17)	4.26 ± 1.90	

*Mann Whitney U Testi

Subjects: 20 cases were admitted to outpatient clinic of physical medicine and rehabilitation department with a knee ligament injury diagnose (Patient group) and 17 healthy individuals (control group) were included into the study. Inclusion criteria were as follows: 1) Aged between 20 and 45; 2) having knee ligament injury (traumatic or non-traumatic); 3) having no contraindication to make exercise. Exclusion criteria were as follows: 1) lower limb surgery; 2) having osteoarthritis; 3) severe neurologic disease; 4) severe metabolic disorder. Control group was selected among age and gender matched hospital staff.

Measurements: The patients were first examined by a physician and their Beighton scores (BS) were obtained. The five criteria of BS are: Passive dorsiflexion of the fifth finger of the hands over 90°; passive flexion of the thumbs to the flexor surface of the forearms; passive hyperextension of the elbows over 10°; passive knee hyperextension over 10°; and forward trunk flexion as the knee is fully extended and palmar surface of the hands resting on the floor (8). For each hypermobile joint, one point is given with an additional point for positive trunk hyperflexion for a total score of 9. Benign joint hypermobility syndrome diagnosis was considered if Beighton score was 4/9 or above (9).

Proprioception testing: Cybex NORM dynamometer (770 Norm, Lumex Inc. Ronkonkoma, NY USA) were used for proprioception testing. Patients were asked to seat in a chair with a lumbar back support and straps at the level of the shoulders, pelvis and thighs; so unwanted movements were minimized. The padded lever arm of the dynamometer was placed on the shin of the affected leg and secured with straps. The contra-lateral limb was also stabilized with a support pad. The seat was adjusted thus the anatomical axis of rotation of the knee joint was aligned with the axis of rotation of the dynamometer. The maximal range of movement at the knee joint was set with safety stops placed at the extremes of extension and flexion. Measurements were recorded for three times in both flexion and extension and mean values were noted. Physician who taken the measurements was blinded to study groups.

Statistical Analysis: Continuous variables were expressed as mean ± standard deviation, categorical data as number and percentage. Analysis of normality with Kolmogorov-Smirnov test was performed in intergroup analysis of continuous variables. T test was used for comparison between the two groups of normal

Table 4. Comparison of proprioceptive sensory measurements in injured knees compared to hypermobility level

	Beighton score ≤3 (n=6) (Mean ± SD)	Beighton score >4 (n=14) (Mean ± SD)	p
Absolute angle error value for extension to flexion in injured knee	3.45 ± 2.58	5.47 ± 3.59	0.239*
Absolute angle error value for flexion to extension in injured knee	3.11 ± 3.79	5.25 ± 4.31	0.207*

* Mann Whitney U Test, SD; Standard Deviation

Table 5. Comparison of proprioceptive sensory measurements in healthy knees compared to hypermobility level

	Beighton score ≤3 (n=13) (Mean ± SD)	Beighton score >4 (n=4) (Mean ± SD)	p
Absolute angle error value for extension to flexion in injured knee	3.50 ± 3.38	4.72 ± 5.63	0.871 *
Absolute angle error value for flexion to extension in injured knee	4.13 ± 2.13	4.70 ± 0.92	0.350 *

*Mann Whitney U Test, SD; Standard Deviation

distribution data, and Mann Whitney U Test was used for comparison of non-normal distribution data. The comparison of proprioceptive measurements between patient and healthy knees was done by Mann Whitney U Test because the data were not suitable for normal distribution. Chi-square test was used to compare categorical data. Analyzes were performed with IBM SPSS Packet Program version 24.0 (IBM Corporation, Armonk, NY, USA). Statistical significance level was considered as $p<0.05$.

Results

A total of 37 patients were included the study. All of the participants completed the study protocol. None of participants had any side effects as falls or other injuries.

The demographic characteristics and baseline values of the outcome measures of the patients are presented in Table 1. The mean age of the groups was 30.50 ± 10.91 in the patient group (range 22 to 30 years) and 23.12 ± 2.89 years in the control group (range 21 to 30 years) ($p<0.05$). There were no statistically significant differences between the groups for sex and body mass indexes (Table 1).

The frequency of hypermobility was higher in the patient group than the control group (%54.1 vs %45.9) and this difference was statistically significant ($p=0.008$) (Table 2).

When the proprioception measurements were evaluated, the increase in average absolute angle error values for extension to flexion was higher in patient group (4.86 ± 3.39) than control group (3.78 ± 3.85), but this difference was not statistically significant (Table 3). Also the increase in average absolute angle error values for flexion to extension was higher in patient group (4.61 ± 4.18) than control group (4.26 ± 1.90), but this difference was not statistically significant too (Table 3). The increase in average absolute angle error values for extension to flexion and for flexion to extension was higher in patients with hypermobility for patient group but this difference was not statistically significant for extension to flexion; for flexion to extension) (Table 4). Also the increase in average absolute angle error values for extension to flexion and for flexion to extension was higher in patients with hypermobility for control group but this difference was not statistically significant for extension to flexion; for flexion to extension) (Table 5).

Discussion

The results of this study indicate that the frequency of hypermobility was higher in people with knee ligament injury. Also for both groups proprioception deficits were higher in hypermobile patients without statistically significant. It is well known that recurrent pain can be a clinical manifestation of joint hypermobility and can lead to traumatic injuries especially on athletes (10). In a study by Hall et al with 10 female cases with hypermobility syndrome and controls, they found that proprioception is worse in cases with hypermobility (11). Also Sahin et al conducted a study with 40 BJHS and 30 healthy subjects and found that proprioception was significantly impaired in cases with BJHS (12). Our results were consistent with these studies; we found that the frequency of hypermobility was higher in the patient group.

Our study has some limitations. Firstly, our sample size was small. Secondly, we cannot compare the difference between the sexes; in a study by Schler et al., female gender was found as important risk factor for hypermobility (13). In Jindal's study with 53 hypermobile and 53 control patients, the authors revealed that participants with generalized joint hypermobility have less isometric muscle strength for knee extensors when compared with control male patients; but there were no difference between female hypermobile and female control participants (14). Also, some injuries can contribute the proprioception deficit more likely; thus injuries can be specialized to groups. On the other hand, our patient population was younger; thus this eliminates the effect of age on proprioception and can be a power of our study.

In conclusion, hypermobility and knee ligament injuries are conditions which contribute to proprioception deficits and hypermobility can more likely lead to knee ligament injuries. Further studies with randomized controlled design are needed.

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