

The effect of gender on range of motion (ROM) for knee joint

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Abstract

This study was distinguished there is a difference between male and female knee range of motion (ROM). Participants were grouped according to injured and non-injured knees within their gender mostly from ages 15-25 years. A goniometer is used to measure range of motion (in degree) of knee joint. The measurements in this study included the comparison of knee ROM in male injured, male non-injured, females injured, and female non-injured participants..

This results showed that injured females have a more decreased motion of flexion while injured males had a more decreased motion of extension , that compared to a normal ROM of flexion of 140° and an extension of 0° .

The results showed non-injured females to have an average flexion of 122.7100° and injured females to have an average flexion of 116.0000 and an average extension 2.1200° . The non-injured males to have an average flexion of 125.4500° and the injured males of our study had a flexion average of 126.5550° and average extension of 2.0730° . The difference between non-injured females and injured females was 6.71° of flexion and the difference between non-injured males and injured males was 1.105° of flexion. When comparing injured males to injured females there was a difference of 10.555° of flexion and 0.047° of extension. These results suggest that injured females have a more decreased flexion while injured males have a more decreased extension.

Introduction

The knee absorbs the impact of full body weight during physical activity . Whatever the underlying injury, the basis of the treatment plan is a timely diagnosis, which

helps ensure that the patient regains full and pain-free use of the joint (Austermuehle, 2001).

An injury to a knee can directly affect the knee range of motion due to lack of

flexibility or the shortening of ligaments. Many studies define motion loss as a deviation of 5° from full extension (Millet et al., 2001).

Range of motion (ROM) is the complete movement of the joint and is based on a common scale of degrees(Fig.1). The range through which a joint can be moved is its range of flexion and extension (MedicineNet, Inc.). ROM is assessed by extending and flexing the knee as far as

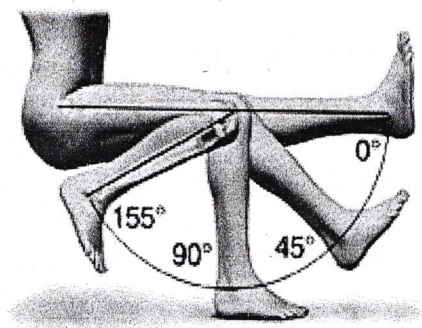


Figure 1. The degrees of movement for the knee (Zimmer, Inc.).

A study by Abdulla (2005) found that women are more likely to tear their ACL(the anterior cruciate ligament) in sports than men, and the incidence of occurrence in knee injuries of females is 5 times higher per player per hour than males. The common ages of occurrence in females are from 15-25 years and there are

possible (normal range of motion: extension, zero degrees; flexion 135 degrees) (Calmbach and Hutchens, 2003).

There are numerous variables that can affect the range of motion in the knee; a few examples are gender, age, and injury. Numerous studies have investigated the nature of ACL injuries and possible explanations for the differences in injury rates between genders (James et al., 2004).

some speculations as to why the ACL injury is so common.

More researched was conducted, however, to reach a more conclusive understanding of why women have a higher risk of ACL injury than men. Researchers have found that a large portion of knee injuries in general and 70% of ACL tears are from non contact injuries. There have been

reports of women having poor hamstring, gluteus medius, and calf muscle recruitment patterns, greater flexibility, poor patellar tracking, tend to use less hip and ankle musculature during sport and tend to land

flat footed with the knee in extension rather than partial flexion (Abdulla, 2005).

The

best methods in preventing ACL injury among women athletes is proper stretching and muscle strengthening.

Methods

In this research, we evaluated the knee ROM. Participants sat at the edge of a table and then flexed and extended their knees while I measured their ROM in degrees using a goniometer. After collecting this information, we compared it to the ROMs collected from other participants. Before we measured the ROM, a participant filled out a survey; this allowed us to group the participants, the total number of participants was 40, with 20 females and 20 males mostly from ages 15-25 years. The measurements in this study included the comparison of knee

ROM in male injured, male non-injured, females injured, and female non-injured participants. we chose to keep the participants around the same age range because the study from Abdulla (2005) stated knee injuries occur mostly from ages 15-25 years. I obtained male and female participants for injured and non-injured groups, measured their ROMs, and analyzed the data to test whether injured females ROM is more decreased than male. Because most scientific research concluded that females are more likely to be injured than males, we focused on injuries and the difference between genders.

The survey questions we used to categorize the results into subgroups are shown in Figure 2. Based on their survey responses the participants were divided into subgroups of male non-injured, female non-injured, male injured and female injured. The controls for this study were male and female non-injured.

ROM Measurements

To measure the knee ROM we only measured the right knee to be consistent,

however, the ROM in the injured individuals was measured only on the injured knee. Active extension and flexion are best evaluated with the athlete in a supine position (Shultz et al., 2000). we followed the directions from Shelbourne and Davis (1999) when they explained how to measure accurate range of motion with a goniometer. To test the flexion of the participant, we had the participant sit on a high table with their legs on the table. They either laid on their back or in a sitting position with their right knee up and foot flat on the table as close to the buttocks as possible (Figure 4). The left leg stayed flat on the table. The degree of the right knee was then measured using the goniometer. According to Shultz et al. (2000) the best way to test for extension is to have the participant sitting on the edge

of the table with both of their legs hanging down. To measure extension I had the participants slowly extend their right leg as far as it could go (Figure 5). The degree of the extended right knee was then measured using the goniometer.

Statistical Analysis

I used a t-test to compare the means of two groups. This analysis was appropriate, because I compared the means of male knee ROM and female knee ROM. First, I established my control group, male and female non-injured. When their data had been collected, I calculated the mean of their group. Then, I took the results from the male injured and female injured to find the mean. The final step was to put all the numbers into the t-test formula (Figure 3).

$$t = \frac{\frac{X_T - X_C}{\sqrt{\frac{\text{var}T}{n_T} + \frac{\text{var}C}{n_C}}}$$

Figure 3. t- test equation.

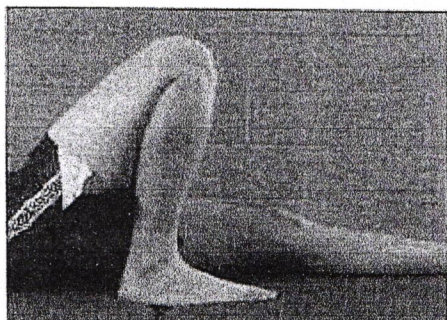


Figure 4. This the leg in the flexion position (Shultz et al., 2000).

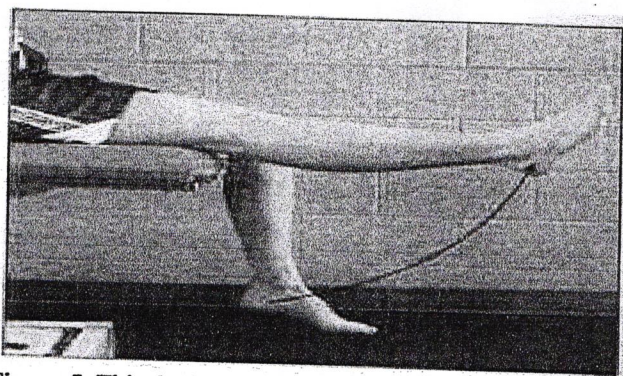


Figure 5. This the leg moving to the extension position to be measured (Shultz *et al.*, 2000)

Results

Participants were divided into subgroups of Female Injured, Female Non- Injured, Male Injured, and Male Non- Injured. When female injured was compared with male injured, the results found for flexion were highly significant.. Female non-injured was also compared to male non-injured and the results found were that at flexion were normal significant. At extension the results for male and female non-injured were highly significant ,when female injured was compared with male injured, the results found for extension were normal significant. By comparing the flexion and extension between injured and non-injured we are able to see the differences between the male and female participants knee ROM and how they are affected by their injuries. According to this research injured females have a more decreased ROM in flexion, but injured males have a more decreased ROM in extension. In Table 1. and Table 2. the average ROMs for flexion and extension are

given as well as their Standard deviations to show the differences between the participants. Figure 5 and Figure 6 are also used to show the differences between the average knee ROMs of participants for flexion (Fig 6.) and extension (Fig 7.).

Discussion

According to Millet *et al.*, 2001, the normal knee flexion is approximately 140° in men and 143° in women. Our research showed that the flexion mean of non-injured females was 122.7100°, while the non-injured males had a mean of 125.4500°. For injured knees Millet *et al.*, 2001, defined motion loss as a loss of extension of 10° or greater or flexion less than 125°. My results showed injured females to have an average flexion of 116.0° and an average extension 2.120°. The males of our study had a flexion average of 126.0° and average extension of 2.07°. The difference between non-injured females and injured females was 6.71° of flexion and the difference between non injured

males and injured males was 1.105° of flexion. When comparing injured males to injured females there was a difference of 10.555° of flexion and 0.047° of extension

References

1. **Abdulla, A., Abdulla, F.** 2005 Preventing knee injuries in the female athlete. Patient Care. 16: 35-38
2. **Austermuehle, P. D.** 2001. Common knee injuries in primary care. Nurse Practitioner. 26: 26-41.
3. **Beynnon, B.D., Johnson, R.J., Abate, J.A., Flemming, B.C., Nichols, C.E.** 2005. Treatment of anterior cruciate ligament injuries: Part I. American Journal of Sports Medicine. 33:1579-1601.
4. **Calmbach, Walter L., Hutchens, M.** 2003. Evaluation of patients with knee pain: Part I. History, physical examination, radiographs, and laboratory test. American Family Physician. 68: 907.
5. **James, R.C., Sizer, P.S., Starch, D.W., Lockhart, T.E., Slauterbeck, J.** 2004. Gender differences among sagittal plane knee kinematic and ground reaction force characteristics during a rapid sprint and cut maneuver. Research Quarterly for Exercise and Sports. 75: 31-39.
6. **MedicineNet, Inc.** © 1996-2005. Definition of range of motion. Med terms dictionary. <http://www.medterms.com/script/main/hp.asp> [accessed 15 Nov. 2005]
7. **Millet, P.J., Wickiewicz, T. L., Warren, R. F.** 2001. Motion loss after ligament injuries to the knee. The American Journal of Sports Medicine. 29: 664-675.
8. **Schultz, S.J., and Hoglum, P.A., Perrin, D.H.,** Assessment of Athletic Injuries. Human Kinetics: Champaign, IL, 2000. pg 295-296.
9. **Shelbourne, K.D., Davis, T.J.,** 1999. Evaluation of knee stability before and after participation in a functional sports agility program during rehabilitation after anterior cruciate ligament reconstruction. The American Journal of Sports Medicine. 27: 156-161.
10. **Smith, I. K.,** 2000. On bended knee. Time. 20: 120.
11. **Tilton, B.,** 1998. Imagine a big hinge. Backpacker. 26:30.
12. **Wong, K.** 2004. The recipe for strong knees. Health. 18: 61-66.
13. **Zimmer, Inc.** 2006. Figure 1. Knee ROM. <http://www.zimmer.co.uk/z/ctl/op/global/action/1/id/520/template/PC/navid/598> [accessed April 18, 2006]

Figure 2. Survey given to participants of study before their knee ROM was measured.

1. Please check the following.
 Male Female

2. Have you ever had a knee injury?
 Yes
 No

3. If yes, was the injury severe enough to need medical attention?
 Yes
 No

4. If yes, please explain what type of injury and how severe it was.
 What type _____
 Just swollen, nothing torn
 Hospitalized, but no surgery
 Other, please explain.

5. Was surgery needed to correct the injury?
 Yes
 No

6. Do you play, or have played any sports? High school, Collegiate or Recreational?
 Yes Collegiate Recreational High school
 No

7. If yes, what sport?

8. Did the knee injury occur during the sports activity?
 Yes, which one(s)? _____
 No

9. If you had a knee injury has it affected your performance?
 Yes, how? _____
 No

10. Can the information provided be used with your consent?
 Yes
 No

11. Would you be interested in the experimental part of this project, where your knee ROM will be measured?
 Yes
 No

10. Please leave your contact information.

Table 1. Average ROM for flexion of participants and their St. Dev

	sex	N	Mean	Std. Deviation
non_injured	Male	10	125.4500	1.42302
	Female	10	122.7100	3.04173
injured	Male	10	126.5550	1.80192
	Female	10	116.0000	7.82801

Table 2 . Independent Samples Test(a)

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	P-Value
non_injured	Equal variances assumed	5.676	0.028	2.580	18	0.019
	Equal variances not assumed			2.580	12.760	0.023
injured	Equal variances assumed	39.634	0.000	4.155	18	0.001
	Equal variances not assumed			4.155	9.951	0.002

Table 3. Average ROM for extension of participants and their St. Dev

	sex	N	Mean	Std. Deviation
non_injured	Male	10	1.0200	0.18938
	Female	10	1.8590	0.41996
injured	Male	10	2.0730	0.42955
	Female	10	2.1200	0.39101

Table 4 . independent Samples Test(a)

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	P-Value
non_injured	Equal variances assumed	5.144	0.036	-5.759	18	0.000
	Equal variances not assumed			-5.759	12.515	0.000
Injured	Equal variances assumed	0.015	0.905	-0.256	18	0.801
	Equal variances not assumed			-0.256	17.843	0.801

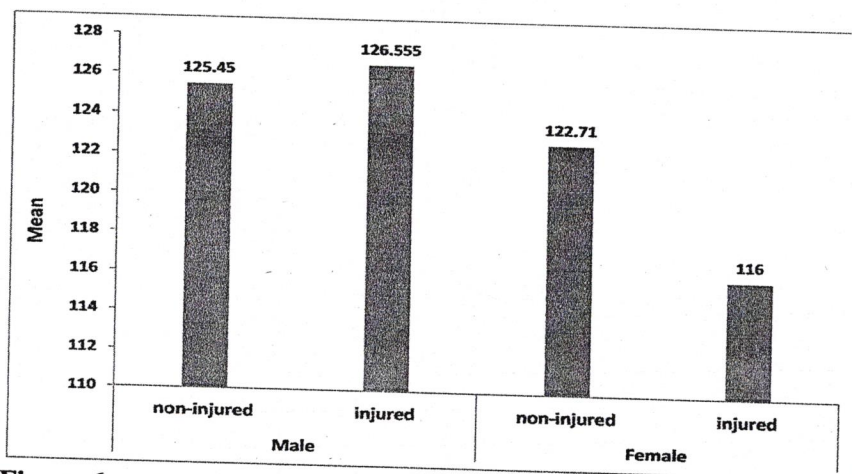


Figure 6. Is the comparison of average flexion between all groups with an error bar one standard deviation from above the mean.

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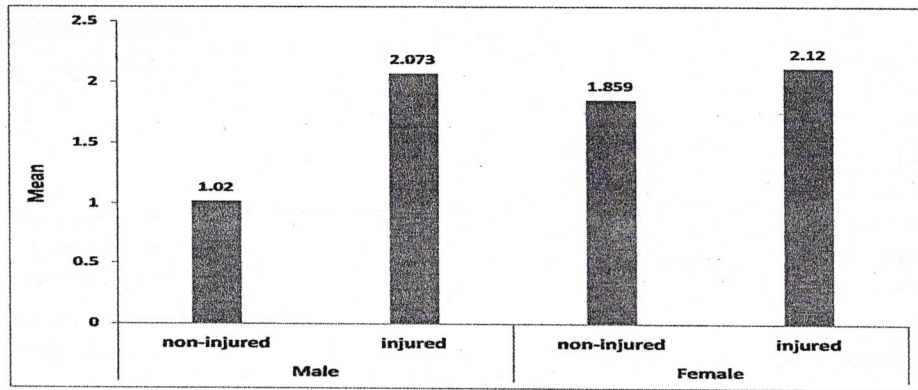


Figure 7. Is the comparison of average extension between all groups with an error bar one standard deviation from above the mean.