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
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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 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).

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 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,
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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).

\[
t = \frac{X_T - X_C}{\sqrt{\text{var}_T + \text{var}_C}} \times \frac{\sqrt{n_T \cdot n_C}}{n_T + n_C}
\]

**Figure 3.** t- test equation.

**Figure 4.** This the leg in the flexion position (Shultz et al., 2000).
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![Figure 5](image.png)

**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 $140^\circ$ in men and $143^\circ$ in women. Our research showed that the flexion mean of non-injured females was $122.7100^\circ$, while the non-injured males had a mean of $125.4500^\circ$.

For injured knees Millet *et al.*, 2001, defined motion loss as a loss of extension of $10^\circ$ or greater or flexion less than $125^\circ$. My results showed injured females to have an average flexion of $116.0^\circ$ and an average extension $2.120^\circ$. The males of our study had a flexion average of $126.0^\circ$ and average extension of $2.07^\circ$. The difference between non-injured females and injured females was $6.71^\circ$ of flexion and the difference between non injured
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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

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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

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<thead>
<tr>
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<th>sex</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
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<tr>
<td>non_injured</td>
<td>Male</td>
<td>10</td>
<td>125.4500</td>
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<td>10</td>
<td>122.7100</td>
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<tr>
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<td>Male</td>
<td>10</td>
<td>126.5550</td>
<td>1.80192</td>
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<tr>
<td></td>
<td>Female</td>
<td>10</td>
<td>116.0000</td>
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Table 2. Independent Samples Test(a)

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<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
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<td>Equal variances not assumed</td>
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<tr>
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Table 3. Average ROM for extension of participants and their St. Dev

<table>
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<td>Female</td>
<td>10</td>
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<tr>
<td>injured</td>
<td>10</td>
<td>2.1200</td>
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Table 4. Independent Samples Test(a)

<table>
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<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
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<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
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<tr>
<td>non_injured</td>
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<td>5.144</td>
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<tr>
<td></td>
<td>Equal variances not assumed</td>
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</table>

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.