**INTRODUCTION**

With overweight and obesity rates remaining high, the need for further knowledge of in vivo motions for obese, overweight and normal weight subjects remains a necessity. It has been proven that body mass index (BMI) plays a role in tibio-femoral kinematics for subject with a TKA [1, 2]. However, further investigation is needed to determine if BMI has an effect on patellofemoral motion as well. Therefore, the objective of this study was to compare in vivo patellofemoral rotation and patellofemoral contact in TKA subjects by BMI category. The hypothesis of the study was that normal weight patients will have the most normal kinematics of the three groups while the obese subjects would have the least normal kinematics of the three groups.

**METHODS**

In vivo kinematics for 266 TKA subjects were analyzed using fluoroscopy and a 2D measurement software package to determine patellofemoral angle (PA) relative to the femur and the normalized patellofemoral contact position (PC) from the distal end of the patella during a deep knee bend from full extension to maximum flexion. Each subject was classified as obese (BMI of 30 and above), overweight (BMI of 25 or more, but less than 30) or normal weight (BMI of 18.5 or more but less than 25) using a standard BMI scale. Subjects were provided by 13 surgeons using 11 different TKA devices. Implant type analysis was also conducted on the mobile bearing (MB), fixed bearing (FB), posterior stabilized (PS), bi-cruciate stabilized (BCS), cruciate retaining (CR), anterior cruciate retaining (ACL-R) and medial pivot (MP) groups. All subjects were deemed clinically successful. Informed consent and Institutional Review Board approval were previously obtained.

**RESULTS**

From full extension to maximum flexion the obese (n=82), overweight (n=123) and normal weight (n=61) groups averaged 74.0º, 75.3º and 80.4º of patellofemoral rotation, respectively, with 6.9% of the obese group, 14.7% of the overweight group and 22.4% of the normal weight group achieving 90º or more of patellofemoral rotation. Patellofemoral rotation of less than 60º was seen in 17.2% of the obese group, 14.7% of the overweight group and 6.1% of the normal weight group (Figure 1).

![Figure 1: Patellofemoral rotation histogram for all subjects by BMI.](image)

The Obese groups PA was significantly higher at full extension than normal weight group (3.2º vs 1.1º, p=0.0344). A similar trend was seen in every implant type group analyzed (Table 1).

![Table 1: Average patellofemoral angle at full extension for all subjects and for implant type groups by BMI category.](image)

<table>
<thead>
<tr>
<th>BMI Category</th>
<th>All Subjects</th>
<th>MB</th>
<th>FB</th>
<th>PS</th>
<th>CR</th>
<th>BCS</th>
<th>MP</th>
<th>ACL-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obese</td>
<td>3.2º</td>
<td>3.8º</td>
<td>2.6º</td>
<td>2.5º</td>
<td>3.0º</td>
<td>3.7º</td>
<td>2.9º</td>
<td>0.2º</td>
</tr>
<tr>
<td>Overweight</td>
<td>2.3º</td>
<td>3.0º</td>
<td>1.7º</td>
<td>3.0º</td>
<td>3.7º</td>
<td>3.7º</td>
<td>3.0º</td>
<td>0.9º</td>
</tr>
<tr>
<td>Normal Weight</td>
<td>1.1º</td>
<td>2.7º</td>
<td>0.0º</td>
<td>1.6º</td>
<td>1.5º</td>
<td>2.7º</td>
<td>2.1º</td>
<td>-3.8º</td>
</tr>
</tbody>
</table>

From full extension to maximum flexion, the obese, overweight and normal weight groups experienced 0.34, 0.34 and 0.32 times patella length of PC translation (Figure 2).

![Figure 2: Average patellofemoral contact point data during a deep knee bend for each BMI group.](image)

When analyzed by implant type, only the mobile bearing group showed a significant difference (normal weight compared to overweight at 60º, p=0.0409) at any contact point increment. All other implant type groups were similar at each increment, across the three BMI categories, within the same implant group.

**DISCUSSION**

The results of this study show that body mass index does play a factor in patellofemoral kinematics for subject who have a TKA, particularly in patellofemoral angle. These differences may occur due to the difference in loading at the patellofemoral joint or due to the differences previously seen in overall range of motion at the knee itself [2]. The results of the contact position data implies that BMI has a lesser effect on where the femur contacts the patella.

A more advanced study with fewer variables, such as a single surgeon study, could help explain why these differences occur. Studying the kinematics of the patella in 3D may also give researchers a more in depth understanding of differences in patellofemoral kinematics for the three BMI groups analyzed.

**REFERENCES**


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