Introduction

The patellofemoral joint (PFJ) is a unique complex joint formed by articulation of the patella and the femoral trochlea [1]. The bony morphology of the joint, the quadriceps/patella tendon, and the capsuloligamentous attachments together play a role in the stability of the PFJ [1], [2]. It has multiple contacting pressure points that are influenced by the degree of knee flexion [3].

Such complex structures will eventually suffer from a wide range of problems. First and foremost, there is commonly patellofemoral instability with incidence reaching 5.8/100,000 population [1]. The next common complaint that may arise is patellofemoral pain that constitutes almost 25% of knee problems [4]. Both of these problems are correlated to each other but the exact pathomechanisms are not fully understood yet because there are so many factors affecting these pathologies. One concern is improper alignment which causes dysfunction of the patellofemoral joint that can lead to abnormal contact pressures, which may explain some of the patients’ symptoms [5].

Many radiological studies have been conducted rigorously by an abundance of authors to better understand the anatomy and biomechanics of the PFJ and its pathologies. Imaging modalities are useful for characterization of patellar malalignment, maltracking, underlying morphologic abnormalities, and stabilizing soft-tissue injuries [6].

Four factors which are relevant in knees with symptomatic patellar instability are trochlear dysplasia, quadriceps dysplasia, patella alta, and the tibial tuberosity-trochlear groove (TT-TG) distance [7], [8], [9]. Patellofemoral dysplasia is a major predisposing factor for instability of the PFJ. The biomechanical effects of patellofemoral dysplasia, with different anatomical and demographic risk factors have been suggested in an attempt to identify the recurrent dislocations [3]. However, it is still presenting an extremely challenging condition to...
manage. Therefore, a comprehensive evaluation of all the radiographic parameters can help the clinicians to assess their patients.

Magnetic resonance imaging (MRI) evaluation of the knee forms an integral part of investigation of patients with knee pain or knee instability because it can provide useful information about the bony morphology of the femur and patella as well as the condition of the articular cartilage [9], [10]. MRI assessments can evaluate some of the factors as measurable parameters such as Insall-Salvati ratio, Caton-Deschamps index, trochlear depth, lateral trochlear inclination, TT-TG distance, and trochlear (Sulcus) angle.

Most of studies relating to PJF and its pathologies were conducted in western countries. We are aware that each country has its own anatomical uniqueness due to race and cultural differences. As the fourth most populated country in the world, Indonesia has many patients with knee pain. But to date, Indonesia does not have any study regarding this important matter. This study aimed to describe the characteristics of patella femoral measurements in an Indonesian population using MRI.

Figure 1: Insall-Salvati ratio and Caton-Deschamps index measurements

Materials and Methods

This descriptive total sampling study was conducted from May 2019 to August 2020. Human research ethics approval was obtained from the local institutional review board before the initiation of any study activities. Patients were included of this study if they are healthy with age 18–65 years old and Indonesian people. We consecutively collected the MRI of normal knees of the right side. The exclusion criteria were the patients with the histories of knee abnormalities, knee disease, or had previous knee surgery.

Outcome measures

The parameters of the measurements in this study included Insall-Salvati ratio, Caton-Deschamps index (Figure 1), trochlear angle (Figure 2), lateral trochlear inclination (Figure 3), trochlear depth (Figure 4), and TT–TG distance (Figure 5). Then, the mean results of the measurements were compared with the international normal values.

Figure 2: Trochlear angle

Descriptive statistics were generated for demographic data. Repeated measures t tests were used to compare values. All analyses were performed using SPSS 26.0 (IBM SPSS, Atlanta, GA). Statistical tests were considered significant at \( a = 0.001 \).

Figure 3: Lateral trochlear inclination angle

Results

A total of 100 normal knees MRI scan from patients consisting of 54 (54%) males and 46 (46%) females were assessed in this study, with an average age of 35.09 ± 12.77 (19–60) years old. The average body mass index (BMI) at the time of assessment
was 28.07 ± 3.0 (22–34) (Table 1). The composition of the subjects based on ethnicity was mostly Javanese (66%), Sundanese (12%), Minangkabau (7%), Madura (4%), and the others (11%) (Table 2 and Figure 6).

The mean of Insall-Salvati ratio was 1.09 ± 0.17 (0.49–1.60). The mean of Caton-Deschamps index was 0.97 ± 0.16 (0.62–1.64). The mean of lateral trochlear inclination was 20.37 ± 4.56 (11.0–30.6), and the mean of trochlear depth was 5.18 ± 1.87 (1.05–8.6). Those values were within the range of normal international values (Table 3).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>International normal value</th>
<th>Result of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insall-Salvati ratio</td>
<td>0.8 – 1.2</td>
<td>1.09 ± 0.17 (0.49–1.60)</td>
</tr>
<tr>
<td>Caton-Deschamps index</td>
<td>0.6 – 1.3</td>
<td>0.97 ± 0.16 (0.62–1.64)</td>
</tr>
<tr>
<td>Trochlear angle</td>
<td>135° ± 10</td>
<td>138.97 ± 119.7 (122–160)</td>
</tr>
<tr>
<td>Lateral trochlear inclination</td>
<td>&gt;11°</td>
<td>20.37 ± 4.56 (11.0–30.6)</td>
</tr>
<tr>
<td>TT-TG distance</td>
<td>12.7 ± 3.4</td>
<td>13.76 ± 5.86 (4.9–41)</td>
</tr>
<tr>
<td>Trochlear depth</td>
<td>&gt;3</td>
<td>5.18 ± 1.87 (1.05–8.6)</td>
</tr>
</tbody>
</table>

SD: Standard deviation

In patellofemoral study, there were several aspects that have been adjusted to Indonesian values and characters such as the Indonesian version of the Kujala [20]. Some countries also adapted, validated and translated the scales in accordance with their language including Chinese, Persian, Turkish, Thai, and German [20]. However, some parameters of patellofemoral measurements from the Indonesian people have not been investigated yet.

### Discussion

The biomechanical effects of patellofemoral dysplasia on patellar stability have not been fully investigated. Furthermore, different anatomic and demographic risk factors have been suggested in attempts to identify the sources of some of the problems.

There were no significant differences in the comparison between males and females (Table 4). Comparison of our results with other published studies showed that the TT-TG of Indonesian people was higher than other Asian, Europe, and American countries (Table 5).

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java</td>
<td>66</td>
<td>66</td>
</tr>
<tr>
<td>Sundanese</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Madura</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Minangkabau</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Others</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

Based on the 2010 population census, the composition of the majority of Indonesia's population is Javanese (41.71%), Sundanese (15.41%), Madura...
(3.37%), and Minangkabau (2.72%) [21], almost the same with our study, that had most of subjects from Javanese (66%), Sundanese (12%), and Minangkabau (7%) ethnicity.

Table 5: Comparison with other studies

<table>
<thead>
<tr>
<th>Method</th>
<th>Place of study</th>
<th>Number of knees</th>
<th>TT-TG</th>
<th>TT-TG standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT Scan</td>
<td>Chile</td>
<td>60</td>
<td>13.6</td>
<td>8.8</td>
</tr>
<tr>
<td>CT Scan</td>
<td>Korea</td>
<td>100</td>
<td>10.24</td>
<td>0.8</td>
</tr>
<tr>
<td>CT Scan</td>
<td>France</td>
<td>100</td>
<td>12.7</td>
<td>3.4</td>
</tr>
<tr>
<td>CT Scan</td>
<td>India</td>
<td>67</td>
<td>13.1</td>
<td>2.84</td>
</tr>
<tr>
<td>CT Scan</td>
<td>Indonesia</td>
<td>100</td>
<td>13.76</td>
<td>5.86</td>
</tr>
</tbody>
</table>

Patellar height of Indonesian people according to the Insall-Salvati ratio and the Caton-Deschamps index, trochlear angle, lateral trochlear inclination, and TT-TG trochlear depth of the Indonesian people were within the international normal range, and higher than other countries’ published measurements.

Conclusions

The means of Insall-Salvati ratio, Caton-Deschamps index, trochlear angle, lateral trochlear inclination, and TT-TG trochlear depth of the Indonesian people were within the international normal range, and higher than other countries’ published measurements.

Acknowledgments

We thank the staff of Klinik Bahasa for their help during manuscript preparation.

References

PMid:30542758
PMid:31019669
PMid:27904787
PMid:20610028
PMid:19258610
PMid:28666038
PMid:16133440
PMid:15208060

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