The morphology of fabella and its prevalence in Turkish society

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Abstract. – OBJECTIVE: Fabella is a sesamoid whose prevalence is unstable and can be found as bone or cartilage, which changes over time. This study aims to reveal the prevalence, distribution, gender differences, and morphometric characteristics of cartilage and bony fabella in the Turkish population.

PATIENTS AND METHODS: The study included 2,035 individuals over 18 years of age. MR images of 121 individuals, whose MR images of both knees could be obtained by anteroposterior and lateral radiographs of the participants, were evaluated retrospectively.

RESULTS: The prevalence of fabella was 39.6% in females, 38.4% in males, and 38.8% in total. The prevalence of cartilage fabella was 9.1%, whereas bone fabella incidence was 29.7% regardless of gender. The fabella’s mean thickness, width, length, and distance to the epicondylus lateralis femoris were 3.84 mm, 6.04 mm, 6.23, and 31.26 mm, respectively.

CONCLUSIONS: The data of this study showing the occurrence and morphometric characteristics of bone and cartilaginous fabella allow early and accurate diagnosis of various pathological conditions caused by fabella.

Key Words: Fabella, Knee, Magnetic resonance images, Prevalence.

Introduction

Fabella, meaning small beads or beans, is a sesamoid bone usually seen within the lateral head of the gastrocnemius muscle. It may have a cartilaginous or bony structure1,2. The prevalence of fabella varies from 3% to 87%, both between societies and within the community2,6. Fabella, which has more than tripled compared with a century ago, is more common in Asians8,9.

Many pathological conditions caused by fabella have been reported. Fabella syndrome, characterized by posterolateral knee pain, is the most common. Knee extension exacerbates pain in fabella syndrome, which can be caused by both bony and cartilage structures9. Fracture of fabella and popliteal artery entrapment syndrome (PAES) is a less common disease, whereas one of the essential pathologies caused by fabella is nervus fibularis communis palsy2,10,11.

There are few studies on the prevalence and distribution of fabella in Turkish society. Only the prevalence, distribution, and gender differences of bony fabella were found in two studies12,13 based on radiographs of the knee, while no data on cartilaginous fabella were included.

This study aims to determine the prevalence, distribution, and gender differences of both cartilage and bony fabella in Turkish society and several morphometric characteristics of fabella. This will help early and accurately diagnose various pathological conditions caused by fabella.

Patients and Methods

Ethics Approval and Consent to Participate

The use of imaging data in this study was reviewed and approved by the Firat University Non-Interventional Research Ethics Committee (dated 15.06.2017, issue 10 and No. 03.). The study was conducted in accordance with the principles of the Declaration of Helsinki. All consents to participate have been collected before the study.
Participants and Radiographic Images Examination

The study retrospectively reviewed anteroposterior and lateral knee radiographs of adults over 18 years of age who presented to Firat University Hospital between December 25, 2016, and June 25, 2017. Two thousand thirty-five individuals (4070 knees), 1366 females and 669 males, who had no knee pathology, and both knee radiographs were obtained were evaluated from the individuals scanned from the hospital database as part of the study.

Both bony and cartilage fabellae were evaluated in knee magnetic resonance imaging (MRI) whereas bony fabellae were studied in knee radiographs. Knee MRI of 594 of the 2035 patients who underwent knee radiographs were obtained for this purpose. Also, MRI of 121 individuals (242 knees), 48 female and 73 males, with both knee images were evaluated retrospectively.

Radiographic Measurement

Fabella’s morphometric measurements (Figure 1) were performed with Enil PACS (V2.5.32-b619; Eskisehir, Turkey) software used in hospital automation based on the study conducted by Chew et al. The maximum length, width, thickness of the fabella and the distance from the fabella to the lateral epicondyle of the femur were measured on MR images. T1W TSE sequences of the axial and sagittal slices of the evaluated MR images were used.

Figure 1. Morphometric measurements on MRI. The red arrow is fabella. A, Sagittal T1W TSE MRI of the knee, the figure showing maximum thickness measurement of fabella. B, Sagittal T1W TSE MRI of the knee, the figure showing maximum length measurement of fabella. C, Axial T1W TSE MRI of the knee, the figure showing maximum length measurement of fabella. D, Sagittal T1W TSE MRI of the knee, the figure showing distance measurement of fabella to epicondylus lateralis of the femur.
IBM SPSS Statistics Version 22.0 (SPSS Corp., Armonk, NY, USA) package software was used for statistical analysis of the data. Categorical measurements were summarized as number and percentage whereas continuous measurements were summarized as mean and standard deviation (median and minimum-maximum where necessary). Chi-square test statistics were used to compare categorical measurements between groups. The Kolmogorov Smirnov test tested whether continuous measurements provided a normal distribution assumption. *t*-test was used in independent groups if assumptions were met to compare continuous measurements between groups, and Mann-Whitney U test was used if assumptions were not met. Statistical significance level was determined as 0.05 in all tests.

**Results**

The prevalence of bony fabella in knee radiography images was 29.5% in females (404 in 1366), 30% in males (201 in 669), and 29.7% in total (605 in 2035). The presence of bilateral fabella was 16.4% in males, 17.6% in females, and 17.2% in total without gender segregation, whereas the unilateral fabella rate was 6.2% in both genders in both right and left knees (Table I). Bilateral fabella prevalence was statistically significantly higher than unilateral fabella prevalence (*p*<0.001).

The presence of bony and cartilage fabella was 39.6% in females, 38.4% in males, and 38.8% in total in MRI. The prevalence of cartilage fabella alone was 9.1% (Table II).

The mean thickness, width, and length of fabella were 3.84, 6.04, and 6.23 mm, respectively, in the morphological measurements performed on MRI. The distance between the fabella and the epicondylus lateralis of the femur, which marks the start of the lateral head of the gastrocnemius muscle, was determined to be 31.26 mm on average. The mean thickness, width, and length of fabella were 3.65, 5.11, and 6.11 mm, respectively, whereas the mean distance to epicondylus lateralis was 30.59 mm in women. In men, these values were measured as 3.97, 6.68, 6.31, and 31.72 mm, respectively. All of these in male values were found to be larger compared to female values, whereas the statistical difference was only found in fabella width (*p*<0.05) (Table III).

**Discussion**

The prevalence of fabella may vary even within the same society while it exhibits different values among societies. The prevalence of fabella was reported by Zeng et al as 86.89%, Hou et al as 48.6%, and Xu et al as 48.38% in Chinese; Kawashima et al as 66% and Tabira et al as 68.6% in Japanese. In addition, the prevalence of fabella was reported to be

<table>
<thead>
<tr>
<th>Fabella Presence</th>
<th>Female</th>
<th>Male</th>
<th>All Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>962 (70.5)</td>
<td>468 (70)</td>
<td>1430 (70.3)</td>
</tr>
<tr>
<td>Unilateral</td>
<td>80 (5.8)</td>
<td>47 (7)</td>
<td>127 (6.2)</td>
</tr>
<tr>
<td>Right</td>
<td>83 (6.1)</td>
<td>44 (6.6)</td>
<td>127 (6.2)</td>
</tr>
<tr>
<td>Left</td>
<td>241 (17.6)</td>
<td>110 (16.4)</td>
<td>351 (17.2)</td>
</tr>
<tr>
<td>Total</td>
<td>404 (29.5)</td>
<td>201 (30)</td>
<td>605 (29.7)</td>
</tr>
<tr>
<td>Overall</td>
<td>1366 (100)</td>
<td>669 (100)</td>
<td>2035 (100)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Fabella Presence</th>
<th>Female</th>
<th>Male</th>
<th>All Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>29 (60.4)</td>
<td>45 (61.6)</td>
<td>74 (61.2)</td>
</tr>
<tr>
<td>Bony</td>
<td>14 (29.2)</td>
<td>22 (30.2)</td>
<td>36 (29.7)</td>
</tr>
<tr>
<td>Cartilage</td>
<td>5 (10.4)</td>
<td>6 (8.2)</td>
<td>11 (9.1)</td>
</tr>
<tr>
<td>Total</td>
<td>19 (39.6)</td>
<td>28 (38.4)</td>
<td>47 (38.8)</td>
</tr>
<tr>
<td>Overall</td>
<td>48 (100)</td>
<td>73 (100)</td>
<td>121 (100)</td>
</tr>
</tbody>
</table>
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The prevalence of fabella was 38.8%, and the prevalence of cartilage fabella was 9.1% in this study investigating the prevalence of both bony and cartilage fabella on the largest sample in the Turkish population. The fabella’s mean thickness,

Table III. Fabella morphometric measurements (mm).

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Female</th>
<th>Male</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabella Thickness</td>
<td>3.84 ± 0.42</td>
<td>3.65 ± 0.31</td>
<td>3.97 ± 0.28</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Width</td>
<td>6.04 ± 0.34</td>
<td>5.11 ± 0.28</td>
<td>6.68 ± 0.36</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Length</td>
<td>6.23 ± 0.35</td>
<td>6.11 ± 0.28</td>
<td>6.31 ± 0.32</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>F-El*</td>
<td>31.26 ± 0.37</td>
<td>30.59 ± 0.32</td>
<td>31.72 ± 0.48</td>
<td>&gt; 0.05</td>
</tr>
</tbody>
</table>

*F-El: Distance from fabella to the epicondylus lateralis of the femur.

be related with lifestyles (e.g., sitting on the ground).

There were no statistically significant differences between genders in the prevalence of fabella, whereas the bilateral presence of fabella was higher than unilateral, consistent with previous studies. Fabella has been larger in males in studies where morphological measurements of fabella were made, and this result is consistent with the results of our study. In addition, Zeng et al reported the mean distance of fabella to epicondylus lateralis as 30.75 mm and Chew et al as 33.19 mm regardless of gender. In addition, Chew et al reported that this distance was greater in males, but the difference between them and females was not statistically significant. The findings of Chew et al are close to that of our study.

The relationship between the prevalence of fabella and age is controversial. Some authors reported that the presence of fabella was associated with age and showed a positive correlation. On the contrary, some researchers reported that the fabella was unrelated to age, which is consistent with the findings of this study.

Fabella may be bony or cartilage. Kawashima et al reported that 57.3% of the fabellae they detected were cartilage, and 34.7% were bony in their study on cadavers. Chew et al reported that all detected fabellae were bony in their study on radiography and MRI. In this study, the prevalence of cartilage fabella and bone fabella was 9.1% and 29.7%, respectively.

**Conclusions**

The prevalence of fabella was 38.8%, and the prevalence of cartilage fabella was 9.1% in this study investigating the prevalence of both bony and cartilage fabella on the largest sample in the Turkish population. The fabella’s mean thickness,
width, length, and distance to the epicondylus lateralis ossis femoris were 3.84, 6.04, 6.23, and 31.26 mm, respectively. We believe that knowing fabella’s prevalence and morphological properties will help early and accurate diagnosis of various pathological conditions, such as fabella syndrome, nervus fibularis communis palsy, chondromalacia, osteoarthritis, rheumatoid arthritis and PAES. In addition, it would be useful to repeat the studies at certain intervals and update the social data considering that the prevalence of fabella changes over time.

Conflict of Interest
The Authors declare that they have no conflict of interests.

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