Peripheral lymph nodes, including the cubital, axillary, inguinal and popliteal type, have been reported to be largest in neonates and to become gradually smaller throughout life, showing minor differences in size change according to location. The replacement of lymphatic parenchyma by fatty tissue (fatty change) is more characteristic of peripheral lymph nodes, which usually receive little antigenic stimulation (1).

In clinical work-up involving MR imaging of the knee, we have frequently noticed popliteal lymph nodes in patients with internal derangement, or rheumatoid or degenerative arthritis. Several studies have reported the...
imaging findings of peripheral lymph nodes at axillary and inguinal sites but not, to our knowledge, those of popliteal lymph nodes. In this report we describe popliteal lymph nodes in terms of their prevalence, location, and size, and the occurrence of fatty change.

**Materials and Methods**

Between January 2000 and February 2001, 249 MR imaging procedures were performed for the evaluation of arthralgia of the knee. The findings of 27 cases were excluded due to presence of metal artifact (n=19) or rheumatoid arthritis (n=8); those remaining related to 115 females and 107 males with a mean age, 47.1 (range, 8-79) years in their first (n=4), second (n=23), third (n=42), fourth (n=34), fifth (n=40), sixth (n=40), seventh (n=28), or eighth (n=11) decade, and are described in Table 1. The most common MR diagnosis was meniscal tear or degeneration, revealed by two or more radiologic findings in one-third of the patients. Other findings included ganglion cyst, fibrous cortical defect, bipartite patella, hemarthrosis, Baker’s cyst, bone infarction, osteochondral lesion, and medial patellar plica syndrome.

For all examinations, a 1.5-T MR imager (Signa; General Electric Medical Systems, Milwaukee, Wis., U.S.A.) was used, together with a dedicated knee coil. The patients were placed in the magnet with the knee in

<table>
<thead>
<tr>
<th>Table 1. MR Imaging Interpretation Results of the 222 Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meniscal tear or degeneration</td>
</tr>
<tr>
<td>Ligament tear</td>
</tr>
<tr>
<td>Contusion</td>
</tr>
<tr>
<td>Chondromalacia</td>
</tr>
<tr>
<td>Discoid meniscus</td>
</tr>
<tr>
<td>Normal</td>
</tr>
<tr>
<td>Others</td>
</tr>
</tbody>
</table>

ligament; anterior and posterior crucate, medial and lateral collateral ligaments

![Fig. 1. A 21 year-old-man with bipartite patella. The popliteal lymph node shows intermediate signal intensity on T1 weighted images (A), high signal intensity on T2 weighted axial and sagittal images (B, C), and low signal intensity on proton weighted sagittal images (D).](image)
the neutral position, and the following sequences were obtained: axial T1-weighted (TR/TE/number of excitations: 600/14/2; field of view, 14 × 14 cm; matrix, 256 × 192; slice thickness, 4 mm; interslice gap, 0 mm); axial fat-suppressed T2-weighted (TR/TE/number of excitations: 4000/50/2; field of view, 14 × 14 cm; matrix, 256 × 192; slice thickness, 4 mm; interslice gap, 0 mm); sagittal T2-weighted (TR/TE/number of excitations: 2000/80/1; field of view, 14 × 14 cm; matrix, 256 × 256; slice thickness, 3 mm; interslice gap, 1 mm); sagittal proton density-weighted (TR/TE/number of excitations: 2000/20/1; field of view, 14 × 14 cm; matrix, 256 × 192; slice thickness, 3 mm; interslice gap, 1 mm); and coronal fat-suppressed fast spin-echo T2-weighted (TR/TE/number of excitations: 4000/50/2; field of view, 14 × 14 cm; matrix, 256 × 256; slice thickness, 3 mm; interslice gap, 1 mm).

All images were reviewed for the presence of popliteal lymph nodes by two of the authors (H.J. Moon, S.H. Lee), who reached a consensus. Nodes were considered to be present if observed in at least two imaging planes, such as axial and sagittal or axial and coronal.

Lymph nodes appeared as discrete round or oval structures which were, at T1- and T2-weighted imaging, respectively, of intermediate or high signal intensity (Fig. 1). Those which showed fatty change were also seen as discrete round or oval structures. At T1-weighted imaging they were of high signal intensity (identical to fat) and were surrounded by a low signal intensity rim, and at T2-weighted fat-suppressed imaging, a central low signal intensity area with a peripheral high signal intensity rim was observed (Fig. 2). Several lymph nodes with fatty change had an incomplete peripheral low signal intensity rim (Fig. 3).

On contiguous images, branching vessels could be easily distinguished from lymph nodes by virtue of their anatomical location, the presence of intraluminal signal.
void, and their tubular branching shape [2, 3].

In terms of localization, lymph nodes were classified as anteromedial, anterolateral, posteromedial or posterolateral, depending upon their relationship with the popliteal vein [Fig. 4]. In addition, the precise location of a node was expressed as the shortest distance from the line tangential to the most distal femoral articular surface to the center of the node [Fig. 5].

The size of a node was expressed as its shortest diameter, as measured on an axial image [5-8].

The relationship between number, fatty change, and the size of popliteal lymph nodes with aging was determined by statistical analysis employing univariate logistic regression.

**Results**

A total of 158 (mean, 1.36) popliteal lymph nodes were present in 116 (52.3%) of 222 patients included in this study. Their number correlated negatively with age (R square = 0.826): they were found in all four subjects in the 1st decade of life, (100%), 15 of 23 in the 2nd (65.2%), 27 of 42 in the 3rd (64.3%), 22 of 34 in the 4th (64.7%), 22 of 40 in the 5th (55%), 12 of 40 in the 6th (30%), 11 of 28 in the 7th (39.3%), and 3 of 11 in the 8th (27.3%) [Fig. 6].

The number of lymph nodes showing fatty change correlated positively with age (R square = 0.840). Fatty change was observed in none of the four subjects in the 1st decade (0%), 4 of 15 in the 2nd (26.7%), 12 of 27 in the 3rd (44.4%), 17 of 22 in the 4th (77.3%), 21 of 22 in the 5th (95.5%), 12 of 12 in the 6th (100%), 11 of 11 in the 7th (100%), and 3 of 3 in the 8th (100%) [Fig. 7].

The number of lymph nodes present in each of the four regions varied: they were most common in the anteromedial region (65 of 222 cases, 29.3%), followed by the posterolateral region (58 of 222, 26.1%), the anterolateral region (27 of 222, 12.2%), and the posteromedial
The distance between the lymph node and the most distal femoral articular surface also varied according to region: 5.3±2 cm (mean±SD) in the anteromedial, 4.1±1.1 cm (mean±SD) in the posterolateral, 4.5±1.1 cm (mean±SD) in the anterolateral and 4.3±1.0 cm (mean±SD) in the posteromedial. The mean distance was 4.6±1.4 cm (mean±SD) (Table 2).

The diameter of the popliteal lymph node was 4.96±2.4 mm [mean±SD; range, 4-8 mm], and did not correlate with age [R square = 0.029].

<table>
<thead>
<tr>
<th>Location</th>
<th>Distance (cm)</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anteromedial</td>
<td>1- 1.9</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2- 2.9</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>3- 3.9</td>
<td>7</td>
<td>6</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>4- 4.9</td>
<td>9</td>
<td>15</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>5- 5.9</td>
<td>1</td>
<td>19</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>6- 6.9</td>
<td>5</td>
<td>16</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>7- 7.9</td>
<td>2</td>
<td>7</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
<td>65</td>
<td>8</td>
<td>58</td>
<td></td>
</tr>
</tbody>
</table>

I: anterolateral region, II: anteromedial region, III: posteromedial region, IV: posterolateral region

Fig. 4. Four popliteal regions; anteromedial, anterolateral, posteromedial, and posterolateral to the popliteal vein. Popliteal space was arbitrarily divided into four regions with respect to its relationship with the popliteal vein as; the anteromedial, anterolateral, posteromedial, and posterolateral regions.

Fig. 5. The precise location of the lymph node was expressed as the shortest distance from the line tangential to the most distal femoral articular surface to the center of the lymph node.

![Fig. 4. Four popliteal regions; anteromedial, anterolateral, posteromedial, and posterolateral to the popliteal vein. Popliteal space was arbitrarily divided into four regions with respect to its relationship with the popliteal vein as; the anteromedial, anterolateral, posteromedial, and posterolateral regions.](image)

![Fig. 5. The precise location of the lymph node was expressed as the shortest distance from the line tangential to the most distal femoral articular surface to the center of the lymph node.](image)
Discussion

In mammals, lymph nodes constitute the major part of peripheral lymphoid tissues. Lymphatic fluid is drained from anatomically distinct regions to a sentinel lymph node, and this becomes a primary target site where interaction occurs between antigenic material and immunologic cells. Hence morphologic change occurring in a regional lymph node may reflect local immune reactivity [1].

Peripheral lymph nodes may be of the popliteal, cubital, axillary, or inguinal type, and show maximum development during the first year of life. At birth, popliteal lymph nodes have, to a certain extent, already undergone fatty change, and this reaches considerable levels by year one [1]. The presence of six or seven small popliteal lymph nodes has been described in anatomy textbooks [4, 9], but, to the best of our knowledge, no imaging study has described human popliteal lymph nodes. In this MR imaging report, the mean number of lymph nodes per person was found to be 0.71, fewer than would be expected on the basis of existing anatomic knowledge. There are several reasons for this. First, fatty change in popliteal lymph nodes makes it difficult to differentiate them at MRI, from adjacent fat. Second, owing to the partial volume averaging artifact, the node is small enough not to be detected.

Anatomically, popliteal lymph nodes usually lie between the popliteal artery and the posterior aspect of the knee joint, receiving from this joint direct vessels, or may be sited near the end of the small saphenous vein [9]. As far as we know, however, their precise location, as determined by imaging studies - particularly MR imaging - has not been reported. According to the results of our study, they are commonly found in anteromedial and posterolateral regions, 4.6± 1.4 cm away from the most distal femoral articular surface.

In conclusion, our findings show that with aging, the number of popliteal lymph nodes decreased but the frequency of fatty change increased, and that the nodes were more common in anteromedial and posterolateral regions.

References

1. Introduction

2. Materials and Methods

3. Results

4. Discussion

5. Conclusion

References