High-resolution magnetic resonance imaging (hrMRI) can assess trabecular bone microarchitecture but the number of image slices required for reliable assessment is unclear. Our aim is to determine the number of images that needs to be processed to yield representative estimates of trabecular bone microarchitecture.

Figure 1. The procedure used to assess trabecular bone microarchitecture in the proximal tibia using hrMRI and image processing using Matlab software.

Table 1: Measures of trabecular bone microarchitecture parameters in 20 healthy adults

<table>
<thead>
<tr>
<th></th>
<th>20IM*</th>
<th>10IM*</th>
<th>5IM*</th>
<th>1IM*</th>
</tr>
</thead>
<tbody>
<tr>
<td>appBV/TV</td>
<td>0.442 ± 0.024</td>
<td>0.441 ± 0.024</td>
<td>0.442 ± 0.025</td>
<td>0.447 ± 0.027</td>
</tr>
<tr>
<td>appTbTh (mm)</td>
<td>0.771 ± 0.049</td>
<td>0.769 ± 0.049</td>
<td>0.764 ± 0.048</td>
<td>0.787 ± 0.051</td>
</tr>
<tr>
<td>appTbN (mm)</td>
<td>0.576 ± 0.043</td>
<td>0.578 ± 0.043</td>
<td>0.584 ± 0.044</td>
<td>0.569 ± 0.045</td>
</tr>
<tr>
<td>appTbSp (mm)</td>
<td>0.979 ± 0.104</td>
<td>0.976 ± 0.105</td>
<td>0.966 ± 0.104</td>
<td>0.981 ± 0.114</td>
</tr>
</tbody>
</table>

Table 2: Measures of within subject coefficient of variation (CoV) for apparent bone volume fraction (appBV/TV)

<table>
<thead>
<tr>
<th>Image sets</th>
<th>Controls n=20</th>
<th>Cases (All) n=10</th>
<th>Cases (OI only) n=4</th>
</tr>
</thead>
<tbody>
<tr>
<td>20IM</td>
<td>2.6 ± 1.1</td>
<td>3.7 ± 2.1</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>10IM</td>
<td>3.0 ± 1.5</td>
<td>4.7 ± 3.0</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>5IM</td>
<td>3.1 ± 1.5</td>
<td>4.3 ± 3.1</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

The mean trabecular bone microarchitecture estimates from 10IM, 5IM and 1IM were strongly and positively related to the estimates from 20IM for appBV/TV (r=1.00, p<0.01), appTbTh (r=1.00, p<0.01), appTbN (r=1.00, p<0.01), and appTbSp (r=1.00, p<0.01).

Figure 2. Scatter plots of the relationships between estimates of apparent trabecular bone volume fraction (appBV/TV) from a total image set in the proximal tibia (i.e. 20 images) and estimates from (A) 10 images, (B) 5 images, and (C) 1 image, in healthy controls.

Figure 3. Scatter plots of the relationships between estimates of apparent bone volume fraction (appBV/TV) from a total image set in the proximal tibia (i.e. 20 images) and estimates from (A) 10 images, (B) 5 images, and (C) 1 image, in cases with childhood-onset bone abnormalities. Sub-analysis of the 4 cases (marked *) of osteogenesis imperfecta (more severe osteopathy) demonstrated even higher mean CoV (Table 2).

Conclusion

These findings indicate that partial MRI sets can reliably represent a larger complete set of images when assessing trabecular bone microarchitecture parameters. However, in cases with severe abnormalities of bone health, a larger set of images may need to be analysed to improve precision.