**INTRODUCTION:**
Polyethylene wear particles induce cytokine release by macrophage, which leads to osteolysis and aseptic loosening in total joint arthroplasties. Generation of polyethylene wear particles is one of the most important factors that affecting mid-term and long-term results of total hip arthroplasty (THA). Therefore, to reduce wear generation and to achieve better long-term results of THA, highly cross-linked polyethylene (HXLPE) was recently introduced and coming into wide use. Wear reduction in hip simulator and excellent mid-term clinical results were reported. However, there have been only a few reports on the in vivo analysis of HXLPE wear particles.

Number, size, and shape were the features of polyethylene wear particles which had very important effects on macrophage response and the prevalence of osteolysis. Increased number, submicron size, and elongated shape of polyethylene wear particles induced stronger macrophage responses and increased the likelihood of osteolysis.

**METHODS:**
Peri-prosthetic tissue of two failed THAs with an annealed HXLPE (Longevity, Zimmer, Warsaw, IN) (10 Mrad e-beam irradiated, remelted above the melting point, and then sterilized using gas plasma) was retrieved on the revision surgery. Mean postoperative period was 2.3 years. Mean age at revision was 66 years old.

Polyethylene particles were isolated from the tissue sample using Campbell’s method. Periprosthetic tissue in each case was digested with sodium hydroxide, ultra centrifuged in sucrose density gradient and isopropanol-water density gradient. Polyethylene particles were collected and filtered through 0.1 µm polycarbonate filters. The filter was dried and coated with platinum for scanning electron microscopic (SEM) (Figure 1). The images were analyzed with a computerized image analyzer. The total number and concentration (particles / g of wet tissue sample) of polyethylene wear particles in the synovial fluid were calculated. Particle size was expressed using equivalent circle diameter (ECD). Particle shape was determined by the aspect ratio and roundness.

**RESULTS:**
The mean number of the particles was 8.02 x 10^7 counts /g, which was much less than the critical dose of osteolysis (1x10^9 counts /g). Particle size (equivalent circle diameter) was 0.62 µm. Particle shape (roundness and aspect ratio) was 1.45 and 1.41 (Table 1).

**DISCUSSION:**
There has been only one case report on in vivo HXLPE wear particle analysis. However, that report analyzed only one case of remelted HXLPE and the case was under the extreme condition with 3rd body wear due to hydroxipatite granules. Therefore, the current study is the first report on in vivo remelted HXLPE wear particle analysis.

Previous in vitro study showed that total volume of wear was much less than HXLPE, but the size of HXLPE wear particle was much less than conventional polyethylene. Therefore, there has been a concern that, if HXLPE generates smaller particles, less weight loss in simulator and less migration in radiographic measurement do not result in reduction of the number and the biological activity of wear particles.

Particle number of a remelted HXLPE in vivo was much less than that of conventional polyethylene and 100 Mrad polyethylene in vivo. Particle size of a remelted HXLPE in vivo was much larger than that in vitro, and was equivalent to that of conventional polyethylene in vivo, and 100 Mrad polyethylene in vivo. Particle shape of a remelted HXLPE in vivo was rounder than that of conventional polyethylene in vivo, and equivalent to that of 100 Mrad polyethylene in vivo. The current in vivo study supported the wear reduction and less biological activity of a remelted HXLPE.

**SIGNIFICANCE:**
A remelted HXLPE generated less and rounder particles than the conventional PE reported. Particle size of an remelted HXLPE in vivo was much larger than that in vitro, and was equivalent to that of conventional polyethylene in vivo. The current in vivo study supported the wear reduction and less biological activity of an remelted HXLPE.

**Table 1:** Comparison of the Number, Size, and Shape of In Vivo PE Wear Particles

<table>
<thead>
<tr>
<th>Materials</th>
<th>Number (x10^7)</th>
<th>ECD (µm)</th>
<th>Roundness</th>
<th>Aspect Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional PE</td>
<td>408 x10^7</td>
<td>0.78</td>
<td>2.61</td>
<td>2.00</td>
</tr>
<tr>
<td>100Mrad PE</td>
<td>59x10^7</td>
<td>0.65</td>
<td>1.53</td>
<td>1.50</td>
</tr>
<tr>
<td>Annoled HXLPE (Crossfire)</td>
<td>5.3x10^5</td>
<td>0.66</td>
<td>1.44</td>
<td>1.37</td>
</tr>
</tbody>
</table>

**Remelted HXLPE**

| Longevity (AV: 4.2 yrs) | 3.6x10^5 | 0.54 | 1.46 | 1.34 |

**REFERENCES:**