Causes of damage to elliptical hip joint prosthesis – mechanical study

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1. Introduction

In this paper, the authors attempted to evaluate the reasons for damage of elliptical head hip joint hemiprostheses. The prostheses failed in a similar manner in the area where the head connected to the conical bushing - a part enabling its placement on the prosthesis neck. Examination of prosthesis construction, macro- and micro-structure analyses and hardness determination of the used materials were performed. The study population consisted of 26 patients after hemiarthroplasty; 7 cases of prosthesis failure were analyzed. Special attention was paid to the correlation between weight, height and age of the patients and the overall time of prosthesis exploitation before its fatigue damage.

2. Methods

The authors analysed 7 cases (24.1%) of prosthesis failure in patients after hemiarthroplasty due to AVN, femoral neck fracture or false joint of the femoral neck. The group consisted of 4 male and 3 female patients. The analysis composed of 2 parts – clinical and metallographical evaluation. In the clinical evaluation, the authors examined the correlation between weight, height and age of the patients, as well as the extent of post-op limb elongation and lateralization. Laboratory examinations consisted of metallographical testing – microstructure observation and microhardness measurements (VICKERS HV0,1 microhardness measurement with ANTOON– PAAR head and penetrator loading F = 100 G).

Table 1: Study population – clinical evaluation

<table>
<thead>
<tr>
<th>No</th>
<th>Patient</th>
<th>Age (years)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>Stem (size)</th>
<th>Head (diameter mm)</th>
<th>Exploitation (years/months)</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T.Ł.</td>
<td>45</td>
<td>185</td>
<td>95</td>
<td>4</td>
<td>58</td>
<td>41.2 m.</td>
<td>27,8</td>
</tr>
<tr>
<td>2</td>
<td>T.K.</td>
<td>26</td>
<td>197</td>
<td>125</td>
<td>4</td>
<td>52</td>
<td>31.9 m.</td>
<td>32,2</td>
</tr>
<tr>
<td>3</td>
<td>I.T.</td>
<td>47</td>
<td>182</td>
<td>120</td>
<td>4</td>
<td>54</td>
<td>51.4 m.</td>
<td>36,2</td>
</tr>
<tr>
<td>4</td>
<td>A.M.</td>
<td>44</td>
<td>182</td>
<td>113</td>
<td>4</td>
<td>54</td>
<td>51.4 m.</td>
<td>34,1</td>
</tr>
<tr>
<td>5</td>
<td>C.S.</td>
<td>84</td>
<td>163</td>
<td>80</td>
<td>3</td>
<td>51</td>
<td>21.11 m.</td>
<td>30,1</td>
</tr>
<tr>
<td>6</td>
<td>M.S.</td>
<td>65</td>
<td>168</td>
<td>94</td>
<td>2</td>
<td>49</td>
<td>61.4 m.</td>
<td>33,3</td>
</tr>
<tr>
<td>7</td>
<td>G.F</td>
<td>45</td>
<td>170</td>
<td>92</td>
<td>2</td>
<td>52</td>
<td>31.4 m.</td>
<td>32,1</td>
</tr>
</tbody>
</table>

3. Results

Based on the clinical evaluation the authors determined, that the prosthesis should not be used in obese patients and young, active patients suffering from overweight (BMI>25). Also, the extent of limb elongation seemed more important in terms of prosthesis durability than extent of lateralization. The microscopy examinations showed noticeable flaws, such as microcracks penetrating inside the material up to ~3mm, large dendritic grain, carbide intrusions and cracks in the weld, which all constitute to the prosthesis failure.
4. Discussion
The range and character of the performed studies will make it possible to elaborate a methodology for laboratory evaluation of prostheses designed for arthroplasty

Acknowledgements An acknowledgement may be placed at the end of the article.

References