**Introduction:** Measurement of polyethylene (PE) wear in clinical series varies greatly in the extent of wear as some report high estimates of wear while others report lower estimates of wear with the same type implants. Several things can influence wear measurements e.g. the method of wear, intraobserver variance and the quality of the radiographs. In retrospective studies some researchers use manual methods known to have a large interobserver variance while others use computerized methods with a more predictable accuracy. Although the precision is far better with computerized methods than manual methods (1,2) wear measurements of hip arthroplasty is performed most accurately with radiostereometric analysis (RSA)(3). The disadvantage of RSA is, however, its limitation to prospective studies with recordings of stereometric radiographs at all follow-ups.

The theory of bedding-in has leaded some researchers to favour exclusion of the first year follow-up (4). Some groups analyse wear based on several sequential radiographs while others only analyse the latest follow-up radiograph and assume zero-wear at baseline. Few evaluate the accuracy of their own investigations with the chosen method of wear measurement by double examinations but rather refer to a specialized laboratory determination of the precision.

Observations and questions raised in our research group upon assessing several series of clinical wear in hip arthroplasty lead us to investigate further if analysis of single or multiple radiographs in the same clinical series of patients could result in different estimates of wear, and if so, how different would they be?

**Materials and Methods:** We measured two-dimensional femoral head penetration into the polyethylene liner of eleven patients from a clinical series. All patients had twelve-year follow-up in sequential series of six radiographs per patient recorded at the following times: post-operative, three months, six months, one year, five years and twelve years.

The acetabular component used was a hemispherical screw-fixed Universal (Biomet) Hexloc with conventional UHMWPE liner and a 28 mm chrome-cobalt femoral head.

Analysis was performed with a computerized method featuring a digital edge detection algorithm to fit circles to the peripheries of the femoral head and acetabular cup (PolyWare 5.10 Digital Version) developed by Devane et al. This technique relies on computer-assisted technology to create a three-dimensional solid model of the acetabular component and the back-projection of the radiographs and computer-assisted design knowledge of the implant (4). The stated accuracy of linear wear determination by this method is approximately 0.15 mm(2).

The AP radiographs were all digitalized to 300 dpi and 100% with a transmission-light scanner (Mustek 3600 A3 pro). The quality of the scanned digital AP-radiographs was generally good and the automatic circle-fitting only rarely had to be overruled by the manual digitizer tablet.

We used three different methods commonly reported in the literature for wear analysis and compared the results. Firstly we analysed all six follow-ups and added the sequential wear between follow-ups to get the mean linear wear. Secondly we analysed the post-operative versus the final twelve-year follow-up and thirdly we analysed only the twelve-year follow-up assuming zero wear at the time of operation.

Students’s t-test was used to estimate statistical differences at the 95% level. F-test was used to test differences in the variances.

**Results:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequential analysis of 6 FU</td>
<td>4.26</td>
<td>1.24</td>
</tr>
<tr>
<td>Post-operative vs. final FU</td>
<td>2.45</td>
<td>1.28</td>
</tr>
<tr>
<td>Final FU assuming initial zero-wear</td>
<td>3.26</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Table 1. Linear wear analysis results and standard deviations. FU = follow-up, SD = standard deviation.

The mean linear wear (4.26 mm, SD 1.24) when analysing sequences between the six points of follow-up was significantly different from the mean linear wear obtained when analysing only the post-operative radiographs and the final radiographs (2.45 mm, SD 1.11) (p=0.000). Also the mean linear wear of sequential analysis (4.26 mm, SD 1.24) was significantly different from that of analysing only the final wear and let the software assume initial zero wear (3.26 mm, SD 0.94) (p=0.01). The linear wear of post-operative vs. final follow-up (2.45 mm, SD 1.28) was not significantly different from (p=0.06) from that of using only one namely the final radiograph and assuming initial zero wear (3.26 mm, SD 0.94).

There was no statistical differences between the variances (p=0.3).

**Discussion:** The number of x-rays used for wear analysis has a significant influence on the result. When reporting clinical polyethylene wear in series of hip arthroplasty it is very important that all patients have the same number of radiographic follow-ups to avoid statistical differences based on the number of radiographs analysed.

Comparing the mean wear or wear rate in studies performed on similar hip arthroplasty – at least with the digital software package PolyWare – does not make sense unless the same number of radiographs is used.

It is unknown which number of radiographs gives the best estimate of the true wear rate and further studies should focus on this matter.

**References:**