INTRODUCTION:
Osteolysis adjacent to the acetabular component of hip prostheses remains the most challenging complication of total hip arthroplasty in the medium to long-term. This loss of bone can cause the prosthesis to lose fixation and, when severe enough, can lead to fracture of the pelvis. Therefore, knowledge of how osteolysis develops and progresses is important in order to develop optimal patient management and therapeutic approaches to this condition. The development of three-dimensional computed tomography (CT) imaging has enabled the detection and accurate measurement of periacetabular osteolysis. The aim of this study was to perform long-term monitoring of periacetabular osteolysis to investigate the way in which osteolytic lesions progress in size and to determine risk factors associated with progression.

METHODS:
Sequential high-resolution spiral multi-slice CT scans (Somatom Volume Zoom, Siemens, Munich, Germany), using an extended scale technique to suppress metal artifact, were used to identify periacetabular osteolysis in a cohort of 26 patients with 30 cementless acetabular components of more than ten years duration at the initial CT. All patients gave informed consent and the study was approved by the Institutional Review Board.

Osteolysis was defined as a localized area of bone loss of at least 1 cm³ that is expansile, with a well-defined sclerotic border, a clear communication between the defect and the joint space and the absence of pre-existing acetabular cysts. The mean number of CT scans performed was three per patient (range 2–5) over a mean time period of 4 years (range 1–9 years). The osteolysis at the initial CT was expressed as the initial osteolysis rate (volume of osteolysis at the initial CT divided by years since total hip arthroplasty). The change in the volume of osteolytic lesions between scans was expressed as the progression in size of osteolytic lesions per year. Associations between the progression in size of osteolytic lesions over the monitoring period and initial osteolysis rate, patient age, gender, walking limitations and activity level were determined. All calculations were performed using SAS Version 9.2 (SAS Institute Inc., Cary, NC, USA).

RESULTS:
Progression in size of osteolytic lesions varied considerably, with a mean progression of 1.6cm³/yr (range 0.7-5.6cm³/yr) at initial CT. Of the variables examined, a high initial osteolysis rate and high activity level predicted progression of osteolytic lesions (Table 1). The presence of both these risk factors was the strongest predictor of osteolytic lesion progression (p<0.0024) (Fig 3).

TABLE 1. Predictors of periacetabular osteolytic lesion progression

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regression coefficient</th>
<th>Standard error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial osteolysis rate (cm³/yr) at initial CT</td>
<td>2.02</td>
<td>0.30</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Gender (M, F)</td>
<td>-0.62</td>
<td>0.71</td>
<td>0.39</td>
</tr>
<tr>
<td>Age (years) at THA</td>
<td>-0.08</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Charnley grade (A, C) at initial CT</td>
<td>0.76</td>
<td>0.82</td>
<td>0.36</td>
</tr>
<tr>
<td>Activity score (&lt;4, ≥4) at initial CT</td>
<td>2.35</td>
<td>0.55</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Figure 1. Axial CT images of the ilium above two acetabular components with screw fixation showing (A) no osteolysis and (B) an osteolytic lesion (arrow).

Figure 2. Longitudinal monitoring of periacetabular osteolytic lesions using CT. Shown is the volume of osteolysis at the time of each CT scan for 30 hips.

Figure 3. Relationship between progression in size of osteolytic lesions over the monitoring period and the initial osteolysis rate analyzed according to the activity levels of the patients.

DISCUSSION:
This study provides the first long-term results of monitoring by CT of osteolytic lesions adjacent to cementless acetabular components. In the second decade after hip arthroplasty, the lesions show considerable variation in progression of size. This is related to the size of the lesion at the initial CT, and therefore the assumed osteolysis rate at that time. The progression is also related to patient activity. The data suggest that, used together, these factors could be useful in predicting the progression in size of periacetabular osteolytic lesions.

SIGNIFICANCE:
This study highlights the need for accurate information on the progression of osteolytic lesions when considering patient management, surgical treatment and for drug trials. The findings of this study enable surgeons to develop guidelines for the monitoring of patients with periacetabular osteolysis.

REFERENCES: