ANALYSIS OF RETRIEVED ACETABULAR LINERS FOR IMPINGEMENT DAMAGE AND EMBEDDED THIRD BODY DEBRIS

*Lundberg, H J; *Liu, S S; *Pedersen D R; *Callaghan, J J; *O’Rourke M R; **Goetz D D; **Vittetoe D A; ***Clohisy J C; +*Brown, T D
+*University of Iowa, Iowa City, IA
tom-brown@uiowa.edu

INTRODUCTION:
Aseptic loosening from polyethylene wear debris is the leading cause of failure for metal on polyethylene total hip implants. Wear of the polyethylene liner can be increased by the presence of third body particles between the bearing surfaces. Once between the bearing surfaces, third body debris may become embedded in the polyethylene liner, scratch the femoral head, and increase wear of the implant. We hypothesized that subluxation of the hip provides a mechanism for third body debris to reach the bearing surface of total hip implants. The purpose of this study was to determine the relationship between the presence of impingement damage (indicating subluxation has occurred) and embedded debris in acetabular liners retrieved at the time of revision total hip arthroplasty.

METHODS:
194 acetabular components were retrieved at revision total hip arthroplasty. The average time in situ was 118 months (range 0 to 344 months). Reasons for revision included aseptic loosening, wear, septic loosening, and dislocation. The acetabular liners were evaluated for impingement damage based on a scale used by Shon et al. [1]. The scale grades impingement damage according to the depth damage reaches into the surface of the acetabular cup (Figure 1).

The relationship between the presence of embedded debris and the presence of impingement damage in cups was evaluated with a chi-square test. The relationship between the presence of embedded debris and the grade of impingement damage of the cup was evaluated with the Cochran-Armitage trend test. For statistical analysis, the highest grade of impingement damage was used for cups with multiple impingement sites. Additional component factors such as head size, skirted femoral heads, fixation type, and cup position were evaluated for their influence on both impingement damage and embedded debris.

RESULTS:
Impingement damage was present in 132/194 (68%) of acetabular liners. Of the 132 cups with impingement damage, 32 (24%) had multiple impingement sites. Embedded debris was present in 73/194 (38%) of the cups. 58/132 (44%) of the cups with impingement damage also had embedded debris. Figure 2 shows the impingement grade for all cups with and without embedded debris. Liners with impingement damage were significantly more likely to have embedded debris than those with lower grades of impingement. These findings have potential implications in terms of the use of alternative bearing surfaces, and constitute a possible explanation for high-wear-rate outliers: inward fluid convection of fluid-suspended third body debris, with subsequent embedment of debris in the polyethylene, in turn scratching the femoral head, in turn increasing polyethylene wear.

DISCUSSION:
While it was not possible to ascertain the level of third body debris present in the individual patients’ periarticular joint fluid, acetabular liners retrieved at the time of revision total hip arthroplasty were significantly more likely to have embedded third body debris if they had evidence of impingement damage on the acetabular rim. Liners with higher grades of impingement were also more likely to have embedded debris than those with lower grades of impingement. These findings have potential implications in terms of the use of alternative bearing surfaces, and constitute a possible explanation for high-wear-rate outliers: inward fluid convection of fluid-suspended third body debris, with subsequent embedment of debris in the polyethylene, in turn scratching the femoral head, in turn increasing polyethylene wear.

REFERENCES:

AFFILIATED INSTITUTIONS FOR CO-AUTHORS:
** Des Moines Orthopaedic Surgeons, West Des Moines, IA
*** Washington University, St. Louis, MO

ACKNOWLEDGEMENTS:
Supported by grants from the NIH (AR46601, AR47653), DePuy, Inc., and an NSF graduate research fellowship.

Figure 1. Example acetabular cup retrievals showing: A. grade 0 (no impingement), B. grade 1 (minimal evidence of impingement), C. grade 2 (damage is less than 1 mm deep into the implant), D. grade 3 (damage is 1-2 mm deep into the implant), E. grade 4 (damage is greater than 2 mm deep into the implant), and F. debris embedded in the articular surface of the acetabular cup. 58/132 (44%) of the cups with impingement damage also had embedded debris. There was also a significant increasing trend for cups with higher grades of impingement damage to have embedded debris (p < 0.0001) (Figure 3). The presence of a femoral head skirt, femoral head size, and cup position were not associated with the presence of embedded debris or with impingement damage. Cemented cups were significantly more likely to have embedded debris (p = 0.001).

Figure 2. Impingement grade for retrieved acetabular cups both with (red) and without (blue) embedded debris.

Figure 3. Percentage of cups with embedded debris for each impingement grade.