# Minimal Backside Surface Changes in Retrieved Acetabular Liners

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**Introduction:** Micromotion of UHMWPE acetabular liners has been implicated as a source of "backside" wear particles, contributing to osteolysis and failure in total hip replacement [1-4]. Backside wear is believed to increase with decreasing liner thickness due to higher contact stresses [5]. The purpose of this study was to evaluate the backside damage of retrieved acetabular liners by a 2D method. We hypothesized that the % damaged area would increase with age *in vivo*, especially for revision due to osteolysis, and decrease with increasing liner thickness.

**Materials and Methods:** A total of 45 UHMWPE acetabular liners (Signal Medical Corp.) were retrieved from revision hip replacement. All liners featured a locking mechanism [6] with 6 tabs (non-crosslinked liners) or 12 tabs (crosslinked liners, XLPE; range = 0.030-2.36 years *in vivo*) locking into a titanium shell (Table 1), and had been sterilized with EtO gas. Areas of backside damage, such as burnishing and abrasion, were outlined and digitally imaged [7]. Damaged backside surface area was scaled, measured, and expressed as a % of total backside projected area, then plotted vs. age *in vivo* and liner thickness to obtain regression lines, with $p < 0.05$ for significance.

**Table 1.** Summary of liners analyzed in this study.

| Reason for revision | No. total | No. XLPE | Age *in vivo* (years) | |
|---|---|---|---|---|
| | | | Range | Avg. |
| Osteolysis | 21 | 0 | 6.46-11.0 | 8.61 |
| Dislocation | 17 | 3 | 0.008-8.46 | 2.29 |
| Loosening | 4 | 0 | 0.334-8.09 | 3.11 |
| Infection | 3 | 2 | 0.030-2.36 | 0.812 |

**Results and Discussion:** Partial burnishing (incomplete flattening of machining marks) was the most common damage mode observed (Figure 1). None of the liners exhibited complete removal of machining marks, including the long-term revisions due to osteolysis (which were non-cross-linked and had been EtO-sterilized). Revisions due to dislocation and osteolysis exhibited positive slopes vs. age *in vivo* (Figure 2, Table 2), while revisions due to loosening and infection exhibited negative regression slopes (data not shown) that were likely an artifact of the few specimens available. Only the regression line for osteolytic revisions approached significance ($p = 0.0796$), but the combined regression line for all specimens was significant ($p = 0.0166$). The regression line for % damaged backside area vs. liner thickness exhibited a positive but non-significant slope ($p = 0.673$; Figure 3). The incidence of liners without backside damage did not increase with liner thickness.

**Conclusions:** All specimens had remarkably little clinically significant backside surface damage; 18 of 45 liners did not even exhibit flattened machining marks. Revision due to osteolysis weakly correlated to backside damage, but revision due to dislocation and liner thickness exhibited no correlation to backside damage. This study was limited by the measurement of 2D projected area of a curved surface instead of 3D wear volume, and by the lack of long-term XLPE specimens.

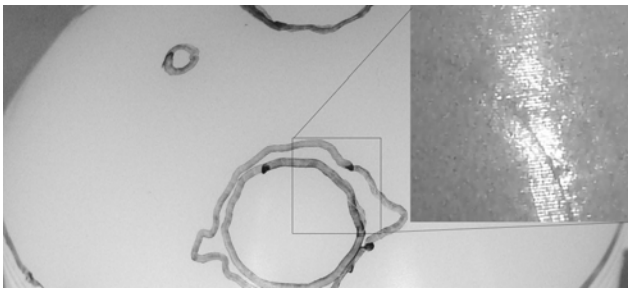

**Figure 1.** Acetabular liner retrieved after 10 years *in vivo*. Inset: detail of partial burnishing around screw hole.

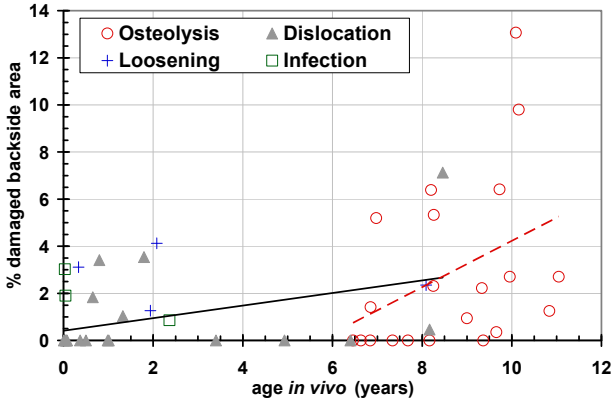


**Figure 2.** Plot of % damaged backside area vs. age *in vivo* for revisions due to osteolysis (○/dotted line), dislocation (▲/solid line), loosening (+), & infection (□).

**Table 2.** Regression data (% damage vs. age *in vivo*).

| Specimens | Avg. % damage | Linear regression line | | |
|---|---|---|---|---|
| | | Slope | Intercept | $r^2$ |
| Osteolysis | 2.86 | 0.983 | -5.60 | 0.15 |
| Dislocation | 1.02 | 0.267 | 0.412 | 0.15 |
| **All data** | **2.09** | **0.260** | **0.734** | **0.13** |

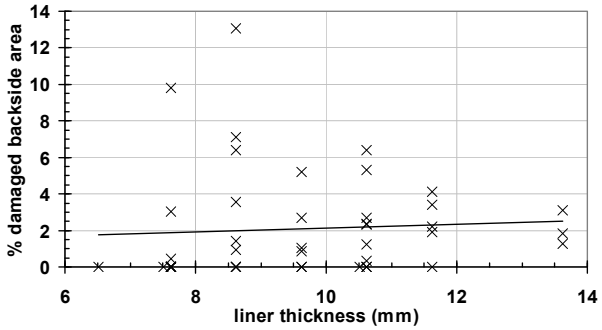


**Figure 3.** Plot of % damaged area vs. liner thickness.

**References:** 1. Wasielewski et al., J Arthroplasty 20:914, 2005. 2. Chen et al., CORR 317:44, 1995. 3. Williams et al., J Arthroplasty 12:25, 1997. 4. Shepard et al., J Arthroplasty 14:860, 1999. 5. Kurtz et al., J Biomech 30:639, 1997. 6. Khalily et al., J Arthroplasty 13:254, 1998. 7. Grochowsky et al., JBMR 79B:263, 2006.