EFFECT OF TRABECULAR METAL THIRD BODY PARTICLES ON WEAR OF UHMWPE

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Statement of Purpose: It has been reported that third body debris from bone or bone cement (PMMA) increases the wear of UHMWPE acetabular liners in hip implants[1]. The highly porous, trabecular configuration of Trabecular Metal™ (TM) (Zimmer TMT) has been shown to increase bone fixation when compared to beaded, meshed, or sprayed surfaces[2]. In an event that TM particles find their way into an articular surface interface, the effect of TM particles on the wear of UHMWPE needs to be quantified. This study compares simulator wear rates of UHMWPE acetabular liners tested in the presence of TM and bone cement (PMMA) particles.

Methods: Twelve conventional GUR 1050, nitrogen-packed Trilogy® acetabular components (Zimmer, Inc., Warsaw, IN) were articulated against Co-Cr-Mo alloy femoral heads. Wear testing was performed using a twelve-station orbital hip simulator (Shorewestern, Monrovia, CA) for 3.0 million cycles (Mc) under a physiological load pattern [3] (Paul-type). The test was performed in undiluted bovine calf serum lubricant (JRH Biosciences, Lenexa, KS, USA). Three groups of four acetabular liners were tested under three conditions: 1) TM third body particles, 2) bone cement particles and 3) no third body particles. The TM particles had a particle size distribution of 1.0 to 100 µm. Bone cement particles had a particle size distribution of 50 to 500 µm. 125 mg of particles were used on each station. Figure 1 shows the TM and bone cement particles. Wear rates of UHMWPE liners were measured gravimetrically at half million cycle intervals. Statistical analysis was performed using a student t-test with a 95% confidence interval.

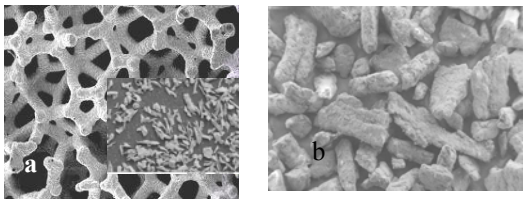

Fig 1: a) TM cellular structure with insert of TM third body particles (100x magnification) b) Bone cement particles (100x magnification).

Results / Discussion: The group average load soak-corrected weight losses of the acetabular liners are shown in Figure 2 and the wear rates are summarized in Table 1. These results clearly show that TM third body particles do not significantly increase the wear of UHMWPE when compared to the control liners ($p = 0.052$). Contrarily, the bone cement particles significantly increase the wear rate of UHMWPE liners ($p = 0.001$) in agreement with published results[4]. The embedded tantalum particles in the liners may have protected them from the Co-Cr-Mo heads by preventing direct articulation during the test. No $BaSO_4$ was embedded in liners articulated in the presence of bone cement. Fewer scratches observed on the femoral heads articulated in the presence of TM particles (Figure 3) most likely resulted from the fact that TM is significantly softer than Co-Cr-Mo. $BaSO_4$ abrading particles in bone cement have been shown to significantly scratch Co-Cr-Mo and enhance the wear of UHMWPE[1]. The Co-Cr-Mo heads articulated in the presence of TM particles had fewer scratches possibly resulting in less wear of the corresponding UHMWPE liner. The frictional properties of TM are different than those of bone cement.

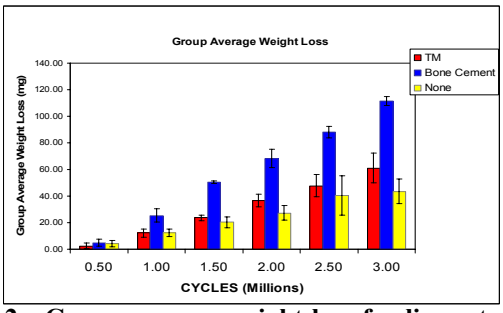

Fig. 2: Group average weight loss for liners tested in the presence of TM particles, bone cement particles, and for the controls.

Table 1: Group average wear rates for liners articulated in the presence of TM particles, bone cement particles, and for the controls.

Accumulative Wear Rates (mg/Mc)		
Trabecular Metal	Bone Cement	Control
20.39 ± 3.77	37.18 ± 1.13	14.48 ± 3.12

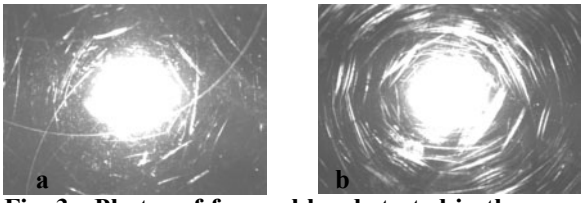

Fig. 3: Photos of femoral heads tested in the presence of (a) TM particles, and (b) bone cement particles.

Conclusions: This study shows that the presence of TM third body particles did not significantly increase the wear of UHMWPE acetabular liners during hip simulator wear testing.

References: **[1]** Que *et al*. J Biomed Mater Res. 50(3): 322-330, (2000). **[2]** Bobyn *et al*., JBJS. 81-B (5): 907-914, (1999). **[3]** ISO 14242-1, 2002 **[4]** Laurent *et al*. *Crosslinked and Thermally Treated Ultra-High Molecular Weight Polyethylene for Joint Replacements*. ASTM STP 1445: 86-103, (2003).

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