INTRODUCTION: In laboratory hip joint simulation, polymeric and composite components should be presoaked to minimize fluid-sorption during the wear run. Without presoaking, components of low-wear polymers such as polyethylene may show a net increase in weight during the initial wear intervals, due to fluid sorption [1]. The error due to fluid sorption can be reduced through presoaking and the use of control soak specimens. Clinically, a surgeon does not presoak liners prior to implantation. The polyethylene liners are directly implanted into a patient right after the packages are opened. Questions we are interested in answering are: Will the hydration affect the polyethylene wear performance? What is the implication for clinical wear? Conflicting results have been reported on the hydrated polyethylene wear. One study showed that longer period of presoaking reduced polyethylene wear [2]. However, they did not report weight gain after various hydration periods and did not utilize load soak controls as the loading cycles during simulation may affect the fluid sorption. Another study demonstrated increased polyethylene wear was due to hydration [3]. The relevance of the conclusions is unknown since a constant load was applied and the test was ran on pin-on-disk equipment, in which the geometry and kinematics was different than those of the ball-socket configuration in a hip simulator. Therefore, using a hip simulator, this study investigated the effect of various hydration levels on the UHMWPE wear, including no hydration, standard hydration protocol, and presoaked soaking to accelerate fluid uptake for the UHMWPE to simulate long term exposure to aqueous environment.

MATERIALS AND METHODS: Extraduced bars of GUR 1050 UHMW polyethylene (Poly Hi, Ft. Wayne, IN) were vacuum packaged in foil bags and subjected to gamma irradiation (Stern Isomedix, Whipppany, NJ) at nominal doses of 5 and 10 Mrads (labeled as XL5 and XL10, respectively). After irradiation all bars were remelted to extinguish free radicals. The bars were then cooled to room temperature, and machined into acetabular liners (28 mm ID). Non-crosslinked polyethylene liners (XL0) were machined directly from GUR 1050 bars. Final sterilization was by gas plasma.

Three hydration processes were applied: 1) the standard testing protocol by presoaking in water for 4 weeks, 2) exposed in air for 4 weeks, and 3) presoaked in water at 900 psi (approx. 60 atm) pressurized chamber for 3 weeks. All were performed at room temperature. The weight of each liner was measured before and after each hydration process to determine amount of hydration.

The wear test matrix is shown in Table 1 (N=2 for each group). The liners were placed in metal shells and run against 28 mm CoCr heads (DePuy, Warsaw, IN) at 1 Hz on a 12-station OBM type simulator (Shore Western, Monrovia, CA) synchronized with a Paul equipment, in which the geometry and kinematics was different than those of the ball-socket configuration in a hip simulator. Therefore, using a hip simulator, this study investigated the effect of various hydration levels on the UHMWPE wear, including no hydration, standard hydration protocol, and presoaked soaking to accelerate fluid uptake for the UHMWPE to simulate long term exposure to aqueous environment.

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DISCUSSION: This study showed that presoaked pressurized soaking could effectively enhance the hydration of polyethylene up to 8 times that achieved simply by soaking in water. However, the hydration had no significant effect on polyethylene wear performance because once the simulation started, the water was lost due to the repeated loading. The results suggested that the different hydration levels between the laboratory test protocol and a surgeon’s operation procedure had minimum effect on polyethylene wear.