WEAR OF RETRIEVED UHMWPE HIP LINERS

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INTRODUCTION

Charnley adopted the combination of metal head and polymer liner for total hip joint arthroplasty in early 1960’s. Nowadays, CoCr alloy-UHMWPE pair is a worldwide standard in total hip joint replacements. However, wear particles from UHMWPE component has been implicated as a major contributor to bone resorption and subsequent aseptic loosening [1]. For the sterilization of implant gamma-irradiation has been popularly utilized, but this procedure causes oxidation in polyethylene. After implantation polyethylene components continuously degraded and they became brittle, especially, the wear resistance decreased [2,3]. In this study the effect of post-irradiation in vivo aging time on the wear of UHMWPE was investigated.

METHODS

Six retrieved polyethylene hip liners were tested. All hip liners were gamma-sterilized, implanted for 3 - 16 years, retrieved, and stored in air for 2 - 8 years until tests. Table 1 shows the periods of in vivo and shelf aging after retrieval for each liner. Two pins (10 mm dia.) were cored by a hollow punch from each liner, and machined to right angle cylindrical pins. Two types of pin-on-disk wear testing were conducted by an unidirectional repeat pass sliding and a linear reciprocating stainless steel disks against stationary polyethylene pins under 4 MPa at 1 Hz with bovine serum lubrication in ambient environment. Both kinematic motions provided an equal sliding distance of 63 mm per each cycle. All tests were interrupted after every 100 thousand cycles and polyethylene pins were weighed with a microbalance (sensitivity of 0.01 mg) to determine wear amount. Wear testing continued for a total of 500 thousand cycles.

RESULTS AND DISCUSSION

The wear test results (Fig. 1) showed that the wear of retrieved polyethylene hip liners does not have direct correlation with in vivo or shelf aging time. This result was not matched with other research [3,4], but it has the same trend as Weightman’s study [5]. Liners #1, #2, #3, and #5 showing relatively large amount of wear were so brittle that cracks were formed in liners when they were punched. It seems to be highly oxidized. No information about resin type, gamma dose, sterilization environment, and pre-implantation shelf aging time limits the thorough analysis on the relationship between wear and oxidation degradation. Linear reciprocal sliding motion generated more wear than unidirectional repeat pass sliding motion. It indicates the kinematic motion affects very crucially on the polyethylene wear.

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REFERENCES