INTRODUCTION

Backside wear of tibial inserts can be a concern due to the possible release of additional polyethylene debris. The amount of backside wear is a function of several factors, including the materials of the tray and insert, the surface finish of the tray, the locking mechanism, insert type and constraint level, and the kinematics [1].

Many studies have looked at the effects of titanium tibial baseplates compared to cobalt chrome baseplates on backside wear [2,3]. However, the surface finish of the materials is usually different, with the cobalt chrome trays being polished while the titanium trays are not. The purpose of this study was to evaluate the wear performance of conventional polyethylene inserts when mated with titanium tibial trays or cobalt chrome tibial trays that both have non-polished topside surfaces using both walking and stair climbing kinematics.

MATERIALS AND METHODS:

Three titanium trays were used along with three cobalt chrome trays. The titanium trays underwent Type II anodization prior to testing. All trays were Triathlon® design (Stryker Orthopaedics, Mahwah, NJ). Tibial inserts, both CR and PS design, were manufactured from GUR 1020 conventional polyethylene then vacuum/flush packaged and sterilized in nitrogen (30 kGy). Appropriate sized cobalt chrome femoral components articulated against the tibial inserts (Triathlon®, Stryker Orthopaedics, Mahwah, NJ).

Surface roughness of the tibial trays was taken prior to testing using white light interferometry (Zygo Corp, Middlefield, CT). A 6-station knee simulator (MTS, Eden Prairie, MN) was used for testing. Two phases were conducted. The first phase used a normal walking profile, as dictated by ISO 14243-3 [4]. The second phase used waveforms created specifically for stair climbing kinematics [5]. Testing was conducted at a frequency of 1 Hz for 2 million cycles for each test with a lubricant of Alpha Calf Fraction serum (Hyclone Labs, Logan, UT) diluted to 50% with a pH-balanced 20-mMole solution of deionized water and EDTA (protein level = 20 g/l) [6]. The serum solution was replaced at least every 0.5 million cycles and standard test protocols were used for cleaning, weighing and assessing the wear loss of the tibial inserts [7]. Soak control specimens were used to correct for fluid absorption with weight loss data converted to volumetric data (by material density). Statistical analysis was performed using the Student’s t-test (p<0.05).

RESULTS:

White light interferometry measurements (Figure 1) showed a significant difference in surface roughness between the titanium and cobalt chrome tibial trays (p < 0.01).

DISCUSSION:

The results of testing show no effect on wear performance when using non-polished anodized titanium trays in comparison to non-polished cobalt chrome trays. Visually, the backside surfaces of the polyethylene mated with anodized titanium trays showed less of a stenciling effect than the tibial trays mated with the cobalt chrome inserts. The location of the stenciled area corresponded to the location of the femoral condyle on the superior surface during the loading cycle.

REFERENCE: