INTRODUCTION

Initial implant stability is important for bone ingrowth and long term uncemented implant fixation [1]. Interfacial friction between the bone and implant surface is one way to achieve this initial stability. Previously, a commercially available friction and wear testing machine was used to evaluate and rank the interfacial friction of different implant surfaces against polyurethane simulated bone [2]. The objective of this study was to evaluate interfacial friction by the same test method against cancellous bovine bone.

MATERIALS AND METHODS

Ti6Al4V test pins (Figure 1) (n = 3 per group) were coated with one of the following: 1) sintered asymmetric titanium powder (Asy-Ti) (Stiktite™, Smith & Nephew, Memphis, TN); 2) plasma-sprayed commercially pure titanium (PS-Ti); 3) sintered titanium beads (Ti beads) (Roughcoat™, Smith & Nephew, Memphis, TN); or 4) tantalum foam (Ta foam) (Trabecular Metal™, Zimmer, Warsaw, IN). The Tantalum foam coating was wire electron discharge machined from monoblock tibial trays and fixed to a solid stub with FM1000 adhesive (n = 2). Representative SEM images of the coatings are shown in Fig 2.

Each pin was attached to an upper fixture of the friction and wear testing machine (Figure 3) (OrthoPod, AMTI, Watertown, MA) and tested against cancellous bone plates (d = 34.75 mm, h = 6.68 mm) machined from bovine femurs. After machining, each bone sample was soaked in saline, sealed and frozen. Prior to testing, bone plates were thawed and soaked in saline for 24 hours in refrigerated conditions. A vertical normal load of 44 N was applied through the coated pin, producing a contact pressure of 0.15 MPa. The base fixture was rotated such that each foam plate produced an arc shaped motion path at a displacement rate of 3.8 mm/sec. Maximum dynamic coefficient of friction was calculated from vertical and horizontal loads recorded at 100 Hz. ANOVA and Duncan’s multiple range test (Statgraphics) were used to determine significant differences between coating groups (α = 0.05).

RESULTS

Mean maximum coefficient of friction results against cancellous bovine bone for each group are shown in Figure 4. Asy-Ti showed the highest mean coefficient of friction and was significantly higher than Ti beads and PS-Ti (p < 0.05). Ta was also significantly higher than Ti beads (p < 0.05), but not significantly different from PS-Ti. While Asy-Ti showed a higher mean coefficient of friction than Ta foam, the difference was not statistically significant.

DISCUSSION

The results of this study are consistent with previous laboratory evaluations against bovine bone indicating superior interfacial friction for sintered asymmetric Ti powder and Ta foam compared to conventional sintered Ti beads [3, 4]. These higher coefficients of friction are expected to translate into clinically into greater initial mechanical stability, lower implant micromotion relative to the host bone, and ultimately more favorable conditions for long-term biologic fixation [1].

REFERENCES