F-E Force

**PAT FORCE**

A-P Force

S-I Force

A-A Force

S-I: Superior-Inferior

A-P: Anterior-Posterior

A-A: Ab-Adduction

**RESULTS**

Patella resurfacing in total knee arthroplasty is still an issue of debate [1]. In light of this it is surprising that there is little information available on in vitro testing of these prostheses. The aim of this study was to develop a methodology for in vitro wear assessment within the patellofemoral joint of total knee replacements (TKR).

The wear within the patellofemoral joint of a commercially available TKR was determined under in vitro conditions. Wear measurements were taken every million cycles (MC). Volumetric analysis of the patella components was performed using unloaded soak controls to isolate the effect of weight gain due to uptake of lubricant.

Testing was performed on a new patellofemoral wear simulator consisting of two dynamic wear stations. Components were mounted such that the superior-inferior (S-I) axis is horizontal and tested under kinematic conditions designed to simulate flat gait post TKR (Fig. 1). The basis for the routine was the kinematic data for the patellofemoral joint following TKR presented by Halloran, et al. [2]. Data for the flexion-extension (F-E) rotation and S-I translation motions were taken directly from this source. Medial-lateral (M-L) translation or shift of the patella was free, constrained only by the inertia and friction of the simulator. No source defining patellar ab-adduction (A-A) rotation over the gait cycle post TKR was found, therefore data recorded for the natural joint [3] was selected and then scaled to post TKR kinematics [2]. This represented a reduction of roughly 80% in A-A amplitude. In order that the model was not over constrained, motion along the anterior-posterior (A-P) axis was determined by kinetic data and the prosthesis geometry. The data used was based on evidence presented by Gill and O'Connor [4] for the natural knee. The internal-external rotation (I-E) of the patella was free, constrained so as not to over restrain the model. This output parameter was then compared to previous investigations in order to measure the model’s ability to reproduce joint kinematics.

The test was run at a cycle rate of 1Hz for a total of 2 MC, 25% (v/v) newborn calf serum (Harlan Serlaf, Loughborough, UK) with 0.1% (m/v) sodium azide solution in de-ionised water was used as the lubricant throughout the test.

**DISCUSSION**

Wear within the patellofemoral joint of TKR has been successfully simulated and quantified experimentally in vitro for the first time. Biomechanically the method has shown to replicate kinematics previously reported for the joint post TKR. Surface damage modes seen within initial testing show good consistency with those seen in clinical studies. A mean wear rate of 1.9 (±0.6 standard error) mm/MC has been quantified. Future studies and further clinical retrievals will allow full assessment of this value to be made. The interactions between design and kinematics are important in determining patella wear and thus will be the focus of future experimental wear simulator studies.

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**REFERENCES**


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