

Askari, E., Flores, P., Dabirrahmani, D., Appleyard, R., Can excessive wear of ceramic bearing couples be a consequence of hip squeaking? Proceedings of the 74th Annual Scientific Meeting of the AOA, Australia, October 12-16, 2014, 1p.

### **Introduction & aims**

The occurrence of Ceramic-on-Ceramic hip squeaking in some patients is a cause for concern. Friction was shown the main reason of hip squeaking [1]. Moreover, hip vibration significantly altered contact point path during the gait cycle [2]. This study investigated the effect of hip squeaking on hip implant wear.

### **Method**

The problem was computationally formulated to model the dynamics of a hip prosthesis taking three-dimensional physiological loading and motion of the gait cycle into account. The vibration of the femoral head inside the cup due to different effective system parameters was incorporated in the numerical analysis. The integration of the Archard wear model into the dynamic calculation of the hip implant was investigated to predict wear. Additionally, to generate a more realistic wear simulation, geometries of the cup and head were updated throughout the simulation.

### **Results**

Trajectory and linear wear computation of the cup and femoral head for CoC hip implants were observed. The trajectories of the contact point between the cup and head conform to the worn path both in terms of location and shape. Moreover, the present study determined that wear increases as bearing surface friction increases. Linear and volumetric wear of the friction model were around 50 times greater than the frictionless case. This wear phenomenon can be justified by considering two physical reasons: (i) friction induced an increase in the overall trajectory of the contact point track and (ii) friction induced microscopic vibration of the femoral head within the cup. Consequently, the sliding distance increased significantly, which increased linear and volumetric wear.

### **Conclusions**

Hip implants that squeak have high friction. This causes the sliding distance of the femoral head across the cup to increase, leading to excessive wear of artificial hip joints, which is consistent with clinical wear results. Therefore, squeaking hips typically have a shorter lifespan compared to non-squeaking hips.

### **References**

- [1] Weiss, C. Hothan, A. Huber, G. Morlock, M. Hoffmann, N.: Friction-induced whirl vibration: Root cause of squeaking in total hip arthroplasty. *Journal of Biomechanics* 45 (2012) 297-303
- [2] Askari, E. Flores, P. Dabirrahmani, D. Appleyard, R. Nonlinear vibration and dynamics of ceramic on ceramic artificial hip joints. *Nonlinear Dynamics* 76 (2014) 1365-1377.