IS INSUFFICIENT JOINT LUBRICATION A CO-FACTOR FOR DEVELOPMENT AND PROGRESSION OF ARTHROSIS?
Georg Bergmann, Alwina Bender, Friedmar Graichen, Philipp Damm
Julius Wolff Institute, Charité – Universitätsmedizin Berlin, Germany

Introduction
High friction in natural hip joints increases the shear stress in cartilage, especially during high demanding activities. The amount of friction depends, among other factors, on the lubricating properties of the synovia. Increased friction generates more friction induced power in the joint and increases the joint temperature during long lasting activities like walking. We assume that high shear stresses and temperatures may cause deterioration of the synovia and, in consequence, a structural deterioration of the natural gliding surfaces and finally lead to joint arthrosis (Bullough et al. 1973). However, the relation between the lubricating properties of synovia and the onset and progression of arthrosis has never been studied in clinical studies.

Goal of this study was to determine indirectly in vivo to which extend synovia lubrication varies inter-individually to support or refute our assumption. We assume that the properties of the synovial fluid are linked to magnitude of friction and the resultant temperatures in the joint.

Methods
Three types of instrumented hip implants were used. With type I and II in vivo forces and friction induced temperatures were measured [Graichen et al. 1999, Bergmann et al. 2001] and with type III the forces and friction moments [Damm et al. 2010]. The implants had an Al2O3 ceramic head and a PE-cup (I and II) or XPE-cup (III). 15 implants (2x I; 5x II; 8x III) were implanted in 13 subjects and measurements were taken between 3 and 82 months post operatively.

In the study of 2001 the peak joint temperatures were measured after one hour of walking. They are normalized here for a body weight of 75kg.

The friction induced power Q was calculated from the contact forces and moments in the joint during short walking sequences and was also normalized for 75kg.

Results
The average joint temperature rise was 3.6°C with a highest value of 5.6°C (Fig. 1). The temperatures individually differed by a factor of 3.1.

The friction induced power was 2.0W on average (Fig. 2); highest and lowest values deviated by a factor of 2.3.

Discussion
The study’s relevance is limited because it is not proven that synovia in implants has similar properties as in natural joints and because the numbers of investigated subjects were small.

However, the data indicates that lubrication in natural joints may also individually differ strongly. This might enable the use of synovia properties, for example the viscosity, as a marker for the onset or progression of arthrosis. Further factors that might influence the inter-individual differences of friction induced power and temperature rise have to be examined in future studies.

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References