IS INSUFFICIENT JOINT LUBRICATION A CO-FACTOR FOR DEVELOPMENT AND PROGRESSION OF ARTHROSIS?

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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 magnate 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 Al_2O_3 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.

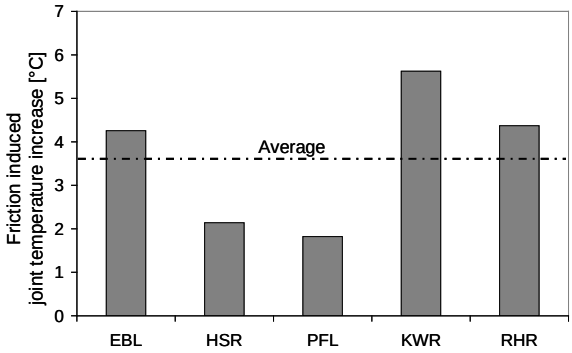

Fig. 1 Temperature increase after 1 hour of walking, normalized for 75kg body weight.

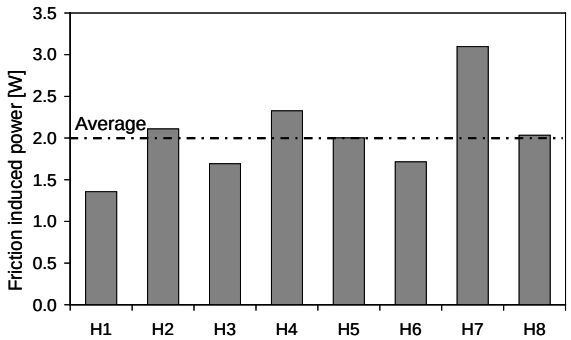

Fig. 2 Friction induced power during walking, normalized for 75kg body weight.

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.

Acknowledgment

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