The New Method for Evaluation of Cartilage Contact

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A healthy natural synovial joint is very important for painless active movement of natural musculoskeletal system. The proper function of natural synovial joints is achieved when the contact surfaces are well lubricated leading to very low friction coefficient and wear of cartilage tissue. The issue of lubrication in natural joints is has not yet been explored enough. The understanding of lubrication process can assist in the development of new suitable medical treatments. This study presents the new approach for evaluation of cartilage contact, which makes the link between friction measurement and visualization of cartilage contact.

Keywords: biotribology, cartilage, friction, lubrication, fluorescence microscopy

1. Introduction

The cartilage represents low-friction and unique lubrication system in natural joints [12], [13]. The research focused on tribological properties of cartilage can be divided to two groups; the studies dealing with friction and the works dealing with lubrication. The first group contains an amount of studies, which suggests a better explored area. The papers dealing with lubrication are less common while the authors usually discuss the theories about the formation of lubricating film. Unfortunately, none of the theories were fully verified by means of experiments.
This contribution combines both aforementioned approaches of cartilage investigation, the frictional behavior together with the visualization of cartilage contact.

2. Methods

2.1. Experimental device

The reciprocating tribometer was used in the present study [38]. The specific design allows simultaneous measurement of friction forces and observation of the contact area. The contact observation and visualization is performed using optical method – fluorescence microscopy. The scheme of the experimental apparatus is shown in Fig. 1.

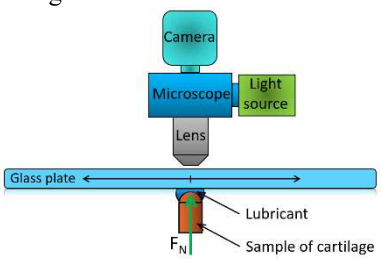

Figure 1: Scheme of the experimental apparatus.

2.2. Specimens

The cartilage specimens were extracted from porcine femurs. Diameter of specimens were 9.7 mm. The specimens were collected shortly after the slaughtery and were immediately frozen in PBS solution. The second part of the contact pair is represented by glass plate made from optical glass B270.
Three various lubricants were used for the experiments. Each fluid had a different composition; nevertheless, the fluorescently labelled component was always the same – albumin.

2.3. Results

The output of the whole set of experiments is dependency of lubricant deviation (deviation of film thickness) on CoF deviation (see in Fig. 2), which indicate impact of individual components of lubricant to lubrication film forming.

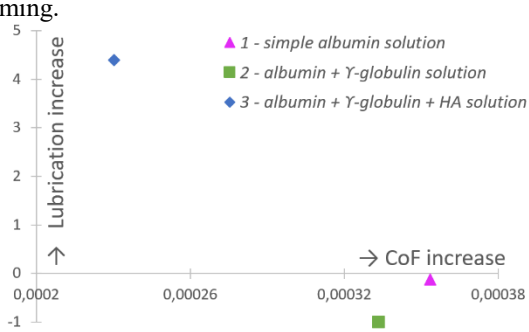

Figure 2: Dependency of lubricant composition on lubrication and friction of albumin protein

3. Discussion

The lubrication 1 shows substantial increase of CoF during experiment and almost none deviation in an amount of albumin clusters observed in the contact. The combination of both proteins (lubricant 2) causes lowering of CoF increase; nevertheless, there is less amount of albumin clusters in the contact. Addition of HA (lubricant 3) to the lubricant causes fall of CoF during the experiment, while there are much more albumin clusters in the lubrication film. This aspect points to significant role of HA during lubricant film formation in cartilage contact.

4. References

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