

INVESTIGATIONS OF RHEOLOGICAL AND TRIBOLOGICAL PROPERTIES OF SOME SYNOVIAL FLUIDS SUBSTITUTES

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Summary

Ensuring adequate lubrication in the synovial joint is extremely important for the proper functioning of the locomotor system. Low movement resistance and favorable viscoelastic characteristics are features that define a healthy joint. Natural biomolecules – present in the synovial fluid – are responsible for the lubrication of the articular surfaces. When they are degraded, due to disease or injury, the joint becomes dysfunctional. In such cases, the most common medical procedure is the administration of a series of injections in order to deliver the biolubricant into the joint's space. The preparations that are substitutes for synovial fluid should be characterized by high biocompatibility as well as the appropriate rheological and tribological properties.

In this paper, the basic compositions of the artificial synovial fluid were tested. They consisted of low-molecular polyacrylamide, high-molecular polyacrylamide and hyaluronic acid sodium salt. For the comparative purposes, the commercial preparation named Hyalgan, which is used in viscosupplementation treatments, was also tested. During the experimental research, physicochemical measurements were carried out, such as the measurement of the pH value, electrolytic conductivity and surface tension. In order to determine the properties of the viscoelastic substitutes, rheological tests were carried out with the use of a rotational rheometer. To determine the resistance to motion, friction tests were carried out for reciprocating motion. Additionally, energy dissipation was estimated, and microscopic analysis of friction traces was performed. This gave a possibility to determine the volume of friction traces and to compare the influence of the tested lubricants on the wear intensity of the samples.

The obtained test results indicate that preparations based on polyacrylamide have a beneficial effect on lowering the resistance to motion in the tested tribological systems. They are also characterized by advantageous viscoelastic properties. It is worth noting that among all the tested synthetic synovial liquid compositions, the preparation based on high molecular weight polyacrylamide showed the most promising functional properties.