EFFECT OF COMBINAION OF PROTEINS ON FRICTIONAL PROPERTY FOR JOINT PROSTHESIS MATERIALS

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ABSTRACT

The constituents included in natural synovial fluid affect on frictional properties of joint prosthesis materials. Authors has investigated the effect of proteins on frictional property[1]. As a results, BSA (bovine serum albumin) and HGG (human γ-globulin) formed lamellar structure when the adsorbed film had excellent tribological properties, but heterogeneous structure was formed when friction and wear increased. It was supposed that the lamellar structure slipped in BSA layer or between BSA and HGG layer. For understanding the mechanisms of excellent lamellar structure, it is necessary to clarify the frictional property of adsorbed protein film. In this study the frictional property of BSA and HGG was investigated and discussed the mechanisms of low frictional property of the lamellar structure.

UHMWPE (ultra-high molecular weight polyethylene, GUR 1050) pin and CoCrMo alloy (ASTMF 75) plate was employed for friction tests. Average contact pressure was varied from 0.047 to 14.6 MPa by changing load and pin end aspect. UHMWPE pin ends were 4mm diameter flat, 250mm radius sphere and 12mm diameter sphere. A reciprocating tribometer was employed to measure frictional properties of protein lubricant. Lubricants were PBS (pH 7.4) with BSA or/and HGG. Frictional test was carried out for 30 min under sliding velocity 10 mm/s (total sliding distance was 18 m).

Figure 1 shows relationship between contact pressure and coefficient of friction. BSA lubricant showed low coefficient of friction compared to HGG lubricant under 5 MPa. Coefficient of friction of BSA lubricant was decreased with increase of contact pressure. The transition indicates that adsorbed BSA was play a role of fluid film under 5 MPa. The experimental condition forms quite thin fluid film under 0.1 nm, so that the transition of BSA lubricant against contact pressure was due to adsorbed BSA molecules. On the other hand, HGG solution showed high coefficient of friction around 0.3 MPa. The different frictional properties of BSA and HGG indicate that shear resistance is different on contact pressure. The lamellar structure composed from BSA and HGG was observed around 0.3 MPa contact pressure, so that the difference induced low frictional property of lamellar structure due to low shear resistance of BSA molecules. Coefficient of friction over 5 MPa showed high compared to that under 5 MPa. In the range, BSA also showed similar property to HGG. Combination of BSA and HGG showed low coefficient of friction. In addition, combination of BSA and HGG did not showed increase of coefficient of friction with increase of contact pressure even over 5 MPa, and the property was similar to BSA lubricant under 5 MPa. Therefore, it is considered that frictional property of BSA was appeared by combination of BSA and HGG by forming lamellar structure.

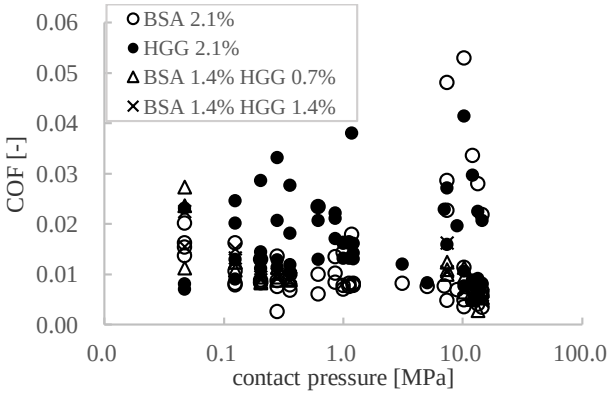

Fig. 1 Coefficient of friction with contant pressure

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