Development of tribological model of human fascia: The influence of contact size and stiffness on friction coefficient

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Since low back pain (LBP) became one of the most common medical concerns, specialists in many scientific disciplines are looking for a reason of the symptom. The recent research points to a thoracolumbar fascia (TLF), specifically its pathological changes, as a possible causality of LBP. Therefore, TLF forming by layers of parallel bundles of collagen fibres separated by loose connective tissues containing hyaluronic acid (HA), improving the lubrication represents an interesting biotribology instance.

The experiments were carried out using a pin-on-plate configuration. The normal force 2 N was kept by a moveable pin moving with the frequency of reciprocal motion 1 Hz. The static bottom pot with plate served as a lubricant reservoir, ensuring fully flooded contact. As the influence of contact mechanics was studied, the experiments were carried with three pins with various radius of curvature (R 8.6, R 30, R 50), resulting in different contact zone. The contact pressure and size of the contact zone was investigated using finite element analysis. Pair of two muscle/fascia layers was substituted by silicones of different stiffness and thickness as representing various properties of the tissues. The contact was lubricated by the solutions of HA.

The measured values of coefficient of friction (COF) in the sliding pair made of the pin with variable radius showed clear importance in terms of size of the contact zone and contact pressure. With increasing size of the contact zone and decreasing contact pressure, friction decreased while further importance was observed for the combination of material the contact pair. Additionally, it was found that COF is decreasing with reduced HA molecular weight and concentration.

The present study offers insight into the effect of contact mechanics on the friction of fascia tissues. Based on experiments, it can be concluded that the appropriate choice of material configuration may represent a suitable technical model of the fascia tissue. The future study will focus on the comparison of technical materials and biological ones.

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