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Tribological properties of PVA/PVP blend hydrogels against articular cartilage

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Abstract

This research investigated in-vitro tribological performance of the articulation of cartilage-on-polyvinyl alcohol (PVA) and polyvinyl pyrrolidone (PVP) blend hydrogels using a custom-designed multi-directional wear rig. The hydrogels were prepared by repeated freezing-thawing cycles at different concentrations and PVA to PVP fractions at a given concentration. PVA/PVP blend hydrogels showed low coefficient of friction (COF) values (between 0.12 ± 0.01 and 0.14 ± 0.02) which were closer to the cartilage-on-cartilage articulation (0.03 ± 0.01) compared to the cartilage-on-stainless steel articulation (0.46 ± 0.06). The COF increased with increasing hydrogel concentration ($p=0.03$) and decreasing PVP content at a given concentration ($p<0.05$). The cartilage-on-hydrogel tests showed only the surface layers of the cartilage being removed (average volume loss of the condyles was $12.5 \pm 4.2 \text{ mm}^3$). However, the hydrogels were found to be worn/deformed. The hydrogels prepared at a higher concentration showed lower apparent volume loss. A strong correlation ($R^2=0.94$) was found between the COF and compressive moduli of the hydrogel groups, resulting from decreasing contact congruency. It was concluded that the hydrogels were promising as hemiarthroplasty materials, but that improved mechanical behaviour was required for clinical use.

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