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GRAPHENE OXIDE-DOPED GELLAN GUM-PEGDA HYDROGEL MIMICKING THE MECHANICAL AND LUBRICATION PROPERTIES OF ARTICULAR CARTILAGE

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Introduction

Articular cartilage (AC) is a specialized connective tissue which provides a low-friction gliding surface, supporting shock-absorption and wear-resistance. Nowadays, conventional strategies show several limitations in restoring chondral defects. This work reports the fabrication of a bilayered structure made of gellan gum (GG) and poly(ethylene-glycol) diacrylate (PEGDA), mimicking mechanical and lubrication of AC in deep and superficial zones. Graphene oxide (GO) was analyzed as lubricant agent.

Methods

Blends of GG and PEGDA were crosslinked by UV-light and magnesium chloride. GO was synthesized following modified Hummer's method1, and embedded into the superficial layer. Wear tests, performed following ISO14243, were performed on a knee simulator. Cytotoxic effects on chondrocytes were assessed by Live/Dead and MTT assays.

Results

Mechanical tests allowed to determine the optimal crosslinking parameters, by combining photo (5 min) and ionic crosslinking with MgCl2, to target the Young's modulus of superficial and deep zone2. The presence of GO into the superficial layer provided a lower coefficient of friction in the kinetic regime (~0.03) than the non-doped hydrogels. The wear test confirmed the resistance of the bilayered hydrogel up to 100,000 cycles. The hydrogel formulations did not show any sign of cytotoxicity.

Conclusions

These results are promising in view of the fabrication of a multi-layered synthetic implant for the restoration of AC.

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Keywords
Cartilage substitute; Cartilage mechanical properties; Cartilage lubrication properties

References
1, D. C. Marcano, Acs Nano 2010, 4, 4806G. 2 O’Connell, ACS Biomaterials Science & Engineering 2017, 3, 2657