Bladder wall biomechanics: A comprehensive study on fresh porcine urinary bladder

Regenerative medicine for reconstructive urological surgery has been widely studied during the last two decades. One of the key factors affecting the quality of bladder regeneration is the mechanical properties of the bladder scaffold. Insight into the biomechanics of this organ is expected to assist researchers with functional regeneration of the bladder wall. Due to extensive similarities between human bladder and porcine bladder, and with regard to lack of comprehensive biomechanical data from the porcine bladder wall (BW), our main goal here was to provide a thorough evaluation on viscoelastic properties of fresh porcine urinary BW. Three testing modes including Uniaxial tensile, Ball-burst (BB) and Dynamic Mechanical Analyses (DMA) were applied in parallel. Uniaxial tests were applied to study how different circumferential and longitudinal cut-outs of lateral region of BW behave under load. DMA was used to measure the viscoelastic properties of the bladder tissue (storage and loss modulus) tested in a frequency range of 0.1 to 3 Hz. BB was selected as a different technique replicating normal physiological conditions where the BW is studied in whole. According to uniaxial tests, the anisotropic behavior of bladder was evident at strain loads higher than 200%. According to DMA, storage modulus was found to be consistently higher than loss modulus in both directions, revealing the elasticity of the BW. The stress-strain curves of both uniaxial and BB tests showed similar trends. However, the ultimate stress measured from BB was found to be around 5 times of the relevant stress from uniaxial loading. The ultimate strain in BB (389.9 ± 59.8) was interestingly an approximate average of longitudinal (358 ± 21) and circumferential (435 ± 69) rupture strains. Considering that each testing mode applied here reveals distinct information, outcomes from the combination of the three can be considered as a helpful database to refer to for researchers aiming to regenerate the bladder.
Fabrication, characterization, and biocompatibility assessment of a novel elastomeric nanofibrous scaffold: A potential scaffold for soft tissue engineering

With regard to flexibility and strength properties requirements of soft biological tissue, elastomeric materials could be more beneficial in soft tissue engineering applications. The present work investigates the use of an elastic polymer, (polycaprolactone fumarate [PCLF]), for fabricating an electrospun scaffold. PCLF with number-average molecular weight of 13,284 g/mol was synthesized, electrospun PCLF:polycaprolactone (PCL) (70:30) nanofibrous scaffolds were fabricated and a novel strategy (in situ photo-crosslinking along with wet electrospinning) was applied for crosslinking of PCLF in the structure of PCLF:PCL nanofibers was presented. Sol fraction results, Fourier-transform infrared spectroscopy, and mechanical tests confirmed occurrence of crosslinking reaction. Strain at break and Young's modulus of crosslinked PCLF:PCL nanofibers fabricated was found to be 114.5 ± 3.9% and 0.6 ± 0.1 MPa, respectively, and dynamic mechanical analysis results revealed elasticity of nanofibers. MTS assay showed biocompatibility of PCLF:PCL (70:30) nanofibrous scaffolds. Our overall results showed that electrospun PCLF:PCL nanofibrous scaffold could be considered as a candidate for further in vitro and in vivo experiments and its application for engineering of soft tissues subjected to in vivo cyclic mechanical stresses.

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Immobilization of silk fibroin on the surface of PCL nanofibrous scaffolds for tissue engineering applications

Poly(ɛ-caprolactone) (PCL) is explored in tissue engineering (TE) applications due to its biocompatibility, processability, and appropriate mechanical properties. However, its hydrophobic nature and lack of functional groups in its structure are major drawbacks of PCL-based scaffolds limiting appropriate cell adhesion and proliferation. In this study, silk fibroin (SF) was immobilized on the surface of electrospun PCL nanofibers via covalent bonds in order to improve their hydrophilicity. To this end, the surface of PCL nanofibers was activated by ultraviolet (UV)–ozone irradiation followed by carboxylic functional groups immobilization on their surface by their immersion in acrylic acid under UV radiation and final immersion in SF solution. Furthermore, morphological, mechanical, contact angle, and Attenuated total reflection- Fourier transform infrared (ATR-FTIR) were measured to assess the properties of the surface-modified PCL nanofibers grafted with SF. ATR-FTIR results confirmed the presence of SF on the surface of PCL nanofibers. Moreover, contact angle measurements of the PCL nanofibers grafted with SF showed the contact angle of zero indicating high hydrophilicity of modified nanofibers. In vitro cell culture studies using NIH 3T3 mouse fibroblasts confirmed enhanced cytocompatibility, cell adhesion, and proliferation of the SF-treated PCL nanofibers.

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In this study, the effect of concentration (0.5, 1, 1.5 and 2%) and heating-cooling rate (1, 5 and 10 °C min$^{-1}$) on the rheological properties of Plantago lanceolata seed mucilage (PLSM) solutions were investigated. It was observed that the gum dispersions exhibited viscoelastic properties under the given conditions. Mechanical spectra of PLSM were classified as weak gels based on the frequency sweep, complex viscosity ($\eta^*$) and tan δ results. All variables had significant impacts on the rheological parameters. Chemical and monosaccharide compositions were also determined to provide more structural information. The results revealed that PLSM had high total sugar content (87.35%), and it is likely an arabinoyxolomannan-type polysaccharide.

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