Abstract

The present study delves into the nuances of the materials used in making the mesh used for Hernia repair, which is available for surgical use. The study focuses on developing an infection-resistant polypropylene (PP) hernia mesh through plasma grafting and immobilization with chitosan-ZnO nanogels and doxycycline. The approach, for the first time, combines surface modification *via* plasma treatment to enhance hydrophilicity and biocompatibility, followed by grafting bioactive chitosan and ZnO nanogels to impart antimicrobial properties. The synergistic effect of ZnO nanoparticles and doxycycline ensures broad-spectrum antibacterial efficacy, aiming to mitigate post-operative infections. SEM, FTIR, and XPS, confirms successful surface functionalization, while antibacterial assays and *in-vitro* cytocompatibility studies validate its efficacy and safety. The developed mesh exhibits very high infection resistance, mechanical integrity, and biocompatibility, offering a promising solution for improving hernia repair outcomes. This research bridges the gap between material innovation and clinical applicability, highlighting the potential of polymeric biomaterials in advancing infection-resistant surgical implants.