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Nylon-coating improves the performance of UHMWPE bearing surfaces

In joint arthroplasty, Ultra High Molecular Weight Polyethylene (UHMWPE) is used as a bearing surface due to its excellent attributes, such as good wear resistance, high strength, bio compatibility, lightweight, chemical stability, and lubricity. We have shown in previous works, the ability of UHMWPE coated with nylon in enhancing both mechanical and biological performances of conventional UHMWPE, including superior tensile strength, higher impact resistance, reduced damage, and improved cell viability. The purpose of the current study is to assess the wound healing and the antimicrobial capabilities of this novel nylon-coated UHMWPE. A combination of biological/biochemical tests, including MTT viability, antibacterial activity (using E. coli and S. aureus), and wound healing assays were performed to assess the bio activity and the bio compatibility of the coated specimens. Additional tests, such as SBF absorption, alizarin staining, SEM, EDX, and FTIR techniques were conducted to evaluate the moisture uptake, osteogenic activity, and the morphology of the coated samples. Our results indicate that the viability of U2OS (osteosarcoma cell line) cells cultured in conditioned media for 48 hours was comparable for both coated (95%) and uncoated (93%) UHMWPE relative to the control. Interestingly, the antibacterial activity test results after 24 hours incubation exhibited that the nylon coated UHMWPE has significantly higher antibacterial activity compared to the uncoated UHMWPE. There was no bone mineralization detected in U2OS as no Alizarin red stain was observed, confirming the absence of any osteogenic induction. Such quality is a preferred characteristic of bearing surfaces. In agreement with Alizarin red staining results, the EDX demonstrated the absence of a hydroxyapatite layer, which is a required feature in the bearing surfaces. The uptake of the simulated body fluid (SBF) by both the coated and uncoated UHMWPE indicated that the nylon coating is of great advantage to the polymer as it prevents the increased absorption of the SBF and hence may decrease the risk of implant degradation. Moreover, our results demonstrate the superiority of the proposed coated biomaterial for wound healing applications with improved antibacterial capabilities.

Biography

Asma Amleh is an Associate Professor of Biology at The American University in Cairo and an Adjunct Professor, Department of Mechanical & Industrial Engineering at Ryerson University, Toronto, Canada. She received a BSc in biology and chemistry at The American University of Beirut, Lebanon, and a Ph.D. in biology from McGill University in Montreal, Canada (1997). She has been a research fellow at the laboratory of cellular and developmental biology, NIDDK, and a research associate at the National Institutes of Health, Bethesda, MD, USA. She has also been an instructor at the Department of Molecular Medicine, Institute of Biotechnology, at the University of Texas Health Science Center and a senior research scientist at the Developmental Biology Program, Memorial Sloan-Kettering Cancer Center in NY. Her research interests are focused on understanding the genetic control of normal and abnormal development in the mammalian system, including tissue compatibility of biomaterials and the incidence of cancer.

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