Surface decoration of PEEK implants with IGF-1 via polydopamine enhances osseointegration and osteogenic differentiation

Teng Wan[123], Pei-Xun Zhang[123]*

[1]Department of Orthopedics and Trauma, Peking University People's Hospital, Beijing 100044, China

[2]Key Laboratory of Trauma and Neural Regeneration, Peking University, Beijing 100044, China

[3]National Centre for Trauma Medicine, Beijing 100044, China

*Corresponding Author: Pei-Xun Zhang, Email: zhangpeixun@bjmu.edu.cn

Polyetheretherketone (PEEK) is a promising biomedical material in orthopedic and dental applications owing to its excellent mechanical properties, near absent immune toxicity, and X-radiolucency, but suffers from bio-inertness and inferior osteoconduction. Surface modification of PEEK can effectively solve this problem, retaining most of its advantageous properties. In this study, porous structures were fabricated using concentrated sulfuric acid and the interface was bio-functionalized by IGF-1 immobilization on the porous surface via polydopamine coating. The surface characteristics of modified PEEK were evaluated by scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS). The pore size generally distributed between 0.3–0.8 μm was evaluated using ImageJ software. The hydrophilicity and BSA protein adsorption capacity were significantly enhanced after dopamine coating. IGF-1 were successfully immobilized onto the porous surface via polydopamine coating and the immobilization efficiency was determined by ELISA. The tensile mechanics study showed that although the surface porous structure maintained its Young's modulus similar to that of human bone, the elongation at break and the maximum yield strength decreased. The in vitro studies revealed that PEEK immobilized with IGF-1 could remarkably improve the attachment, spreading, proliferation, extracellular matrix secretion, and alkaline phosphatase (ALP) activity of MC3T3-E1 pro-osteoblasts. These findings indicate that IGF-1 modification on the surface of PEEK implants using pDA as an intermediate layer can significantly enhance the osseointegration and osteogenic differentiation potential of PEEK, which has great potential for clinical application.

Key words： Polyetheretherketone, Surface modification, IGF-1 , Ploydopamine, Biocompatibility, Osteointegration.

First Author: Wan Teng, Email: TengWan.med@hotmail.com

*Corresponding author:Pei -Xun Zhang, Email: zhangpeixun@bjmu.edu.cn