Synergistic Effect of Nano Strontium Titanate Coating and Ultraviolet C Photofunctionalization on Osteogenic Performance and Soft Tissue Sealing of poly (ether-ether-ketone)

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論 文 名：Synergistic Effect of Nano Strontium Titanate Coating and Ultraviolet C Photofunctionalization on Osteogenic Performance and Soft Tissue Sealing of poly (ether-ether-ketone)
（ポリエーテルエーテルケトン表面における骨形成および軟組織封鎖性向上に与えるナノチタン酸ストロンチウムコーティングと紫外線C波による光機能化の相乗効果に関する検討）

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論 文 内 容 の 要 旨

This study aimed to evaluate the bioactivity of poly (ether ether ketone) (PEEK) after surface modification by persistent photoconductive strontium titanate ($SrTiO_3$) magnetron sputtering and ultraviolet (UV) C irradiation. According to the different modifications, the PEEK specimens were randomly divided into five groups (n = 38/group): PEEK, Sr100-PEEK, Sr200-PEEK, UV/PEEK, and UV/Sr200-PEEK. Then, the specimens of Sr100-PEEK and Sr200-PEEK groups were, respectively, coated with 100 and 200 nm thickness photocatalyst $SrTiO_3$ on the PEEK surface by magnetron sputtering. Subsequently, UV–C light photofunctionalized the specimens of PEEK and Sr200-PEEK groups to form UV/PEEK and UV/Sr200-PEEK groups. The specimens were characterized by a step meter, scanning electron microscopy (SEM), atomic force microscopy (AFM), energy dispersive X-ray spectroscopy (EDX), and a water contact angle meter. The release test of the Sr ion was performed by inductively coupled plasma mass spectrometry (ICP–MS). In vitro study, osteogenic activity (MC3T3-E1 osteoblast-like cells) and epithelial and connective tissue attachment (gingival epithelial cells GE1 and fibroblasts NIH3T3) were analyzed in five groups. Surface morphology of the specimens was changed after coating, and the Sr content on the Sr-PEEK surface was increased with increasing coating thickness. In addition, the contact angle was increased significantly after magnetron sputtering. After UV–C photofunctionalization, the content of surface elements changed and the contact angle was decreased. The release of Sr ion was sustained, and the final cumulative release amount did not exceed the safety limit. In vitro experiments showed that $SrTiO_3$ improved the cell activity of MC3T3-E1 and UV–C irradiation further enhanced the osteogenic performance of PEEK. Besides, UV–C irradiation also significantly promoted the cell viability, development, and expression of adhesion proteins of GE1 and NIH3T3 on PEEK. The present investigation demonstrated that nano $SrTiO_3$ coating with UV–C photofunctionalization synergistically enhanced the osteogenic properties and soft tissue sealing function of PEEK in vitro.

Keywords: PEEK, Implant, Photofunctionalization, $SrTiO_3$, Osteogenic activity, Soft tissue