**Evaluation of Epigallocatachin Gallate Coating of Surface Treated Poly Ether Ether Ketone Implant Material**

**Abstract**

**Research Problem and Objectives:** Poly ether ether ketone is a thermoplastic polymer that offers excellent mechanical properties and biocompatibility, making it a promising material for dental implants. However, it's bioinert and hydrophobic nature limits its capacity for optimal osseointegration, presenting challenges in its use as an implant material. To overcome these limitations, this study aimed to enhance the surface properties and bioactivity of Poly ether ether ketone implants. This was achieved by first optimizing the concentration of piranha solution, a mixture of sulfuric acid and hydrogen peroxide, to modify the surface roughness and wettability of samples. Following this, the study developed an electrospraying process to coat Poly ether ether ketone with Epigallocatechin Gallate, a natural extract from green tea known for its bioactive properties. Comprehensive characterization of the modified surface was conducted, and the enhanced implants were tested *in-vivo* to evaluate their mechanical attachment, biocompatibility, and osseointegration, ultimately aiming to improve the overall performance of Poly ether ether ketone implants.

**Methodology:** Poly ether ether ketone discs were divided into four groups: control, piranha treated, Epigallocatechin Gallate coated, and piranha treated with Epigallocatechin Gallate coating. The characterization of these samples included field emission scanning electron microscope, energy dispersive X-ray spectroscopy with mapping, nano roughness assessment by atomic force microscope, surface microroughness testing by profilometer, wettability by measuring static contact angle and Fourier transform infrared spectroscopy. Additionally, Vickers surface micro hardness and coating adhesion by cross cut test were measured.

For the *in-vivo* study, 120 poly ether ether ketone screws were divided into four groups: control, piranha treated, Epigallocatechin Gallate coated, and piranha treated with Epigallocatechin Gallate coating. They were implanted into the femur of 30 New Zealand rabbits for 2 and 6 weeks. Each group consisted of 30 screws (15 for each healing period). The screws were evaluated for removal torque and new bone formation through histopathological and histomorphometric analyses.

**Results:** *In-vitro* study showed that the combined piranha treated and EGCG-coated group exhibited the highest surface roughness and wettability, followed by EGCG-coated group, piranha treated group, then control group. *In-vivo* results indicated that the piranha treated and EGCG-coated group showed the highest removal torque and new bone formation area at both 2 and 6 weeks, compared to the other groups.

**Conclusions and recommendations:** The study demonstrates that surface treatment with piranha solution followed by EGCG coating markedly enhances the physical and mechanical properties of poly ether ether ketone, such as wettability and surface nano and micro roughness, compared to untreated or singly treated groups. This enhancement positively impacted osseointegration, as evidenced by increased removal torque and new bone formation. The combined piranha treatment and EGCG coating showed promising results, suggesting a potential approach for improving the performance of poly ether ether ketone for future use as dental implants. However, further investigation is needed to validate these findings and explore the long-term clinical implications of the modifications.