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In Vitro Biofilm Formation of *Staphylococcus aureus* on Implants used in Surgical Treatment of Destructive Spondylodiscitis

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Background: Cases of spondylodiscitis are increasing. In case of bone destruction, the infected tissue is removed surgically. Reconstruction can be performed by inserting an implant. Relapses are common. Biofilm formation is a major factor leading to relapses.

Research question: There is no consensus regarding the material of choice to minimize formation of biofilm. The objective of this study was to assess whether certain surgical implants are more prone to biofilm formation.

Design & Methods: Eight cages of each Polyetheretherketone (PEEK), PEEK with Titan coating (PEEK-Ti), Titanium, Polyetherketoneketone (PEKK), Tantalum and bone cement were incubated with 20% human plasma for 24h. Three cages of each material were incubated with *S. aureus* for 24h or 48h. Two cages per material served as negative controls. The biofilm was then removed by sonication. The attained fluid was used to prepare a 1:10 serial dilution which was plated on Mueller-Hinton agar plates. The CFUs were counted after 24h. Scanning electron microscopy of one PEEK cage was performed to confirm bacterial attachment.

Results: The surface area of the implants differed. The mean CFU count after 24h and 48h was calculated both per implant and per mm^2. Bone cement was found to bear significantly more CFUs per mm^2 surface area after both 24h and 48h than all other materials ($p<0.05$ each). When comparing the CFU count per implant, bone cement was forming significantly more CFUs than PEEK after 48h ($p<0.05$). No statistically significant differences were observed between the other materials ($p>0.05$ each). Electron microscopy showed the attachment of bacteria and early stages of biofilm formation (Fig. 1 and 2).

Discussion: Bone cement showed statistically significantly more bacterial attachment than all other examined materials. No differences were found between the other materials regarding bacterial attachment after 24h or 48h. Next, we aim to expand our investigations on additional bacterial pathogens.

Fig. 1

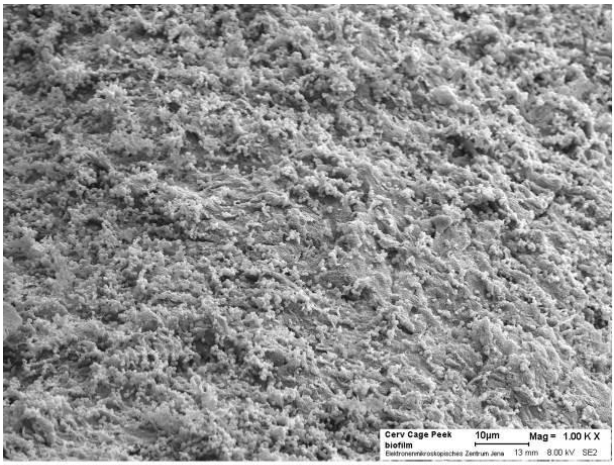

Figure 1 – Scanning electron microscopic image of the surface of a PEEK spinal cage after initial coating with human plasma and 48 h incubation with *S. aureus* suspension.

Fig. 2

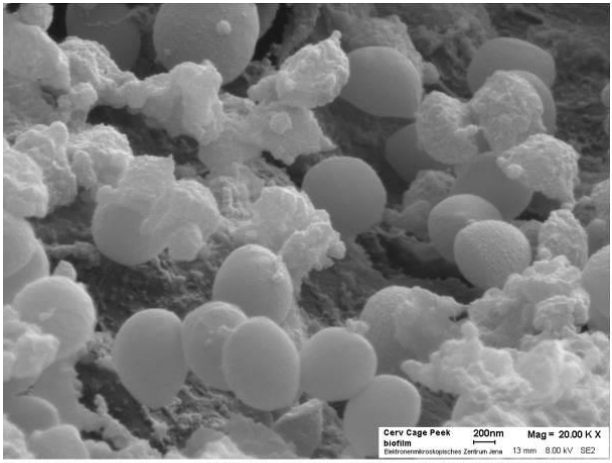

Figure 2 – Scanning electron microscopic image of the surface of a PEEK spinal cage after initial coating with human plasma and 48 h incubation with *S. aureus* suspension. The bacteria can be seen on the surface, together with EPS indicating that biofilm formation has begun.