The Effect of Surface Roughness of Poly(Methyl Methacrylate) on Bacterial Attachment

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Introduction. Polymethyl methacrylate (PMMA) bone cement is widely used for fixation of joint prostheses. Previous studies have established a connection between surface roughness and bacterial adhesion on many surfaces. This project evaluates the effect of surface roughness on bacterial attachment to bone cement.

Methods. PMMA was mixed under vacuum, flattened to 3 mm, and cut into 1 cm x 1 cm disks using a band saw. One group was sanded to achieve a smooth surface, another was sanded smooth, then grooved to make a controlled roughness, and another was left untreated to have natural roughness of bone cement (N = 10 for each group). Roughness of all disks was measured via optical profilometry. Disks were then incubated with bioluminescent *S. aureus* for 24 hours. After rinsing with phosphate-buffered saline, the disks were plated, and luminescence was measured via plate reader.

Results. The sanded group showed an average luminescence of 431.2 relative light units (RLU), the natural group showed 1102.2 RLU, and the grooved group showed 739.2 RLU. The average roughness (Ra) was 3.27 µm for the sanded group, 18.03 µm for the natural group, and 9.307 µm for the grooved group. A linear regression of roughness of each disk vs luminescence measured for each disk gave an R^2 value of 0.273 with a P-value of 0.0159.

Conclusions. Increased individual specimen roughness of PMMA disks correlated with increased bacterial attachment. The innate surface of bone cement allows for substantially more bacterial attachment than the modified surfaces of the other two groups.

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