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The Effect of Porosity and Contact Angle on the Fluid Capillary Rise for Bone Scaffold Wettability and Absorption

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Abstract:

Introduction: Wettability and fluid absorption are two important bone scaffold characteristics that determine proper cell attachment and flow of nutrition and oxygen. To imitate the human bone structure, the current study was carried to investigate the effect of the porosity of bone scaffold and contact angle of the fluid by evaluating the height of capillary rise. Methods: The structure was simplified based on the circle and square pattern and evaluated using Computational Fluid Dynamic (CFD). Porosity and contact angle were varied from 50% to 80%, while the contact angle ranged from 0 degrees to 60 degrees. The result was evaluated further using statistical analysis. Results: The CFD result was in agreement with Jurin's law (9% error). The height of capillary rise was found to be excellent for the square pattern, while the circle was found to work across all the investigated parameters better. The porosity was correlated with the height of capillary rise ($r = -0.549$). The strongest correlation happened to contact angle ($r = -0.781$). Conclusion: The study concludes that water absorption and wettability can be altered and improved based on porosity. Meanwhile, the height of capillary rise depends strongly on the contact angle.