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Abstract

Microtopography on poly-ε-caprolactone and their wettability properties

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Biological tissues predominantly interact with the implant at the material surface, which can affect cell responses, such as attachment and proliferation of cells, due to differences in protein adsorption [1]. A wide array of modifications to the surface have been researched over the past decades, to achieve enhanced osseointegration and subsequently lead to less implant failure [2]. Microtopographies can influence cell adhesion by the means of biophysical and mechanobiological cues. The aim of this study was to investigate the effect of microtopography on the biophysical surface property of wettability.

Four distinct microtopographies (inverted pyramids, grooves, pillars, and osteon-like structures) were designed as mold forms via 3D-CAD modelling. These molds, together with a negative control (no microtopography), were manufactured by the means of a two-photon-polymerization (2PP) printer (NanoOne, Upnano GmbH, Vienna, Austria). Poly-ε-caprolactone (Mn 80k, Sigma Aldrich, St. Louis, USA) was hot-extruded into the molds. The water contact angle (WCA) was measured five times per microtopography with a contact angle goniometer (DSA25E, Krüss, Hamburg, Germany).

The measurements of the WCA revealed that the microtopographies, compared to the negative control, lead either to no change or to an increase in the WCA (Pillars Δ=0.1°±11.7°, Osteon-like Δ=8.5°±11.3°, Grooves Δ=12.5°±17.9°, Inverted Pyramids Δ^*=21.6°±11.2°, * $p<0.05$). Protrusion-like structures such as the pillars do not show an increase compared to the other cavity-like structures, likely due to the creation of a Cassie-Baxter state which entraps air within the cavities.

Cavity-like microtopographies on poly-ε-caprolactone reduces wettability, which might not be advantageous for cell adhesion. The geometry of the microtopography determine the extent of this wettability decline. Detailed studies to assess the influence of microtopgraphies on cell responses in relation to wettability need still to be performed.

Author's Statement

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References

[1] K. Kulangara and K.W. Leong, Soft Matter, 2009, 5, 4072-4076
[2] Pandey, C., D. Rokaya, and B.P. Bhattarai, Contemporary Concepts in Osseointegration of Dental Implants: A Review. Biomed Res Int, 2022. 2022: p. 6170452.

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