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Optimization of design and printing parameters of solid microneedle array produced by SLA printer

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Microneedles are widely investigated in both pharmaceutical and cosmetical sciences. These sub-millimetre structures tend to pierce the stratum corneum and deliver pharmaceutically active ingredients with poor absorption properties. Different forms of microneedles are present from the 1990's but the production cost was incredibly high due to the expensive and hardly accessible technologies. Additive manufacturing helped to step over this gap.[1] 3D Printing of Microneedle Arrays (MNA-s) in laboratory scale has become an affordable for many research groups throughout the globe. By having access to a Projet 6000 HD Stereolitographic printer (3D Sytems, Rock Hill, USA) we focused on the optimization of directly printed MNAs. Over the 4 generation of the printed MNAs the influence of printing and design parameters to the final MNA product was investigated. Conical geometry was chosen for this study due to its circle-based shape and simplicity. Our aim was to optimize 3 crucial geometrical parameters: the needle base diameter, needle height and the needle tip diameter. However, varying the printing parameters did not show significant improvement in the 3 mentioned geometrical parameters, the design parameters showed strong influence. It was observed that the real base diameter could not be set under 320 ±9 µm-s. Nominal and real needle heights showed a linear correlation. Using the equation of correlation in the 1000 – 1500 µm range, the needed nominal parameter can be set to reach the desired nominal height. The equation may be used on a broader spectrum – further measurements required. Needle tip diameters showed an inverse relationship with the needle height parameters. Altogether, by determining the correlation between the investigated setting parameters and obtained geometrical parameters MNAs with desired design can be produced and applied for further medical purpose.

References:

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