

CYTOTOXICITY STUDY OF COMMON 3D PRINTING MATERIALS IN INDIRECT CONTACT WITH HUMAN SKIN FIBROBLASTS IN VITRO

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Introduction

The development of 3D printing cannot be overlooked. Thanks to affordability, the number of products - prints that can be used for everyday activities, for sports, cooking and entertainment - is growing. The most common materials for printing, the so-called filaments, are polymers of the PLA, PET/CPE, ABS, or FLEX type and are available in an abundance of colors and properties. We present the results of a pilot study that evaluated the cytotoxicity of selected materials for 3D printing on the primary line of human skin fibroblasts, a very resistant type of human mesenchymal cell. Experiments simulate the interaction of skin with 3D printed objects, e.g. plastic bracelets, gadgets or shoe soles.

Material and methods

16 samples of commonly available material for 3D printing of various compositions and pigmentation were selected for testing. A line of human skin fibroblasts (HDF, Axolbio ax3027) cultured in standard (DMEM v/v 10% FBS, 1% L-Glutamine, 1% P/S) in an incubator with 5 kPa pCO₂ was selected for cytotoxicity evaluation. The tested cells were exposed to the interaction for 24 h (acute interaction) and 7 days (long-term exposure). Evaluation methods of cell proliferation and viability are based on recommendations and methods described in ISO-10993-5 (test methods for evaluation of in vitro cytotoxicity of medical devices). Another method used was the measurement of mitochondrial respiration with high resolution (Oroboros, Austria).

Results and conclusion

In our study, we did not observe a statistically significant change in cell viability and mitochondrial respiration for PLA and ABS materials, neither did the pigments used. PET/CPE results show the expected slightly negative effect.

The FLEX material is thermoplastic polyurethane (TPU), used to make, for example, flexible bracelets or slippers. With this material, we noted a significantly negative effect on cell morphology, the ability of cell growth, as well as metabolic and mitochondrial activity. During long-term indirect contact, fibroblasts showed significantly increased electron leakage through the mitochondrial membrane and at the same time extremely reduced ATP production in the order of higher hundreds of percent compared to controls. Preliminary results suggest that this material may cause inflammatory skin reactions (eczema) in sensitive individuals.

A positive result of the study is the finding that, assuming 3D printing in a sterile environment and subsequent aseptic handling of the samples, the prints are microbially sterile.