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Assessment of adhesion response to 3D printed materials for ophthalmic device development

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Introduction: Glaucoma is the leading cause of irreversible visual impairment worldwide. Glaucoma surgical devices fail due to a scarring response those results in fibrous encapsulation surrounding the device preventing aqueous humor drainage. 3D printing technology has the potential to develop personalized ophthalmic devices or organs with improved cost effectiveness and productivity. Limited experimental data exists as to the biocompatibility response of 3D printed photopolymers. We performed cell adhesion and protein adsorption studies of 3D printed photopolymers compared to materials used in current ophthalmic devices (Silicone, Polytetrafluoroethylene (PTFE) and Poly methyl methacrylate (PMMA)) to assess 3D printed materials as a potential route for ophthalmic device development.

Methods: 3D printed materials (n=6) were developed using a high-resolution, desktop stereolithography (SLA) 3D printer and compared to materials used in current ophthalmic devices. Protein adsorption was quantified using a micro bicinchoninic acid (Micro BCA) assay and fluorescein-conjugated bovine serum albumin (FITC-BSA) adsorption. Cell adhesion (monocytes, fibroblasts) was assessed using alamarBlue, CyQUANT and live/dead assays. Data were compared using a two-tailed unpaired t-Test.

Results: 3D printed materials demonstrated low cell adhesion and protein adsorption. Results were similar to those found with materials used in current ophthalmic devices ($P>0.05$). However it was noted that 3D printed materials demonstrated increased cytotoxicity ($P<0.05$).

Conclusion: 3D printed photopolymer materials demonstrated a similar biocompatibility response to currently used materials and may allow for the development of customisable ophthalmic devices or organs. Subsequent testing will determine the adhesion response to 3D printed materials containing anti-scarring agents.

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