Open-Source, Customizable, 3D-Printed Ocular Prosthetics as a Viable Alternative to Traditional Ocular Prosthetics

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INTRODUCTION: Disfiguring eye conditions cause significant psychosocial distress.[1] For enucleation, phthisis bulbi, or even disfigured blind eyes, among other conditions, ocular prosthetics not only serve an extremely valuable cosmetic purpose, but also help maintain the anatomic integrity of the orbit. Current ocular prosthetics are costly and are time consuming to produce with an average cost ranging from $1500-8000 and production time between 4-6 weeks. We developed a 3D-printed prosthetic eye that is customizable, inexpensive, and available to anyone with access to the internet and a 3D-printer.

MATERIALS AND METHODS: Using open-source CAD modeling software,[2] we developed a customizable prosthetic eye model. The eye can be customized within the following parameters: shape, height, length, width, thickness, concavity, iris diameter, and pupil diameter. The customization process is user friendly, requiring numeric inputs or parametric adjustments. The final model is exported and processed by an open-source slicing software.[3] Using a commercially available and inexpensive dual extruder 3D-printer, the eye is printed with commonly available acrylonitrile butadiene styrene (ABS) plastic, in any arrangement of colors. The model is then chemically de-burred and temporarily softened with acetone, then veined with red thread. The final model is then cast into resin.

RESULTS: The production of our 3D printed prosthetic eye is significantly faster than traditional methods, requiring a total of 85 minutes to complete. The process requires less than 10 minutes to customize, 30 minutes to print, and 45 minutes for post processing. Given access to the internet and a 3D printer, the raw cost breakdown for producing our prosthetic eye is: $0.03 for 1.7g of ABS, $0.11 for 3mL of resin, and $0.18 for 30mL of acetone; totaling $0.32 per prosthetic. Due to the automation of much of the process, the usual cost of labor is greatly reduced.

CONCLUSION: Although yielding excellent life-like results, the current process of hand making ocular prosthetics leads to high production costs and long production times. This raises accessibility issues for uninsured or underinsured patients, and patients in regions or countries where custom-made ocular prosthetics are unavailable. With the increasing popularity of 3D printers, many of which are becoming publicly available (i.e. schools/public libraries), the production of a customizable prosthetic eye will be a viable, less costly, and more accessible option in the near future.

REFERENCES:

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