polarized to the M2 phenotype in vitro and in vivo. Full-thickness excisional wounds all healed significantly faster (*p<0.05) when treated with macrophages seeded onto the IL10 scaffold.

CONCLUSION: Our results demonstrate that our novel proprietary scaffold can polarize macrophages to the M2 phenotype and deliver supraphysiologic levels of macrophages to wounds to significantly accelerate wound healing in the absence of adverse effects on scar size and quality. Polarizing macrophages on a scaffold in vivo minimizes time in cell culture and is a desirable method for simultaneous directed differentiation and cell delivery. With further studies, this could prove to be a novel therapeutic for wound regeneration.

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Bioactive Peptide Amphiphilic Gels Enhance Burn Wound Healing: In Vitro and In Vivo Studies

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INTRODUCTION: More than 2.5 million Americans suffer burn injuries annually. Many methods have been used to manage burn injuries including skin grafts, various dressings, and a variety of systemic and topical agents. Despite this, burn wounds continue to be a major health problem. Our previous report showed that peptide amphiphilic (PA) gels promote cell proliferation and have great potential in regenerative medicine for rapid repair of peripheral nerve. In this study we hypothesized that the PA gels are capable of accelerating the wound healing in the burn injury.

MATERIALS AND METHODS: The thermal damaged fibroblasts and human umbilical vein endothelial cells (HUVECs) models were artificially manufactured, then seeded onto the various PA gels. The cell proliferation was assessed via WST-1 assay at different time points. To determine the in vivo effects, the burn wounds of rats were treated with RGDS PA gel or non-treatment. The wound closure was observed every other day, and skin samples were harvested each week for histologic and immunohistochemical analysis.

RESULTS: The cell proliferation in both E2-NH2-RGDS PA and E3-NH2-RGDS PA were each significantly higher than that in backbone-PA gel and collagen gel. The E3-NH2-RGDS-PA gel significantly enhanced re-epithelialization during the burn wound healing process between day 7 and day 21.

CONCLUSION: The application of PA gels accelerates the recovery of deep partial thickness burn wounds by stimulation fibroblasts and epithelial cells proliferation and promoting wound closure. We believe that this novel biomaterial represents new therapeutic strategies to challenges we currently face in treating clinical burn diseases.

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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. 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, 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. 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.

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Desktop Stereolithography: An Affordable And Time-Efficient Alternative

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INTRODUCTION: Three-dimensional printing technology has been used in medicine for anatomical modeling, pre-operative planning, prosthetic construction, and most recently bioprinting. The high purchase cost of 3D printers has previously limited their widespread use, causing surgeons to outsource 3D anatomic model manufacturing at an average cost of $4,000/print. The development of “desktop” 3D printers has decreased printer purchasing costs from $45,000 (2001) to under $2,000 (2016), providing an opportunity to bypass high-cost third-party manufacturing to create patient-customized 3D models. We provide a proof-of-concept demonstration using a desktop 3D printer and open-access software to create patient-specific computerized tomography (CT)-based 3D models to guide skeletal deformity reconstructions.

METHODS: Four patients (2 syndromic craniosynostosis, 1 cranial defect, 1 distal radius deformity secondary to arthrogryposis) were included. CT scans (≤1 mm slices) were obtained (DICOM file) for volumetric conversion to 3D models (STL file) using free open-source software (3D Slicer, http://www.slicer.org). The resulting STL files were uploaded to the MakerBot desktop application for printing with the MakerBot Replicator 2 ($2,750, MakerBot Industries, Brooklyn, NY). Material cost and printing time were recorded for comparison to alternative manufacturing methods. The 3D models were used to guide pre-operative planning and intra-operative reconstruction.

RESULTS: CT-to-3D models were successfully printed for all patients. Two distinct 3D models were created for the cranioplasty case (volumetric skeletal reconstruction and topographic representation of the defect). The printing material (polylactic acid) averaged $15/model and its unique properties allowed for inexpensive gas sterilization for intraoperative use. CT-to-3D model conversion time averaged 24-hours/case. All patients underwent successful reconstruction without complications.

CASE EXAMPLE: A 23-month old female with a history of ruptured middle cerebral artery aneurysm requiring craniotomy, hematoma evacuation, and ventriculoperitoneal