INTRODUCTION: There has been an increasing interest in the applications of three-dimensional (3D) printing in plastic surgery. A physical 3D model provides visualization of complex defects that supersede digital imaging and can be used as a template for preoperative planning and surgical education. With the advent of affordable quality and reliable printers, office-based 3D printing has become possible. We describe our experience with office-based 3D printing in the management of comminuted mandible fractures. The distorted topography of the bony surface and instability of fracture fragments can lead to suboptimal reduction, and shaping of the plate to contour the fracture can be challenging in the operating room. We used a 3D printed model of the patient’s mandible to bend plates preoperatively in order to achieve an ideal plate shape and thus optimum bony reduction.

METHODS: Patients diagnosed with a comminuted mandible fracture at R Adams Cowley Shock Trauma Center were identified. Patient’s maxillofacial CT scan DICOM images were uploaded into 3D Slicer (www.slicer.org) and a 3D image model of the mandible was generated using a threshold segmentation technique. The model image was uploaded into Netfabb (Autodesk, San Rafael, CA) and the non-fractured side was mirrored to replace the comminuted side. The final model image was uploaded into Cura software (Ultimaker, Geldermalsen, Netherlands) and the 3D model was printed using a LulzBot TAZ 6 3D printer (Aleph Objects, Loveland, CO) and a 2 millimeter Polylactic acid filament. Titanium plates were then pre-bent according to the 3D printed mandible model and autoclaved in standard fashion prior to use in the operating room. Proper fracture reduction was evaluated with a postoperative CT scan.

RESULTS: Three patients with comminuted mandible fractures had a 3D model of their mandible printed preoperatively. Average print time was 6 hours. Excluding the one-time cost of the 3D printer of $2,500, the average materials cost to print one mandible was $4.20. All three patients had successful placement of the titanium plates which were pre-bent preoperatively according to the 3D model. Postoperative CT imaging demonstrated adequate reduction in all three cases.

CONCLUSION: Office-based three-dimensional printing is feasible and affordable. We demonstrated how 3D printed models of comminuted mandibular fractures can optimize fracture reduction by preoperatively bending plates.

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stem cells (ASCs) are predictive of fat graft retention in mice. In this study, we aimed to examine the relationship between fat retention, cell type, and molecular characteristics in humans. We hypothesized that CD34+ ASCs are correlated with increased submetatarsal fat graft retention and lower collagen content in humans.

METHODS: Fat was harvested by manual liposuction and processed by standard Coleman technique from 24 patients undergoing fat grafting to the forefoot as part of a randomized cross-over clinical trial. Ultrasound-assessed submetatarsal tissue thickness was obtained at baseline, 6mo, & 12mo visits. Processed lipoaspirate was returned to the lab for stromal vascular fraction (SVF) isolation, flow cytometry characterization, collagen assessment using western blot, and histological imaging.

RESULTS: Average age was 63.6+/−6.7, and average BMI was 26.1+/−4.6. No patients were diabetic. Flow cytometry demonstrated that the proportion of CD34+ ASCs in the fat graft and the viability of the SVF isolate were correlated with significantly improved retention of tissue thickness at 6mo (p=0.044, p=0.033 respectively) but not at 12mo. Fat grafts with lower collagen1 concentration in western blots were associated with significantly greater SVF viability and CD34+ ASC content (p=0.046, p=0.005 respectively).

CONCLUSION: Volume loss after fat grafting remains a perplexing problem. The inverse association between collagen vs ASC content and SVF viability merits further study, particularly given the fact that ASC content and SVF viability predicted retention of tissue thickness at 6mo in grafted feet.

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3D-Printed Bioactive Ceramic Scaffolds Demonstrate Intrinsic Osteogenic Properties in an Undisturbed Osseous Environment

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INTRODUCTION: The osteogenicity of 3D-printed bioactive ceramic (3DBC) scaffolds has been demonstrated in several translational models. Scaffolds can be designed to fit and fill defect sites while directing osseosynthesis by utilizing the micro-environmental cues of violated bone primed for healing. However, preoperative access to large segments of accessory bone replacement could be of significant benefit, particularly in settings of planned oncologic resection or congenital correction. Despite this, the osseoconductivity of biomaterials synthesized with 3D-printed geometric design to optimize bone growth has not been explored in an intact bone model. This study used a sheep model to evaluate the innate ability of 3DBC scaffolds to induce bone growth supplementary to the undisturbed calvarium.

METHODS: Cylindrical 3DBC scaffolds, measuring ~5-mm in diameter and ~1.5-mm in height, were composed of 100% β-tricalcium phosphate and designed with an inner lattice network and solid outer wall. Dorset-Finn sheep (n=5) underwent surgical placement of four 3DBC scaffolds subperiosteally on top of the calvarial bone, which were stabilized by periosteal closure. Two scaffolds were placed on each side of the calvarium, with the right-left distinction corresponding to the treatment period length (3- vs. 6-weeks). Samples were evaluated through histologic quantification of bone, scaffold, and soft tissue as a function of time in vivo. For between-group comparisons, statistical analysis was conducted using a Student’s t-test with 95% confidence intervals and significance was set at an α=0.05.

RESULTS: On histologic analysis, there was no evidence of inflammation around the scaffold site. Gross examination revealed a trend of bone growth from the calvarium into the interior lattice network and up the outer walls of the scaffold in an inferior-superior directionality. At the 6-week