These models are rendered and imported into Blender™ (Amsterdam, The Netherlands). They are then inverted along the vertical axis to create a working template of the contralateral ear. The depths of the scapha, triangular fossa and cymba are deepened to accentuate contours. Additional relief is added to the helical root for further definition. The final template is digitally separated to create the requisite components for the Nagata technique: helix; antihelical fold with the superior and inferior crus; tragus; and base frame. The helix is digitally straightened to optimize modeling. Finally, the complete auricular model and its components are individually 3D-printed (Builder Premium 3D Printer, Noordwijkerhout, The Netherlands) using polylactic-acid filament and sterilized according to manufacture’s specifications (121°C for 1 hour and 30 minute dry cycle).

RESULTS: Average time of digital preparation and 3D-printing was 5 and 5.5 hours, respectively. Total cost of consumables was $1.00/construct. On the day of surgery, the sterilized, patient-specific 3D models were brought to the operating room and placed alongside the sculpting tools and carving block. The models were placed on the cartilage grafts so that the forms and relief of the cartilage construct can be easily appreciated and incorporated into the cartilage shape. All three reconstructions were completed without complication and with a high patient satisfaction. Compared to the classic auricular tracings also present during surgery, the 3D printed models provided more detailed anatomic information and eliminated much of the guesswork involved in 3-dimensional auricular reconstruction.

CONCLUSION: By leveraging software platforms, hardware and expertise already available within academic medical centers, sterilizable, patient-specific auricular 3D models can be affordably manufactured and used during autogenous ear reconstruction.

3D Printed Ceramic Scaffolds: A Novel Approach to Mandibular Regeneration

Presenter: Christopher D. Lopez, BA
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**INTRODUCTION:** Vascularized bone flaps, commonly used to reconstruct critical sized defects, have several limitations in terms of complications, donor-site morbidity, and costs, thereby advocating for innovative treatment options. Biomaterials offer virtually limitless quantities of bone tissue substitute, and 3D printing permits geometric design control for osteoconductive porous scaffolds as an alternative approach for bone regeneration. This pilot study presents a novel 3D printed ceramic scaffold with osteoconductive properties to treat segmental, critical size mandibular defects in a rabbit model.

**METHODS:** Critical sized defects were created at the mandibular body of six rabbits and replaced by 3D printed ceramic scaffold made of 100% β-tricalcium phosphate, fit to defect based on CT imaging. After 8 weeks, animals were euthanized, mandibles were retrieved, and bone regeneration was assessed. Bone growth was quantified both histologically (area) and with microCT and advanced 3D image software (volume), and compared to unoperated mandible segments (UMS). Data was presented as mean values with 95% confidence intervals.

**RESULTS:** UMS baseline bone area and volume occupancy averaged 55.8±4.4% and 33.4±3.8% respectively. Histology quantified scaffold + newly formed bone area occupancy at 54.3±11.7%, and bone area occupancy as a function of scaffold free space at 52.8±13.9%. 3D analysis quantified scaffold + newly formed bone volume occupancy at 36.3±5.9%, and bone volume occupancy as a function of free scaffold space at 57.4±12.7%.

**CONCLUSION:** Bone growth comprised over half of free space available in both 2D and 3D analysis, and regenerated segmental defect scaffold + new bone area/volume occupancy matched UMS at 8 weeks. Studies to determine scaffold replacement through bone formation and remodeling over extended periods of time are warranted.

Mandibular Reconstruction Using Cost-Effective Three-Dimensional Printing

Presenter: Silviu Diaconu, MD
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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Fat Graft Retention in Pedal Fat Grafting: Association with CD34+ Adipose Stem Cells and Collagen

Presenter: Sheri S. Wang, BS

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INTRODUCTION: Fat grafting is an important and versatile procedure, but it is limited by unpredictable volume retention. Many studies have tried to correlate characteristics of grafted fat to retention, but this has been largely limited to animal models. Butala et al. demonstrated in mice that high-density fat is associated with increased graft retention, higher progenitor concentration, and fewer collagen bands. Similarly, previous work by our group demonstrated that CD34+ adipose...