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 collagen content 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 osseoco conductivity 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
timepoint, samples demonstrated a significantly greater mean of available space occupied by bone (23.33 ± 3.4% vs 14.35 ± 3.72%; p<0.01). When bone and scaffold were considered together, there was no significant difference in mean space occupancy (6-Week: 56.86 ± 5.88%, 3-Week: 63.27 ± 12.98%; p=0.43), suggesting a stable rate of scaffold degradation/osseous remodeling over time.

CONCLUSION: 3DBC scaffolds composed of β-TCP are capable of inducing bone growth in an undisturbed osseous environment. This osteogenic influence is continually exerted over time, necessitating longer-term follow-up to determine the temporality of the bone-forming capacity of this tissue engineering construct.

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**Dipyridamole Enhances Osteogenesis of 3D-Printed Bioactive Ceramic Scaffolds in Calvarial Defects**

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**INTRODUCTION:** The objective of this study was to test the osteogenic capacity of dipyridamole-loaded, 3D-printed bioactive ceramic (3DPBC) scaffolds utilizing a translational, skeletally-mature, large animal calvarial defect model.

**METHODS:** Custom 3DPBC scaffolds designed to present lattice-based porosity only towards the dural surface were either coated with collagen (control) or coated with collagen and immersed in a 100 µM concentration dipyridamole (DIPY) solution. Sheep (n=5) were subjected to 2 ipsilateral trephine-induced (11 mm diameter) calvarial defects. Either a control or a DIPY scaffold was placed in each defect and the surgery was repeated on the contralateral side 3 weeks later. Following sacrifice, defects were evaluated through microcomputed tomography and histologic analysis for bone, scaffold, and soft tissue quantification throughout the defect. Parametric and non-parametric methods were utilized to determine statistical significance based on data distribution.

**RESULTS:** No exuberant or ectopic bone formation was observed and no histologic evidence of inflammation was noted within the defects. Osteogenesis was higher in DIPY-coated scaffolds compared to controls at 3 weeks (p=0.013) and 6 weeks (p=0.046) in vivo. When bone formation was evaluated as a function of defect radius, average bone formation was higher for DIPY relative to control scaffolds at both time points (significant at defect central regions at 3 weeks and at margins at 6 weeks; p=0.046 and p=0.031, respectively).

**CONCLUSION:** Dipyridamole significantly improves the calvarial bone regeneration capacity of 3D-printed bioactive ceramic scaffolds. The most significant difference in bone regeneration was observed centrally within the interface between the 3DPBC scaffold and the dura mater.