average production time was 11.8 hours but varied widely (SD=12.5). The majority of studies had no information about manufacturing variables including cost (n=127), time (n=131), software (n=47), or printer used (n=60).

CONCLUSION: Patient-specific 3DP offers innovative applications capable of changing the face of pediatric care, ranging from patient education to intraoperative ease. In this review, plastic surgery emerged as a leader among subspecialties, contributing the highest volume of patient-specific 3DP use compared to other fields. In particular, 3DP was utilized most commonly to enhance the quality of care to cranio/maxillofacial patients. Studies exhibited a wide range of manufacturing variables; this variability suggests that clinicians may have significant latitude in regards to manufacturing decisions, allowing them to tailor product design to an individual needs. This study demonstrates the wide range of applications and enhanced quality of care provided by 3DP models, and highlights the impact 3DP has on plastic surgery.

Revitalizing Structural Cryopreserved Allografts in a Porcine Tibia Defect Model

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**INTRODUCTION:** The treatment of segmental bone defects remains challenging as complications frequently occur with the currently available methods, including vascularized autograft, prosthetic replacement, bone transport and cryopreserved bone allograft (CBA). Although the use of CBA is comparatively simple, it lacks donor site morbidity and provides immediate stability, however the grafts remain largely avascular resulting in high failure rates due to nonunion, infection and stress fractures. Revitalizing the CBA has the potential to solve these problems. Previous studies in small animal models have shown the use of surgical revascularization to induce neo-angiogenesis and improve bone viability in the CBA. The purpose of this study is to investigate if surgical revascularization enhances bone circulation and bone remodeling in a tibial defect-orthotopic reconstruction model, placing a cryopreserved allograft in a Yucatan mini Pig.

**MATERIAL AND METHODS:** Cryopreserved tibial bone allografts were transplanted in swine leukocyte antigen (SLA) mismatched Yucatan minipigs after creating a 3.5cm segmental bone defect in the tibia. The anterior tibial arteriovenous bundle (AV-bundle) was inserted into the intramedullary canal. Eight pigs received a patent AV-bundle (revascularized group), 8 pigs received a proximally ligated AV-bundle (control group) and the contralateral side was used as an untreated control. The graft was fixated with a locking compression plate to provide a weight bearing construction. After 20 weeks, the pigs were sacrificed and the tibia was removed and analyzed. Neo-angiogenesis was evaluated by quantifying vascular volumes using the micro-CT. Bone remodeling was measured by quantitative histomorphometry and micro-computed tomography.

**RESULTS:** Seven of 8 AV-bundles in the revascularized group were patent, and 1 thrombosed due to allograft displacement. Total vascular volume was higher in the revascularized allografts (127 mm³) compared to both the control group (55 mm³, p=0.015) and the contralateral side (29 mm³, p=0.015). All patent bundles showed neovascularization extending into the cortical bone. Revascularized allografts had increased bone remodeling in the inner cortical area of the graft compared to the non-revascularized grafts (Bone Formation Rate: 381 ± 64 μm³/μm³/year versus 299 ± 143 μm³/μm³/year, p=0.05).

**CONCLUSION:** Surgical revascularization of porcine tibial CBAs by implantation of an AV-bundle creates an enhanced autogenous neoangiogenic circulation and accelerates active bone formation in the inner cortical area.

Successful Prolonged Extracorporeal Perfusion and Replantation of Free Rectus Abdominis Flaps in a Porcine Model

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**PURPOSE:** Extracorporeal perfusion (ECP) aims to reduce ischemia-reperfusion injury and thereby prolong tissue
preservation time. Safe prolongation of ischemia time will benefit multiple surgical procedures, e.g. multi-trauma surgery or VCA transplantation. Although currently available results on ECP of free flaps and extremities are promising, long-term perfusion of free muscle flaps is scarcely examined. The aim of this research was to evaluate long-term ECP and replantation of free rectus abdominis flaps and compare results to short static cold storage (CS).

MATERIALS AND METHODS: Unilateral free rectus abdominis flaps were harvested from 14 female Dutch landrace pigs (weight 63-84kg), followed by a 150cc passive flush of heparin-saline solution. Flaps were preserved in accordance to one of the following groups: 1) cold storage at 4°C for 4hr (n=4), 2) 18hr oxygenated continuous mid-thermic perfusion with Histidine-Tryptophan-Ketoglutarate (HTK) solution (n=5) or 3) 18hr oxygenated continuous midthermic perfusion with University of Wisconsin (UW) solution (n=5). After preservation, flaps were replanted to their original vascular pedicle and observed for 12 hours.

RESULTS: A total of 14 flaps was included in this study. The mean off-pedicle period in the CS-group was 5.4hr, compared to 19.2 and 19.1hr in UW resp. HTK-perfusion groups. Twelve flaps had uneventful post-replantation microsurgical controls and showed complete and homogenous perfusion on ICG-fluorescence angiography. One flap had acute arterial failure at 11.8hr post-replantation (UW-group) and one flap at 8hr post-replantation (HTK-group). A successful salvage procedure was performed for the latter after which controls and ICG-angiography patterns turned normal again.

Mean creatinine-kinase increase was higher in perfused groups (UW 48,571 U/L, HTK 32,014 U/L) compared to CS (9,494 U/L). However, mean venous lactate was lowest in UW-perfused flaps (0.68mmol/L), compared to CS-flaps (0.81mmol/L) and HTK-perfused flaps (0.86mmol/L). Mean weight increase was highest in HTK-flaps (114gr; 39%), followed by UW-flaps (72gr; 24%) and CS-flaps (50gr; 17%). Systemic cytokine levels (IL-1, IL-6 and TNF-) and histological evaluation (H&E, TUNEL) and qRT-PCR on muscle biopsies are currently under evaluation.

CONCLUSION: All flaps were successfully perfused for 18 hours. Although CK increase was higher in the perfused flaps, post-replantation microsurgical controls and perfusion patterns were normal in all but two flaps. Lactate levels and weight increase were lower in UW-perfused flaps compared to HTK-perfused flaps. Upcoming results will give more insight into underlying cellular processes and flap survival rate. Overall, extracorporeal perfusion might be a promising solution for free flap preservation, with a more than four-fold lengthening of maximum ischemia time. The extra time will benefit multiple surgical fields, for instance vascularised composite allograft transplantation or multi-trauma surgery.

The Use of Integra Flowable Matrix as a Soft Tissue Filler

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BACKGROUND: The search for an effective, biocompatible, and nonimmunogenic filler for soft tissue loss has been an ongoing effort. Integra Flowable Matrix has been demonstrated to improve wound healing in irregular-shaped wound beds and tunneling wounds. However, it has not been investigated for potential as a long-term filler. The matrix is a gel-like mixture of collagen and chondroitin sulphate matrix, which may lead to better volumetric and cellular infiltration than traditional fillers. This study’s aim was therefore to assess volume retention over time, cellular infiltration into the matrix, and immunogenic properties of the material in a small animal model.

METHODS: This study included a total of 40 SKH1-elite, hairless mice. All mice underwent injection of 1mL of Integra Flowable Matrix in the subdermal region of the scalp. Micro-CT was performed on 10 randomly selected mice at time 0, 2 weeks, and 8 weeks. CTs were 3D reconstructed and volume assessed of the implanted graft. 20 mice were euthanized at 2 weeks and 20 at 8 weeks. Volume of the grafts were assessed at this point using volume displacement. Grafts also went histological analysis with hematoxylin-eosin staining and immunohistochemistry to assess cell type infiltration into the matrix. Electron microscopy was also performed to assess cellular infiltration on a microscopic level into the material.

RESULTS: Integra Flowable Matrix was tolerated well by all mice as a filler. Average volume retention, measured by volume displacement, was 72.9% at 2 weeks and 47.9% at 8 weeks. This correlated well with volume measured