without complications, 40.2% underwent elective revisions, with significant differences noted by reconstructive modality (p<0.001) (min. DTI 25%, max. LD 59%). The average number of elective revisions also differed by modality (p<0.001) (min. TE 0.7 (SD 1.3), max. fTRAM/DIEP/SIEA 1.3 (SD 1.5)). Average total number of procedures in patients without complications at two years was 2.9 (SD 1.6), ranging from 1.7 for PTRAM to 3.3 for TEI (p<0.001). Reconstructive complications occurred in 462 (23.1%) patients achieving a stable reconstruction at 2 years. Within this cohort, 67.1% underwent elective revision procedures and differences were noted by reconstructive modality (p=0.041) (min. DTI 56%, max. LD 80%). The mean number of procedures to achieve reconstruction in patients with complications was 3.6 (SD 2.0), and also differed by reconstructive modality ranging from 2.5 in DTI to 4.2 in TEI (p<0.001). Controlling for clinical and demographic characteristics, patients undergoing DIEP, FTRAM, and LD were more likely to undergo elective revisions (p<0.05) compared to TEI patients; OR 2.66 (CI 1.83, 3.86), OR 2.26 (CI 1.35, 3.78), and OR 1.98 (CI 1.07, 3.64) respectively. While patients undergoing DTI reconstruction (p=0.035) or requiring post-operative radiation (p=0.012) were less likely. Having a postoperative complication further increased the odds of undergoing elective revision procedures (p<0.001) OR 3.21 (CI 2.52, 4.10).

CONCLUSIONS: Breast reconstruction involves multiple procedures to achieve a final satisfactory result, with the average number of revisions differing by reconstructive modality and when complications are encountered. Patients experiencing complications undergo more elective revision procedures in comparison to patients without complications, with differences noted across reconstructive modalities in terms of total procedures performed. Patients should be counselled that the average patient without a complication undergoes nearly 3 procedures to achieve a satisfactory reconstruction. Whereas if a complication occurs, the number of procedures increases.

**Utilizing Shear Stress to Optimize Endoluminal Linings with Pre-Vascularized Engineered Tissues**

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**PURPOSE:** Regeneration of thicker or larger tissues of clinically relevant size remains a challenge due to poor oxygen diffusion into cells that are contained within non-vascularized tissue-engineered constructs. Another major obstacle in the ability to precisely replicate the intricate design of the vascular system is due to a lack of proper endothelialization on the luminal surface of vessels. However, without exposing the vascular lining cells to flow, their functionality and *in vivo* stability are suboptimal. In physiological conditions, hemodynamic shear stress alters cellular morphology and biological activity, especially luminal endothelial cells within blood vessels. In our previous work, we have fabricated tissue engineered constructs with microvasculature comprised of anatomically correct neointimal and neomedia layers. Here, we “prime” these constructs by dynamically perfusing them and determine how flow induced shear stress optimizes the endoluminal surfaces of our tissue-engineered vessels.

**METHODS:** Pluronic F127 fibers, were sacrificed in type-I collagen, creating a central looped microchannel. Twenty-four hours following fiber sacrifice, a cell suspension mixture of normal human dermal fibroblasts and human aortic smooth muscle cells was seeded into the microchannel. The following day, another cell suspension of human placental pericytes and human umbilical vein endothelial cells was seeded into the microchannel. All constructs underwent daily cell media changes in static culture for 72 hours, and then perfused at 10 dynes/cm² for an additional 1, 3, 5 or 7 days using a peristaltic pump in a bioreactor. Scaffolds were processed for histology and immunohistochemical analysis. Images were quantified using ImageJ (NIH). A two-tailed unpaired t-test was used to compare variables between experimental groups.

**RESULTS:** After culture, all constructs formed intact endoluminal linings along the microchannel with increasing thickness over time. CD31 expressing endothelial cells were noted along the luminal surface after 7 days and throughout the endoluminal lining after 14 days, establishing a neointima. Constructs undergoing static and dynamic culture had robust, vascular linings that spanned the entire microchannel. Representative slides were taken from each construct, and the area of robust cellular lining was measured and normalized to channel diameter. Perfused constructs had a 59% significantly thicker lining in the channel than compared to constructs cultured under static conditions (p=0.0057). In addition, cellular proliferation (measured by calculating the
ratio between Ki67 and DAPI) was significantly increased in perfused constructs \((p=0.0429)\). Taken together, these data suggest that shear stress plays a significant role in the proliferation and maturation of the vascular lining.

**CONCLUSION:** We have successfully created tissue engineered scaffolds with microchannels that support the attachment of fibroblast, smooth muscle, endothelial and pericytes cells which form neointimal and neomedial layers. Shear stress through dynamic perfusion was used to optimize the development of a layer of vascular lining cells to provide a non-thrombogenic surface to allow continuous blood flow in these tissue engineered vessels. Exposing pre-vascularized engineered tissues to controlled perfusion produces vessels with architecture that more accurately recapitulates the \(in vivo\) phenotype and provides a surface for thrombosis-free blood flow, allowing for surgical implantation via microanastomosis.

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**Breast Reconstruction Pre-operative Risk Assessment: Applying the Risk Calculator to Define High Risk Patients**

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**PURPOSE:** In the last decade an increasing number of patients with breast cancer have undergone breast reconstruction, including high risk ones. Patients with multiple comorbidity factors have been associated with increased complications. However, how should we define a high risk patient and should their reconstruction plan follow the same of a lower risk patient? The BRA Score has been proposed to calculate the pre-operative risk. Our aim was to correlate the validity of BRA Score as a pre-operative risk calculator for its practical use.

**METHODS:** Patients that underwent different types of breast reconstruction had their pre-operative risk retrospectively calculated per breast using the BRA Score, and the actual complications they developed were collected. From the BRA Score we calculated risk of overall complication based on MROC (Risk-MROC) and TOPS (Risk-TOPS), surgical site infection risk (SSI-Risk), and 30 day reoperation risk (Reop-Risk). Data gathered from patient charts included post-operative overall complications (PO-Comp), surgical site infection (SSI), and reoperations due to complications. The following groups were considered: group 1, reconstructed breasts that had the analyzed complication; group 2, breasts without the complication. The ROC curve was used to evaluate the calculated risk as a complication predictor test.

**RESULTS:** Charts of 389 breast reconstructions from 255 patients were evaluated. Compared to Group 2, Group 1 had a significantly higher Risk-MROC (20.8 ± 11.12 vs 15.24 ± 9.16, \(p \leq 0.01\)), Risk-TOPS (19.7 ± 7.28 vs 15.5 ± 6.56, \(p \leq 0.01\)), and Reop-Risk (7.48 ± 3.27 vs 6.22 ± 5.22, \(p \leq 0.01\)); and similar SSI-Risk (3.75 ± 2.3 vs 3.94 ± 2.38, \(p=0.96\)). As tests for predicting the PO-Comp, Risk-MROC and Risk-TOPS were adequate, with areas under the ROC curve of 0.662 and 0.669, respectively. For predicting the reoperations, Risk-MROC, Risk-TOPS, and Reop-Risk presented areas of 0.666, 0.691, and 0.652, respectively. A predicted risk of 25.5% using Risk-MROC and Risk-TOPS would provide a specificity of 79% and 89%, respectively.

**CONCLUSIONS:** In this patient population, the BRA Score was a helpful tool to predict overall complications and reoperations. The calculator was not found to be useful in predicting surgical site infection. An overall risk of 25.5% derived from either the MROC or TOPS database would provide high specificity in determining a very high risk breast reconstruction patient. Patients with such high pre-operative risk may benefit from modifications in the breast reconstruction treatment plan to lower the complication rate. By using BRA Score, we can reliably predict the possible outcome of the reconstructions which can be used to better counsel the patient.