Excising abdominal wall defect in a rodent model to measure efficacy against pelvic organ prolapse

Zion Rouege\textsuperscript{1}, Qinhan Zhou\textsuperscript{2}, Kristin S. Miller\textsuperscript{3}

**Introduction**

Pelvic organ prolapse (POP) is a condition characterized by the lack of support from female pelvic floor muscles and tissues. The limited support causes pelvic organs to herniate through the vagina or anus. This is a common disorder which affects 33% to 50% of women annually\textsuperscript{1}. Current surgical repair treatments for POP include synthetic mesh implants andacellular biologic grafts (ABGs). However, both techniques create significant health and safety risks for patients. For example, synthetic meshes cause genital nerve and tissue damage while ABGs result in reduced pelvic mechanical strength and improper integration into the patient’s tissue. There is an urgent need for a new surgical repair therapy due to the lack of effective treatment solutions. As a result, BioAesthetics has developed a polymer-impregnated ABG (polyABG)\textsuperscript{1}. Furthermore, this novel graft supports patient-mediated recellularization and sustains the mechanical strength of the pelvic floor muscles. The long-term goal of the project is to assess the efficacy of silkABGs as a response to POP. The grafts will be implanted and excised from an in vivo rat model using 1% and 10% concentrations of silk fibroin to focus on mechanical strength. The objective of this research project was to investigate previous studies that conducted similar surgical procedures and simulating the POP repair surgery on a practice pad and frozen rats.

**Results**

The use of the surgical kit was a helpful tool to practice suture techniques required to implant silkABGs in rat models. The simulated surgical procedure on the frozen rat provided a fulfilling experience in comparison to the practice kit. During this experience incisions and sutures were measured and precise according to the surgical operation protocol.

**Conclusion**

This project is essential to the larger study of discovering an effective surgical repair surgery for pelvic organ prolapse. The literature review aspect of the project educated the research team on fundamental practices that must be incorporated into the new POP study. In addition, the use of surgical kits and frozen rat simulations provide necessary hands-on experience to properly perform implant surgery on the rat models. Further objectives for the research team are to acquire 1% and 10% concentrated silkABGs from BioAesthetics and Repliform for the implant surgery. Also, members of the team will need to shadow surgeons to learn how to properly perform the operation.

**References**

2. Fang Zheng, Yuan Lin, Eric Verbeeken, Filip Claerhout, Maxime Fastrez, Dirk De Ridder, Jan Deprest; Host response after reconstruction of abdominal wall defects with porcine dermal collagen in a rat model
3. Daniela Ulrich, Sharon L. Edwards, Jacinta F. White, Tommy Supit, John A. M. Ramshaw, Camden Lo, Anna Rosamilla, Jerome A. Werkmeister, Caroline E. Garnett; A Preclinical Evaluation of Alternative Synthetic Biomaterials for Fascial Defect Repair Using a Rat Abdominal Hernia Mode
4. Nicholas Bryan, Helen Ahswin, Neil Smart, Yves Bayon, Stephen Wohlert, John A. Hunt; The in vivo evaluation of tissue-based biomaterials in a rat full-thickness abdominal wall defect model

**Methods**

**Literature Review:**

Host response after reconstruction of abdominal wall defects with porcine dermal collagen in a rat model\textsuperscript{2}

The material evaluated in this study was Pelvicol\textsuperscript{TM} and Prolene\textsuperscript{TM} in Wistar rat model. A full-thickness defect surgical operation was performed on the rat models and repaired with either Pelvicol\textsuperscript{TM} or Prolene\textsuperscript{TM} sutures. A tensile load testing technique was used to determine the mechanical strength of the explant. In comparison, our POP research study will incorporate similar technique to test the mechanical durability of the silkABG explants using a planar biaxial mechanical testing device.

A Preclinical Evaluation of Alternative Synthetic Biomaterials for Fascial Defect Repair Using a Rat Abdominal Hernia Mode\textsuperscript{3}

This project focuses on addresses a similar problem as our POP research team, which is the inadequate use of synthetic mesh surgery as a response to pelvic fascial defects. In order to improve hernia repair treatment the team used polymers with different tensile properties to form three new warp-knitted synthetic meshes: polyetheretherketone (PEEK), polyamide (PA) and a composite mesh coated with gelatin referred to as PA (PA+G). The meshes were implanted in the female rat models and later explanted at Day 7 and Day 90. The explant was uniaxially tensile tested to determine that PA+G meshes were the stiffest. The mesh biocompatibility with host tissue was analyzed using histological and immunohistochemistry techniques to discover PA+G as the mesh with most tissue and cell growth.

The in vivo evaluation of tissue-based biomaterials in a rat full-thickness abdominal wall defect model\textsuperscript{4}

The longevity of a full thickness abdominal wall defect repair is essential to the success of treatment. This study focused on the long-term effects of implanting various biomaterial in a Wistar rat model over a 2 year period. The tissue- based implants examined were Surgisis TM, Strattice TM, Permacol TM, Alloderm, Patch A, and Patch D. In order for an implant graft to be effective as a repair treatment for POP, it must assimilate with the cells of the host and undergo histological testing. In this study the Surgisis TM graft was completely colonized within one month and sustained cell colonization within the rat model throughout the two-year duration of the experiment.

**Acknowledgements**

We thank the National Science Foundation for financial support of the SMART REU Program through grant DMR-1852274 and grant1R43 HD102296-01 (Pashos)