402-13-Tong-SyntheticBowel-ExecutiveSummary

Synthetic Small Bowel Model for Resident Training

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Globally, penetrating abdominal trauma results primarily from military actions and wars, with the majority due to gunshot wounds. In penetrating abdominal wounds, the small bowel has the highest incidence of perforation at 50% incidence. Small bowel trauma reparations like resection and anastomosis are commonly practiced on cadaveric horse and rodent bowel tissue. While animal tissue is useful because of its genuine anatomical attributes, samples can be costly, unavailable, and short-lived. With medical error being the third leading cause of death in the United States in 2013, residents and tenured surgeons cannot afford to translate animal tissue practice incorrectly to surgical procedures on humans.

Current products on the market that model the small bowel lack the proper shape or texture of human bowel, some even being made with fabric, and cost upwards of $375 and cannot be reused. In regards to market opportunity, the healthcare simulation market is predicted to reach $22.7 billion by 2021, aided by increased healthcare costs, technological advancements, and increased focus on patient safety. This product meets the demand for lower costs and would increase surgical readiness for medical professionals and improve patient safety. Therefore, this product has a wide appeal in the healthcare industry, especially in trauma units and in military hospitals where abdominal trauma is very common and preparedness is crucial to ensure the patient's survival.

The synthetic small bowel is made from Smooth-On silicone, a material that is employed regularly for anatomical simulations. An organic cotton fiber matrix models the muscularis layer of the small bowel, giving it the desired tensile properties. A novel Nesting Dolls fabrication method creates the annulus of silicone around the hollow interior of two nested PVC pipes. Preliminary testing was conducted to assess the efficacy of the small bowel model. Two surgical personnel from UW Hospital performed an anastomosis procedure on the prototype and answered a survey questionnaire. Additionally, six prototypes, from both the initial as well as improved design, underwent MTS testing. Data was then compared to the true mechanical properties of human small bowel.

MTS testing proved the bowel models, on average, were stronger than that of true small bowel, however, the surgical residents agree that this simulation provides accurate practice for skill assessment and maintenance and all in all consider it a valuable educational tool.

The product's design solves the current problems with synthetic bowel products: significant reduction in cost, use of more realistic materials, and increased anatomical accuracy. Anatomical accuracy was specifically improved by introducing a more compliant material, like that of small bowel tissue, and also implementing a mucosal lining that allows the practitioner to discern between two primary layers of small bowel. Practice and familiarity with different anastomotic scenarios are crucial to protect the long term safety and longevity of the patient, with patients showing four times the risk of mortality should they experience an anastomotic leak. The realistic practice and familiarity with the anastomosis procedure that our small bowel provides can decrease the mortality rate of a procedure that is carried out on both soldiers and civilians alike.