Prostate cancer affects 1 in 8 men in the United States, where around 60% undergo radical prostatectomy as treatment. Urinary incontinence is a very common side effect of the surgery, for which the AMS 800™ Artificial Urinary Sphincter (AUS) is the standard of care. However, the core design of this device has remained largely unchanged since 1972, and at 5–10 years post-implantation, approximately 50% of devices require surgical revision due to complications including fluid leakage, urethral erosion, device malfunction, and infection. This project aimed to address these persistent complications through two parallel approaches: the development of a validated benchtop testing model and the design of an improved urethral cuff. The benchtop model replicates male urinary physiology using MRI-derived, silicone elastomer bladder and urethral components, 3D-printed pelvic supports, and integrated sensors for real-time monitoring of bladder pressure and urine flow rate. A barometric pressure sensor was calibrated using a manometer setup across 59 pressure points, achieving an $R^2$ of 0.998, while a pulse-based flow sensor measured simulated urine flow rate. Both sensors were sampled at 10 Hz via Arduino-Python serial communication and validated across a simulated void cycle. In parallel, a new 15-chamber cuff design was proposed to address the localized high-pressure regions created by the current cuff, which contribute to urethral erosion and long-term device failure. The redesign aims to distribute urethral compression more uniformly, reduce tension on individual seams, and serve as a model for subsequent Finite Element Analysis (FEA). Future directions include physical fabrication and experimental validation of the cuff design on the benchtop model.