# MRI-Based Assessment of the Lower Urinary Tract Biomechanics During Voiding

Cody J. Johnson, BS[1]; Juan P. Gonzalez-Pereira, BS [2]; Maxwell Kounga[1]; Shane A. Wells, MD[1]; Wade A. Bushman, MD[3]; Alejandro Roldan-Alzate, PhD[1,2]
*[1]Radiology; [2]Mechanical engineering; [3]Urology – University of Wisconsin - Madison*

Background: Lower Urinary Tract (LUT) biomechanics during voiding has not been well studied. Diagnostic tools such as uroflowmetry, cystometry, and video urodynamics are invasive and limited in what they provide. Dynamic imaging during voiding using Magnetic Resonance Imaging (MRI) allows for non-invasive assessment of LUT anatomy and function. Therefore, the goal of this study was to implement an MRI-based urodynamics protocol for the comprehensive assessment of LUT biomechanics during voiding.

Methods: 5 healthy and 1 BPH patient were recruited. All scans were completed on a clinical 3T scanner (GE Healthcare, Waukesha, WI), using a dynamic MRI sequence. The subjects were equipped with a condom catheter to void in the scanner. Bladder lumen, and bladder wall were segmented from the images at each time step. Segmented volumes were used to calculate bladder wall thicknesses and bladder volumes and subsequently voided volume, flow rate, and post void residual. Bladder voiding prolapse distance, bladder neck angle (BNA), urethral length, urethral diameter, prostate volume, and prostatic urethral angle were measured.

Results: All subjects were able to void in the scanner. The voids varied, as the total volume voided, post void residual, and maximum flow rates ranged between 91-597cc, 10-599cc, and 4-24cc/s, respectively. All subjects' bladder prolapsed inferiorly at an average of 12.8mm before returning after the void. The BNA decreased an average of 20.3° during this prolapse.

Conclusion: This non-invasive, comprehensive MRI protocol was successfully implemented to evaluate LUT anatomy, function, and biomechanics throughout the voiding cycle in a safe, accurate, and reproducible way.