

# OP22

## THE GEOMETRY OF A BLADDER CONTRACTION: TECHNIQUES FOR BLADDER SHAPE MEASUREMENT DURING ULTRASOUND URODYNAMICS (BlaST)

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### Background

Bladder Shape Test(BlaST) is a novel conceptual urodynamic modality designed to measure the shape of the bladder during filling as a marker for involuntary detrusor contraction. Reliable and reproducible techniques for quantifying changes in bladder shape will be essential for the utility of this novel test. We aimed to evaluate different approaches to measure bladder shape during bladder filling.

### Methods

Multiple ultrasound images of the bladder in transverse plane were captured from 72 women who underwent BlaST during feasibility studies. Methods developed to assess bladder shape were compared with intra and inter-observer reliability, correlation co-efficient and inter-metric variability.

### Results

Three techniques used measurements following manual tracing of the bladder outline. The 'AB' method utilised division of height(a) by width(b) to derive a ratio. Inner and outer 'circles of best-fit' and subsequently 'ellipses of best-fit', whereby the area of the inner circle or ellipse was divided by the area of the outer circle or ellipse, produced a ratio, termed 'sphericity quotient'(SQ). Of these the ellipses of best fit method had the best inter-rater and intra-rater reliability and was adopted.

Automated SQ has now been developed, utilising angular analysis, reducing time and error in this calculation. Computed SQ strongly correlated with manual SQ measurement( $r=0.997$ ). Angular analysis was also used to evaluate curvature, measuring the gradient of each section of the bladder and change in gradient between adjacent sections, enabling the derivation of 'curvature quotient'(CQ) and 'gradient quotient'(GQ). These correlated strongly with computed SQ( $r=0.87$ ). A further method under evaluation is Fourier analysis, which aids measurement by breaking down complex shapes into constituent simple shapes, aiding measurement.

### Conclusion

Whilst further work and evaluation is required, sphericity quotient(SQ) appears to offer a reliable and reproducible technique for bladder shape analysis. Developing machine learning for these techniques may be aided significantly by integrating Fourier analysis.

### Reference:

Gray T, Phillips L, Li W, Buchanan C, Campbell P, Farkas A, Abdi S, Radley S. Evaluation of bladder shape using transabdominal ultrasound: feasibility of a novel approach for the detection of involuntary detrusor contractions. *Ultrasound*. 2019;27(3):167-75.