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WEAKENED LEVATOR ANI AND URETHRAL HYPERMOBILITY IN WOMEN

Hypothesis / aims of study

Urethral hypermobility results from weakening of urethral-supporting structures leading to downward displacement and rotation of the urethra. However the relative importance of each anatomical structure of the female pelvic floor in contributing to the urethral hypermobility remains unclear. Our goal is to utilize a computational modelling approach to simulate the urethral hypermobility in a Valsalva maneuver to better understand the role of each anatomical structure of the female pelvic floor in the urethral-supporting function. This model investigates the specific role of the Levator Ani muscles in relation to the urethral hypermobility.

Study design, materials and methods

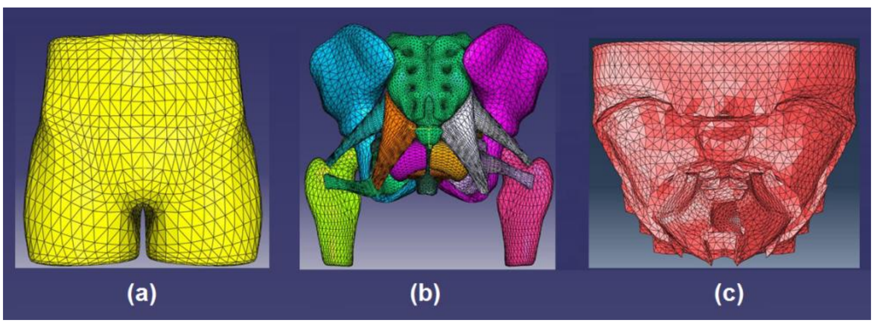

Fig 1: (a) Subject-specific pelvic model; (b) Anatomical structures of the pelvic floor of the pelvic model; (c) Body fill part of the pelvic model.

An asymptomatic subject-specific pelvic model (Fig 1a) was developed from a female subject's MR images. Detailed anatomical structures (Fig 1b) of the female pelvic floor were incorporated in the pelvic model to investigate the role of each structure in urethral supporting. A weakened pelvic model was formed based on the asymptomatic model by weakening the Levator Ani (decrease the elastic modulus from 2.4MPa to 0.1MPa). An intra-abdominal pressure of 100 mm Hg was utilized as the model input, via a specifically designed model part, body fill (Fig 1c), to simulate the Valsalva maneuver. Dynamic urethral mobility was generated utilizing a dynamic biomechanical analysis method based on the asymptomatic and weakened pelvic models.

Results

Fig 2 shows the maximum deformation of the urethra and bladder achieved from the Valsalva simulation based on the asymptomatic and weakened pelvic model. The urethral angle changes are 6.7 and 24.3 degrees respectively. The dynamic response of the bladder neck and urethra of this subject indicated her urethral mobility was also achieved utilizing the dynamic biomechanical analysis method, but could not be shown here. A video will be presented at the ICS conference to demonstrate the capability of the subject-specific pelvic modelling approach in dynamically simulating the biomechanical responses induced by IAP changes.

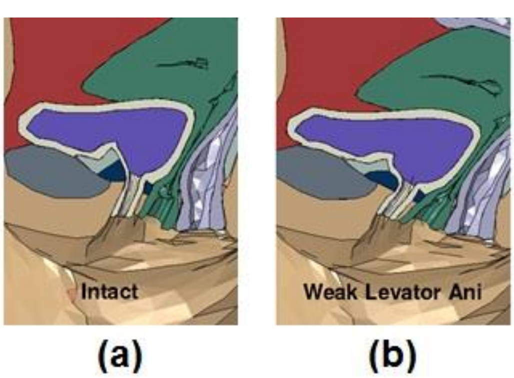

Fig 2: Deformation of the Urethra and bladder achieved from Valsalva simulation based on (a) the asymptomatic pelvic model and (b) the pelvic model with weakened Levator Ani.

Interpretation of results

The urethral angle change in the pelvic model with weakened Levator Ani is remarkably larger than that in the asymptomatic pelvic model (24.3 vs. 6.7 degrees) in the same Valsalva maneuver, which indicates the generation of the urethral hypermobility. A future parametric study will be conducted to assess the role of other pelvic floor structures in the urethral-supporting function.

Concluding message

The results demonstrate that the Levator Ani play a critical role in urethral-supporting which is associated with the urethral hypermobility.

Disclosures

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