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IS THERE AN ASSOCIATION BETWEEN LEVATOR FUNCTION OR MORPHOMETRY AND THE ABILITY TO AUGMENT MAXIMUM URETHRAL CLOSURE PRESSURE VOLUNTARILY?

Hypothesis / aims of study
Activation of the urethral rhabdosphincter and of the levator ani muscle, whether voluntarily or reflexly, is thought to contribute to stress continence. It is generally assumed that women are able to voluntarily augment intra-urethral pressure by contracting those muscles, but there is no data on whether this pressure increase is due to factors intrinsic to the urethra or extrinsic, e.g. compression of the urethra due to contraction of the levator ani. This study was designed to test whether women with symptoms of pelvic floor dysfunction can augment maximum urethral closure pressure (MUCP), and whether augmentation is associated with structure and function of the levator ani muscle.

Study design, materials and methods
Between January and December 2009, 300 women attended a tertiary referral service for multichannel urodynamic testing (Neomedix Acquidata) and 4D pelvic floor ultrasound (GE Kretz Voluson 730 expert). The MUCP was obtained with a perfused fluid- filled catheter with a freehand pull- through technique. Augmented MUCPs were obtained during directed pelvic floor muscle contraction (PFMC), after confirmation of technique (and, if necessary, teaching) by visual inspection of the perineum. Twenty- five patients did not have an MUCP performed due to technical problems or operator error. Levator contraction strength was assessed digitally, using the Modified Oxford Grading (MOS), in 297 women. Levator integrity was determined using tomographic ultrasound as previously described (1). A patient was rated as positive for avulsion of the puborectalis muscle if the plane of minimal hiatal dimensions as well as slices 2.5 and 5 mm cranial to that plane all showed an abnormal muscle insertion, with a levator urethra gap measurement over 2.5 mm. The first author determined hiatal dimensions at rest and on PFMC, as previously described (2). A reduction in anterioposterior dimensions of the levator hiatus on PFMC was taken as evidence of vaginal and urethral compression. All data to be compared to MUCP values was obtained blinded against MUCP data.

Results
A test-retest series of 52 augmented MUCP measurements showed good repeatability (ICC 0.922, CI 0.869 to 0.955) for single measurements. A test- retest series for hiatal biometry also demonstrated excellent repeatability, consistent with multiple previous reports, with an ICC of 0.957 (0.914- 0.977 for hiatal diameters (n=42) and 0.94 (0.735- 0.98) for area (n=21). Mean age of study participants was 56 years (21-90). Body mass index was on average 29 (18-59). Patients presented with stress incontinence (n=221, 74%), urge incontinence (n=206, 69%), frequency (n=82, 27%), nocturia (n= 138, 46%), symptoms of voiding dysfunction (n=82, 27%) and/ or symptoms of prolapse (n=145, 48%). Ninety-two percent (n=276) were vaginally parous, 98 had had a previous hysterectomy (33%), and 69 a previous incontinence or prolapse procedure (23%). On clinical examination, 64% (n=192) showed a significant prolapse (ICS POP-Q stage 2+). This was a cystocele in 39% (n= 117), uterine prolapse in 9% (n=18), an enterocele in 3% (n=9) and a rectocele in 44% (n= 131). MOS grading yielded a mean of 2.3 on the right and 2.4 on the left (range, 0-5 bilaterally). Levator defects were diagnosed on tomographic ultrasound in 24% (n= 71), which were on the right in 21%, on the left in 13% and bilateral in 11%. Hiatal biometry demonstrated a mean reduction of the sagittal hiatal diameter of 6.1 (SD 7.1) mm on PFMC, of the coronal diameter of 2.4 (SD 6.1) mm, and of hiatal area of 2.8 (SD 4.65) cm2. On multichannel urodynamics, 197 (66%) were diagnosed with urodynamic stress incontinence, 83 (28%) with detrusor overactivity, and 106 (36%) with voiding dysfunction. The MUCP was measured at a mean of 36 cm H2O (range, 2-111). Augmented MUCP was 42 cm H2O on average (4-125). Of those who attempted augmentation (n= 275), 80 produced a reduction in MUCP and were excluded, leaving 195 women. All further analysis pertains to those 195 datasets. Median augmentation was 8 cm H2O (IQR, 4-17). MUCP augmentation data was not normally distributed and analysed with Spearman's correlation. There was no correlation between reduction in hiatal diameters or area and MUCP augmentation. However, we did find a significant correlation between MOS (21- point scale) and augmentation (r= 0.24, P= 0.001), see Figure 1. When avulsion status was tested against augmentation, women with intact muscle were able to augment more effectively (9.1 cm H2O vs. 12.8 cm H2O, P= 0.038).

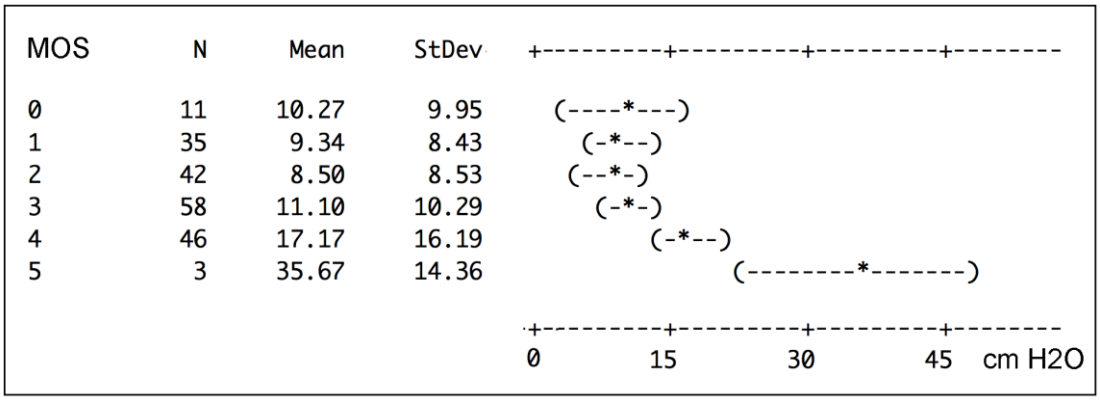

Figure: Mean Oxford Grading against MUCP augmentation on pelvic floor muscle contraction (n= 195).

Interpretation of results

Urethral closure pressure can be augmented voluntarily by symptomatic patients, on average by about 8 cm H2O which equates to about 20%. The degree of augmentation is positively associated with MOS grading of levator contractility and negatively with levator avulsion, confirming data obtained on MR imaging (3). This implies that augmentation of MUCP is (at least) partly due to levator ani contraction.

Concluding message

Contraction of the levator ani may contribute to maximal urethral closure pressure. However, this effect seems to be limited.

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Is this a clinical trial?	**No**
What were the subjects in the study?	**HUMAN**
Was this study approved by an ethics committee?	**Yes**
Specify Name of Ethics Committee	**SWAHS HREC**
Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**No**