

PELVIC FLOOR MUSCLE (PFM) ACTIVITY AS A PREDICTOR OF STRESS URINARY INCONTINENCE (SUI)

Hypothesis / aims of study

To determine whether the function of the PFM is significantly different in continent women compared with women with SUI as indicated by trajectory, velocity, acceleration and displacement of urogenic structures during manoeuvres that elicit either a voluntary or involuntary contraction of the PFM.

Study design, materials and methods

Data were obtained from 22 continent women, age 41.1 \pm 13.6yr, (parity 0.4 \pm 0.9) and 9 SUI women age 47.9 \pm 13.2 yr, (parity 1.6 \pm 0.7) recruited according to an IRB approved protocol. Investigators were blinded to the continence state of the volunteers. A preliminary examination assessed the ability of the volunteers to elicit all 5 manoeuvres. Volunteers were imaged using a Hitachi EUB-52 ultrasound scanner (Hitachi, Japan) connected to a 128 element high definition linear array operating at 3.4-5.0 MHz. The transducer was placed on the perineum in a mid sagittal orientation. Volunteers performed a voluntary PFM, a Transversus Abdominis (TrA) contraction, a valsalva, the knack, and a cough in supine crook lying and standing.

Video recordings of the imaging and audio signals were recorded on a PC using a USB capture card and stored uncompressed in AVI format for off line analysis. A reliable image processing system described previously (1) was used to accurately map the trajectory of the urogenital tissues during the manoeuvres. The coordinate system is fixed during the manoeuvre, so when the subject deforms the bladder and urethra, the coordinate system will maintain its original position and the ensuing trajectory of Ano Rectal Angle can be measured relative to this fixed axis. Puborectalis and Pubococcygeus wrap around the anorectal junction, and its displacement, and the change in ARA is closely associated with a PFM contraction.

Statistical comparisons, using the T-test, were performed to evaluate the level of significant differences of the trajectory of displacement, velocity and acceleration during the manoeuvres and also to compare the effects of a change, between standing to supine within each group. Values are quoted as mean and Standard Error (SE).

Results

Statistically significant differences were found in each manoeuvre when comparing continent controls to SUI women, ranging from P<0.0001 during a cough to P=0.03 during a voluntary PFM contraction. The differences in trajectories are described in Figure 1 below.

Interpretation of results

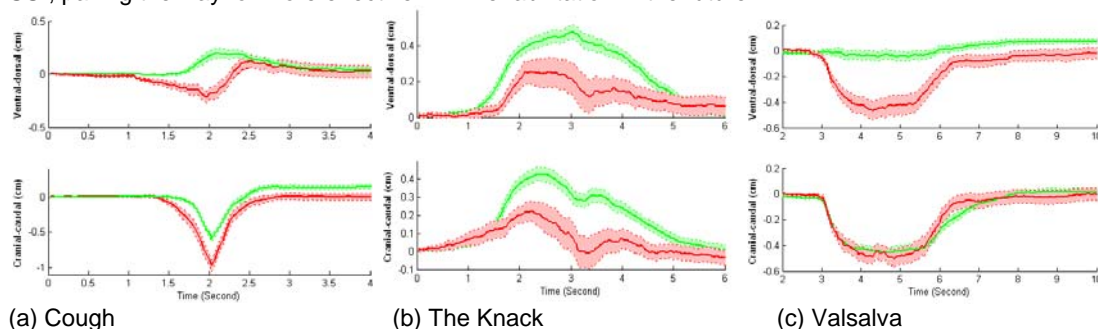
There is much to interpret and describe within each manoeuvre, however as a whole, these results indicate that although strength of PFM contraction does not always correlate with continence state, how the PFM functions during these manoeuvres clearly distinguishes between continent and incontinent women. During the cough, as IAP increases, the PFM of continent women initially contracts producing a ventral movement towards the urethra and pubic symphysis. They act like a brake to limit the caudal-dorsal shearing force of the urogenital structures, reducing the acceleration and velocity through increases in intra-abdominal pressure. This brake is applied late or has diminished effectiveness in SUI women.

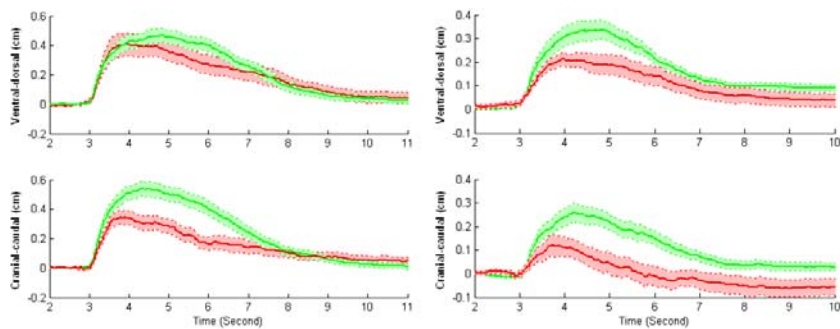
In a PFM and TrA contraction, there is greater displacement of the ARA in a cranio-ventral direction compared to SUI women, indicating increased support of the urogenital structures towards the pubic symphysis, which is more likely to increase the intra-urethral pressure. In the knack, the continent women are more able to maintain this cranio-ventral shift during the cough component, creating less shear on the urogenital structures. Our data also indicates that the PFM work very differently during a cough than in the knack, and indicate that one mechanism of the knacks' effectiveness in rehabilitation of women with SUI is that it significantly limits the degree of dorsal shear, velocity and acceleration of urogenital structures during rises in IAP.

Finally, during a valsalva, the PFM of continent women, maintain a slight ventral displacement of the urogenital structures towards the pubic symphysis, which is lost in women with SUI. The two groups have a similar caudal displacement and highlights why urethral hyper mobility is often seen in both groups, yet the direction of displacement is significantly different (p<0.001).

Concluding message

2D ultrasound analysis with motion tracking of the ARA provides clear evidence to how the PFM play a vital role in the continence mechanism. Furthermore it gives us greater understanding of the varying dysfunctions that occur in SUI, paving the way for more effective PFM rehabilitation in the future.





(d) PFM contraction

(e) TrA contraction

Figure 1 ARA movement during the described manoeuvres. The continent subject and the SUI patient are shown in green and red respectively. The SE of the movement is marked by the coloured areas.

References

(1) Neurourology and Neurodynamics 2006

FUNDING: None

CLINICAL TRIAL REGISTRATION: This clinical trial has not yet been registered in a public clinical trials registry.

HUMAN SUBJECTS: This study was approved by the Stanford IRB and followed the Declaration of Helsinki Informed consent was obtained from the patients.