

EFFECT OF “THE KNACK” ON THE PELVIC FLOOR: EVALUATED BY 2D REAL TIME ULTRASOUND AND IMAGE PROCESSING METHODS.

Hypothesis / aims of study

The purpose of this current study was to gain greater understanding of the mechanisms of “The Knack”, describing the kinematic properties of the pelvic floor (PF) in continent and stress urinary incontinent (SUI) women by measuring the displacement, velocity and acceleration of the ano-rectal angle (ARA) and the urethra. We hypothesised that during “The Knack”; there would be less dorso-caudal displacement, velocity and acceleration of the urethra in continent women than in women with SUI.

Study design, materials and methods

With an ultrasonic transducer placed on the perineum in a mid sagittal orientation, 32 women performed “The Knack” with the command “Squeeze around the back passage, as if you were trying to prevent breaking wind (flatus); bring that feeling forward towards the urethra/pubis bone and then lift, as if you were elevating the PFM. Whilst holding this contraction, cough as hard as you can”. Video recordings of imaging signals were recorded on a PC for off-line analysis. Methods for the reliable novel image analysis have been reported^(1,2) and operators were blinded to the continence status of the volunteers. Statistical comparisons using one-tailed unpaired T-tests, were performed to evaluate the mean values (+SD) and level of significant differences at the maximum caudal displacement and where appropriate, maximum or minimum values irrespective of time. Welch’s correction was applied where the variances were unequal, and a level of $P < 0.05$ was considered significant.

Results

ARA and urethral displacements, velocities and accelerations were normally distributed and the general demographics of the study population are described in Table 1.

	Age	Parity	Body Mass Index	Continence Severity Scale ⁽³⁾
Continent (N=23)	41.1± 13.6	0.4±0.9	22.4 ±1.99	Continent
SUI (N=9)	47.9 ± 13.2	1.6±0.7	25.0 ± 4.11	5 slightly incontinent 4 moderately incontinent

Table 1: General demographics of study population

Displacement: There are significant differences in both the direction and magnitude of displacement of the ARA and urethra during a knock between groups (Figure 1). In the initial PFM component of “The Knack”, the ARA of the continent group has significantly more ventral displacement than that of the SUI group ($P=0.02$) and unlike the ARA of the SUI group, the continent group is able to maintain most of its ventral displacement throughout the cough part of the manoeuvre. There is also over twice as much displacement of the urethra in the SUI groups ($1.10 \pm 0.12\text{cm}$) compared to the continent group ($0.51 \pm 0.19\text{cm}$) ($P < 0.0001$). In addition, there is significantly more ($P < 0.05$) initial ventral displacement of the posterior edge of the urethra in the continent ($0.42 \pm 0.21\text{cm}$) than in the SUI group ($0.26 \pm 0.14\text{cm}$). Cranio-caudally the overall displacement pattern is more similar but there are significant differences in magnitude of displacement of both the ARA ($P < 0.01$) and urethra ($P < 0.0001$). Through the cough part of “The Knack”, both groups lose much of the caudal displacement created by the PFM component of “The Knack”, although the ARA of the SUI group descends over twice the distance of the ARA of the continent group.

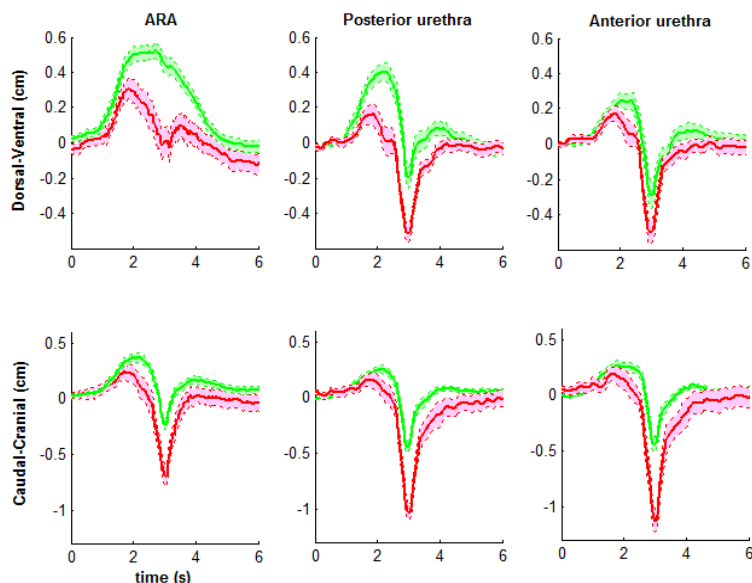


Figure 1: Comparison of the ventro-dorsal and cranio-caudal displacements of the ARA, and both edges of the urethra during “The Knack” in supine continent (green line) and SUI (red line) women. The shaded area represents the Standard Error.

Velocity and Acceleration:

In the caudal-cranial direction, the maximum velocity and accelerations of the ARA and urethra of the SUI women are significantly greater than that of the continent group. In the dorsal-ventral direction, the maximum velocities and accelerations are more similar, although in the time periods 0.5 seconds before and after the synchronisation point at the maximum caudal displacement, the ARA of the continent group moves with a significantly slower velocity in the ventro-dorsal direction ($P < 0.05$).

Interpretation of results

Although there is no physiological reasons why women without PF dysfunction would need to perform “The Knack”, comparing the manoeuvre between groups does help to understand how the PF of continent women differs to that of women with SUI. The displacement of the ARA through the PFM contraction component of “The Knack” illustrates the significantly greater ventral displacement of the continent group compared to the SUI women, and their ability to maintain this ventral shift through the cough component. This, along with a reduced caudal displacement, illustrates how the PFM of continent women are better able to resist the force created by a cough, and implies greater stiffness of the PF. The PFM contraction also results in a significantly greater ventral displacement of the posterior edge of the urethra in the continent compared to the SUI group and there is significantly less displacement of this edge throughout the cough component of “The Knack”. In the continent group, during the cough component, there is less overall displacement of the posterior edge compared to the anterior edge, especially in the dorsal direction. In continent women, there are also no differences in the amount of caudal displacement in the urethral edges. Given the comparatively reduced fascial attachments of the posterior edge with respect to the anterior edge, it supports the hypothesis that the PFM in the continent group provide greater support to the urethra than the SUI group. In addition, in the SUI group, there is slightly greater displacement of the posterior edge than the anterior edge in the dorsal direction.

Concluding message

There is less dorso-caudal displacement, velocity and acceleration of the ARA and urethra in continent women than in women with SUI consequent to “The Knack” which highlights the greater stiffness and control of the PFM and urethra in continent women.

References

1. Annals of Biomedical Engineering (2006) 34; 477-493
2. Ultrasound in Medicine & Biology (2007) 33; 342-352
3. Neurourol Urodyn (2006) 19 137-45

<i>Specify source of funding or grant</i>	This work was funded in part by NIH, grant 1R21 EB001654-1
<i>Is this a clinical trial?</i>	No
<i>What were the subjects in the study?</i>	HUMAN
<i>Was this study approved by an ethics committee?</i>	Yes
<i>Specify Name of Ethics Committee</i>	The Institutional Review Board (IRB) of Stanford University, California, USA
<i>Was the Declaration of Helsinki followed?</i>	Yes
<i>Was informed consent obtained from the patients?</i>	Yes