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COMPARISON OF ""THE KNACK"" AND A COUGH ON THE PELVIC FLOOR: EVALUATED BY 2D REAL TIME ULTRASOUND (RTUS) AND IMAGE PROCESSING METHODS.

Hypothesis / aims of study

The purpose of this study was to determine the differences in the response of the pelvic floor to stress due to coughing and in the presence of pre-contraction or "The Knack"[(1)] Secondly, this study was designed to gain greater understanding of the immediate benefits of ""The Knack"" as a rehabilitation tool. We hypothesised that in SUI women the displacement, velocity and acceleration of the urethra during ""The Knack"" would be comparable to the properties of continent women coughing without the benefit a PFM pre-contraction.

Study design, materials and methods

With an ultrasonic transducer placed on the perineum in a mid sagittal orientation, 32 volunteers performed a cough and ""The Knack"", the order of which was randomised. "The Knack" was verified earlier by digital palpation and elicited 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/pubic 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 [(2,3)] and operators were blinded to the continence status of the volunteers. Mean and Standard Deviation (SD) of the displacement, velocity and acceleration were calculated and presented graphically. The graphs are aligned at the maximum caudal displacement. 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

The wave forms produced from a cough and a knack demonstrates equivocally that it is very possible to differentiate between the two manoeuvres, predominately by reference to the initial cranio-ventral displacement of the ARA and urethra in "The Knack", which is absent during a cough (Figure 1)..

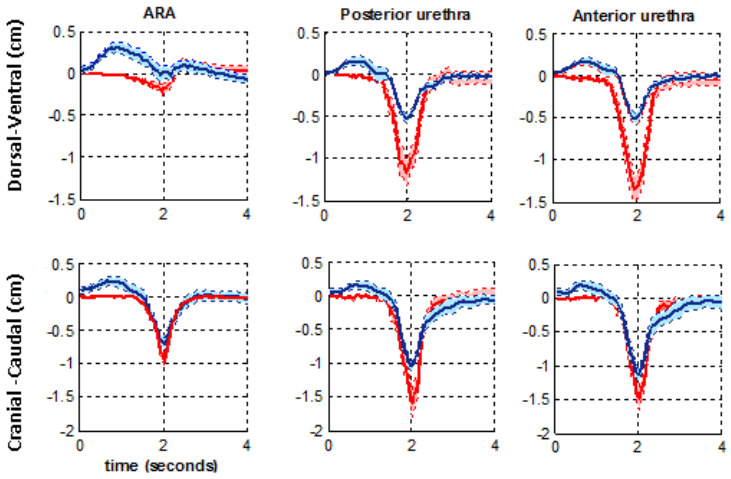

Figure 1: Comparison of the ventro-dorsal and cranio-caudal displacements of the ARA, and both edges of the urethra during a cough (red line) and "The Knack" (blue line) in SUI women. The shaded area represents the Standard Error (SE).

Comparing the displacement produced by a cough from continent women to "The Knack" from a woman with SUI highlights the immediate change in the behaviour of the ARA and urethra that could occur when a PFM pre-contraction is added to a cough during a rehabilitation programme for SUI (Figure 2).

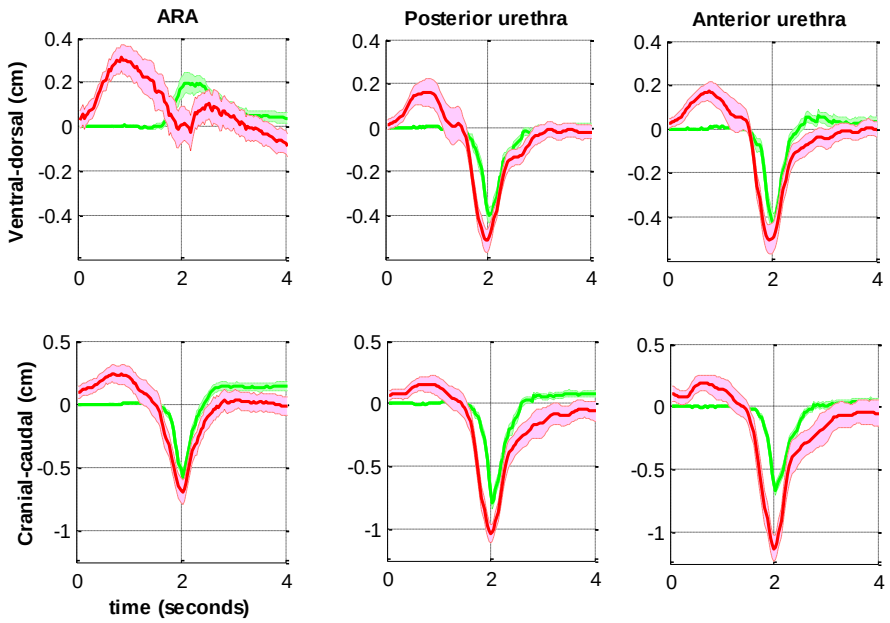

Figure 2: Comparison of the ventro-dorsal and cranio-caudal displacements of the ARA, and both edges of the urethra in supine during a cough in continent (ARA n = 23; urethra n = 23; green line) and "The Knack" in SUI (ARA n = 9; urethra n = 9; red line) women. The shaded area represents the Standard Error.

Although there is more initial ventral displacement of the ARA in the SUI group during ""The Knack"" in comparison with the cough from the continent group; the ARA of the SUI group loses almost all this ventral displacement during the cough component of "The Knack", whereas the continent women sustain the ventral displacement until the end of the manoeuvre. The dorsal displacements of the urethra between groups are very similar and the overall cranial displacement of the ARA and posterior edge show little difference between the two manoeuvres. In the caudal direction (Y) and overall displacement (R) of the anterior edge of the urethra there is significantly greater displacement in the SUI compared to continent groups (P=0.004 and P=0.08 respectively), although the velocities and accelerations are similar.

Interpretation of results

There is evidence to suggest that the PF of SUI women is more compliant than that of continent women[3], yet the addition of an active PFM contraction prior to and during a cough, is sufficient to generate a stabilization of the urethra and consequently reduce its motility, velocity and acceleration to values comparable of a continent women coughing. However, during "The Knack" in SUI women, even with the addition of a PFM contraction, the anterior edge of the urethra is still displaced significantly more caudally than that of a continent woman coughing. This may provide an explanation to why some women with SUI fail to significantly reduce leakage volume with the use of "The Knack" manoeuvre and that the addition of an active PFM contraction maybe insufficient to adequately compensate for significant fascial or ligamentous injury.

Concluding message

Our methodology is specific enough to be able to distinguish between "The Knack" and the cough, and we have been able to describe significant differences between the behaviour of both the urethra and ARA of continent and SUI women. This study highlighted the basis of the immediate benefits reported using "The knack" as a rehabilitation tool, and it illustrates the potential of image processing methodology to quantify the effect of a treatment. As such this approach can be used to predict whether conservative intervention may be indicated.

References

1. Obstet Gynecol. (2001) 97: 255–260
2. Annals of Biomedical Engineering (2006) 34; 477-493
3. Ultrasound in Medicine & Biology (2007) 33; 342-352

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Was this study approved by an ethics committee?	**Yes**
Specify Name of Ethics Committee	**The Institutional Review Board (IRB) of Stanford University**
Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**