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Murphy C, Sherburn M, Allen T
The University of Melbourne

INVESTIGATION OF TRANSABDOMINAL DIAGNOSTIC ULTRASOUND AS A CLINICAL TOOL AND OUTCOME MEASURE IN THE CONSERVATIVE MANAGEMENT OF PELVIC FLOOR DYSFUNCTION.

Aims of Study

Clinical measurement of pelvic floor dysfunction commonly uses measures, which are both physically and psychologically invasive to the patient. Recently diagnostic ultrasound has been investigated as a tool to image the pelvic floor using a transperineal approach (1,2). However, to date, no published material has investigated the totally non-invasive (neither internal or perineal) application of ultrasound to examine pelvic floor activity.

The aim of this study was to investigate the transabdominal application of diagnostic ultrasound as a non-invasive clinical tool to image pelvic floor activity. A series of studies was undertaken to :

1. establish the face validity of ultrasound derived displacement measures of the pubocervical fascia as a reflection of pelvic floor muscle contraction
2. establish the reliability of ultrasound derived measures of the pubocervical fascia resulting from a pelvic floor muscle contraction between raters and between testing occasions
3. investigate if any difference in ultrasound displacement measures existed between three cohorts of adult subjects with assumed differences in the mechanical properties of their pelvic fascia: nulliparous females, parous females and males.
4. establish any limitations which this clinical tool may have.

Methods

Non-pregnant adult female subjects aged 18 to 60 years were recruited for the series of studies and 20 adult males for the fascial study. No exclusions were made other than being able to consent to the study and perform a pelvic floor muscle contraction. All subjects completed a questionnaire to obtain a medical, surgical, obstetric and gynaecological history, and lifestyle and mechanical stressors related to the condition of their pelvic fascia. Subjects underwent a bladder filling protocol prior to ultrasound testing. Subjects were tested in lying with a 3.5MHz 35mm curved linear array ultrasound transducer placed on the subject's lower abdomen to image the pelvic floor. Subjects then performed maximum voluntary pelvic floor contractions according to the protocol for each study.

1. Subjects performed a maximal voluntary pelvic floor muscle contraction while digital vaginal palpation and transabdominal ultrasound was simultaneously undertaken. The first investigator confirmed a correct contraction and graded the strength of the contraction. The second investigator recorded the ultrasound images of the same contractions.
2. Subjects who could consistently perform ten pelvic floor muscles contractions were tested on two occasions and by two investigators, with the testing randomised to avoid order effects.
3. Sixty subjects (20 per cohort) were tested on one occasion by one investigator

Images were taken in both sagittal and transverse planes. Contraction images were captured and the displacement of the pubocervical fascia measured using electronic callipers on the ultrasound monitor screen. All contractions were held for 2 seconds with rests of 10 seconds and the average of three measurements used for data analysis. Results were entered into computer storage and analysed using statistical software.

Results

Study 1. In all ten subjects, a correct pelvic floor muscle contraction was confirmed on palpation, with consistent direction of movement observed on ultrasound imaging. The direction of the imaged displacement was in agreement with the direction of movement palpated by the first investigator. Digital strength grading did not correlate with ultrasound derived displacement measures in either transverse or sagittal planes ($r = 0.18$, $r = -0.29$).

Study 2. Intraclass correlation (ICC) values with 95% confidence intervals (CI) calculated for both sagittal and transverse planes. ICC's for inter-rater reliability ranged between 0.92 and 0.94, and for intra-rater reliability

between 0.79 - 0.93.
Study 3. Univariate ANOVA F values showed no statistically significant difference between the three subject groups. Sagittal plane results were $F(2,57) = 2.779$; $p = 0.071$, transverse plane results were $F(2,57) = 1.510$; $p = 0.230$. Comparison of parous females and nulliparous females almost reached significance $F(1,38) = 4.265$; $p = 0.046$ in the sagittal plane results.

Conclusions

The most significant outcome of this research is that transabdominal application of diagnostic ultrasound to image and assess pelvic floor muscle activity has shown a high level of reliability and validity, while remaining totally non-invasive. This clinical tool does not assess all aspects of the function of the pelvic floor as shown by the poor correlation between digital strength grading and ultrasound displacement measures. However, there is currently no assessment tool or outcome measure that does. This study has opened up possibilities for future research to establish normative data and further clinical applications for this tool.

References

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2. Dietz HP, Clarke B, Wilson PD (1998) A new method for quantifying levator activity and teaching pelvic floor exercises. *Neurourology and Urodynamics* 17:436–437.