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Title (type in CAPITAL LETTERS, leave one blank line before the text):

TRANSVAGINAL ULTRASOUND IMAGING OF THE PELVIC FLOOR; VALIDATION OF A NEW TECHNIQUE.**Aims of Study.**

Recent improvements in ultrasound imaging of the pelvic floor musculature have allowed new insight and reopened debate into the functional anatomy of stress incontinence and pelvic organ prolapse. Objective changes in the musculature and fascial supports of the pelvis, which are important in pelvic floor dysfunction, have previously been described using ultrasound.¹ The aim of this study was to assess reproducibility and to establish a normal range of values for the levator musculature and levator hiatus during the third trimester of pregnancy in primiparous women.

Methods.

Primiparous women were recruited from the antenatal clinic between 32 and 42 weeks of pregnancy. Women were placed in the lithotomy position with a comfortably full bladder. A transvaginal scan was performed at rest using a 7.5MHz mechanical sector endoprobe. The levator ani were visualised at the level of the bladder neck such that the pubococcygeus muscle was seen in its entirety. The levator hiatus was measured transversely in three planes; at the level of the urethra where the pubococcygeus appeared to meet the pubic bone (1), midvagina (2), at the level of the rectovaginal septum (3) and in the longitudinal plane (L) in the midline (Figure 1). The surface area of the levator hiatus was mapped using a rollerball. Measurements were repeated by a second observer blinded to the first recorded measurements. Analysis was performed using limits of agreement².

Results.

114 women were recruited to the study. In order to assess reproducibility a subset of 11 women were reanalysed by a second observer who repeated all of the measurements. The results are given below (Table 1.) in addition to the mean and standard deviation of the differences thus establishing a normal range of values.

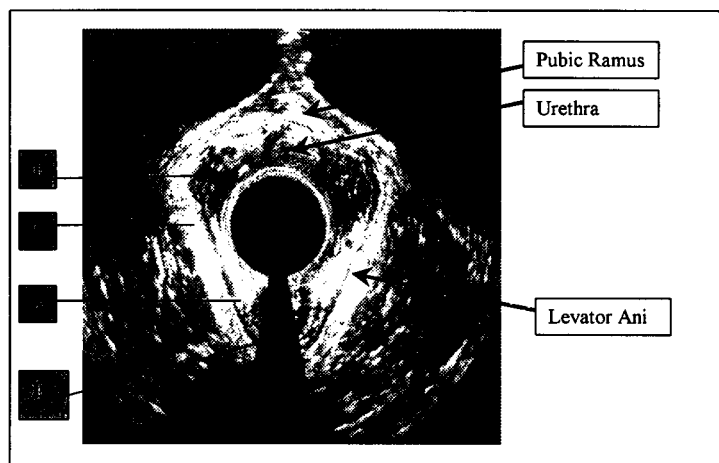


Figure 1.

Table 1.

	Number	Mean	5 th Centile	95 th Centile	Mean of differences	SD. Of differences
Width 1	11	32.85	24.84	44.16	0.76	1.10
Width 2	11	33.81	28.04	39.69	0.02	1.66
Width 3	11	28.59	18.36	28.37	0.13	1.14
Length	11	52.90	40.56	67.81	0.70	1.34
Surface Area	11	14.50	11.83	21.83	0.26	0.42

Conclusions.

This study demonstrates that transvaginal ultrasound of the pelvic floor offers an accurate, non-invasive method of assessing the levator ani and levator hiatus. In addition a normal range of values have been described and the reproducibility has been confirmed. Although still a research tool at present it may be useful as a tool to better understand the aetiology of stress incontinence and pelvic organ prolapse. This technique in the future may have a role in the prediction of lower urinary tract symptoms post-partum.

¹ Br. J. Obstet Gynaecol. 1992; 99: 310–313.

² Practical statistics for medical research. Chap 14. Chapman and Hall. ISBN 0412 27630 5.

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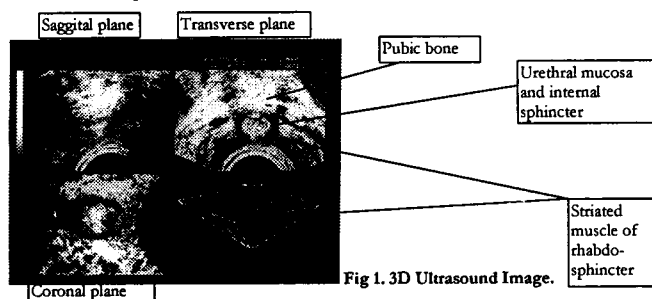
Institution, city, country:
KINGS COLLEGE HOSPITAL, LONDON, UK.

Title (type in CAPITAL LETTERS, leave one blank line before the text):

THREE-DIMENSIONAL ULTRASOUND: A NOVEL TECHNIQUE FOR ASSESSING THE URETHRAL SPHINCTER.

Aims of Study. The development of stress incontinence is known to be associated with intrinsic sphincter incompetence¹ and bladder neck hypermobility². Ultrasound offers the opportunity to image and assess the urethral sphincter³. A decrease in sphincter volume using three-dimensional ultrasound has been associated with stress incontinence. The aim of this study was to establish a normal range of values for the urethral sphincter during the third trimester of pregnancy in primiparous women using a novel three-dimensional ultrasound technique. The reproducibility was assessed and the results compared to calculated volumes using two-dimensional ultrasound measurements.

Methods. Primiparous women were recruited from the antenatal clinic between 32 and 42 weeks of pregnancy. Women were placed in the lithotomy position with a comfortably full bladder. A three dimensional transvaginal ultrasound scan of the urethra was performed using a Kretz Combison 530 machine with a 7.5 MHz mechanical sector probe which allowed simultaneous viewing of the sagittal, transverse and coronal sections.



These images were then computer regenerated into a three dimensional picture. The urethral endothelium and submucosal vascular plexus were demonstrated by a hyperechogenic core and the rhabdosphincter as a surrounding incomplete hypoechoic band (Fig.1). Length and cross-sectional area were measured allowing the rhabdosphincter volume to be calculated. Analysis was performed using limits of agreement.

Results. 114 women were recruited and the urethral parameters are shown below (Table 1). Indirectly calculated volumes (2D scan) were compared with directly measured volumes (3D scan) using the standard error of the mean (Table 2) and found to reach significance.

	Number	Mean	5 th centile	95 centile
Urethral sphincter length	100	19.5 mm	15.70 mm	23.30 mm
Sphincter diameter	110	12.4 mm	10.00 mm	14.89 mm
Sphincter surface area	110	1.26 cm ²	0.80 cm ²	1.80 cm ²
Rhabdosphincter	111	0.97 cm ³	0.60 cm ³	1.45 cm ³
Internal sphincter volume	111	1.13 cm ³	0.60 cm ³	1.73 cm ³
Total sphincter volume	111	2.09 cm ³	1.27 cm ³	2.94 cm ³

Indirectly calculated volumes (2D scan) were compared with directly measured volumes (3D scan) using the standard error of the mean (Table 2) and found to reach significance.

Table 2. Comparison of 3D measurement and calculated 2D measurement.

Urethral sphincter	3D measurement	2D measurement	difference %
Total volume	2.09 cm ³	2.46 cm ³	15%
Internal volume	1.13 cm ³	1.09 cm ³	4%
Rhabdosphincter	0.97 cm ³	1.37 cm ³	29%

A subset of 10 scans was reanalysed by a second observer blinded to the first measurements and these results were analysed using limits of agreement (Table 2) confirming a high degree of reproducibility.

Table 3. Reproducibility analysis using Limits of Agreement.

	Number	Mean	5 th centile	95 centile	Mean difference
urethral sphincter length	10	20.02mm	19.22mm	21.22mm	-0.027mm
Sphincter diameter	10	12.89mm	12.49mm	14.19mm	0.27mm
Sphincter surface area	10	1.30 cm ²	1.2 cm ²	1.60 cm ²	0.063 cm ²
rhabdosphincter volume	10	0.92 cm ³	0.81 cm ³	0.99cm ³	<-0.00cm ³
internal sphincter volume	10	1.12 cm ³	0.86 cm ³	1.22 cm ³	-0.05 cm ³
total sphincter volume	10	2.03 cm ³	1.84 cm ³	2.15 cm ³	-0.05 cm ³

Conclusions. Three-dimensional ultrasound offers an accurate and non-invasive method of assessing the urethral sphincter with a high degree of reproducibility. Assessment of the urethral sphincter in all three planes allows a more accurate measurement of sphincter volume and would appear to be superior to conventional two-dimensional techniques. Whilst still a research tool at present three dimensional ultrasound may have a role in predicting the outcome of continence surgery and in its longitudinal assessment.

¹ Am J Obstet & Gynaecol. 1997; 177(2): 303-310.

² Neurourol & Urodyn. 1983; 2: 103.

³ Int. Urogyn J Pelvic Floor Dysfunct. 1996; 7(1).

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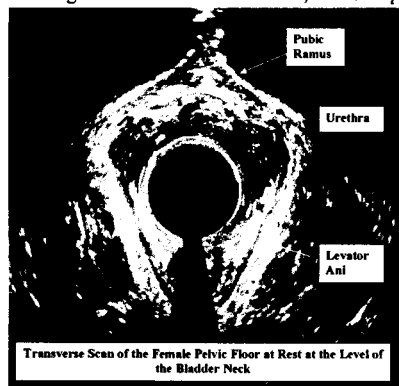
Kings College Hospital Dept. Urogynaecology, London, UK

Title (type in CAPITAL LETTERS, leave one blank line before the text):

CAN ULTRASOUND IMAGING OF THE PELVIC FLOOR PREDICT CURE OF GENUINE STRESS INCONTINENCE?

Aim To assess the effect of pelvic floor physiotherapy on the levator muscle complex in women with genuine stress incontinence (GSI) using transvaginal ultrasound.

Method Women with GSI diagnosed on videocystourethrography were studied. Each woman had a transvaginal ultrasound (US) scan in the supine position, using a 7.5MHz mechanical sector endoprobe. The levator ani were visualised at the level of the bladder neck. The width of the urogenital hiatus in the anterior, mid and posterior thirds, its length and surface area were



recorded. Measurements were taken at rest, during maximum valsalva and during pelvic floor contraction. Over a fourteen week period women were seen by a dedicated research physiotherapist six times and taught to perform pelvic floor exercises correctly. Following treatment stress incontinence was reassessed with a standard one hour pad test and the US measurements were repeated. Pre and post treatment measurements were analysed with Wilcoxon signed rank tests. Linear regression analysis was performed to identify pre-treatment variables associated with success. Cure was defined by a follow up pad test loss of less than 2 g combined with a standard symptom questionnaire.

Results 38 women were recruited to the