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BIOMETRY OF THE PUBORECTALIS MUSCLE AND HIATUS BY 3D PELVIC FLOOR ULTRASOUND

Hypothesis / aims of study

The levator ani muscle is thought to play a significant role in the pathogenesis of incontinence and prolapse(1). Until recently, magnetic resonance was the only imaging method capable of assessing the levator in vivo(2). The advent of 3D pelvic floor ultrasound now enables us to evaluate the levator ani with much less cost to the health provider and minimal discomfort to the patient(3). While spatial resolution may be inferior, ultrasound technology allows dynamic imaging which is almost impossible using current MRI technology. This study was designed to define levator biometric indices on 3D ultrasound and to establish test- retest variability for those parameters in a group of young women recruited for a twin study of pelvic floor function.

Study design, materials and methods

In a prospective observational study, 52 nulligravid female volunteers between 18 and 24 years of age underwent pelvic floor imaging. 3D translabial ultrasound was performed after voiding and in the supine position, using a GE Kretz Voluson 730 system with 7-4 MHz 3D US transducers. Image acquisition took 3-5 seconds. The main transducer axis was oriented in the midsagittal plane. Volumes were acquired at rest and on Valsalva.

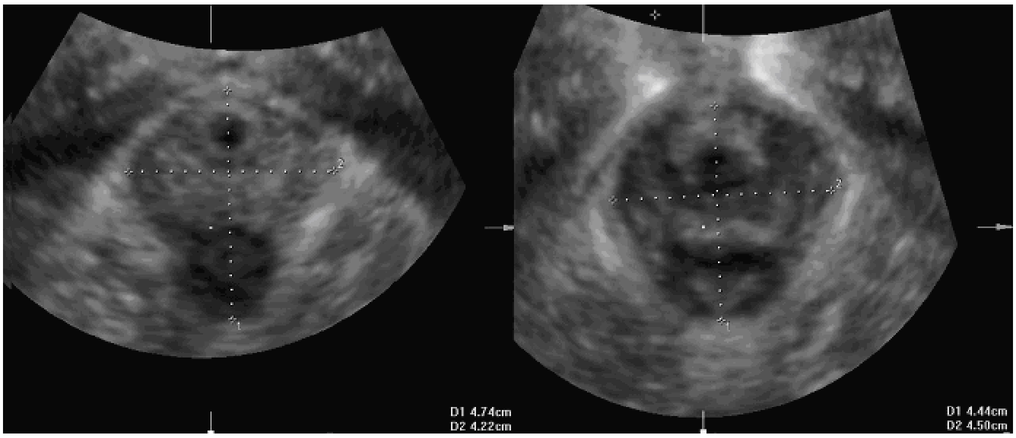

***Figure:** Levator hiatus at rest (left) and on Valsalva (right), oblique axial plane at the level of minimal ap. hiatal distance.*

The following parameters were assessed: In the axial view, we measured maximum diameters of the puborectalis strap in two locations bilaterally and determined muscle area by tracing its outline. The plane of minimal ap- diameters was identified in the sagittal image; the axial plane was then utilized to determine the minimum ap and lateral diameters as well as the area of the hiatus. In the coronal plane we determined the distance between perineal skin and puborectalis strap, its diameter perpendicular to the skin, and its area at a level just anterior to the anorectal junction.
Repeatability measures were obtained for all the above parameters and ranked between 0.45 and 0.82 (Intraclass Correlations), with best agreement shown for measures of the levator hiatus (0.7 for coronal hiatal diameter, 0.82 for the sagittal hiatal diameter and 0.74 for hiatus area.

Results

Of 52 sets of volumes, 3 were excluded form formal analysis since the volumes were technically inadequate, leaving 49 datasets. The table shows results for measurements taken in the axial plane.

Parameter	mean	range
Puborectalis diameter (axial plane)	0.73 cm	0.4- 1.1 cm
Puborectalis area (axial plane)	7.59 cm^2	3.96- 11.9 cm^2
Levator hiatus at rest (anteroposterior)	4.5 cm	3.26- 5.84 cm
Levator hiatus at rest (left-right)	3.75 cm	2.76- 4.8 cm
Hiatal area at rest	11.25 cm^2	6.34- 18.06 cm^2
Levator hiatus on Valsalva (anteroposterior)	4.73 cm	3.18- 8.01 cm
Levator hiatus on Valsalva (left-right)	4.11 cm	2.99- 6.26 cm
Hiatal area on Valsalva	14.05 cm^2	6.67- 35.01 cm^2

Table: *Selected biometric indices for pubococcygeus/ puborectalis muscle and levator hiatus in 49 nulligravid Caucasian women aged 18-24.*

In the coronal plane, average distance from the perineal surface was 2.42 (range 1.48- 3.18) cm, average puborectalis diameters were 1.33 (0.5-2.55) cm; average area measurements were 1.33 (0.4- 2.72) cm^2.

There were no significant correlations between puborectalis biometric indices and levator function as quantified by cranioventral displacement of the bladder neck on pelvic floor contraction (e.g. total puborectalis area in the axial plane vs. displacement, $r= 0.09$, $p= 0.5$ and hiatus area vs. displacement, $r= 0.08$, $p= 0.6$)). However, there were statistically significant correlations between measures of pelvic organ mobility and hiatus area at rest (BND, $p= 0.035$, Cystocele descent, $p= 0.018$, uterine descent, $p< 0.001$ and rectal descent, $p= 0.004$). Hiatus area on Valsalva correlated even more strongly with descent (BND, $r= .675$, $p< 0.001$, Cystocele descent, $r=-.628$, $p< 0.001$, uterine descent $r=-.656$, $p< 0.001$), rectal descent, $r= -.6$, $p< 0.001$).

Interpretation of results

3D ultrasound can be used to determine biometric indices of the puborectalis muscle, both for the muscle itself and the levator hiatus, with the latter probably being more reproducible. A wide range of measurements was obtained, with the levator hiatus on Valsalva varying from approximately 6 to 36 cm^2. There were significant correlations between levator hiatus area and pelvic organ descent, and this relationship was observed for all three compartments. This is not surprising on Valsalva, and the increase in levator hiatus may be either cause or effect of pelvic organ descent. However, it is remarkable that levator area at rest seemed to predict descent on Valsalva. The wider the hiatus was at rest, the more descent of pelvic organs occurred on Valsalva.

Concluding message

This study provides support for the hypothesis that levator ani anatomy plays an independent role in determining pelvic organ support. This role seems to be stronger for the central and posterior compartments and relatively weaker in relation to bladder support.

References

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