Levator Ani Hiatus Elongation in Old Post-Menopausal Women is Associated with Pelvic Floor Symptoms

Jonia Alshiek, MD, MSc[1], Mehrsa Jalalizadeh, MD[1], Qi Wei, PhD[2], Parag Chitnis, PhD[2], S. Abbas Shobeiri, MD, MBA[1, 2]

[1] Department of Obstetrics & Gynecology, INOVA Women's Hospital
[2]Bioengineering, George Mason University

ABSTRACT

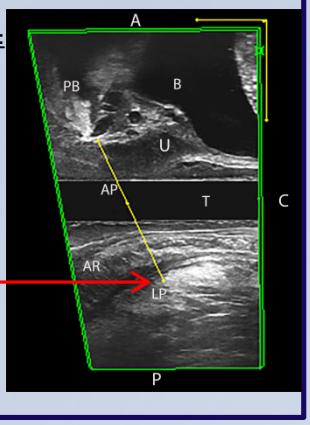
- **Background:** the female human pelvic floor muscles provide mechanical support for the pelvic organs. Poor function of these muscles is shown to cause urinary incontinence and pelvic organ prolapse, both of which are very common and bothersome in older women.
- **Objective:** To determine whether age is associated with change in pelvic floor 3-Dimenttional Endovaginal Ultrasound (EVUS) parameters, sexual function or urinary status in nulliparous women.
- **Study design:** We compared two groups of young (18-40 years) and old (52-85 years) postmenopausal nulliparous women based on their pelvic ultrasonography measurements. Those measurements included anterior to posterior (AP) and left to right (LR) diameters, and the Minimal Levator Hiatus (MLH), representing the smallest area of the muscular pelvic floor hiatus. The AP/LR ratio was calculated to compare the shape of the pelvic floor muscles between participants (oval vs circular). Using internationally acknowledged questionnaires, participants were assessed for 1) distress symptoms of pelvic floor prolapse, urinary, and fecal symptoms by the Pelvic Floor Distress Inventory (PFDI-20), 2) quality of life via the Pelvic Floor Impact Inventory (PFIQ-7), and 3) sexual function by the Female Sexual Function Inventory (FSFI-19).
- **Results:** In this study we found that older women have more oval pelvic floor musculature shape assessed by the higher AP/LR ratio, while other measurements were not significantly different. Oval shape was related to symptoms of urinary incontinence and pelvic floor prolapse. Older women also had worse urinary and pelvic organ prolapse symptoms (p=.002 and .004, respectively). Older women were less likely to be sexually active 6/10 vs 11/12 in the younger group, and had less quality of sexual life measured by the FSFI-19.
- **Conclusions:** Levator ani muscle hiatus changes to a more oval form in older women and this change in shape is possibly associated with worse pelvic floor symptoms.

METHODS

- This was a pilot cross-sectional study that was approved by the Institutional Review Board of Inova Health System in Falls Church, Virginia.
- Two groups of young (18-40y/o) and old (52-85y/o)_nulliparous women were recruited for the study via Inova Net webpage and Inova Health System Five-in-Five emails.
- Recruitment took place between **March 2017 and December 2017**.
- **Exclusion criteria:** A history of prior incontinence or prolapse surgery, a diagnosis of reproductive anomalies, prior pelvic radiation, inability to complete written questionnaires.
- We obtained the following variables: Age, Height, Weight, Body Mass Index, Race, Ethnicity
- **Subjects had completed** :Pelvic floor distress inventory [PFDI-20], Pelvic floor impact questionnaire [PIQ-7], Female Sexual Function Inventory [FSFI-19], A standard urogynecological examination, including PS, POPQ, 3D-EVUS.

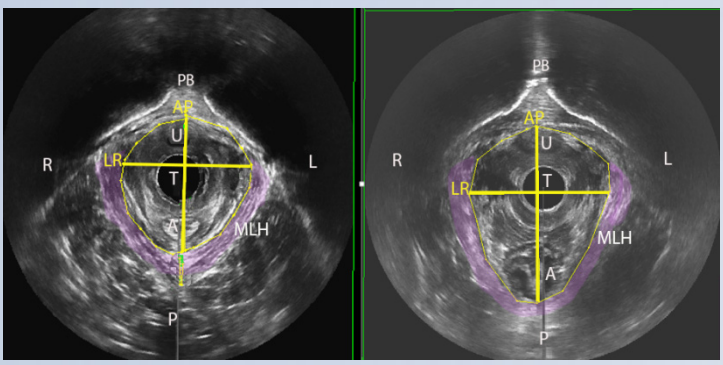
- **Sonographic measurements included:**
- **MLH**
- **AP diameter**
- **LR diameter**

- To measure the MLH, we used a mid-sagittal view indicating the shortest distance between the pubic symphysis and the levator plate, which formed the AP diameter of the MLH (Fig1).



	Younger (n=12) Mean (±SD)	95%CI	Older (n=10) Mean (±SD)	95%CI	p-Value
PFDI20	3.7 (±7.9)	0-9.0	50.4 (±39.6)	22.1-78.7	.001
POPDI6	0 (±0)	0-0	9.6 (±10.8)	1.9-17.3	.006
CRADI8	0.3 (±0.9)	0-0.9	13.7 (±13.8)	3.9-23.6	.004
UDI6	3.8 (±7.4)	0-8.5	27.1 (±25.8)	8.6-45.6	.007
PFIQ7	2.4 (±4.8)	0-5.4	31.4 (±40.7)	2.2-60.6	.023
UIQ7	0 (±0)	0-0	18.6 (±22.9)	2.2-35.0	.011
CRAIQ7	1.6 (±4.2)	0-4.3	6.2 (±10.5)	0-13.7	.180
POPIQ7	0.8 (±1.8)	0-2.0	6.7 (±21.1)	0-21.7	.346
FSFI19*	29.4 (±3.2)	27.2-31.6	22.3 (±9.130)	12.7-31.8	.031

	Younger (n=12) Mean (±SD)	95%CI	Older (n=10) Mean (±SD)	95%CI	p-Value
MLH	9.9 (±2.0)	8.7-11.2	10.7 (±1.8)	9.4-11.9	.372
AP	41.3 (±4.6)	38.4-44.3	45.7 (±5.8)	41.7-49.6	.058
LR	33.5 (±3.3)	31.4-35.6	32.4 (±3.7)	29.6-35.2	.464
AP/LR ratio	1.2 (±0.2)	1.1-1.3	1.4 (±0.1)	1.3-1.5	.017



RESULTS

Our younger premenopausal patient group included **12** nulliparous women with a mean age of **28.2 years** (95% CI 24.8-31.5); our older post-menopausal group included **10** nulliparous women with a mean age of **61.8 years** (95% CI 55.8-67.8).
There were no significant differences in BMI, race, and history of medical illness between the two groups using chi-squared or two sample t-test analyses.
The younger group had a lower mean PFDI-20 score, 3.6 (95% CI 0.0-8.9) vs 50.4 (95%CI 22.08-78.7), p=.001, a lower mean POPDI-6 score, 0 (95% 0-0) vs. 9.5 (95% 1.8-17.2), p=.006, lower mean CRADI-8 score, 0.28 (95% CI 0-0.9) vs. 13.75 (95% 3.9-23.5), p=.004, and lower mean UDI-6 score 3.8 (95% CI 0-8.5) vs. 27.08 (95% 8.6-45.6), p=.007. The younger group also showed a lower mean UIQ-7 score 0 (95% 0-0) vs. 18.57 (95% CI 2.2-35), p=.011 and a lower mean PFIQ score 2.38 (95% CI 0-5.4) vs. 31.4 (95%CI 2.2-60.5), p=.023 (Table 1). The sexual activity was higher among the younger group (11/12) vs (6/10) in the older group. Moreover, the FSFI scores of sexually active women were also significantly different between the two groups 29.4 (95% CI 27.2-31.5) vs. 22.2 (95% CI 12.7-31.8), p=.031 (Table 1). Minimal levator hiatus (MLH) as was not significantly different in the two groups (p=0.372) (Table 2). AP diameter was higher in the older group: 41.3mm vs. 45.7mm (p=.058). LR diameter was lower in the older group but not statistically significant: 33.5 vs. 32.3 (p=0.46). The AP/LR ratio was significantly higher in the older group (1.2 vs 1.4, p=.017).
The two groups were merged for **regression analysis.** PFIQ, POPDI, UDI, and PFDI scores were found to be positively correlated with AP diameter (Table 3). POPDI score was also positively correlated with AP/LR ratio (p=.028). **Logistic regression analysis showed significant negative correlation between age and sexual activity (OR= .921, p=013).**

Fig 2: A 3-D EVUS sagittal sections of two women; a young female (left) with Antero-posterior diameter (AP)-35.4mm , Left to Right diameter (LR)-31mm, Minimal Levator Hiatus (MLH)-7.82cm2, AP/LR ratio 1.14, versus an old female (right) with Antero-posterior diameter (AP)-47mm, Left to Right diameter (LR)-34.1mm, Minimal Levator Hiatus (MLH)-12.1 cm2, AP/LR ratio - 1.35. The young woman illustrates a more circular shaped of the levator hiatus (yellow marked-left) versus the more oval shaped of the old woman (yellow marked-right). The levator ani muscle that comprises the musculature hiatus is marked with sof

purple.

	MLH	AP	LR	AP/LR ratio
PFDI20				
R^2	.155	.343	0	.227
p-Value	.044	.003	.690	.019
POPDI6				
R^2	.041	.183	0	.190
p-Value	.184	.027	.872	.028
CRADI8				
R^2	.032	.135	0	.259
p-Value	.213	.057	.553	.013
UDI6				
R^2	.094	.263	0	.097
p-Value	.089	.008	.376	.092
PFIQ7				
R^2	.226	.438	.061	.110
p-Value	.015	<.001	.146	.078
UIQ7				
R^2	.191	.350	.025	.097
p-Value	.024	.002	.234	.091
CRAIQ7				
R^2	.026	.001	0	0
p-Value	.227	.322	.675	.462
POPIQ7				
R^2	.086	.301	.052	.030
p-Value	.100	.005	.163	.217
FSFI19				
R^2	.012	0	.227	0
p-Value	.290	.555	.035	.335

CONCLUSIONS

Woman's increasing age was found to be significantly associated with a more oval pelvic floor shape, affecting pelvic floor urinary and prolapse function.

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