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PELVIC FLOOR MORPHOLOGY IN OLDER CONTINENT AND URINARY INCONTINENT WOMEN: AN MRI STUDY.

Hypothesis / aims of study

A large proportion of women aged 60 and over experience mixed urinary incontinence (MUI) and its negative consequences on their quality of life (1); however, to date, the pathophysiology of this disorder is not completely understood. We hypothesized that deficiencies in the morphology of the pelvic floor muscles at rest, during a contraction and during effort may be, in part, responsible for MUI symptoms: urine leakage resulting from urgency and with effort. Thus, the purpose of this study was to compare pelvic floor muscle (PFM) morphology in continent women and women with MUI under three conditions using magnetic resonance imaging (MRI): at rest, during a maximal voluntary pelvic floor muscle contraction (PFM MVC), and during a Valsalva manoeuvre.

Study design, materials and methods

Women 60 years and older were recruited and included in the study if they were independently ambulatory and were either continent or reported at least weekly symptoms of MUI. Women were excluded if they reported other conditions or medications that were likely to interfere with the study. Women who had contraindications to MRI scanning were also excluded. An experienced pelvic floor physiotherapist taught the women to perform PFM contractions correctly; their technique was confirmed by both vaginal palpation and dynamometry. MRI imaging in the sagittal plane was performed with a Siemens 3.0T Magnetom Trio, using an IPAT torso/pelvis coil centered on the symphysis pubis. Six slices in the mid-sagittal plane were taken with T2-weighted SSFSE sequences (field of view 24 x24cm, 5mm thick, matrix= 256 x 256, TR = 3000ms, TE 110ms, bandwidth 320 Hz/pixel). During the scan, 18-second recordings were made at rest, during PFM MVC and, lastly, during a Valsalva manoeuvre. The Valsalva effort was controlled by having the women blow into a standardized tube.

The measurements at rest were taken from the mid-sagittal slice with the clearest image. For the PFM MVC and the Valsalva images, the measurements were taken from the mid-sagittal slices that demonstrated the greatest bladder-neck elevation and depression, respectively. The following eight measurements were taken in each of the three conditions. 1) The pubococcygeal line (PCL) was drawn from the inferior edge of the pubic symphysis to the anterior aspect of the sacrococcygeal joint line. 2) The anorectal (AR) angle was measured at the intersection of the lines drawn along the posterior walls of the anal and rectal canals. 3) The H-line was drawn from the inferior edge of the pubic symphysis to the apex of the anorectal angle. 4) The M-line was drawn perpendicularly from the PCL to the tip of the H-line. 5) The levator plate (LP) angle was measured as the angle between the H-line and the PCL. 6) The heights of the urethrovesical (UV) and 7) the uterocervical (UC) junctions were both measured perpendicularly to the PCL. In women who had undergone hysterectomies, the height of the vaginal apex was measured instead. 8) Finally, the UV junction approximation was drawn as the perpendicular distance between the urethrovesical junction and the axis of the pubis. Bilateral independent-sample t-tests were conducted to compare the eight measurements between the groups: continent and MUI.

Table 1: Pelvic floor muscle morphological parameters for continent and MUI women

Measurements	Rest			PFM MVC			Valsalva		
	C (n=14)	MUI (n=24)	t	C (n=14)	MUI (n=24)	t	C (n=14)	MUI (n=23)	t
H-line	55.07 (8.54)	60.40 (8.31)	-1.89	48.51 (8.36)	52.09 (8.39)	-1.27	54.96 (10.75)	60.94 (10.34)	-1.68
Anorectal Angle	113.14(12.96)	118.44(13.33)	-1.19	93.11 (16.72)	98.47 (19.58)	-0.86	112.51(23.73)	122.64(23.03)	-1.28
Pubococcygeal Line	114.12(9.93)	118.41 (9.85)	-1.29	115.00(10.25	118.37(9.82)	-1.00	114.18(10.69)	118.73(9.56)	-1.34
M-Line	18.40 (6.86)	25.57 (10.12)	**-2.35 ***	6.72 (5.14)	12.79 (9.84)	**-2.14***	24.68 (15.92)	27.89 (13.28)	-0.66
Levator plate Angle	19.79 (7.31)	24.68 (9.28)	-1.69	7.84 (6.48)	13.07 (9.05)	-1.89	26.02 (13.57)	26.33 (11.02)	-0.08
Urethrovesical Junction Height	13.86 (4.51)	9.97 (5.52)	**2.24 ***	18.29 (4.26)	16.61 (6.20)	0.89	6.16 (10.27)	4.32 (9.08)	0.57
Uterocervical Junction Height	21.37 (6.66)	16.39 (12.13)	1.64	27.80 (5.82)	25.81 (8.88)	0.75	9.82 (14.34)	9.80 (14.99)	0.01
Urethrovesical Junction Approx	13.51 (1.48)	14.56 (2.98)	-1.45	13.50 (2.72)	15.69 (2.72)	**-2.40***	10.33 (4.35)	11.31 (5.26)	-0.58

C: Continent women, MUI: mixed urinary incontinent women. All measurements are expressed as mean (SD) and t values are two-tailed. Significant difference: * $p<0.05$.

Results

Thirty-eight women (mean age 67.42 (4.93)) participated in the study: 14 continent and 24 with MUI. There were no differences among the groups in age (p = 0.43), body mass index (p=0.67) or parity (p=0.65). Pelvic floor muscle morphological parameters, for both the continent and MUI groups, are presented in Table 1. For the rest condition: there were significant differences between the groups in terms of the M-line and the UV junction height. The M-Line was significantly longer in the MUI group at rest (p=0.025); the magnitude of the difference was moderate to large: mean difference = -7.17, 95% CI: -13.36 to -0.97, η^2=0.133. The UV junction height was significantly lower in the MUI group as compared to the continent group (p=0.032); the magnitude of the difference was moderate to large: mean difference = 3.90, 95% CI: 0.36 to 7.43, η^2=0.122. For the PFM MVC condition: the M-Line was also significantly longer in the MUI group (p=0.039); the magnitude of the difference was moderate to large (mean difference = -6.08, 95% CI: -11.84 to -0.31, η^2=0.113). The UV junction approximation was significantly longer in the MUI group during the PFM MVC (p=0.022); the magnitude of the differences was large: mean difference = -2.19, 95% CI: -4.05 to -0.34, η^2=0.138. However, for the Valsalva condition, there were no differences between the groups for any of the MRI measurements. All analyses were repeated with the measurements normalized using the length of the pelvic inlet; there were no changes in the results.

Interpretation of results

There were significant differences between the two groups for some of the measurements at rest and during a PFM MVC. At rest, the longer M-line and the lower UV junction height in the MUI group could suggest that these women have greater pelvic floor laxity, hence their muscle tone at rest and fascial support is decreased compared to that of continent women. These findings are similar to those of Unterweger et al., 2001 and Hoyte et al., 2001 (2,3). In the continent group, the greater shortening of the M-line and the proportionately smaller UV junction approximation noted during PFM MVC are likely a reflection of the greater PFM strength and contraction efficiency of continent women. Consequently, these findings support the current rationale for using PFM exercises as a first-line treatment for MUI - based on the rationale that such treatments work by elevating the position of the pelvic floor (which improves pelvic organ support) and by improving both the strength and effectiveness of PFM contractions. Ideally, it would have been interesting to compare our findings to those of other studies on older women. However, few researchers have studied PFM morphology in older women, and, due to a lack of standardization in MRI-references lines, none of the studies compare the same parameters; hence, comparisons were impossible. Finally, a possible explanation for the lack of any differences between the two groups, in terms of the measurements taken during the Valsalva manoeuvre, could be related to the greater variability within each of these measurements. This greater variability may be due to the possibility that some of the women may have contracted their PFMs during the Valsalva manoeuvre – indeed, this possibility is evidenced in those measurements most closely related to PFM function: the H-line and the AR angle, which only increased to their resting length.

Concluding message

The morphological differences in the pelvic floor muscles, as found in this study, suggest that older women with MUI have poorer pelvic organ support and are less able to produce effective PFM contractions compared to their continent counterparts. These findings support the rationale for PFM exercise treatment for older women with MUI.

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