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Fecal Incontinence in Older Women: Are Levator Ani Defects a Factor?

Christina Lewicky-Gaupp, MD, **Cynthia Brincat, MD**, **Aisha Yousuf, MD**, **Divya A. Patel, PhD**, **John O.L. DeLancey, MD**, and **Dee E. Fenner, MD**
Division of Gynecology, Department of Obstetrics and Gynecology, Pelvic Floor Research Group, University of Michigan, Ann Arbor, Michigan, USA

Abstract

Objective—To compare pelvic floor structure and function between older women with and without fecal incontinence (FI) and young continent women.

Study Design—Young (YC, n=9) and older (OC, n=9) continent women were compared to older women with FI (OI, n=8). Patients underwent a POP-Q, measurement of levator ani (LA) force at rest (F_{LAR}) and with maximum contraction (F_{LAC}), and MRI. Displacement of structures and LA defects were determined on dynamic MRI.

Results—LA defects were more common in the OI v. the YC (75% v. 11%, p=0.01) and OC groups (22%, p=0.14); women with FI were more likely to have LA defects than women without (OR 14.0, 95% CI: 1.8-106.5). OI women generated 27.0% and 30.1% less F_{LAC} v. the OC group (p=0.13) and YC groups (p=0.04). During Kegel, OI absolute structural displacements were smaller than in the OC group (p=0.01).

Conclusions—OI women commonly have LA defects, and cannot augment pelvic floor strength.

Keywords

fecal incontinence; levator ani defects

Introduction

With aging, the prevalence of fecal incontinence (FI) increases.[1, 2] FI is a debilitating condition[3,4] and a common cause of institutionalization in the elderly,[5] yet the mechanisms underlying FI are still not fully understood.[6] Fecal continence is maintained by a complex sphincter system involving three anatomical elements: the smooth muscle internal anal sphincter (IAS), the striated external anal sphincter (EAS), and levator ani (LA) muscles. Failure of each of these elements has been implicated in the multifactorial etiology of FI,

Corresponding author: Christina Lewicky-Gaupp, 1500 East Medical Center Dr., Ann Arbor, MI 48109-0276, clewicky@med.umich.edu, Fax: 734-647-9272, Phone 734-764-9386.

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however, how much the failure of each these individual components, especially the LA, contribute to FI has not been reported.

It is known that LA muscle defects are associated with pelvic organ prolapse[7] and difficult vaginal delivery.[8] In addition, Nichols et al. found that anal incontinence was more common in women with pelvic floor disorders (including pelvic organ prolapse and/or urinary incontinence) than normal controls.[9] However, the association of LA defects with FI is still unclear. The aims of this study were twofold. First, it was our objective to examine the relationship of LA muscle structure as it relates to FI in older women using dynamic MRI. Second, we sought to examine changes in the function of the pelvic floor (specifically, force of LA contraction and movement of perineal structures with Kegel and Valsalva) that occur in older women with FI.

Materials and Methods

We recruited 8 older women with weekly FI aged 63-85 (older incontinent, or OI) as well as 9 young continent women aged 20-41 years (young continent, or YC) and 9 older continent women aged 60-88 years (older continent, or OC) (representing asymptomatic continent control groups) between February 2006 and October 2007. Due to funding limitations, young incontinent women were not recruited. Subjects were recruited through the university-based gynecology clinic and campus-wide advertisements. All were community dwelling. The study was approved by the University's Institutional Review Board (#2005-0294).

As previously described,[10] older women who reported loss of solid stool ≥ once per week and had a Wexner score of >8 were considered cases. Women who reported *only* incontinence of gas/flatus or reported the use of a pad or lifestyle alterations *without* reporting loss of solid stool were not included. Continent controls (both older and younger) had to have a Wexner score of <4. Exclusion criteria was as follows: previous gynecological surgery for pelvic floor disorders and prolapse, previous anal sphincter repair surgery, current treatment for cancer, chronic use of steroids, HIV positive status, sickle cell disease, irritable bowel syndrome (based on ROME III criteria), neurological conditions, uncontrolled diabetes, stroke, or Alzheimer's disease. Women who had undergone hysterectomy were eligible if the indication for the surgery was not prolapse and occurred at least 1 year before enrollment.

In order to assess vaginal and uterine support, all women were examined using Pelvic Organ Prolapse Quantification (POP-Q) measurements in the semi- recumbent position at a 45 degree angle. In order to assess LA muscle function, an instrumented speculum exam was performed to measure LA muscle force at rest (F_{LAR}) and with maximal contraction (F_{LAC}) as previously described in our group's work.[11]

Women also underwent trans-rectal ultrasound as reported in our previous study. 10 All women also underwent dynamic, supine MRI of the pelvic floor. Images were taken in the axial, saggittal and coronal planes using a fast spin proton density technique. Scans were performed on a 1.5 T superconducting magnet (Signa; General Electric Medical Systems, Milwaukee, WI). Slice thickness was 4 mm, with a gap of 1 mm, yielding 5-mm image spacing. Twenty cubic centimeters of ultrasound gel was added to the vagina to better delimit its location and boundaries.

Using an identification and grading system for LA defects (encompassing both the pubovisceral and puborectal portions of the muscle) previously described by our group,[8,12] muscle defects were identified on static, axial images in all three groups. Examiners were blinded to the age and continence status of all of the subjects.

On static, mid-sagittal MRI images at rest, maxium Kegel, and maximum Valsalva, a sacrococcygeal-inferior pubic point (SCIPP) line (x-axis) and perpendicular y-axis were drawn. Using these axes as references, measurements of levator and urogenital hiatus diameters were made in all three groups and compared. The angle of the levator plate was measured relative to the SCIPP line as well. When the levator plate was parallel to SCIPP line, the angle was considered zero. When the angle was above the parallel in a clockwise direction, it was considered negative; and when it was below the parallel in a counter-clockwise direction, the angle was considered positive. Similarly, on dynamic images, locations of the perineal body (PB) and EAS were determined as x,y coordinates in centimeters relative to these axes, again at rest, maximum Kegel and maximum Valsalva (Figure 1). Using these x and y coordinates, displacements of the perineal body and external anal sphincter from rest to maximum Kegel as well as from rest to maximum Valsalva in each individual were calculated. All measurements were made using Image J 1.4l (NIH) software.[13]

All statistical analyses were completed using SPSS software version 16.0 (Chicago, IL). Bivariate relationships were explored between the OI, OC and YC group POP-Q points and MRI measures using ANOVA. Additional pair-wise comparisons with Student's t-tests were made when a significant difference between the groups was detected with the ANOVA. To determine whether LA defects were associated with continence status, the OC and YC groups were combined and compared to the OI group. Logistic regression analyses with and without adjustment for EAS defects were conducted to determine associations between LA defects in women with FI (OI) and those without (OC + YC) as well. An alpha of ≤0.05 was used for significance in all tests.

Results

The demographics of the OI, OC and YC groups are shown in Table I. No significant differences were observed between the OI and OC groups. The OI group was significantly older than the YC group and also had more vaginal and forceps-assisted deliveries. The OC group was also older and had more vaginal deliveries than the YC group. All three groups were similar with respect to number of bowel movements per week (OI= 9.9 ± 2.3, OC= 7.6 ± 1.2, YC= 8.3 ± 1.3, p=0.34).

Differences in pelvic organ support on POP-Q examination among the OI, OC and YC groups are shown in Table II. No significant differences in POP-Q were seen between the two groups of older women (OI and OC). The OI group had less anterior vaginal wall support than YC group (points Aa and Ba); apical support (point D) was also diminished in the OI group compared to the YC group. Posterior support, genital hiatus (GH), perineal body (PB) measurements did not differ significantly between the OI and YC groups. Total vaginal length was slightly longer in the YC group compared to the OI group. Point D in the OC group was less than the YC group as well. None of the women had prolapse outside of the hymen.

On MRI, LA defects were more common in the OI group of women than the OC or YC women, though these differences were only significant when the OI and YC women were compared (Table III). As reported in our previous study, on trans-rectal ultrasound, two women in the OI group and one woman in the OC group had focal defects in the external anal sphincter.[10] Overall, women with FI (OI) were more likely to have LA defects than women without FI (YC + OC) [odds ratio (OR): 14.0, 95% CI: 1.8-106.5]. This association remained significant after adjustment for EAS defects (OR: 23.3, 95% CI: 2.0-267.6).

On instrumented speculum exam, resting LA force (F_{LAR}) did not differ between the three groups, however, the OI group generated 27.0% less force during contraction (F_{LAC}) compared to the OC group and 30.1% less than the YC group (Table III). Regardless of continence, women with LA defects had 25.9% less F_{LAC} (6.0 ± 2.3 N vs. 8.1 ± 2.7 N) compared to those without a defect (p=0.05).

During maximum Kegel, PB and EAS displacements were smaller in the OI group compared to the OC group (Figure 2); no differences were observed in displacement at maximum Valsalva among the three groups. At rest, the average perineal body location of the YC group was 1cm closer to the pubic bone compared to the OC group and 1.6cm closer compared to the OI group (p=0.02 for both). Similarly, at rest, the external anal sphincter of the YC was located 1.2cm closer to the pubic bone compared to the OC group and 1cm closer compared to the OI group (p=0.03 and p=0.09, respectively). No differences were seen between the two groups of older women (Figure 2).

Levator and urogenital hiatuses were significantly larger at rest, Kegel and maximum Valsalva in both groups of older women compared to the younger women (Table IV); no significant differences were seen hiatus measurements between the OI and OC groups. Similarly, the OI and OC groups had less vertically-oriented levator plate angles with Kegel.

Comment

In this study, we found that LA defects are significantly more common in fecally-incontinent older women and are strongly associated with FI, even when adjusting for defects in the external anal sphincter. Older women with FI are also unable to augment their pelvic floor strength, as shown by both direct measurement of decreased LA contractile force on instrumented speculum exam and indirect measurement of inability of elevate perineal structures on MRI. These findings suggest the importance of the levator muscles in maintaining fecal continence in this population of women.

The association of LA defects and EAS defects has been studied in post-partum women and in women with pelvic organ prolapse, but not in a group of older incontinent women. Obstetrical observations have shown that sphincter lacerations and levator defects tend to occur together. For example, Kearney et al. reported an increased odds ratio of LA defect if a sphincter laceration was also present (OR 8.1, 95% CI 3.3-19.5) at first vaginal birth.[8] Similarly, LA defects have been documented on MRI in some middle-age women with FI and not in others.[14,15] For example, in a study of 105 women with FI and a mean age of 57±13 years, Terra et al. showed that over 30% of women had LA muscle defects, however, over 80% of the defects were not isolated; they were associated with sphincter lacerations.[14] On the other hand, in another study which compared 34 patients (mean age 57±11.7 years) with anal incontinence on “most or every day” to 114 women reporting incontinence “never or on occasion”, there were no differences in LA ani defect status between the two groups.[15] The majority of women in our study did not have sphincter lacerations, and the association of LA defects with FI persisted even when adjusting for the small number of sphincter defects that were present in this cohort. These findings emphasize likely differences in the mechanism of FI in younger and older women; while sphincter integrity is extremely important for continence in younger women, our findings would suggest that in older women, both sphincter and levator ani competence is crucial in maintaining fecal continence

In this study, older incontinent women exhibited impaired LA function. The two groups of older women, however, did not differ from one another in force generated, which is similar to our previous work where older age was not associated with an overall decrease in pelvic floor strength in a cohort of nulliparous women.[16] Evaluating voluntary muscle function is difficult (as it is often measured by numerous, differing techniques) and relies on the effort of the patient. Therefore, it is not surprising that studies show conflicting data regarding pelvic floor strength in women with FI. In a sub-analysis of women with pelvic organ prolapse, Morgan et al. showed no differences in LA augmentation force between women with and without FI.[15] However, Fernandez-Fraga did find an association between pelvic floor function and fecal incontinence severity. Women with FI and impaired LA function not only had more severe FI, but also did not respond as well to biofeedback therapy[17]; this study, however, utilized a perineal dynamometer, which relies on an intrarectal balloon, to measure levator contraction. The authors did show distinction between levator and sphincter function, it is possible that their findings were still confounded by the sphincter itself.

The impaired levator ani function found in our study is further demonstrated by the inability of older women with FI to elevate pelvic structures on MRI with contraction. These findings are similar to those of Bharucha et al. who found that one third of the patients studied with FI had reduced upward anorectal motion during squeeze on MR.[18] Their findings, like others[19] however, were in a group of younger women (mean age 61.2± 14.4 years); of these women, 50% also carried a diagnosis of diarrhea-predominant irritable bowel syndrome. Similarly, Law et al. showed diminished elevation of the anorectal junction in multiparous women, however, their findings focused on a group of women with symptomatic stress urinary incontinence rather than fecal incontinence.[20] Our study extends these findings in a population of older women without other functional bowel disorders, thus eliminating many confounders present in the current literature.

Levator and urogenital hiatus measurements on MRI were larger and levator plate angles more vertically-oriented in older women, irrespective of continence status, compared to younger women. It is known that larger levator hiatus measurements and more caudal levator plate angles on MRI are associated with pelvic organ prolapse.[21,22] However, studies looking at hiatal measurement changes with aging in women without prolapse are sparse. In our study, fecal incontinence was not associated with changes in hiatus or levator plate measurements. This is inconsistent with other studies that have shown larger hiatal measurements in women with combined fecal and urinary incontinence[23] when compared to asymptomatic controls. In our population of older women without clinical evidence of pelvic organ prolapse, our findings that size of hiatus was associated only with age and not continence status suggest that hiatal relaxation may be related to compromise of support structures other than the LA such as connective tissue. These findings also suggest that hiatal size, while important in the pathophysiology of pelvic organ prolapse, does not necessarily impact bowel function or control.

Several factors should be taken into account when interpreting the results of this study. First, due to our small sample size, our multivariable analysis was somewhat limited. Because sphincter lacerations and LA defects are interrelated, further analyses using larger sample sizes are needed to clarify the role of levator defects in the pathophysiology and mechanism of FI in the elderly. The majority of our older incontinent women were Caucasian, and a more diverse cohort would be more representative of community-dwelling women. Also, we did not recruit a young group of women with FI which, in the future, will add breadth to the analysis.

In summary, the results of our study suggest an important role of the levator ani muscles in maintaining the fecal continence mechanism in elderly women. These findings support treatment modalities, such as pelvic floor exercises and muscle stimulation which target the levator ani muscles, for fecal incontinence in populations of older women. In the future, it will be important to consider preventative strategies that decrease the risk of LA injury in younger women thereby potentially decreasing the incidence of FI as these women age.

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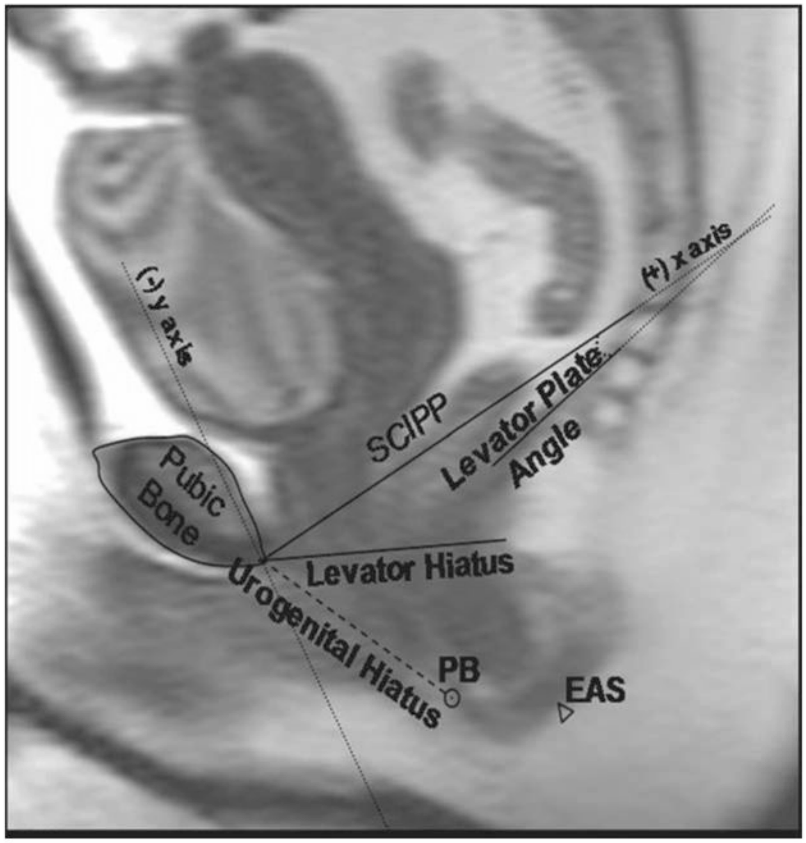

Figure 1.
Mid-saggittal MRI showing locations of perineal structures at rest. The SCIPP line is shown (x-axis). The pubic bone, levator plate angle, levator hiatus and urogenital hiatus are also shown. The perineal body (PB) and external anal sphincter (EAS) are demonstrated as well.

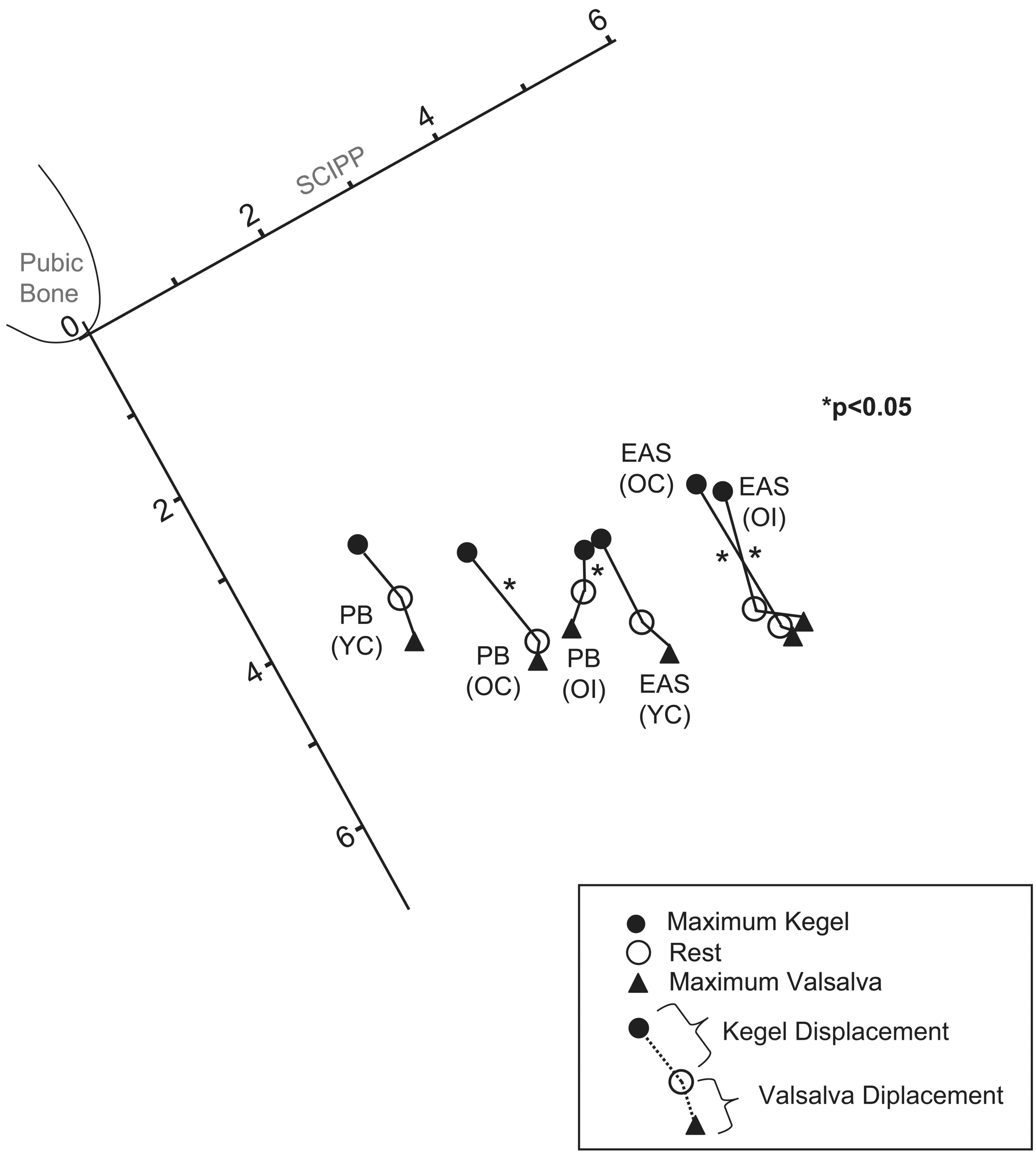

Figure 2.
Average location and displacement of the perineal body (PB) and external anal sphincter (EAS) at rest, maximum Kegel and Valsalva in the three cohorts of women

Table I

Demographics among three cohorts

	OI (n=8)	OC (n=9)	OI v. OC p-value	YC (n=9)	OI v. YC p-value	OC v. YC p-value
Age (Yrs)	71.6 (7.5)	71.6 (7.5)	0.8	28.7 (7.3)	*<0.001*	<0.001
BMI (kg/m^2)	27.6 (4.2)	25.4 (4.3)	0.3	27.2 (7.4)	0.9	0.5
Vaginal Parity (number)	2.6 (1.2)	2.8 (1.7)	0.8	0.2 (0.4)	*<0.001*	*<0.001*
Forceps-Assisted Deliveries (number)	1.0 (1.1)	0.6 (1.0)	0.4	0	*<0.001*	0.1
Cesarean Sections (number)	0.1 (0.4)	0	0.4	0.1 (0.3)	0.9	0.3

Values reported as means (SD)

Table II

POP-Q measurements among three cohorts

POP-Q measure (cm)	OI (n=8)	OC (n=9)	OI v. OC p-value	YC (n=9)	OI v. YC p-value	OC v. YC p-value
Aa	-0.3 (2.0)	-1.4 (1.4)	0.2	-2.4 (0.7)	*0.01*	0.1
Ba	-0.1 (2.6)	-1.5 (1.2)	0.1	-2.4 (0.7)	*0.02*	0.1
C	-5.3 (4.1)	-7.1 (0.8)	0.2	-7.6 (1.5)	0.2	0.5
D	-5.8 (4.3)	-7.9 (1.2)	0.2	-9.6 (1.1)	*0.03*	*0.01*
Ap	-1.0 (2.4)	-1.6 (1.5)	0.5	-2.3 (0.9)	0.1	0.3
Bp	-1.6 (1.0)	-1.6 (1.5)	0.9	-2.3 (0.9)	0.1	0.3
GH	3.7 (1.8)	2.6 (0.7)	0.1	2.4 (0.5)	0.1	0.5
PB	3.0 (1.8)	4.1 (1.7)	0.9	3.5 (0.9)	0.2	0.2
TVL	9.3 (1.0)	9.4 (1.4)	0.8	10.3 (0.9)	*0.04*	0.2

Values reported in means (SD)

Table III

Levator ani defect status on MRI and force generated at rest and with maximum contraction on speculum exam

	OI (n=8)	OC (n=9)	OI v. OC p-value	YC (n=9)	OI v. YC p-value	OC v. YC p-value
Any Levator Ani Defect, % (n)	75.0 (6)	22.2 (2)	0.14	11.0 (1)	*0.01*	1.0
Levator Ani Force						
Rest (F_{LAR})	4.2 (1.0)	4.1 (0.6)	0.9	4.7 (0.9)	0.4	0.2
Max Contraction (F_{LAC})	5.8 (2.4)	8.0 (3.2)	0.1	8.3 (1.8)	*0.04*	0.83

Values reported as means (SD)

Table IV

MRI anatomic differences among three cohorts of women

	OI (n=8)	OC (n=9)	OI v. OC p-value	YC (n=9)	OI v. YC p-value	OC v. YC p-value
Levator Hiatus (cm)						
Rest	6.7 (1.0)	6.5 (1.0)	0.80	5.5 (1.0)	*0.03*	*0.05*
Kegel	6.3 (1.0)	5.6 (0.7)	0.14	4.5 (0.8)	*0.002*	*0.01*
Valsalva	7.0 (1.2)	6.9 (1.4)	0.83	5.6 (1.0)	*0.03*	*0.05*
Urogenital Hiatus (cm)						
Rest	5.7 (1.2)	5.8 (1.0)	0.87	4.4 (1.3)	*0.05*	*0.02*
Kegel	5.5 (1.2)	4.7 (0.8)	0.15	3.6 (1.0)	*0.004*	*0.02*
Valsalva	6.1 (1.3)	6.0 (1.2)	0.82	5.0 (1.3)	*0.002*	0.11
Levator Plate Angle (degrees)						
Rest	10.9 (12.2)	11.0 (9.2)	1.00	-3.2 (20.2)	0.12	0.10
Kegel	3.4 (16.4)	-6.1 (6.6)	0.16	-16.1 (10.6)	*0.02*	0.04
Valsalva	17.1 (14.6)	18.5 (14.5)	0.85	12.1 (22.2)	*0.02*	0.50

Values reported as means (SD)