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Urethral Sphincter Morphology and Function With and Without Stress Incontinence

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Abstract

Purpose—Using magnetic resonance images we analyzed the relationship between urethral sphincter anatomy, urethral function and pelvic floor function.

Materials and Methods—A total of 103 women with stress incontinence and 108 asymptomatic continent controls underwent urethral profilometry, urethral axis measurement with a cotton swab, vaginal closure force measurement with an instrumented speculum and magnetic resonance imaging. Striated urogenital sphincter length was determined and its thickness was measured in the proximal sphincter, where its circular shape enables estimation of striated urogenital sphincter area. A length-area index was calculated as a proxy for volume.

Results—The striated urogenital sphincter in women with stress incontinence was 12.5% smaller than that in asymptomatic continent women (mean ± SD length-area index 766.4 ± 294.3 vs 876.2 ± 407.3 mm^3, p = 0.04). The groups did not differ significantly in striated urogenital sphincter length (13.2 ± 3.4 vs 13.7 ±3.9 mm, p = 0.40), thickness (2.83 ± 0.8 vs 3.11± 1.4 mm, p = 0.09) or area (59.1 ± 18.4 vs 62.9 ± 24.7 mm^2, p = 0.24). Striated urogenital sphincter length and area, and the length-area index were associated during voluntary pelvic muscle contraction with more urethral axis elevation and increased vaginal closure force augmentation.

Conclusions—A smaller striated urogenital sphincter is associated with stress incontinence and poorer pelvic floor muscle function.

Keywords

urethra; urinary incontinence, stress; magnetic resonance imaging; female; muscle, striated

INTRODUCTION

The relative importance of urethral function and support has long been acontroversy in evaluating and treating urinary incontinence. In the ResearchOn Stress Incontinence Etiology study we recently reported the unexpected finding that urethral function measures were more strongly associated with stress incontinence than those of urethral support when women with stress incontinence were compared with asymptomatic matched controls.[1] MUCP in women with stress incontinencewas 42% lower than that in women matched for age, race, parity and hysterectomy status, and it had an effect size that was remarkably higher than any other variable. (Effect size is a measure to determine how effective a variable is for distinguishing 2 populations and it is calculated by taking the difference of 2 population means divided by

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the pooled population SD.) MUCP effect size was 1.5, whereas measures of urethral support (point Aa, urethral axis movement by cotton swab testing) were no larger than 0.6. We explored whether differences in urethral sphincter anatomy could account for the differences in urethral function observed in these cohorts with and without stress incontinence.

MRI is an established means of studying the female urethra. It has been used clinically since the 1990s to evaluate urethral diverticula and neoplasms.[2] Strohbehn et al established the histologicaland radiological identification of its layers.[3] Several studies of normal asymptomatic women showed that urethral anatomy can be visualized with MRI.[4–7] However, to our knowledge differences in women with and without pelvic floor dysfunction have been not been directly compared and analyzed. We compared SUS length, thickness, area and volume estimates in women with and without stress incontinence, and explored the relationship between measures of sphincter size and other pelvic floor function tests.

MATERIALS AND METHODS

This case-control cohort study included 103 women with daily stress urinary incontinence and 108 asymptomatic continent controls.[1] Study inclusion and exclusion criteria, the protocol and the groups were described in the original report.[1] Briefly, women with stress incontinence and asymptomatic controls who had never undergone surgery for pelvic floor disorders were recruited through university based gynecology and urology clinics, and local advertisements. Stress continence was confirmed by a 3-day diary and full bladder stress testing. Group matching was done based on factors associated with stress incontinence,including age, race, parity and hysterectomy status.The protocol included urethral profilometry, POP-Q, cotton swab urethral axis determination, VCF with an instrumented speculum and MRI to assess levator ani defect status using a previously described system.[8]

Urethral Length

Identifying characteristic female urethral structures onMRI was based on our previous anatomical study,[9] and oncomparison of anatomy and MRI scans.[3] Axial MRI scansin each individual were reviewed to determine slices containingthe bladder base, the vesical neck and SUS, includingCU/UVS (Figure 1).[7] Figure 2 shows an exampleusing MRI. Each slice was considered to have a single predominant region, that is each slice was identified as the bladder base, vesical neck or SUS but not 2 designations.The length of the vesical neck, SUS and total urethral length were calculated by multiplying the number of slices in which these structures were seen by the 5 mm interval between each slice.

SUS ThicknessMeasurements and Area Estimations

All axial MRI slices determined to contain SUS were analyzed quantitatively (Figure 2). When outer and inner SUS edges were well enough defined, they were digitally measured with Image J, version 1.34 (National Institutes ofHealth, Bethesda, Maryland). SUS thickness was calculated by taking the difference between the outer and inner diameters, and dividing by 2 (Figure 3). Measurements of each analyzed MRI slice were reviewed by at least 2 of us.Proximal portions of SUS are best suited to measurement because the borders are usually well-defined and approximate a circle. SUS distal portions, including CU/UVS, cannot be analyzed quantitatively in this way because the muscle forms a strap over the urethra and not an encirclingring.[6] SUS area was calculated as the difference between the circular areas represented by the outer andinner diameters (Figure 4). The number of trilaminar urethralslices in which the mucosa, submucosa and SUSwere seen as clearly distinct layers were counted.

Length-Area Index as Volume Proxy

A length-area index was developed as a composite estimate of volume. It was calculated by multiplying the mean SUS area in the 2 most proximal slices by SUS length.Proximal rather than distal SUS slices were better suited to quantitative area measurement, as described. Furthermore, the proximal SUS is the site where striated muscle length and thickness are lost with aging.[10] The average of the areas in the first 2 SUS slices was used. When only 1 SUS slice was present, the area of the single slice was used.

RESULTS

Original Report Findings

Demographics of the stress incontinent and continent groups that were previously described[1] are briefly summarized. Women with and without stress incontinence did not differ in age, parity, race, menstrual status, percent receiving hormone replacement therapy or hysterectomy status. Those with stress incontinence had a higher body mass index than continent women (mean ± SD 30.4 ± 6.6 vs 27.6 ± 5.6 kg/m2, $p < 0.01$). There were differences in MUCP (40.8 ± 17.1 vs 70.2 ± 22.4 cm H_2O, $p < 0.01$), POP-Q point Aa (−0.6 ± 0.8 vs −1.0 ± 0.8 cm, $p < 0.01$), the cotton swab test of the urethral axis at rest (−0.8 ± 11.8 vs −6.3 ± 15.1 degrees, $p = 0.004$), genital hiatus (4.0 ± 1.0 vs 3.4 ± 1.0 cm, $p < 0.01$) and maximum intravesical pressure with cough (143.2 ± 43.4 vs 126.4 ± 34.3 cm H_2O, $p < 0.01$). The stress incontinent and continent groups did not differ in resting VCF, augmentation of VCF with pelvic floor contraction or the percent of MRI scans showing major, minor or no levator ani muscle defects (12.8%, 26.5% and 60.8% vs 17.6%, 19.4% and 62.3%, respectively, $p = 0.37$).

MRI Adequacy for Study

Urethral length could not be calculated in 6 women. Two women per cohort had MRI scans that were in adequate for analysis due to motion artifact. An additional 2 women in the stress incontinent group could not be measured due to a urethral diverticulum that distorted anatomy and the inability to complete MRI due to claustrophobia in 1 each. The percent of scans inadequate to estimate urethral length did not differ significantly between the stress incontinent and continent groups (Table 1). SUS area could not be calculated in 28 individuals due to poor definition of the hypointense ringon proton density imaging, which precluded accurate assessment. The number of women with such MRI scans in the stress incontinent and asymptomatic continent groups did not differ (Table 1).

Stress Incontinence and Continence

Table 2 shows several topographical aspects of urethral anatomy (Figures 1 and 2). The groups did not differ in vesical neck length, ie the distance between the bladder base and the first SUS slice, in the frequency with which 1 or 2 proximal axial MRI scans were adequate to estimate SUS area or in the number of slices in which a trilaminar appearance was observed. Table 3 shows quantitative SUS analysis. In women with vs without stress incontinence SUS thickness and length were 8.9% and 6.0% smaller, respectively. The SUS length-area index in those with stress incontinence was 12.5% less than that in continent women. Total length of the urethra and the vesical neck did not differ between thegroups.

Demographics

Aging correlated with a shorter SUS and a longervesical neck (Table 4). SUS thickness and area were larger in older women. The associations of aging with SUS length and area were in approximately equal and opposite directions, leading to no discernible relationship between aging and SUS volume.There was no association between MRI urethral measures and vaginal parity (Table 4). When the groups were analyzed by hysterectomy status, no significant differences were found in vesical neck length (13.2 ± 3.8 vs 13.1 ± 2.6 mm, p = 0.95), SUSlength (12.7 ± 4.8 vs 13.6 ± 3.7 mm, p = 0.31), mean thickness (2.7 ± 0.9 vs 3.0 ± 1.2 mm, p = 0.25), mean area (55.5 ± 19.6 vs 61.8 ± 22.1 mm^2, p = 26)or the length-area index (761.4 ± 348.2 vs 834.2 ± 363.6 mm^3, p = 0.46).

Pelvic Floor Function

Pelvic floor contraction strength on VCF was associated with SUS length, area and the area-length index.Greater urethral axis elevation (a more negative angle from the horizontal) with pelvic floor contraction was inversely associated with SUS thickness, area and volume.Resting pelvic floor tone was positively associated with the area-length index and inversely associated with vesical neck length.

Levator Ani Defects

SUS length was shorter in women with major andminor levator ani defects compared to the length in those with normal levator ani muscles (12.3 ± 3.6 vs 12.7 ± 4.4 mm vs 14.0 ± 3.5 mm, p = 0.03). A significant difference was observed in asymptomatic continent women (12.4 ± 4.2, 12.3 ± 5.5 and 14.5 ± 3.5 mm, p = 0.03) but not in women with stress incontinence (12.3 ± 2.6, 13.1 ± 3.5 and 13.5 ± 3.5mm, respectively, p = 0.50). SUS thickness and area, and the length-area index did not differ according to levator ani defect status.

Urethral Function and Mobility

Higher MUCP and KUCP were associated withSUS length and inversely associated with vesical neck length. SUS thickness, area and volume were not associated with MUCP. The SUS length-areaindex was associated with KUCP but SUS thickness and area were not (Table 4). Measures of urethral mobility, such as POP-Q point Aa and Ba, and the straining urethral axis on cotton swab testing did not correlate with any SUS anatomy measures (Table 4).

DISCUSSION

SUS in women with stress incontinence is 12.5% smaller than that in continent women matched forage, parity and hysterectomy. We used a length area index to estimate volume because it accounts for changes in SUS length and area, and provides a more complete picture than when either factor is considered separately. Although it is not possibleto exactly calculate SUS volume, it provides a parameter that reflects these 2 aspects of a non linear complex anatomy. The smaller length-area index in women with stress incontinence accountsto some degree for the 42% loss in MUCP. However, the modest difference between the groups suggests that additional factors are involved in urethral function aside from urethral anatomy.

The relationships between several measures of pelvic floor muscle function and SUS anatomy help demonstrate that changes in SUS anatomy do not occur in isolation. For instance, with voluntary pelvic muscle contraction there are larger increases in VCF and greater urethral elevation in women with larger SUS measures (length, area and length-area index). These associations most likely reflect levator ani structure and function, and not urethral anatomy. They could be due to a greater general pelvic muscle mass and activation in some women, to simultaneous damage of theSUS and levator ani muscles in some or to a combination of these factors. It is also possible that an alteration in a central neural mechanism might have a global impact on several pelvic floor muscles.

The finding that a shorter urethra is associated with levator ani injury deserves consideration. It is not clear why asymptomatic continent women with levator ani injury but not women with stress incontinence have a shorter SUS. Increased variation in urethral support in continent women could be responsible. Continent women have better urethral support than incontinent women. A levator ani defect in continent women could result in a greater change in urethral support. The greater loss in urethral support in continent women is significant because the resulting urethral curvature may lead to fewer images showing SUS and an apparently shorter SUS length.

Changes in SUS anatomy with age may have interesting implications for stress urinary incontinence pathophysiology. The association betweena shorter SUS and aging is consistent with that in previous studies. The increase in area with aging is likely due to a relative increase in connective tissue since previous study has also demonstrated a decrease in the number of striated muscle cells. These findings suggest that with aging the high pressure zone in the urethra becomes shorter in length and larger in diameter, which may not be advantageous in a continence mechanism.[10–12]

This study builds on a series of studies of SUS imaging. Studies using intraurethral and transurethral ultrasonography provide interesting insights into urethral structure and function.[13–15] However,there are concerns about the limitations of this technique to adequately image SUS[16,17] and there maybe urethral compression on ultrasonography.[18] This latter issue could theoretically be avoided using MRI without endocoils. A study using axial MRI recentlyshowed qualitative changes in the proximal and midportion of the posterior urethral wall in women with stress incontinence.[19] Our study in women with stress incontinence and asymptomatic continent women has advanced the understanding of urethral changes and provides quantitative data on the differences.

The strengths and limitations of this study deserve consideration. Using asymptomatic, proven continent volunteers matched for age, parity hysterectomyand race avoided the potential for confounding by these common factors. MRI also provides clear images of urethral anatomy but there are limitations, as with any technique. Slice thickness in this study limited the sensitivity of measurementsto 5 mm in urethral length estimates. We attempted to measure length on sagittal images but the vague nature of the upper and lower margins led to a lack of confidence in this strategy. Smaller slice thickness might allow more discrete information when identifying a critical region, such as vesical neck vs striated sphincter. Advances in magnet technology and the ability to perform isovolumetric scans may also offer more sensitive scanning in the future. Regardless, MRI is unable to assess histology. With time there are changes in fiber density in the urethra.[10,11] Individual muscle cells in the SUS gray ring are lost with changes to connective tissue architecture, as discussed, which may not be reflected on MRI.

CONCLUSIONS

A smaller SUS is associated with stress incontinenceand poorer pelvic floor muscle function. This study provides an anatomical analysis of SUS that begins to explain some physiological differences observed in women with and without stress incontinence.However, the morphological differences that we observed do not approach the 42% difference observed in MUCP. Technical advances and biomechanical modeling that integrate structure function findings will provide an opportunity to understand how subtle changes in urethral anatomy can affect the stress continence system. Research efforts exploring the interaction of anatomy and physiology may yield novel insights into stress incontinence pathophysiology.

Acknowledgments

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Abbreviations and Acronyms

CU/UVS, compressor urethra/ urethrovaginal sphincter; KUCP, urethral closure pressure Kegel augmentation; MRI, magnetic resonance imaging; MUCP, maximum urethral closure pressure; POP-Q, Pelvic Organ Prolapse Quantification; SUS, striated urogenital sphincter; VCF, vaginal closure force.

REFERENCES

1. DeLancey JO, Trowbridge ER, Miller JM, Morgan DM, Guire K, Fenner DE, et al. Stress urinary incontinence: Relative importance of urethral support and urethral closure pressure. J Urol 2008;179:2286. [PubMed: 18423707]
2. Hricak H, Secaf E, Buckley DW, Brown JJ, Tanagho EA, McAninch JW. Female urethra: MR imaging. Radiology 1991;178:527. [PubMed: 1898991]
3. Strohbehn K, Quint LE, Prince MR, Wojno KJ, Delancey JO. Magnetic resonance imaging anatomy of the female urethra: a direct histologic comparison. Obstet Gynecol 1996;88:750. [PubMed: 8885907]
4. Tan IL, Stoker J, Lameris JS. Magnetic resonance imaging of the female pelvic floor and urethra: body coil versus endovaginal coil. MAGMA 1997;5:59. [PubMed: 9219181]
5. Tunn R, DeLancey JO, Quint EE. Visibility of pelvic organ support system structures in magnetic resonance images without an endovaginal coil. Am J Obstet Gynecol 2001;184:1156. [PubMed: 11349182]
6. Tunn R, Delancey JO, Howard D, Ashton-Miller JA, Quint LE. Anatomic variations in the levator ani muscle, endopelvic fascia, and urethra in nulliparas evaluated by magnetic resonance imaging. Am J Obstet Gynecol 2003;188:116. [PubMed: 12548204]
7. Umek WH, Kearney R, Morgan DM, Ashton-Miller JA, DeLancey JO. The axial location of structural regions in the urethra: a magnetic resonance study in nulliparous women. Obstet Gynecol 2003;102:1039. [PubMed: 14672484]
8. Morgan DM, Umek W, Stein T, Hsu Y, Guire K, DeLancey JO. Interrater reliability of assessing levator ani muscle defects with magnetic resonance images. Int Urogynecol J Pelvic Floor Dysfunct 2007;18:773. [PubMed: 17043740]
9. DeLancey JO. Correlative study of paraurethral anatomy. Obstet Gynecol 1986;68:91. [PubMed: 3725263]
10. Perucchini D, DeLancey JO, Ashton-Miller JA, Galecki A, Schaer GN. Age effects on urethral striated muscle. II anatomic location of muscle loss. Am J Obstet Gynecol 2002;186:356. [PubMed: 11904591]
11. Perucchini D, DeLancey JO, Ashton-Miller JA, Peschers U, Kataria T. Age effects on urethral striated muscle. I changes in number and diameter of striated muscle fibers in the ventral urethra. Am J Obstet Gynecol 2002;186:351. [PubMed: 11904590]
12. Carlile A, Davies I, Rigby A, Brocklehurst JC. Age changes in the human female urethra: a morphometric study. J Urol 1988;139:532. [PubMed: 3343739]
13. Mitterberger M, Pinggera GM, Mueller T, Frauscher F, Pallwein L, Gradl J, et al. Dynamic transurethral sonography and 3-dimensional reconstruction of the rhabdosphincter and urethra: initial experience in continent and incontinent women. J Ultrasound Med 2006;25:315. [PubMed: 16495491]
14. Umek WH, Laml T, Stutterecker D, Obermair A, Leodolter S, Hanzal E. The urethra during pelvic floor contraction: observations on threedimensional ultrasound. Obstet Gynecol 2002;100:796. [PubMed: 12383551]
15. Athanasiou S, Khullar V, Boos K, Salvatore S, Cardozo L. Imaging the urethral sphincter with three-dimensional ultrasound. Obstet Gynecol 1999;94:295. [PubMed: 10432146]
16. Heit M. Intraurethral sonography and the testretest reliability of urethral sphincter measurements in women. J Clin Ultrasound 2002;30:349. [PubMed: 12116097]
17. Schaer GN, Schmid T, Peschers U, Delancey JO. Intraurethral ultrasound correlated with urethral histology. Obstet Gynecol 1998;91:60. [PubMed: 9464722]

18. Umek WH, Obermair A, Stutterecker D, Hausler G, Leodolter S, Hanzal E. Three-dimensional ultrasound of the female urethra: comparing transvaginal and transrectal scanning. Ultrasound Obstet Gynecol 2001;17:425. [PubMed: 11380968]

19. Tunn R, Goldammer K, Neymeyer J, Gauruder-Burmester A, Hamm, Beyersdorff D. MRI morphology of the levator ani muscle, endopelvic, fascia, and urethra in women with stress urinary incontinence. Eur J Obstet Gynecol Reprod Biol 2006;126:239. [PubMed: 16298035]

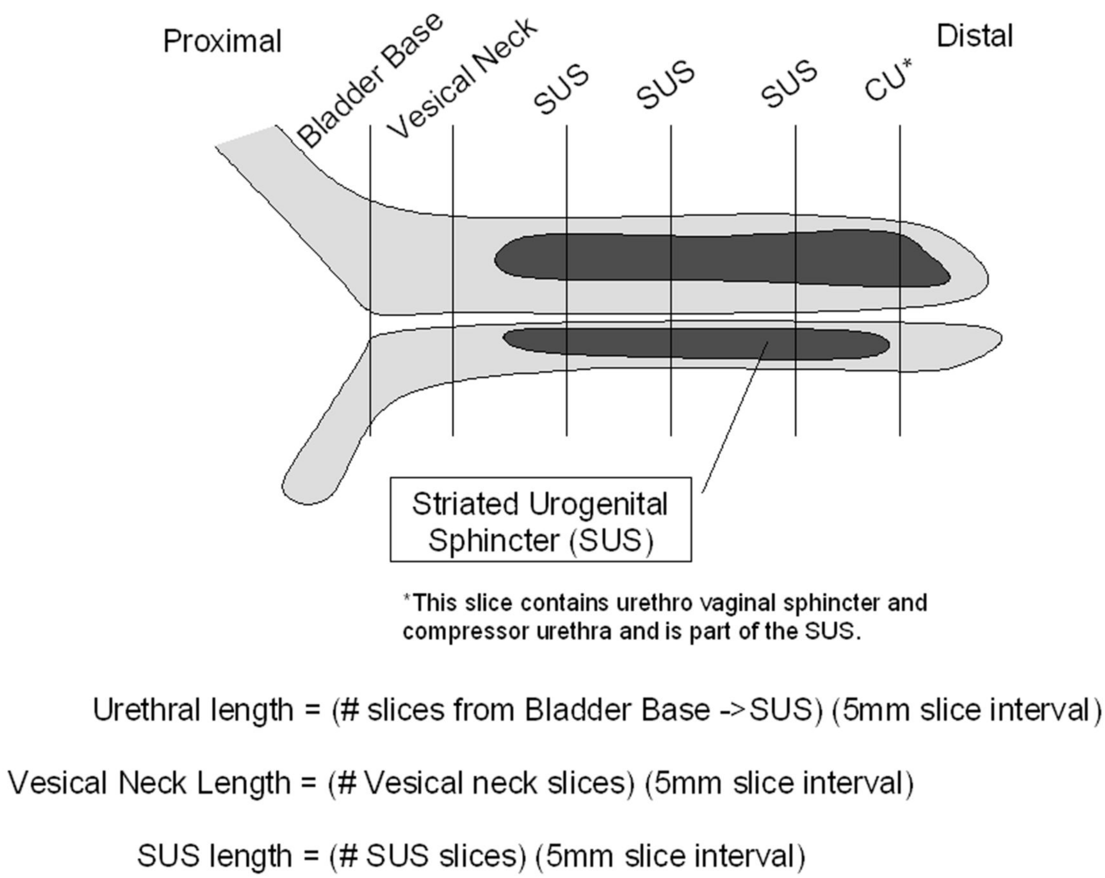

Figure 1.

Characteristic anatomical urethral regions divided by 5 mm slice thickness. Urethral length equals number of slices from bladder base to SUS, vesical neck length equals number of vesical neck slices and SUS length equals number of SUS slices with each slice at 5 mm intervals. Asterisk indicates that slice contains CU/UVS and is part of SUS.

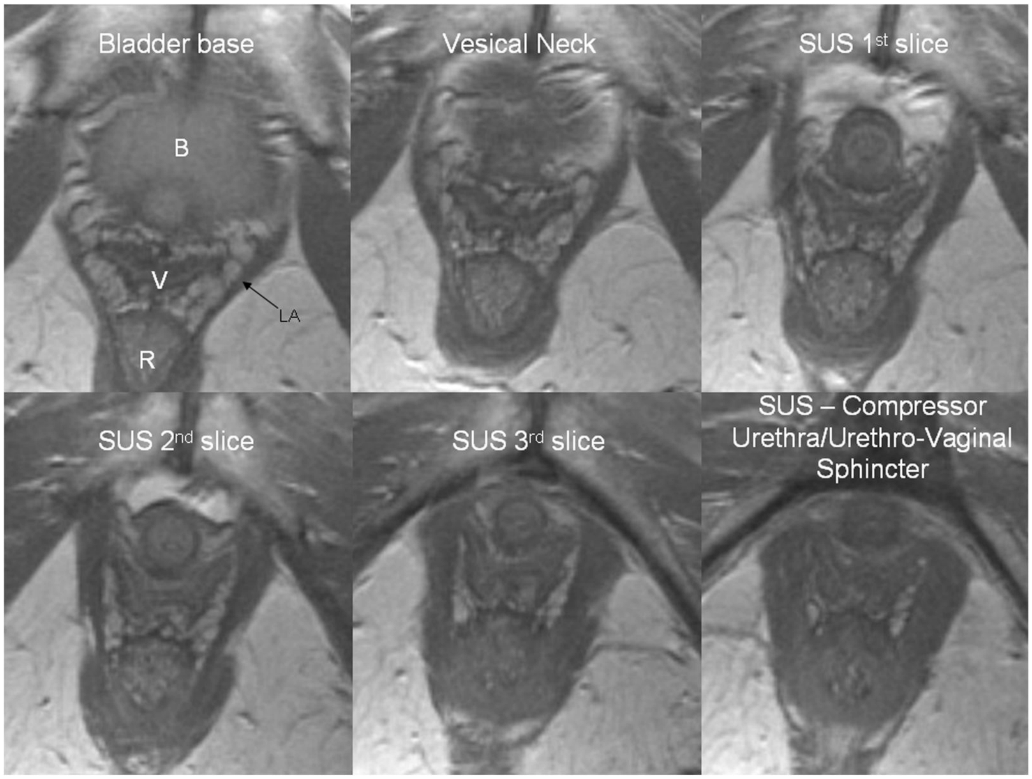

Figure 2.

Examples of predominant urethral regions and calculations. For orientation bladder (*B*), vagina (*V*), rectum (*R*) and levator ani muscles (*LA*) are shown in bladder base slice. Three axial MRI scans show SUS approximating circle. Also note SUS slice showing CU/UVS. SUS length was 20 mm (4 slices × 5 mm slice thickness). SUS thickness could be measured in first 3 slices but since in most individuals only 2 SUS slices were measured, area was estimated by calculating average area of first 2 slices.

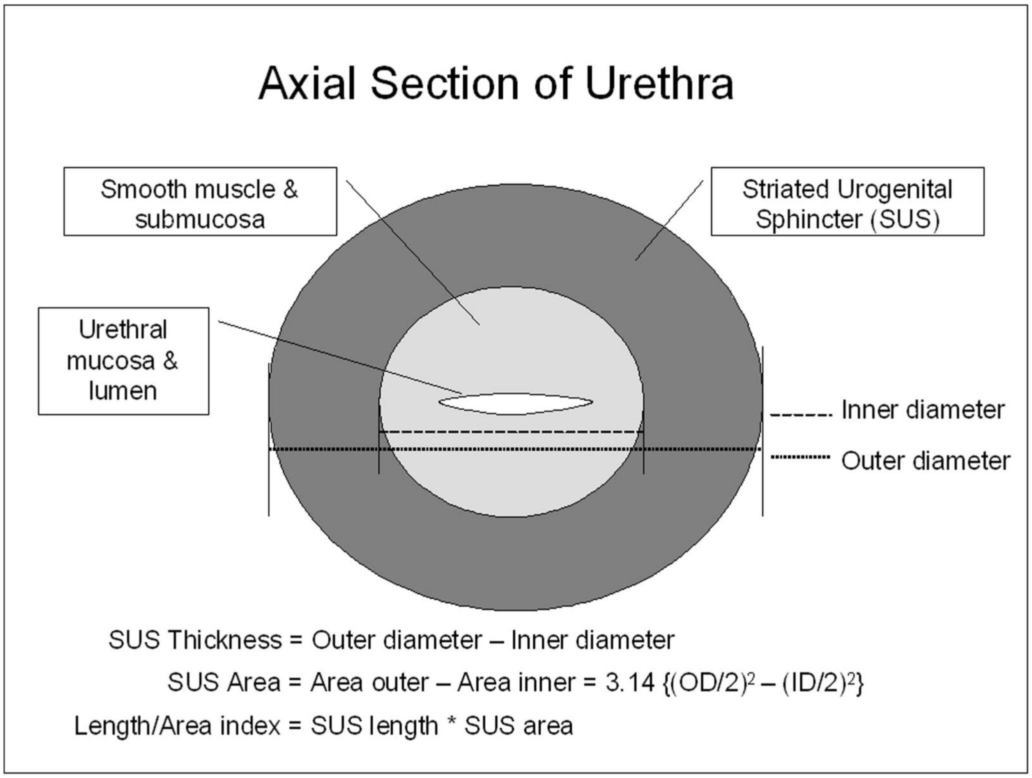

Figure 3.

Single axial urethral section demonstrates 3 layers observed and how SUS measures were calculated using equations, SUS thickness = outer - inner diameter, SUS area = outer - inner area = 3.14 $[(OD/2)^2 - (ID/2)^2]$ and length/area index = SUS length× SUS area.

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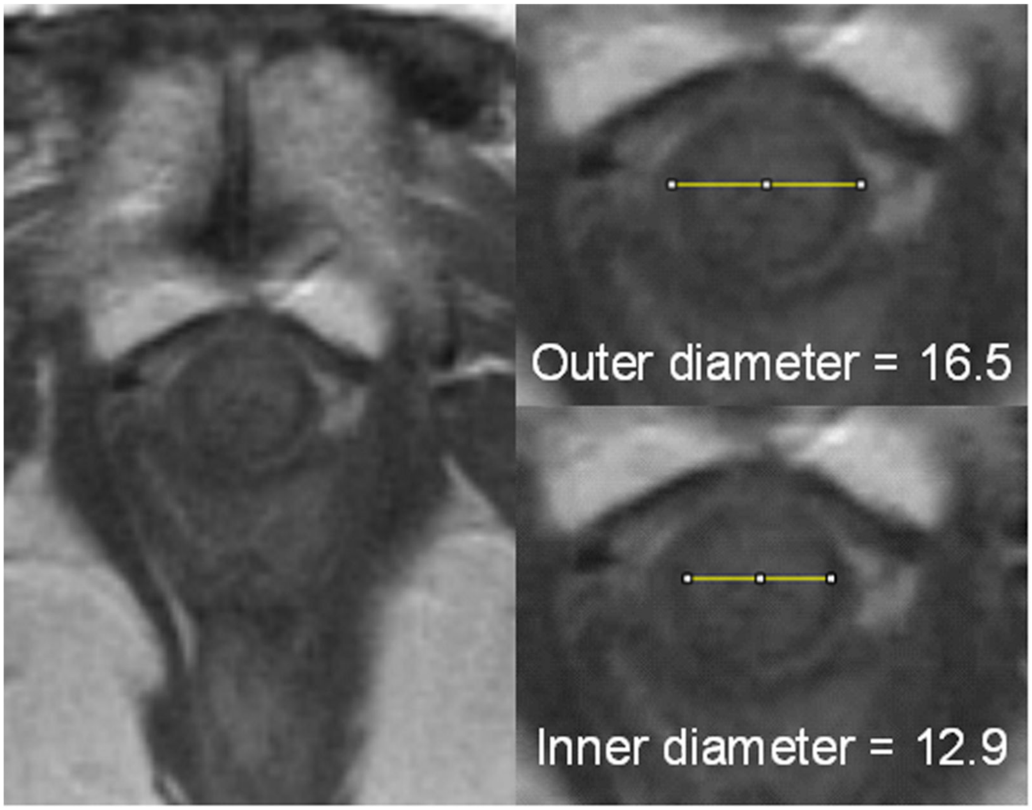

Figure 4.
Measurement of proximal SUS outer and inner diameters

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Table 1

Adequacy of MRI scans for estimation of urethral lengths and for calculations of striated urogenital sphincter area

MRI adequate to:	Stress incontinent N=103 (%)	Continent N=108 (%)	P value
Describe the visibility of urethral anatomy (bladder base versus vesical neck versus striated sphincter)	99 (96.1)	106 (98.2)	.38
Analyze SUS thickness in the proximal urethral slices	87 (84.5)	96 (88.9)	.34

Table 2

Assessment of SUS when layer is visible and measurable

MR characteristic	Stress incontinent N=87 (%)	Continent N=96 (%)	P value
Vesical neck length (distance from the bladder base to 1st measurable SUS slice)			.35
5mm	78 (90.7%)	81 (85.4%)	
10mm	9 (10.3%)	12 (12.5%)	
15 mm	0 (0%)	2 (2.1%)	
Number images used to estimate SUS area			
one	6 (6.9)	13 (13.5)	
two	81 (93.1)	83 (86.5)	.141
Number images in which a trilaminar urethra was observed.	1.90 ± 1.36	1.85 ± 1.47	.83

Table 3

Comparison of MRI measures of the urethra in stress incontinent and continent women

	Stress incontinent	Continent	Percent difference	p value
Urethral Lengths	N=99	N=106		
SUS (mm)	13.2 ± 3.4	13.7 ± 3.9	−3.3	.40
Vesical neck (mm)	13.2 ± 2.7	13.0 ± 2.7	2.0	.51
Total length (mm)	26.5 ± 4.1	26.7 ± 4.1	−0.6	.47
SUS	N=87	N=96		
Thickness (mm)*	2.83 ± 0.8	3.11 ± 1.4	−8.9	.09
SUS area in proximal SUS slices (mm^2)**	59.1 ± 18.4	62.9 ± 24.7	−6.0	.24
Length-area index (mm^3)***	766.4 ± 294.3	876.2 ± 407.3	−12.5	.04

*Thickness = outer diameter — inner diameter

**Area = outer diameter area — inner diameter area

***Volume = (proximal SUS slices, mean area)*(SUS length)

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Table 4

The correlation coefficients of demographics & examination findings with magnetic resonance imaging measures (includes cases & controls)

Demographics	**Vesical Neck**	**SUS length**	**SUS thickness**	**SUS area**	**SUS length/ area index**
Age	**.20**	**−.27**	**.19**	**.21**	.003
	p<.01	**p<.01**	**p=.01**	**p<.01**	p=.98
Parity	.08	−.07	−.03	−.01	−.04
	p=.30	p=.36	p=.68	p=.94	p=.53
Urethral function					
MUCP	**−.15**	.13	.01	.04	.11
	p=.03	p=.07	p=.89	p=.62	p=.13
KUCP	−.01	**.15**	.08	.11	**.15**
	p=.93	**p=.04**	p=.28	p=.16	**p=.04**
Pelvic muscle function					
Resting Vaginal Closure Force (VCF)	**−.27**	.10	.05	.08	**.18**
	p<.01	p=.16	p=.44	p=.26	**p=.02**
Augmentation of VCF with pelvic muscle contraction	−.06	**.27**	.13	**.15**	**.28**
	p=.39	**p<.01**	p=.07	**p=.04**	**p<.01**
Urethral axis with pelvic muscle contraction	−.04	−.13	**−.18**	−.13	**−.18**

Demographics	**Vesical Neck**	**SUS length**	**SUS thickness**	**SUS area**	**SUS length/area index**
	p=.56	p=.06	**p=.01**	p=.06	**p=.01**
Urethral support					
Point Aa	−.037	.03	−.10	−.05	−.01
	p=.60	p=.62	p=.20	p=.42	p=.85
Point Ba	−.03	.02	−.09	−.04	−.01
	p=.67	p=.79	p=.23	p=.55	p=.85
Cotton swab urethral axis with strain	−.06	−.034	.001	.03	.01
	p=.32	p=.629	p=.99	p=.67	p=.87