

# Role of MR imaging in diagnosis of urethra hypermobility and intrinsic sphincter deficiency in women with stress urinary incontinence.

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**Significance:** There are two hypotheses for female stress urinary incontinence (SUI); urethral intrinsic sphincter deficiency (ISD) results from decreased muscle volume and urethral hypermobility results from defects in urethra supporting ligaments. The traditional diagnosis of SUI is based on urodynamics (UDs). MR imaging allows the assessment of both sphincter and periurethral ligaments, and may contribute to diagnosis established with UD that evaluate function but not morphology.

**Purpose:** Our purpose was to: 1) evaluate urethral sphincter in women with SUI and age-matched continent volunteers, and 2) correlate the MR imaging findings of the status of urethral sphincter and urethral ligaments with UD results in women with SUI.

## Materials and Methods:

1) We evaluated 10 incontinent women (mean age  $59.7 \pm 14.5$ ) and two groups of continent volunteers, one group of 8 volunteers was age-matched to the incontinent group (mean age  $51.7 \pm 5.9$ ), and the second group of 6 volunteers was not age-matched, mean age  $43.8 \pm 5.8$ . We imaged patients using 1.5T GE scanner and 14F endourethral coil. Diagnostic sequences included T2W FSE images in three planes (TR/TE 3000-6300/60-75 ms, slice/space 2.5-3.0/0.5-2.0 mm, FOV 5-7 cm, 6-8 NEX, 256x256). We measured urethral length, thickness of striated and smooth muscle layers, and area of muscles at the proximal, mid, and distal urethra. We compared sphincter muscle sizes between incontinent patients and two groups of volunteers using student T-test.

2) We evaluated 12 women with SUI (mean age  $57 \pm 12$ ) with MR protocol including endocavitary imaging (endourethral 14F coil and endovaginal or endorectal coil), and standard pelvic protocol with phased array coil. Diagnostic sequences included T2W FSE images in three planes, with 256x256 imaging matrix and FOV adjusted to the receiver coil. We analyzed the status and thickness of the urethral sphincter muscle, sphincter length, status of the urethral support ligaments, urethral mobility and bladder neck competency during strain. We correlated the imaging findings with measurements of Valsalva leak point pressure (LPP), maximal urethral closure pressure (MUP), functional urethral length obtained from UD evaluation and urethral Q-tip test mobility. Pearson's product moment correlation coefficient was used for the assessment of correlation between paired variables.

**Results:** When the sphincter muscle size in incontinent patients was compared to that of age-matched volunteers group, there was no significant difference in the striated or smooth muscle layers. However, when the sphincter muscle size in incontinent patients was compared to that of non age-matched volunteers group (on average 10 years younger), there was a significant difference ( $p < 0.05$ ) in the size of the striated muscle in the mid anterior urethra and lower posterior urethra (Table 1), and in total urethral length.

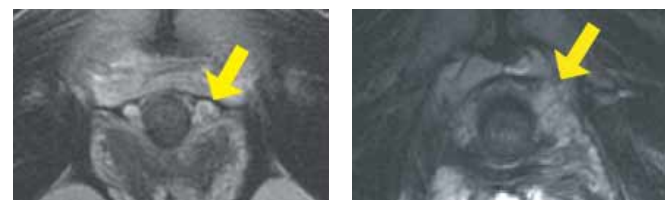
In women with SUI, there was very high correlation ( $r = 0.93$ ) between LPP and sphincter muscle length, and high correlation ( $r = 0.83$ ) for Q-tip mobility versus hypermobility angle on MR imaging, and ( $r = -0.74$ ) between MUP and posterior striated muscle thickness of mid urethra. There was moderate correlation ( $r = 0.68$ ) between the functional length of urethra by UD and the length of sphincter muscle on MR imaging. 2 of 3 patients with low MUP,  $\leq 20$  mm H<sub>2</sub>O showed bladder neck funneling, a feature of ISD and 1 of 3 showed short urethral sphincter  $< 2$  cm. All 9 patients with hypermobility  $> 30$  degrees showed laxity, partial or complete disruption of periurethral ligaments and 3 showed vaginolevator separation (Figure 1).

## Conclusions:

Intraurethral MR imaging allows detailed visualization and precise measurements of the urethral sphincter. Although, the decrease in urethral sphincter volume has been associated with stress incontinence it is also associated with normal aging. By providing information about urethral morphology and ligamentous support, MR imaging contributes findings that characterize the type of urethral dysfunction. MR imaging supplements UD evaluation and may assist in classification of incontinent patients into hypermobility and ISD categories which require different treatment.

**Table 1. Urethral striated muscle comparison between continent and incontinent women.**

Urethra Sphincter Muscle	Continent Volunteers mean age 43.8	Continent Volunteers mean age 51.7	Incontinent Patients mean age 59.7
Mid ant. striated mm	$2.5 \pm 0.6$	$2.1 \pm 0.3$	$1.9 \pm 0.4$
Lower post. striated mm	$1.5 \pm 0.3$	$1.2 \pm 0.3$	$0.9 \pm 0.2$



**Figure 1. Comparison of urethral ligament support. Left continent patient - Intact periurethral ligament (arrow). Right incontinent patient - Disrupted periurethral ligament (arrow) and left paravaginal attachments.**