in-phase (IP, TR 150 in phase), and out-of-phase (OP, TR 150 out of phase).
A 160x160 mm field of view was used with an imaging matrix of 256x256 voxels. The signal intensity (SI) measurements of the levator ani muscle were carried out with Advantage Windows sdc AW 2.0.18.
The SI ratio of the levator ani to obturator internus muscle was calculated to control for interindividual differences in signal intensity.

Results

The mean MR signal intensities obtained with the different examination techniques (sequences) are shown in Table 1. The signal intensities did not correlate with maximal urethral closure pressures during kegel exercises (**K-UCP,** Table 2) or the speculum measurements. Calculating the ratio between the levator ani and the obturator internus muscle did not affect the P-values or correlations with the urodynamic data (Table 2). Nor did we find significant correlations between the different signal intensities and the body mass index or age. The mean T2 signal intensity of the obturator internus muscle was 29 ± 1 for the nulliparas and 34 ± 8 for the primiparas with urinary incontinence.

Table 1

Signal intensity	**PD**	**T1**	**T2**	**STIR**	**FS**	**IP**	**OP**
Nulliparas (n=11)	166±19	86±26	39±4	54±9	153±26	124±14	123±18
Primiparas (n=6)	174±17	112±34	52±15	58±17	145±35	130±32	120±30
P-values	0.56	0.1	**0.02**	0.58	0.6	0.57	0.81

Table 2

Correlation coeff.	**PD**	**T1**	**T2**	**STIR**	**FS**	**IP**	**OP**
SI - K-UCP	-0.27	-0.11	-0.38	-0.19	0.13	-0.05	0.24
Ratio - K-UCP	-0.32	-0.11	-0.29	-0.01	-0.54	-0.23	0.36

Conclusions

The T2-weighted sequence is the most sensitive one for describing the muscle quality (density of striated muscle fibers) of the levator ani muscle and has shown significant differences between nulliparas and primiparas with urinary incontinence. If urinary incontinence is caused by changes in levator ani muscle structure, MR imaging can objectify these changes. In contrast, urodynamic and speculum measurements did not identify the demonstrated differences in levator ani muscle signal intensity.

Comment: Since there is a 2- to 3-fold interindividual difference in levator ani muscle morphometry, the low standard deviation of the levator ani muscle signal intensity indicates a constant tissue composition in nulliparas. Primiparas, on the other hand, show birth related changes in signal intensity in the region of the levator ani and obturator internus muscles.

References: 1) Neurourol Urodynam 1998;17:197-205; 2) Obstet Gynecol 1998;91:406-12

54

SE Speights, JOL DeLancey, JA Ashton-Miller, D Howard

University of Michigan,
Ann Arbor. USA

WOMEN WITH LOCALIZED LEVATOR ANI ABNORMALITIES ON MR IMAGES AND STRESS INCONTINENCE HAVE WEAKER MUSCLES AND DECREASED PELVIC ORGAN SUPPORT

Aims of Study: The levator ani muscles (LA) are involved in pelvic organ support and urinary continence [1]. MR imaging has demonstrated localized LA abnormalities [2]. The functional status of these visibly abnormal muscles in normal women and women with stress incontinence has not been studied. This study was done to test the null hypothesis that continent and incontinent parous women with visible muscle abnormalities on MR images have similar LA strength as those without such abnormalities including nulliparous women.

Methods: Seventy-five women volunteered for a case-control study of vaginal birth and stress incontinence. The study groups included 19 nulliparous continent women (NC), 30 parous continent women (PC) and 26 parous stress incontinent women (SI). A pelvic examination with provocative full-bladder stress test was completed in all patients. Vaginal support was graded during maximum Valsalva maneuver using the hymeneal ring as a reference. LA strength at rest and during a maximum pelvic muscle contraction was measured using an instrumented intravaginal speculum [3]. Maximum contraction force during two contractions was recorded and the best effort used for data analysis.

MR imaging (Signa, General Electric Medical Systems, Milwaukee, WI) was used to evaluate the LA in all subjects. Transverse and coronal fast-spin proton density weighted images were made of the pelvic region using a slice thickness of 4 mm separated by a slice gap of 1 mm. A 160 x 160 mm field of view and an imaging matrix of 256 x 256 were used. Axial MR images at the mid-urethral level were independently reviewed for the presence of abnormalities in LA morphology by two examiners blinded to LA function, parity, and continence.

Group comparisons were made with ANOVA using the Statview statistical package (Abascus Concepts, Inc. Berkeley, CA).

Results: None of the 19 NC women had abnormal LA. Sixteen LA abnormalities were identified among the 56 parous women (28%). Nine of the LA abnormalities were in parous continent women (PC_A) and seven abnormalities were in parous stress incontinent women (SI_A). This left 21 parous continent women with intact LA (PC_I) and 19 stress incontinent women with intact LA (SI_I). There were no differences among any of the groups of women with respect to age, body mass index, race, or estrogen status. As shown in the table below there is a 31% difference in mean LA strength based on contraction force in Newtons when parous women with LA abnormalities on MR images (PC_A + SI_A) are compared to parous women without abnormalities (PC_I + SI_I) and this is statistically significant.

Table 1. Maximum Levator Ani Muscle Contraction Force (Newtons)

	N=	Mean Max. Ctx. (Newtons)	% Difference	SD	p
PC_I + SI_I vs PC_A + SI_A	**40 16**	**5.66 3.94**	**31**	**2.98 2.33**	**0.044**
SI_I vs SI_A	**19 7**	**5.43 2.46**	**55**	**3.05 0.90**	**0.048**
PC_I vs PC_A	21 9	5.87 5.09	14	2.98 2.47	0.561
NC vs PC_I	19 21	6.53 5.87	11	4.58 2.98	0.536

These strength differences were statistically different when comparing stress incontinent women with abnormalities (SI_A) to stress incontinent women without abnormalities (SI_I). Although not statistically different, a 14% difference existed when comparing parous continent subjects with abnormalities (PC_A) to parous continent subjects without abnormalities (PC_I).

Examination of pelvic organ support revealed that the anterior vaginal wall lay at or below the hymen in 50% of parous subjects with LA abnormalities (PC_A + SI_A) compared to 34% of parous subjects without abnormalities (PC_I + SI_I). In stress incontinent subjects with abnormalities (SI_A), 86% had anterior vaginal wall prolapse at or below the hymen compared to 44% of incontinent subjects without abnormalities. Although these differences trended in the expected direction they were not statistically significant at this sample size.

Conclusion: The levator ani muscles are weaker in parous women with LA abnormalities than in those without abnormal muscle and incontinent women have an even greater loss of contractile force. Furthermore, when LA abnormalities are present, parous women, especially those with incontinence, there may be more descent of the anterior vaginal wall.

References

1. Am J Obstet Gynecol 1994;170:1713-23.
2. Br J Urol 1993;72:715-8.
3. Obstet Gynecol 1998;91:406-12.

55

M. Fynes, C. O' Herlihy, P.R. O' Connell, M. Behan

Dept. of Obstetrics and Radiology, University College Dublin, The National Maternity Hospital, Dublin, Ireland

COMPARISON OF TRANS-ANAL SONOGRAPHY AND MRI MAPPING OF INTERNAL AND EXTERNAL OBSTETRIC ANAL SPHINCTER DEFECTS

Aims of study : To compare trans-anal sonography and body coil MRI in the assessment of obstetric anal sphincter injury.

Methods: 14 consecutive women with a history of frank fecal incontinence following primary repair of recognised obstetric anal sphincter disruption were recruited from a dedicated perineal clinic 14 weeks postpartum. Two of these women had recognised recto-vaginal fistulae identified at clinical examination.

Anatomical integrity of the internal (IAS) and external (EAS) anal sphincter mechanisms was assessed using trans-anal sonography and body coil MRI. Trans-anal sonography was performed in the prone position using a 360^0 lOMHz rotating endoprobe. MRI imaging was performed using a 1.5T Magnetom imager. Oblique axial T1W pre and post gadolinium and T2W turbo spin echo three sequences were performed on all patients using a phased array pelvic coil. Localisation of the anal sphincter was achieved with the aid of a sagittal scout . Gadolinium was used to enhance scar tissue and aid the identification of anal sphincter injury.

Anal sphincter injury was graded for both the IAS and EAS according to a) the degree of sphincter disruption (partial or full thickness) and b) the extent of the defect according to the number of quadrants of the anal sphincter mechanism involved. The thickness of the IAS was also measured at two standardised points corresponding to the three and nine o' clock position with the patient in the lithotomy position.The extent of EAS injury was also graded according to the number of muscle components of the sphincter mechanism involved (subcutaneous,superficial or deep).

Image analysis for both ultrasound and MRI was performed by two independent radiologists blinded to the patients history. The duration of each radiological procedure and patient tolerance assessed by means of a visual analogue score was recorded. These data were then transferred to an IBM compatible database and statistical analysis was performed using a dedicated software package.

Results: Trans-anal sonography was well tolerated compared to body coil MRI which most women found uncomfortable. The mean duration of the ultrasound assessment was significantly shorter compared to MRI [US mean 6, range 4 - 10 minutes / MRI mean 45 range 25 -60 minutes, $p<0.001$ Fishers exact test].The mean thickness of the internal (IAS) sphincter measured at two standardized points were comparable for both ultrasound(mean 1.6 / range 0 -3.4mm) and MRI (mean 1.6mm / range 0 -3.5mm)($r = 0.98$). 12 IAS defects were identified at both ultrasound and MRI. The type and extent of IAS injury was comparable for both methods (Table 1). 14 EAS defects were identified at ultrasound compared to only 4 at MRI. The extent and site of EAS injury identified at MRI did not compare with ultrasound (Table 2). MRI however identified two recto-vaginal fistulae not detected at ultrasound.

TABLE 1: IAS DEFECTS IDENTIFIED AT TRANS-ANAL SONOGRAPHY COMPARED TO BODY COIL MRI

	US	MRI
Number of IAS defects	12	12
Type of IAS defect		
Full thickness	6	6
Partial thickness	6	6
Extent of IAS defect		
1 quadrant	6	3
2 quadrants	3	9
3 quadrants	3	0