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Title (type in CAPITAL LETTERS): NORMAL VARIATION AND INTERRATER RELIABILITY OF MAGNETIC RESONANCE IMAGING (MRI) OF PELVIC FLOOR MUSCULATURE IN NULLIPARAS

Aims of Study: 1) Investigate the ability of MRI to demonstrate clinically relevant pelvic and perineal anatomy in normal nulliparous women, 2) document normal variation, and 3) test interrater reliability of measurements.

Methods: 15 normal nulliparous Caucasian women (mean age 28.7±7.5, range 20-49 years) underwent MRI of the pelvis (1.5T, Signa; GE Medical Systems). Axial FSE images (TR:3000, TE:104, 2.0mm thick section, no interspace gap, 16cm FOV, 256x160 matrix and 2 excitations) were performed. Dynamic sagittal SSFSE images (TR:maximum, TE:100, 90° flip angle, 5mm thick sections, 5mm interspace, 20cm FOV, 256x256 matrix, and 0.5 excitations) were obtained in the supine position with the subjects relaxed and at maximal Valsalva. Two radiologists blinded to the clinical history independently reviewed the images, which were intermixed with those of patients with incontinence and prolapse. Reported measures included levator ani (LA) muscle thickness, urethral diameter and distance from the pubic symphysis, and position of the bladder base, cervix, and inferior margin of rectal air relative to a line between the pubis and coccyx (PCL) at rest and strain on the sagittal images. Qualitative assessments of the LA, superficial perineal muscles (SPM), and posterior pubourethral ligaments (PPL) for integrity and right/left symmetry were made. Urethral axis, POPQ stage, and pelvic muscle strength (on a nine point scale) were determined by one examiner. Mean±SD for continuous variables are reported, and Spearman correlation coefficients calculated. Interrater agreement was assessed via the kappa statistic. All definitions conform to ICS standards.

Results: All subjects had Stage I or II pelvic support, and none had urethral hypermobility (mean strain angle 5.3±5.2°, range -50-10°). Pelvic floor contraction score averaged 7.9±1.4. Mean total width of both LA was 14.7±3.6mm, and muscle thickness was symmetrical (left 7.3±1.8mm, right 7.4±1.9mm). The mean urethral diameter was 12.4±1.7mm, and mean distance of the urethral lumen from the pubis was 13.5±2.4mm. The latter did not correlate with urethral strain angle. The SPM were not adequately imaged to allow determination of integrity in 4/15 patients. The bladder, cervix, and rectum were above the PCL at rest (22.5±4.1mm, 34.9±9.8mm, 11.7±7.8mm respectively), and descended with strain (9.0±7.1mm, 10.4±5.3mm, 10.3±1.2mm respectively). No subject had the bladder or cervix below the PCL on Valsalva, but the margin of the inferior rectum was below the PCL at rest in 1 subject and with Valsalva in 4. LA thickness measures by the two raters were within 2mm in 10/15 subjects on the left and all subjects on the right. Attachment of the LA to the sidewall was rated intact bilaterally in 12/15 subjects, with good agreement (K=.47). PPLs were imaged and judged intact in all subjects by both raters. Interrater agreement on LA muscle signal homogeneity, LA symmetry, SPM integrity, and SPM symmetry were no better than chance.

Conclusions: The attachments of the LA and PPL to the sidewall are reliably imaged and intact in normal nulliparas, but perineal anatomy was not reliably imaged. Interrater reliability is excellent for determination of integrity of attachments and thickness of the LA, but poor for other qualitative measures. The bladder and cervix of normal

nulliparous women does not descend below the PCL at rest or Valsalva, though the inferior rectum may do so with Valsalva. While MR images certain attachments very well, our inability to confirm certain anticipated normal findings in this group of subjects cautions against an assumption of abnormality of similar findings in symptomatic patients.

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