

## LEVATOR ANI AND ANAL SPHINCTER MEASURES ARE COMPARABLE WITH MAGNETIC RESONANCE AND THREE-DIMENSIONAL ULTRASOUND IMAGING TECHNIQUES.

### Hypothesis / aims of study

Three muscles are thought to maintain anal continence: the internal anal sphincter (IAS), external anal sphincter (EAS) and the puborectalis muscle (PRM). These muscles have been imaged in the past with different techniques including magnetic resonance imaging (MRI) and more recently with three-dimensional ultrasound (3DUS). MRI and 3DUS can assess anatomical integrity and dynamic motion (function) of the anal sphincter complex. We hypothesized that the 3DUS can obtain comparable imaging of the PRM, and anal sphincters. Our aim was to compare the MRI and the 3DUS techniques in imaging of the levator ani (the PRM) and the anal sphincters (the EAS and IAS).

### Study design, materials and methods

Studies were performed in 5 nulliparous, asymptomatic female volunteers (mean age 32 yrs, range 23-47) to assess the anal sphincter complex using MRI and 3DUS. MRI was performed using T-2 weighted images in the axial plane to assess anatomical muscle integrity. Dynamic MRI images were recorded in the coronal and sagittal planes during a pelvic floor contraction. For 3DUS we used an HD11 (Philips Medical Systems, Bothel, WA) ultrasound machine with an endo-vaginal 3-9 MHz transducer probe placed on the perineum. The transducer was oriented posteriorly to capture the EAS/IAS complex images and then oriented cranially to capture the pelvic floor hiatus and the PRM images. The image volumes were collected at rest and during a sustained pelvic floor contraction (squeeze). After image capture, processing of the images was performed with eFilm Workstation 1.5.3 (MRI) and Q-lab 5.0 (3DUS) software. The anterior posterior length (APL) of the pelvic floor hiatus was measured in the midline from the symphysis pubis to the inner edge of the PRM sling - using the sagittal MRI images and the axial 3DUS images. The cranio-caudal EAS total length was measured on the rest images. For the MRI images this measurement was performed on the sagittal plane. For the 3DUS the EAS length measurements were performed by assessing the ultrasound data volumes with 1mm slices. The dynamic measure of cranial displacement was measured from the most caudal portion of the anal canal using a line connecting bilateral ischial tuberosities as the reference line. The dynamic MRI measurements were performed on the rest and squeeze images.

### Results

No anatomic abnormalities in the PRM and the anal sphincters were imaged by either technique. The subcutaneous (located caudal to the IAS) and superficial (surrounding the IAS) portions of the EAS are seen by both techniques. The subcutaneous portion of the EAS is better visualized on the MRI. The IAS is better visualized in the 3DUS images (Fig 1). During pelvic floor contraction, both MRI and 3DUS allow dynamic evaluation in the sagittal plane (anterior-posterior movement) but movements in the coronal plane (cranio-caudal direction) are better assessed by the MRI (Table I).

Table I: Summary of the measurements by the 3DUS and the MRI.

Measurements	3DUS (cm)	MRI (cm)
<b>APL* at Rest</b>	5.8 ± 0.9	5.5 ± 0.9
<b>APL* with Pelvic floor contraction</b>	5.0 ± 0.7	4.8 ± 0.8
<b>EAS** (total length)</b>	2.6 ± 0.5	2.9 ± 0.3
<b>EAS subcutaneous</b>	0.8 ± 0.1	1.0 ± 0.3
<b>Cranial displacement</b>	Not available	1.2 ± 0.4

\*APL = Anterior-posterior length - distance between lower end of pubic symphysis and anorectal angle

\*\*EAS = external anal sphincter

^EAS, subcutaneous portion – is the portion of the EAS that is located caudal to the IAS.

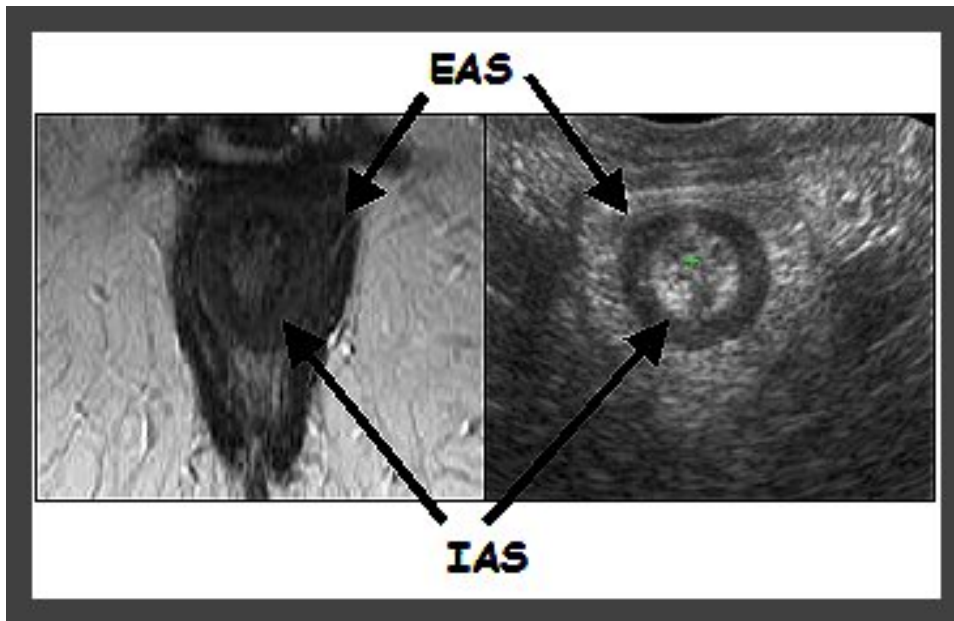


Figure 1: MRI (left) and 3DUS (right) images with external anal sphincter (EAS) and internal anal sphincter (IAS) identified on the images from the same subject.

Interpretation of results

Pelvic floor hiatus dimensions and cranio-caudal EAS length are similar whether measured by MRI or 3DUS. EAS is well imaged by either technique, whereas the IAS is better imaged by 3DUS.

Concluding message

MRI and 3D-US are complementary imaging techniques in the assessment of the levator ani muscles and the anal sphincter complex.

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**HUMAN SUBJECTS:** This study was approved by the Institutional Review Board, University of California, San Diego and followed the Declaration of Helsinki Informed consent was obtained from the patients.