



Variability in utilization and techniques of pelvic floor imaging: findings of the SAR pelvic floor dysfunction disease-focused panel

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Abstract

Pelvic floor disorders are common and can negatively impact quality of life. Imaging of patients with pelvic floor disorders has been extremely heterogeneous between institutions due in part to variations in clinical expectations, technical considerations, and radiologist experience. In order to assess variations in utilization and technique of pelvic floor imaging across practices, the society of abdominal radiology (SAR) disease-focused panel on pelvic floor dysfunction developed and administered an online survey to radiologists including the SAR membership. Results of the survey were compared with published recommendations for pelvic floor imaging to identify areas in need of further standardization. MRI was the most commonly reported imaging technique for pelvic floor imaging followed by fluoroscopic defecography. Ultrasound was only used by a small minority of responding radiologists. The survey responses demonstrated variability in imaging utilization, patient referral patterns, imaging protocols, patient education, and interpretation and reporting of pelvic floor imaging examinations. This survey highlighted inconsistencies in technique between institutions as well as potential gaps in knowledge that should be addressed to standardize evaluation of patients with pelvic floor dysfunction.

Keywords Pelvic floor · Prolapse · Magnetic resonance defecography

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Introduction

Pelvic floor disorders are common and include a range of urinary, defecatory, and sexual disorders which may result in distressing symptoms and impaired quality of life [1, 2]. Accurate diagnosis and treatment planning by physical examination alone may be limited due to the multifactorial and multicompartiment nature of these disorders, as well as due to overlap in clinical presentation [3, 4]. Imaging has been increasingly used as an adjunct to clinical evaluation, particularly to guide operative management [5]. Imaging techniques for pelvic floor evaluation include fluoroscopic defecography (FD), magnetic resonance defecography (MRD), dynamic pelvic floor MRI with straining but without defecation (dMRI), dynamic pelvic floor ultrasound, and rarely routine static pelvic MRI.

There are no universally accepted guidelines for functional pelvic floor imaging, and protocols often vary between institutions. Recent attempts to standardize protocols, grading, and reporting of pelvic floor imaging studies have led to recommendations published by the European Society of Urogenital Radiology (ESUR) and the European Society of Gastrointestinal and Abdominal Radiology (ESGAR) [6], and the society of abdominal radiology (SAR) Pelvic Floor Dysfunction disease-focused panel (DFP) [7]. However, expert recommendations have not necessarily considered current practice patterns. Knowledge of practice variations can identify important gaps in application of pelvic floor imaging techniques, highlight educational opportunities to standardize technique and reporting, and help guide development of more comprehensive future recommendations. The SAR Pelvic Floor Dysfunction DFP recently utilized a survey to gain an understanding of variations in utilization patterns and techniques of pelvic floor imaging in general, and specifically MRD, across practices within and outside the USA. This perspectives report will review some of the survey findings with a focus on areas of discrepancy between real-world practice and expert recommendations.

Methods

An anonymous 33-item survey developed by members of the SAR Pelvic Floor Dysfunction DFP was administered using an online survey tool (Survey Monkey®, San Mateo, CA) to members of the SAR, and forwarded to members of the ESUR and ESGAR by the DFP liaison. The survey included 4 questions to gather demographic information, including numbers of years of practice, nature of practice (academic, private practice, hybrid, other), geographic location of

practice, and total volume of all imaging studies performed on an annual basis as a marker of practice size. The remainder of the survey consisted of 10 multiple choice questions regarding general practice patterns in pelvic floor imaging and 19 questions specifically regarding use and technique of MRD or dMRI. Respondents were allowed to choose more than one response to certain survey questions when applicable or skip questions that did not apply to their practice. For each question, counts and percentages were calculated based on the total number of responses for that question. The survey questionnaire is provided in Online Appendix 1.

Results

General

In total, 209 radiologists responded to the survey; the number of respondents for each question varied. Respondent demographics are detailed in Table 1. Of 209 respondents, 177 (84.5%) perform at least one pelvic floor examination; 133 (63.6%), 96 (45.9%), 23 (11%), and 38 (18.2%) perform MRD/dMRI, FD, pelvic floor ultrasound, and routine static MRI for pelvic floor indications, respectively. Defecatory dysfunction and pelvic organ prolapse (POP) were

Table 1 Respondent demographics

	N	%
Professional radiology experience (total respondents = 208)		
≤ 5 years	53	25.5
6–20 years	101	48.6
> 20 years	54	26
Practice type (total respondents = 206)		
Academic	131	63.6
Private/hybrid	69	33.5
Other	6	2.9
Practice location (total respondents = 208)		
Within U.S.	149	71.6
Northeast or Mid-Atlantic USA	50	24
Midwest USA	29	13.9
Southern USA	32	15.4
Western USA	37	17.8
Outside U.S.	59	28.4
Other response (retired)	1	0.5
Practice size (number of annual cases) (total respondents = 191)		
< 500,000	71	37.2
500,000–1,000,000	65	34.0
> 1,000,000	55	28.8

N number of responses in each category

reported as the most common indications for pelvic floor imaging (reported as being the indication > 50% of the time by 45.7% and 24.6% of respondents, respectively). 40.9% of respondents reported that colorectal surgery was the most common referring specialty (i.e. accounted for > 50% of patient referrals), followed by urogynecology (reported most common by 28.2%) and gastroenterology (reported most

common by 20%). Template/structured reporting was used for MRD by 57 of 107 (52.8%) respondents and for FD by 34 of 75 respondents (45.3%). Trends in patient preparation techniques for the various pelvic floor imaging examinations are detailed in Table 2. Data on patient positioning and maneuvers during pelvic floor imaging studies are detailed in Tables 3 and 4, respectively.

Table 2 Patient preparation for pelvic floor imaging studies

	UGI Prep/ PO con- trast N (%)	Rectal enema N (%)	Rectal contrast N (%)	Vaginal contrast N (%)	Standardized bladder disten- tion N (%)	IV contrast N (%)	No Pt prep N (%)	Total # of respond- ents
Fluoroscopic Defecography	34 (54.0)	25 (39.7)	47 (74.6)	27 (42.9)	5 (7.9)	0 (0)	6 (9.5)	63
MRI Defecography or dynamic MRI	1 (1.1)	23 (25.0)	73 (79.4)	36 (39.1)	19 (20.7)	5 (5.43)	11 (12.0)	92
MRI for pelvic mesh/slings	0 (0)	5 (13.2)	16 (42.1)	15 (39.5)	5(13.2)	10 (26.32)	13 (34.2)	38
Ultrasound for prolapse	0 (0)	3 (25.0)	0 (0)	0 (0)	3 (25)	0 (0)	7 (58.3)	12
Ultrasound for mesh/slings/bulking agent	0 (0)	1 (10.0)	0 (0)	0 (0)	2 (20.0)	0 (0)	7 (70.0)	10

Percentages add up to > 100% because respondents were asked to choose all types of patient preparations that applied for each imaging study. “Total” column excludes those that responded “Don’t know” or “exam not performed at practice”; UGI – upper gastrointestinal; PO – oral; IV – intravenous; Pt – patient; prep – preparation; UGI – Upper gastrointestinal; PO – oral; IV – intravenous; Pt – patient; N – number of responses

Table 3 Patient positioning for pelvic floor imaging studies

	Supine N (%)	Upright sitting N (%)	Upright standing N (%)	Lateral decubitus N (%)	Dorsal lithotomy N (%)	Total N
Fluoroscopic defecography	6 (8.3)	66 (91.7)	2 (2.8)	6 (8.3)	0 (0)	72
MRI defecography or dynamic MRI	97 (95.1)	3 (2.9)	0 (0)	7 (6.9)	2 (2.0)	102
MRI for pelvic mesh/slings	49 (98.0)	0 (0)	0 (0)	1 (2)	0 (0)	50
Ultrasound for prolapse	8 (57.1)	2 (14.3)	1 (7.1)	1 (7.1)	4 (28.6)	14
Ultrasound for mesh/slings/bulking agent	7 (58.3)	1 (8.3)	0 (0)	1 (8.3)	3 (25.0)	12

Percentages add up to > 100% because respondents were asked to choose all types of patient positioning that applied for each imaging study. “Total” column excludes those that responded “Don’t know” or “exam not performed at practice”; N number of responses

Table 4 Patient maneuvers during pelvic floor imaging examinations

	Rest N (%)	Kegel/contraction N (%)	Valsalva/strain N (%)	Evacuation N (%)	Post-evac vals- alva/strain N (%)	Total N
Fluoroscopic defecography	64 (91.4)	60 (85.7)	65 (92.9)	66 (94.3)	36 (51.4)	70
MRI defecography or dynamic MRI	79 (79.8)	67 (67.7)	92 (92.9)	77 (77.8)	27 (27.3)	99
MRI for pelvic mesh/slings	33 (80.5)	17 (41.5)	24 (58.5)	15 (36.6)	6 (14.6)	41
Ultrasound for prolapse	8 (80.0)	6 (60.0)	10 (100.0)	0 (0)	0 (0)	10
Ultrasound for mesh/slings/bulking agent	6 (75.0)	3 (37.5)	5 (62.5)	0 (0)	0 (0)	8

Percentages add up to > 100% because respondents were asked to choose all types of patient maneuvers that applied for each imaging study. “Total” column excludes those that responded “Don’t know” or “exam not performed at practice”; N number of responses

MR defecography/dynamic pelvic floor MRI

Between 40 and 89 survey participants answered the questions relating specifically to MRD/dMRI. 80 of 83 (96.4%) of respondents perform dynamic cine imaging in the sagittal or sagittal oblique plane. Regarding minimal number of defecation/Valsalva attempts, 30 of 79 (38.0%), 26 of 79 (32.9%), and 23 of 79 (29.1%) reported no set number, two attempts, and three attempts, respectively. Of 85 respondents, 74 (87.1%) use ultrasound gel or lubricating jelly as rectal contrast material for MRD/dMRI, while 10 (11.8%) reported not using any rectal contrast.

Of 83 respondents, 51 (61.5%) reported that patients are educated about MRD/dMRI upon arrival to the radiology department, while 32 (38.6%) reported that patients received education prior to arrival from either the radiology department or referring physician. 80 of 85 (94.1%) respondents

reported that someone coaches the patient on how to perform Kegel, Valsalva/strain, and defecation maneuvers prior to positioning on the magnet, most commonly the technologist (68/85; 80%).

Regarding interpretation, 80 of 83 radiologists (96.4%) reported using the pubococcygeal line (PCL) as an anatomic landmark. Of 137 respondents, 92 (67.2%) reported that pelvic floor imaging studies are interpreted only by specific subspecialty radiologists with experience or interest in pelvic floor imaging, while 41 (29.9%) reported that pelvic floor imaging studies are interpreted by any abdominal or pelvic-trained radiologists. Other details regarding interpretation of findings on MRD are in Table 5.

Reported obstacles to performing MRD/dMRI included radiologist inexperience (18 of 40; 45%), lack of referral base or need for MRI (17 of 40; 42.5%), excessive prep time or protocol length (16 of 40; 40%), technologist or

Table 5 Reporting of findings on MRD/dMRI

	Always report		Report only if positive or abnormal finding		Never/ almost never report		Total <i>N</i>
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	
Anatomic changes in pelvic floor (levator tear, levator thinning, asymmetric bulge, vaginal symmetry, etc.)	50	63.3	25	31.7	4	5.1	79
Presence and description of synthetic materials (slings, mesh, urethral bulking agent, etc.)	45	56.3	32	40.0	3	3.8	80
Documentation of which line/landmark is used as reference for prolapse	63	78.8	10	12.5	7	8.8	80
Bladder volume	4	5.3	25	32.9	47	61.8	76
Cystocele (present/absent)	65	81.2	15	18.8	0	0.0	80
Cystocele (size/grade)	57	70.4	23	28.4	1	1.2	81
Urethral angle or urethral hypermobility	33	41.8	35	44.3	11	13.9	79
Vaginal length	6	8.0	19	25.3	50	66.7	75
Vaginal/cervix/uterine prolapse (present/absent)	58	73.4	20	25.3	1	1.3	79
Vaginal/cervix/uterine prolapse (size/grade)	49	62.8	25	32.0	4	5.1	78
H-line (cm or mm)	39	50.0	12	15.4	27	34.6	78
M-line (cm or mm)	40	51.3	11	14.1	27	34.6	78
Anorectal angle	43	54.4	16	20.2	20	25.3	79
Levator plate angle	20	25.3	21	26.6	38	48.1	79
Rectal intussusception (present/absent)	44	55.0	35	43.8	1	1.2	80
Rectal intussusception (size/grade or full thickness/partial thickness)	35	44.3	39	49.4	5	6.3	79
Rectocele (present/absent)	68	84.0	13	16.0	0	0.0	81
Rectocele (size/grade or location)	57	70.4	22	27.2	2	2.5	81
Enterocoele (present/absent)	54	66.7	27	33.3	0	0.0	81
Enterocoele (size/grade)	45	57.0	31	39.2	3	3.8	79
Content of enterocoele sac (small bowel, sigmoid, peritoneal fat)	44	55.0	33	41.2	3	3.8	80
Other	3	23.1	6	46.2	4	30.8	13

Radiologists were asked: "Which of the following do you report when interpreting Dynamic pelvic floor MRI?" For each finding, respondents selected from one of three choices: always report, report only if abnormal or positive finding, never/almost never report. "Other" included: anatomic details of the anal canal, anus open or closed during maneuvers, anal sphincters, % gel expelled, degree of pelvic floor relaxation, opening of ureterovesical junction, iliococcygeus angle, width of levator hiatus, level I, II, III fascial defects, rectal prolapse and type/grade; *N* number of responses

non-radiologist personnel-related issues (15 of 40; 37.5%), lack of MR capacity (2 of 40; 5.0%), problems with defecation on table (1 of 40; 2.5%), and high cost (1 of 40; 2.5%). 10 of 40 (25.0%) radiologists reported no obstacles. Of 86 respondents, 23 (26.7%) reported being extremely satisfied with the quality of MRD/dMRI at their institution, 32 (37.2%) somewhat satisfied, 11 (12.8%) were neutral, 16 (18.6%) somewhat unsatisfied, and 4 (4.7%) extremely unsatisfied.

Discussion

This anonymous online survey sought to assess variations in utilization and technique of pelvic floor imaging. Overall, responses indicated a range of different practice patterns. Approximately 85% of survey respondents reported performing pelvic floor imaging.

MRD and dMRI

MRI was the most widely used pelvic floor imaging modality among respondents. Areas of concordance between practice and expert recommendations included performance of MRD/dMRI in the supine position (95% of respondents), use of sagittal or sagittal oblique plane for cine imaging (96% of respondents), use of the PCL as the reference landmark for grading prolapse on MRD/dMRI (96% of respondents), and patient coaching prior to scanning (94% of respondents).

There was less uniformity among respondents for other crucial MRD performance factors. 87% of respondents report using rectal gel or lubricating jelly for MRD while nearly 12% reported not using any rectal contrast. However, both the SAR and ESUR/ESGAR expert groups had 100% consensus that rectal ultrasound gel should be used in performance of MRD [6, 7]. Only 78% of respondents reported having patients evacuate during pelvic floor MRI (Table 4). Studies have demonstrated that defecation is critical to detection and characterization of pelvic floor abnormalities [14, 15], therefore imaging during defecation should be attempted routinely in all exams as previously agreed upon by experts [6, 7]. There was variability among respondents regarding the number of defecation/Valsalva attempts. The European recommendation is for performance of the evacuation maneuver as many times as needed until rectal evacuation is achieved [6], while 55% of SAR Pelvic Floor Dysfunction DFP experts stated that defecation should be attempted at least three times [7]. Repetition of these maneuvers is important; grading of anterior compartment abnormalities has been shown to change significantly between a first and third Valsalva attempt [17]. As a distended urinary

bladder or rectocele may mask abnormalities in other compartments, additional Valsalva attempts after complete rectal emptying may demonstrate otherwise occult prolapse and cul-de-sac hernias [18]. However, only 27.3% of respondents in this survey have patients perform a post-defecation Valsalva/strain maneuver. These discrepancies between practice and expert recommendations indicate that more education is needed to improve and standardize MRD technique across institutions. The SAR pelvic Floor DFP-endorsed imaging protocols are available online [19].

Only about half of radiologists performing FD and MRD reported using standardized reporting templates. Use of structured templates has been shown to improve the quality and comprehensiveness of radiology reports in a number of disease processes, often affecting treatment planning [20–22]. A template can act as a checklist, and may be particularly helpful for radiologists with less experience interpreting these studies. Indeed, this survey found that for MRD, there was a range of reporting practices (Table 5). For example, only half of respondents indicated that they always reported the length of the H-line and M-line, reference lines typically used for grading pelvic floor relaxation [23]. The structured reports for FD and MRD recommended by the SAR Pelvic Floor Dysfunction DFP can be found online [19]. The impact of structured reporting in pelvic floor imaging, particularly for multidisciplinary treatment planning, is an area for potential future research.

Due to the unique nature of MRD, where the patient is expected to defecate in an unnatural environment, patient education prior to arrival at the radiology department is important to minimize patient embarrassment and hesitation. However, nearly two-thirds of respondents reported that at their practices, patients did not receive education or information about MRD/dMRI until their appointment time. This highlights the need for education regarding appropriate patient preparation. Resources for patient education including those sponsored by RSNA and ACR are available online [24] and should be discussed with patients by referring physicians or sent by radiology departments prior to patient arrival for the examination.

Fluoroscopic defecography

Fluoroscopy was the second most commonly used imaging modality after MRD, performed by just over 45% of respondents. Fluoroscopy was more likely to be utilized in academic practices, larger practices, and practices within the USA. This may be because academic and larger practices are more likely to have on-site residents and attending radiologists available and trained to perform FD and may also be a function of patient and referring physician populations. FD tends to be preferred over MRD by colorectal surgeons

for cases of defecatory dysfunction given the more physiologic positioning. A majority (75%) of respondents reported routine use of rectal contrast for FD, with fewer reporting use of oral contrast, vaginal contrast, and urinary bladder contrast. Fluoroscopy can be tailored to address specific clinical symptoms; FD with rectal contrast only may be the examination of choice for defecatory dysfunction, whereas fluoroscopic cystocolpoproctography, which also includes opacification of the vagina, urinary bladder, and sometimes the small bowel, is preferred to evaluate POP [10]. Given the nature of the survey, correlation between technique and clinical indication could not be performed. It is important to note the low (8%) percentage of radiologists that reported use of bladder contrast. Although bladder prolapse can be inferred by posterior displacement of vaginal contrast, use of bladder contrast may be of value to detect extent of prolapse, particularly if vaginal contrast is not instilled, and also assess degree of bladder filling, as an overdistended bladder may mask prolapse in other compartments [25]. Interestingly, nearly 10% of radiologists reported not using any type of patient preparation for FD. At the very least, FD requires instillation of rectal contrast. This may represent an opportunity to increase radiologist awareness regarding optimal pelvic floor imaging techniques.

Regarding positioning for FD, almost 92% of respondents perform FD in the upright sitting position at their institution. Upright positioning is preferred when possible as it matches the physiologic position of defecation. 94% of radiologists reported that their institutional FD protocol involves patient defecation. The ability to image patients during evacuation of rectal contrast in an upright physiologic position is the main advantage of FD as a mode of evaluation. Thus, upright positioning, rectal contrast use, and imaging during defecation should be universally adopted as standard technique for FD.

Pelvic floor ultrasound

Ultrasound was the least frequently used pelvic floor imaging modality, performed at only 11% of respondents' practices. Less than 5% (4/97) reported performing more than 10 ultrasounds per month. Some reasons for this may include limited radiologist familiarity with the anatomy and technique, need for specialized training, and time commitment of the exam. Additionally, urogynecologists and urologists may perform pelvic floor ultrasound in their offices without referral to radiology [26].

A majority of respondents who perform pelvic floor ultrasound do not use a specific patient preparation. There was variability in patient positioning, with some institutions imaging in more than one position. Indeed, one benefit to ultrasound is the ability to reposition the patient in real time in order to maximize detection of abnormalities. 100% of

respondents (10/10) use a Valsalva maneuver for ultrasound evaluation of POP, while none reported imaging during evacuation. Since defecation is not typically a part of most pelvic floor ultrasound techniques, universal use of Valsalva/strain is appropriate. Overall, the low number of respondents performing pelvic floor ultrasound limits any major conclusions from this survey; however, this does highlight the importance of educating more radiologists regarding the utility of this relatively low-cost technique for patients with pelvic floor disorders. Importantly, pelvic floor ultrasound is included in the ACR appropriateness criteria as an appropriate test for various indications in patients with pelvic floor dysfunction [10].

MRI for mesh and slings

There was significant variability in the performance of MRI for evaluation of mesh and slings, with no consensus on use of rectal contrast, vaginal contrast, or intravenous contrast. Additionally, use of Kegel, Valsalva, defecation, and post-defecation Valsalva was also variable. Only a small number of respondents perform MRI for evaluation of mesh and slings, limiting interpretation of these numbers. It is possible that many departments perform imaging of mesh and slings as part of an MRD or dMRI protocol while others perform dedicated imaging without functional evaluation which would increase the variability in technique. Imaging of pelvic floor mesh and slings is a relatively young field and additional radiologist training modules may be needed to help standardize technique and reporting.

Survey limitations

Limitations of the survey include the overall small number of respondents, lack of knowledge of a true denominator to determine the response rate, and inability to control for multiple radiologist responders from the same institution. Furthermore, only a small number of respondents utilize ultrasound or perform imaging of mesh and slings, which may account for the variability in techniques reported. Since the survey was administered to members of subspecialty abdominopelvic imaging societies, there is a selection bias toward academic practices. Nonetheless, this survey is an important initial step in learning the variability in use and technique of pelvic floor imaging at different institutions. Finally, given the wide spectrum of pelvic floor disorders, further investigation into imaging for specific clinical indications may discover more trends and allow for more tailored recommendations in the future.

Conclusion

MRI was the most widely used imaging modality for evaluation of pelvic floor dysfunction among the respondents of this survey; however, the survey uncovered variations in utilization and technique of pelvic floor imaging across different types of practices. Variability in imaging protocols, patient preparation, and interpretation and reporting of pelvic floor imaging underscores the need for standardization to improve quality and consistency of patient care, allow easier development of new pelvic floor imaging programs, and enable multi-institutional and multi-specialty research on pelvic floor imaging. Practice patterns that differ from existing expert recommendations represent gaps in knowledge which serve as targets for future educational efforts. Ultrasound remains an uncommonly used pelvic floor imaging technique among radiologists, and its use should be encouraged given its applicability for multiple pelvic floor indications and relative low cost.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s00261-021-02957-5>.

Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest to declare.

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