

Consensus Definitions and Interpretation Templates for Magnetic Resonance Imaging of Defecatory Pelvic Floor Disorders: Proceedings of the Consensus Meeting of the Pelvic Floor Disorders Consortium of the American Society of Colon and Rectal Surgeons, the Society of Abdominal Radiology, the International Continence Society, the American Urogynecologic Society, the International Urogynecological Association, and the Society of Gynecologic Surgeons

Brooke H. Gurland, MD¹, Gaurav Khatri, MD², Roopa Ram, MD³, Tracy L. Hull, MD⁴, Ervin Kocjancic, MD⁵, Lieschen H. Quiroz, MD⁶, Rania F. El Sayed, MD⁷, Kedar R. Jambhekar, MD³, Victoria Chernyak, MD, MS⁸, Raj Mohan Paspulati, MD⁹, Vipul R. Sheth, MD, PhD¹⁰, Ari M. Steiner, MD¹¹, Amita Kamath, MD¹², S. Abbas Shobeiri, MD, MBA¹³, Milena M. Weinstein, MD¹⁴, Liliana Bordeianou, MD, MPH¹⁵, on behalf of the Members of the Expert Workgroup on Magnetic Resonance Imaging of Pelvic Floor Disorders

Genitourinary Imaging · Society-Endorsed Statement

Keywords

defecography, dynamic MRI defecogram, MRI defecography, MRI proctogram, pelvic floor MRI

B. H. Gurland, G. Khatri, and R. Ram contributed equally to this work.

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The Pelvic Floor Disorders Consortium (PFDC) is a multidisciplinary organization of colorectal surgeons, urogynecologists, urologists, gynecologists, gastroenterologists, radiologists, physiotherapists, and other advanced care practitioners. Specialists from these fields are all dedicated to the diagnosis and management of patients with pelvic floor conditions, but they approach, evaluate, and treat such patients with their own unique perspectives given the differences in their respective training. The PFDC was formed to bridge gaps and enable collaboration between these specialties. The goal of the PFDC is to develop and evaluate educational programs, create clinical guidelines and algorithms, and promote high quality of care in this unique patient population. The recommendations included in this article represent the work of the PFDC Working Group on Magnetic Resonance Imaging of Pelvic Floor Disorders (members listed alphabetically in Table 1). The objective was to generate inclusive, rather than prescriptive, guidance for all practitioners, irrespective of discipline, involved in the evaluation and treatment of patients with pelvic floor disorders.

Statement of the Problem

MR defecography (MRD) has emerged and continues to evolve as a powerful tool for dynamic evaluation of pelvic floor function. MRD provides multicompartiment visualization and is able to evaluate the complex and dynamic interplay of the three pelvic floor

¹Division of Colorectal Surgery, Stanford University, Palo Alto, CA.

²Department of Radiology, University of Texas Southwestern Medical Center, Dallas, TX.

³Department of Radiology, University of Arkansas for Medical Sciences, Little Rock, AR.

⁴Department of Colorectal Surgery, Cleveland Clinic Hospitals, Cleveland, OH.

⁵Department of Urology, College of Medicine University of Illinois, Chicago, IL.

⁶Department of Obstetrics & Gynecology, University of Oklahoma, Oklahoma City, OK.

⁷Department of Radiology, Cairo University Pelvic Floor Centre of Excellency and Research Lab, Faculty of Medicine, Cairo University Hospitals, Cairo, Egypt.

⁸Department of Radiology, Albert Einstein College of Medicine, Montefiore Medical Center, Bronx, NY.

⁹Department of Radiology, University Hospitals Cleveland Medical Center, Cleveland, OH.

¹⁰Department of Radiology, Stanford University, Palo Alto, CA.

¹¹Department of Radiology, Mount Sinai South Nassau Hospital, Oceanside, NY.

¹²Department of Radiology, Icahn School of Medicine at Mount Sinai, New York, NY.

¹³Department of Obstetrics & Gynecology, University of Virginia, INOVA Women's Hospital, Falls Church, VA.

¹⁴Department of Obstetrics & Gynecology, Massachusetts General Hospital Pelvic Floor Disorders Center, Harvard Medical School, Boston, MA.

¹⁵Department of Gastrointestinal Surgery, Massachusetts General Hospital Pelvic Floor Disorders Center, Harvard Medical School, 55 Fruit St, GRB 425, Boston, MA 02114. Address correspondence to L. Bordeianou (lbordeianou@partners.org).

compartments [1]. In addition to providing global assessment of pelvic floor function, MRD can provide exquisite assessment of the pelvic floor anatomy because of its high contrast resolution. Known limitations of MRD include the varied techniques used in performing this examination as well as the differences in nomenclature and reporting of MRD findings across different institutions and subspecialties. Furthermore, various experts involved in the care of patients with pelvic floor dysfunction sometimes use different definitions for the same condition and various thresholds for grading severity, consequently hindering consistent and effective communication between clinicians in the same institution and across institutions.

To help standardize MRD technique, expert radiologists from the Pelvic Floor Dysfunction Disease Focused Panel of the Society of Abdominal Radiology (SAR) have recently published recommendations for MRD protocol and technique [2]. However, these recently published recommendations from the SAR as well as other previous publications on dynamic MRD of the pelvic floor have lacked substantial multidisciplinary input from clinicians in other specialties [3, 4]. Consequently, there is a lack of shared understanding and cross-talk between various specialties involved in the care of patients with pelvic floor dysfunction, resulting in high variability in how different physicians and specialties interpret and utilize findings seen on MRD. This is of particular concern in this field of pelvic floor disorders, where patients often have recurrent or multifactorial symptoms and seek care from multiple different specialists serially. Furthermore, multiple health care providers may be managing different aspects of pelvic floor dysfunction in the same patient in parallel. This can frequently create misunderstandings and confusion for both health care providers and patients. Thus, this effort was undertaken with the explicit goal of inviting and including representatives from all relevant clinical specialties for whom MRD holds clinical significance. The goal of this effort was to create a universal set of recommendations and language for MRD technique, interpretation, and reporting that can be utilized and carry the same significance across disciplines. Notably, pelvic floor disorders can manifest in both male and female patients. These recommendations do not make a distinction based on patient sex; however, certain recommendations may only be applicable to female pelvic floor anatomy, and normal criteria for pelvic floor imaging in male patients are less well established.

Methods

This document was created at the initiative of the PFDC Working Group on MRI. The PFDC is composed of a volunteer cohort of clinicians with demonstrated expertise in the care and treatment of pelvic floor conditions. The working group was created by enlisting PFDC volunteers. Invitation criteria included leadership in the field of pelvic floor disorders with academic scholarship and a history of interdisciplinary collaboration. Members of the working group participated in preliminary group phone calls and researched assigned topics (Table 1). A radiologist was paired with a clinical specialist for each of the working group topics. An organized search of MEDLINE, PubMed, EMBASE, and the Cochrane Database of Collected Reviews was performed on July 1, 2018, and repeated on September 1, 2018. Retrieved publications were limited to the English language, but no limits on year

of publication were applied. The search terms included: "dynamic MRI," "dynamic pelvic floor MR," "MR defecography," "pelvic floor MR," "positioning for MR defecography," "levator descent," "pelvic organ prolapse," "rectocele," "rectal emptying," "cystocele," "rectal intussusception," "cul-de-sac hernias pelvic floor," "uterine prolapse," "vaginal prolapse," "urethral hypermobility," "pubococcygeal line," "pelvic floor dyssynergia," and "anorectal angle." Each working group pair identified the updated literature on the assigned relevant topic or point of controversy regarding MRD technique and/or reporting and performed a careful review of the pertinent literature using a standardized literature review format. A collective summary document of the researched topics was generated and used as a reference to steer discussion at the PFDC meeting. The working group presented their preliminary research to the consortium at large for further discussion.

Pelvic Floor Consortium Expert Meeting

The Pelvic Floor Consortium Expert Meeting convened on June 2, 2019, in Cleveland, OH. It was hosted and funded by the American Society of Colon and Rectal Surgeons (ASCRS) and included 126 in-person (or online) volunteer participants from North America, Europe, and Asia. These experts belonged to several subspecialties (colorectal surgery, gastroenterology, urogynecology, urology, physiotherapy, and radiology) and professional societies involved in the diagnosing and treating of pelvic floor disorders. The event was also audited by formal representatives from the ASCRS, the SAR, the International Continence Society, the American Urogynecologic Society, the International Urogynecological Association, and the Society of Gynecologic Surgeons, who then reported back to their leadership on the event.

The participants at the expert consensus meeting analyzed all the proposed radiologic definitions measuring each of the conditions reviewed in this statement, ultimately recommending a synoptic reporting template that included the recommended steps for a thorough and clinically relevant examination, as well as the clinically relevant radiologic definitions for common evacuatory pelvic floor disorders seen on defecography. They labeled this final template as the "Magnetic Resonance Imaging Defecography Interpretation Template for the Initial Measurement of Patient Reported Pelvic Floor Complaints" or "MRI-IMPACT" (Table 2). For a recommendation to be included in the MRI-IMPACT template, an expert consensus was required. Consensus was defined as at least 70% agreement or more from the voting participants. When consensus was not reached, the workgroups performed additional research and literature reviews to clarify any questions raised during the meeting. A subsequent committee meeting was held to conduct final voting on the recommendations and definitions listed in the MRI-IMPACT document, while keeping the directives of the expert consensus panel discussions in mind.

Final Review

Once the document was finalized, the proposed recommendations were presented for review by the ASCRS Pelvic Floor Disorders Steering Committee. This Steering Committee is directed to develop clinical practice recommendations on colorectal pelvic floor disorders based on best available evidence. The ASCRS Steering Committee edited the document and sent it to the ASCRS Executive Committee for final approval for publication. Sim-

TABLE 1: Members of the Working Group

Name, Degree	Affiliation	City, State or Country
Jennifer Ayscue, MD	Division of Colorectal Surgery, MedStar Washington Hospital Center	Washington, DC
Pedro Basilio, MD	Department of Colorectal Surgery, Clinica de Saúde Intestinal	Rio de Janeiro, Brazil
Victoria Chernyak, MD	Department of Radiology, Albert Einstein College of Medicine, Montefiore Medical Center	Bronx, NY
Rania Farouk El Sayed, MD	Cairo University Pelvic Floor Centre of Excellency and Research Lab, Department of Radiology, Faculty of Medicine, Cairo University Hospitals	Cairo, Egypt
Brooke Gurland, MD	Division of Colorectal Surgery, Stanford University	Palo Alto, CA
Cynthia Hall, MD	Department of Obstetrics and Gynecology UMass Memorial Medical Center	Worcester, MA
Karin Herrmann, MD	Department of Radiology, University Hospitals of Cleveland	Cleveland, OH
Kedar Jambhekar, MD	Department of Radiology, University of Arkansas for Medical Sciences	Little Rock, AR
Andreas M. Kaiser, MD	Division of Colorectal Surgery, City of Hope National Cancer Center	Duarte, CA
Amita Kamath, MD	Department of Radiology, Icahn School of Medicine at Mount Sinai	New York, NY
Gaurav Khatri, MD	Department of Radiology, University of Texas Southwestern Medical Center	Dallas, TX
Erin Kocjancic, MD	Department of Urology College of Medicine University of Illinois	Chicago, IL
Khashayar Rafatzand, MD	Department of Radiology, UMass Memorial Medical Center	Worcester, MA
Luz Maria Rodriguez, MD	Division of Colorectal Surgery National Cancer Institute	Rockville, MD
Kavita Mishra, MD	Department of Obstetrics and Gynecology, Stanford University	Palo Alto, CA
Leila Neshatian, MD	Division of Gastroenterology, Stanford University	Palo Alto, CA
Erin O'Neill, MD	Department of Radiology, MedStar Washington Hospital Center	Washington, DC
Albert Parlade, MD	Department of Radiology, Cleveland Clinic	Weston, FL
Raj Mohan Paspulati, MD	Department of Radiology, University Hospitals Cleveland Medical Center	Cleveland, OH
Roopa Ram, MD	Department of Radiology, University of Arkansas for Medical Sciences	Little Rock, AR
Vipul Sheth, MD	Department of Radiology, Stanford University	Palo Alto, CA
Ari Steiner, MD	Department of Radiology, Mount Sinai South Nassau Hospital	Oceanside, NY
Raveen Syan, MD	Department of Urology, University of Miami Miller School of Medicine	Miami, FL
Amber Traugott, MD	Division of Colorectal Surgery, The Ohio State University Wexner Medical Center	Columbus, OH

ilar reviews and endorsements were also given by the American Urogynecologic Society Publications Committee, the SAR Board of Directors and SAR Disease Focused Panel on Pelvic Floor Dysfunction, the International Continence Society Board of Directors, the International Urogynecological Association Board of Directors, and the Executive Board of the Society of Gynecologic Surgeons.

Recommendations

General Considerations

1. MRD can be performed in either the upright (sitting) or supine position, and the position should be documented in the report to provide context for the imaging findings (degree of consensus: 81%).

MRD can be performed in upright or supine positions. The upright, or sitting, position is more physiologic and maximizes the impact of gravity to stimulate defecation. Defecation in the supine position can be difficult or even impossible for individuals who depend on gravity or various maneuvers such as digital splinting to effectively empty their bowels. However, most institutions lack open magnets to perform upright imaging, and the widely available closed magnets have excellent performance for MRD in the supine position. Literature comparing supine MRD

to upright studies have produced variable results. A study comparing supine to upright MRD in the same patient population reported lower positions of the bladder and vagina during upright MRD, but no significant difference in position of the anorectal junction [5]. A study by Gufler et al. [6] found that supine MRD and upright colpocystography were not significantly different in terms of depiction of anterior and middle compartment prolapse. However, Kelvin et al. [7] showed that supine MRD underestimated cystoceles and enteroceles compared to upright fluoroscopic defecography. More recently, a study assessing anterior compartment prolapse showed more severe anterior prolapse and urethral hypermobility on supine MRD than on upright voiding cystourethrography [8]. For posterior compartment pathology (perineocele, rectocele, rectal prolapse, and anismus), Poncelet et al. [9] retrospectively compared upright fluoroscopic defecography to supine MRD in 50 women and revealed similar diagnostic sensitivities. van Iersel et al. [10] found that supine MRD was less sensitive than fluoroscopic defecography for diagnosing rectocele and enterocele but was superior in detection for intussusception. Foti et al. [11] reported no significant differences between fluoroscopic defecography and supine MRD for evaluating outlet obstructive syndrome.

TABLE 2: MRI-IMPACT Template

EXAMINATION: MRI defecography (pelvis) without intravenous contrast

HISTORY: [] years old [female/male] with []

TECHNIQUE: [] mL of [gel/other contrast] was instilled into the rectum. Multiplanar MRI of the pelvis was performed utilizing [enter specific protocol]. All images were obtained with patient in [supine/upright/other] position following careful patient education.

Intravenous contrast: None

COMPARISON: [Prior study used for comparison]

FINDINGS

Anatomic Evaluation: [Anatomic findings including pertinent surgical changes (hysterectomy), urethral slings, vaginal mesh, urethral bulking agent. Discuss appearance of levator ani muscles, anal sphincter complex, and anal canal anatomy]

Functional Evaluation

Defecatory effort: [good/moderate/poor].

[None/one-third/two-thirds/nearly all] of the instilled rectal contrast was evacuated by the end of the examination.

Anterior Compartment

Bladder base location relative to the PCL:

Rest: [] cm [above/below] PCL.

Defecation/maximal Valsalva: [] cm [above/below] PCL.

Findings are [consistent with/not consistent with] significant cystocele.

Urethral hypermobility: [present/absent]

Middle Compartment (female patients)

[Vaginal apex/cervix/uterus] location relative to PCL:

Rest: [] cm [above/below].

Defecation/maximal Valsalva: [] cm [above/below].

Findings are [consistent with/not consistent with] significant vaginal/cervix/uterine prolapse.

Levator hiatus and perineal/anorectal descent

Levator hiatus (H-line):

Rest: [] cm (normal ≤ 5 cm).

Defecation/maximal Valsalva: [] cm.

M-line:

Rest: [] cm [above/below] the PCL (normal ≤ 2 cm below).

Defecation/maximal Valsalva: [] cm [above/below] the PCL.

Above findings are consistent with [normal/widened] levator hiatus and [normal/low-lying] anorectal junction at rest with [no excessive widening/excessive widening] and [no excessive descent/excessive descent] of the anorectal junction/perineum during defecation/maximal Valsalva.

Posterior Compartment

Peritoneocele/enterocele/sigmoidocele [present/absent].

Contents of cul-de-sac hernia sac: [small bowel/sigmoid colon/peritoneal fat only/other (specify)/NA]

Distance below PCL [] cm

Relationship to vaginal apex: [at top of vaginal apex, to middle of vagina, to pelvic floor]

Protrusion of structures into vagina noted [yes/no]; protrusion into rectum noted [yes/no]

Cul-de-sac hernia appears to [obstruct/not obstruct] complete rectal emptying

Rectocele [present/absent].

Rectocele size: [] cm AP.

Contrast entrapment within rectocele is: [present/absent/NA].

Rectal Intussusception: [present/absent]

Location: [intrarectal/intraanal/ extraanal/NA].

(Table 2 continues on next page)

TABLE 2: MRI-IMPACT Template (continued)

Anorectal angle measurements:

Rest: [] degrees

Kegel: [] degrees

Defecation/maximal Valsalva: [] degrees

The anorectal angle [widens normally during defecation/stays the same during defecation /paradoxically narrows during attempted defecation]. The anus is [open/closed] at rest and [open/closed] at the point of maximum attempt to defecate.

Other: [incidental findings as appropriate].

IMPRESSION

1. [Anatomic findings]
2. [Anterior compartment findings]
3. [Middle compartment findings]
4. [Levator hiatus and anorectal junction/perineal descent findings]
5. [Posterior compartment findings]

Note—MRI-IMPACT = Magnetic Resonance Imaging Defecography Interpretation Template for the Initial Measurement of Patient Reported Pelvic Floor Complaints, AP = anterior-posterior, NA = not available, PCL = pubococcygeal line.

Given the variable results from different studies, consortium members agreed that it is acceptable to perform MRD in the supine position when upright MRD is not available. Importantly, consortium experts stressed that it is very important that this imaging be performed after proper patient education on the purpose of the examination. The purpose of this education is to promote patient participation during acquisition of the defecation sequences; the importance of adequate patient effort is further discussed in subsequent sections [2, 12–15].

2. MRD quality is highly dependent on patient cooperation and effort. Patients should be adequately educated on the purpose and the steps of the MRD examination to ensure their cooperation with the examination (degree of consensus: 98%).

Patient participation is essential to obtain a successful and meaningful MRD examination. The consortium experts agreed that educating patients before the examination regarding what to expect and the sequence of events during the study results in a more meaningful examination. Patients are instructed to rest, then perform full defecation of gel on command with maximum effort to empty. Referring physicians can initiate this process of patient preparation by explaining the examination and its value for patient management to the patients either in person or on the phone before, or at the time of, ordering the examination. Referring physicians should emphasize the value of optimal patient defecatory effort during the study to achieve the most diagnostic results. Written educational material or trusted online resources were recommended to educate patients about the examination before their arrival at the radiology department. Knowledge of what to expect during the examination can help alleviate patient anxiety and minimize embarrassment during this unique examination. The patients should be given an opportunity to discuss any questions or concerns on arrival at the radiology department. Furthermore, the consortium experts emphasized that it is important for radiologists or technologists to coach the patients before starting the examination so they can follow instructions appropriately, resulting in the best quality examination. Technical terms such as “Kegel,” “Valsalva,” and “defecation” should

be explained in lay language before patients are positioned in the MRI machine and before the rectal gel is inserted [2]. The Kegel maneuver may be explained as maximal pelvic floor squeeze as if trying to prevent the passage of feces or urine; the Valsalva maneuver may be explained as bearing down on the pelvic floor maximally without evacuating any rectal contents; and defecation may be explained as bearing down maximally with complete evacuation of rectal contents. The patient should be instructed to sustain each maneuver for the duration of image acquisition as instructed by the radiology personnel performing the examination. Such proactive coaching is important to alleviate any confusion on the part of the patient during image acquisition.

Contrast Medium Considerations

1. Rectal contrast medium and defecation are essential for an appropriate MRD examination in both female and male patients (degree of consensus: 100%).

On the basis of the evidence in the literature and the experience of the experts, the consortium recommended that MRD should be performed with rectal distention using rectal contrast medium and with acquisition of images during defecation. Rectal distention and defecation are critical elements of an MRD examination and differentiate it from simple dynamic pelvic floor MRI performed with the Valsalva maneuver. Multiple studies have shown larger and/or more frequent prolapse on MRD examinations with rectal distention and on defecation images compared with Valsalva images [12–16] (Fig. 1). Rectal distention is an essential element of the technique to obtain images during defecation. Although various institutions have described protocols with different agents for rectal distention, most centers use ultrasound gel or lubricating jelly inserted in the rectum by using hand injection with a catheter tip syringe. This is easy to administer and is typically well tolerated by patients, although, in theory, the gel consistency may preclude adequate assessment of stool retention within rectoceles and, in other cases, may not induce the urge to defecate as would a more solid consistency of contrast medium. To our knowledge, there is no convincing evidence

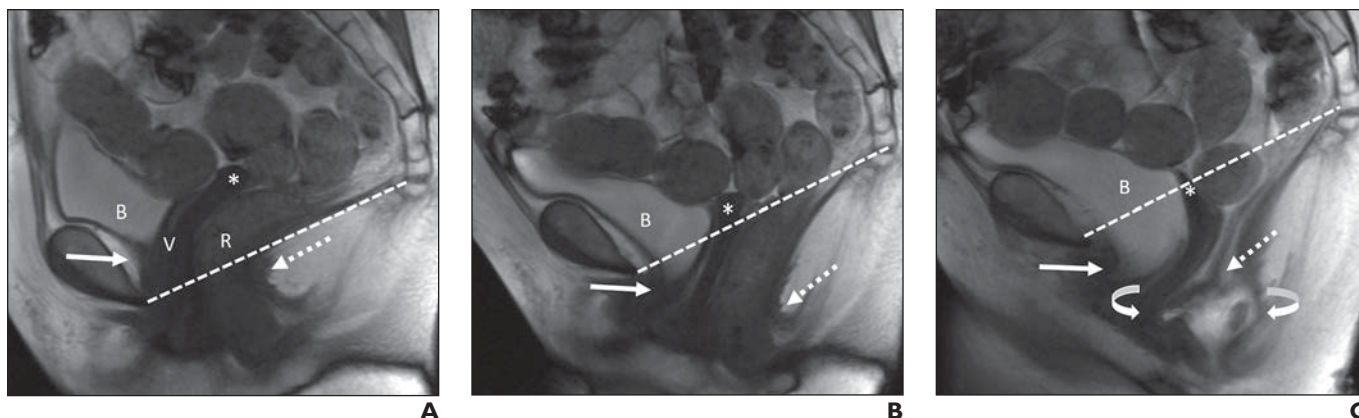


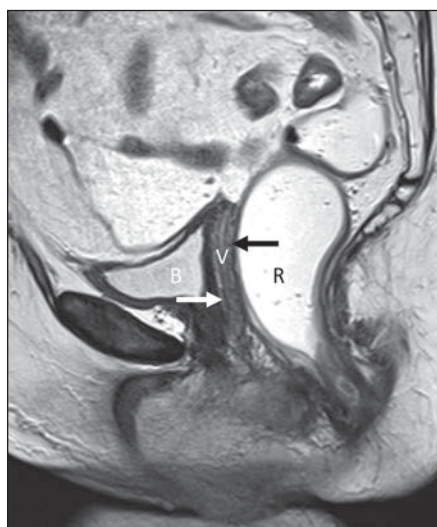
Fig. 1—59-year-old woman with history of rectal bulge and sensation of incomplete defecation. B = bladder, R = rectum, V = vagina.

A–C, Sagittal steady-state images at rest (**A**), Valsalva (**B**), and defecation (**C**) show bladder, vaginal apex (*asterisk*), and anorectal junction (*dashed arrow*) at or above pubococcygeal line (PCL) (*line*) at rest (**A**). During Valsalva (**B**), bladder extends below PCL and there is a small cystocele (*solid arrow*), vaginal apex is lower than at rest (*asterisk*) but remains above PCL, and there is descent of anorectal junction (*dashed arrow*). During defecation (**C**), there is significantly larger descent of bladder below PCL and enlargement of cystocele (*solid straight arrow*), vaginal apex now prolapses below PCL (*asterisk*), and there is significant descent of anorectal junction below PCL (*dashed arrow*). There are also anterior (*left curved arrow*) and posterior (*right curved arrow*) rectoceles.

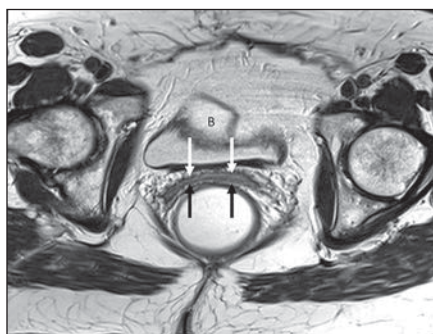
in the literature supporting the use of one consistency of rectal contrast medium over another for MRD. The volume of contrast medium used also varies widely between institutions, ranging from 60 mL to over 250 mL. Although there is a paucity of literature assessing the most appropriate volume of contrast medium in the rectum, a small study found no significant difference in the success of defecatory effort when comparing rectal distention with 120 mL to 180 mL and advocated use of the lower volume to minimize patient discomfort and risk of masking prolapse in other compartments due to rectal overdistention [17]. Although the consortium experts did not specify the exact volume of rectal contrast medium to be used, practices should strive to use an appropriate volume that successfully induces defecatory urge without overdistending the rectum. One strategy may be to start with 60 or 120 mL of rectal contrast medium and increase the volume if the patient does not report fullness or an adequate urge to defecate. The volume of rectal contrast medium used should be stated in the report.

2. MRD does not require routine use of vaginal contrast medium for adequate imaging of pathology (degree of consensus: 88%).

Some institutions use vaginal contrast medium for MRD in female patients to assist in detection of vaginal vault prolapse, and authors have reported using volumes ranging from 5 to 60 mL [15–18], but there is no convincing evidence in the literature to support routine use of vaginal contrast medium during MRD. Given its high spatial and contrast resolution, MRI allows direct visualization of soft tissue structures in the pelvis such as the anterior and posterior vaginal walls and vaginal apex (Figs. 2 and 3), precluding the need for routine use of vaginal contrast medium [19] and avoiding the added burden on patient privacy and discomfort [2, 3]. Furthermore, if the vaginal contrast medium is not expelled during the examination, it could conceivably mask vaginal prolapse (descent of vaginal apex below the pubococcygeal line [PCL]) or prolapse in other compartments. Thus, there was consensus among the experts against the routine use of vaginal contrast medium for MRD.



A



B

Fig. 2—68-year-old woman with prior bladder suspension presents with inability to complete defecation. B = bladder, R = rectum, V = vagina. **A** and **B**, Sagittal (**A**) and axial (**B**) T2-weighted images at rest show clear delineation of anterior (*white arrows*) and posterior (*black arrows*) vaginal wall without intravaginal contrast medium.

(**Fig. 2** continues on next page)

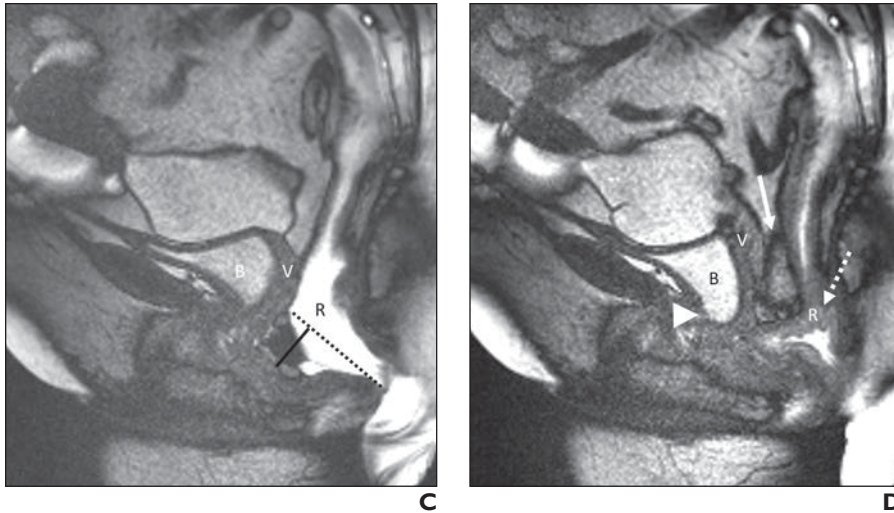


Fig. 2 (continued)—68-year-old woman with prior bladder suspension presents with inability to complete defecation. B = bladder, R = rectum, V = vagina.

C, Sagittal steady-state image during early defecation shows rectocele (solid line). Vertical line is drawn from anorectal junction to extrapolate location of anterior rectal wall at rest (dotted line). Rectocele is measured in anterior-posterior dimension using line drawn from this location to anteriorly displaced wall of rectum (solid line). **D**, During late defecation, partial-thickness intrarectal intussusception (dashed arrow) and sigmoidocele (solid arrow) are seen. These findings were not present on early defecation image. There is also increased descent of bladder neck on late defecation image (arrowhead).

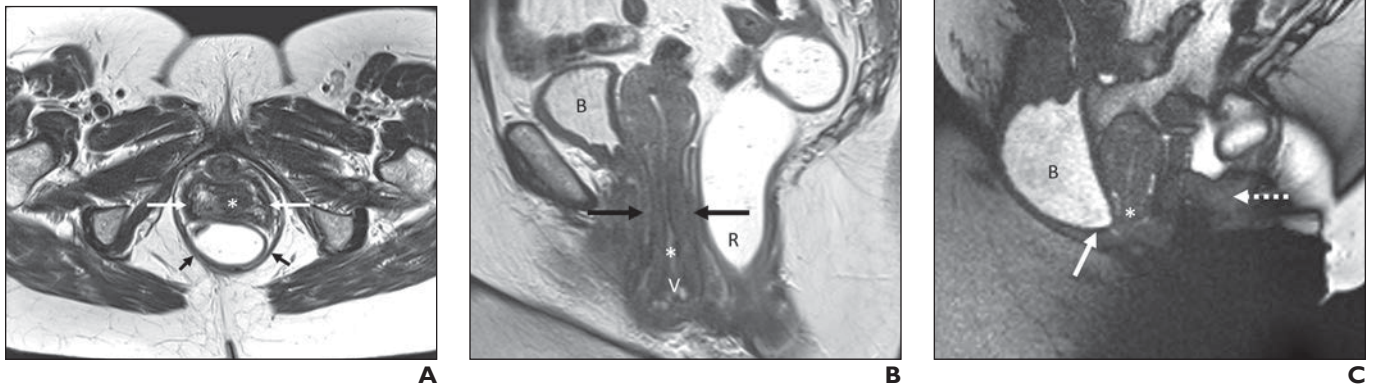


Fig. 3—64-year-old woman with history of bladder and uterine prolapse. B = bladder, R = rectum, V = vagina.

A and B, Axial (A) and sagittal (B) T2-weighted images of pelvis at rest show uterocervical prolapse. Vaginal walls are well delineated circumferentially (long arrows) surrounding caudally prolapsed cervix (asterisk). Also clearly visible are symmetric thinning and ballooning of levator ani muscles on axial image (short arrows, A). **C**, Sagittal steady-state image during end defecation shows large cystocele (solid arrow), more significant uterine prolapse (asterisk), and rectal intussusception (dashed arrow).

Technique and Reporting/Grading of Relevant Pathology

1. A) Findings on MRD are highly dependent on patient effort during defecation, which should be reported as “good,” “moderate,” or “poor” to provide clinical context (degree of consensus: 100%). B) Furthermore, patients should be coached to attempt defecation until complete rectal emptying is achieved or at least three times during the examination (degree of consensus: 88%). C) Following defecation, the degree of evacuation should be assessed subjectively and reported as a function of initial rectal volume in thirds. The presence and location of contrast medium retention during maximal defecatory effort should be described (degree of consensus: 80%).

It is important to note that, based on their clinical experience and evidence in the literature, experts emphasized that MRD images should be acquired during full defecation rather than only a maximal Valsalva maneuver [12, 13]. They observed that the arti-

cial lack of rectal emptying during a Valsalva maneuver may limit the detection of prolapse and may result in an underestimation of pelvic floor pathology on MRD [20]. Thus, experts recommended not requiring a Valsalva phase of image acquisition during MRD but rather proceeding directly to a defecation phase, where patients are encouraged to achieve complete or near-complete rectal emptying. Because rectal emptying can be difficult to achieve on command, experts recommended acquiring images during a minimum of three evacuation attempts, in particular in cases when the rectum fails to fully empty during the initial attempts [21]. In such cases, the later defecation images often show a larger degree of prolapse or new defects that may have been occult on earlier attempts (Figs. 2 and 4). Regardless of order, the set of images demonstrating the maximal degree of effort or largest degree of dysfunction should be used for measurement. Contrast medium reinstallation is not needed during these repeat defe-

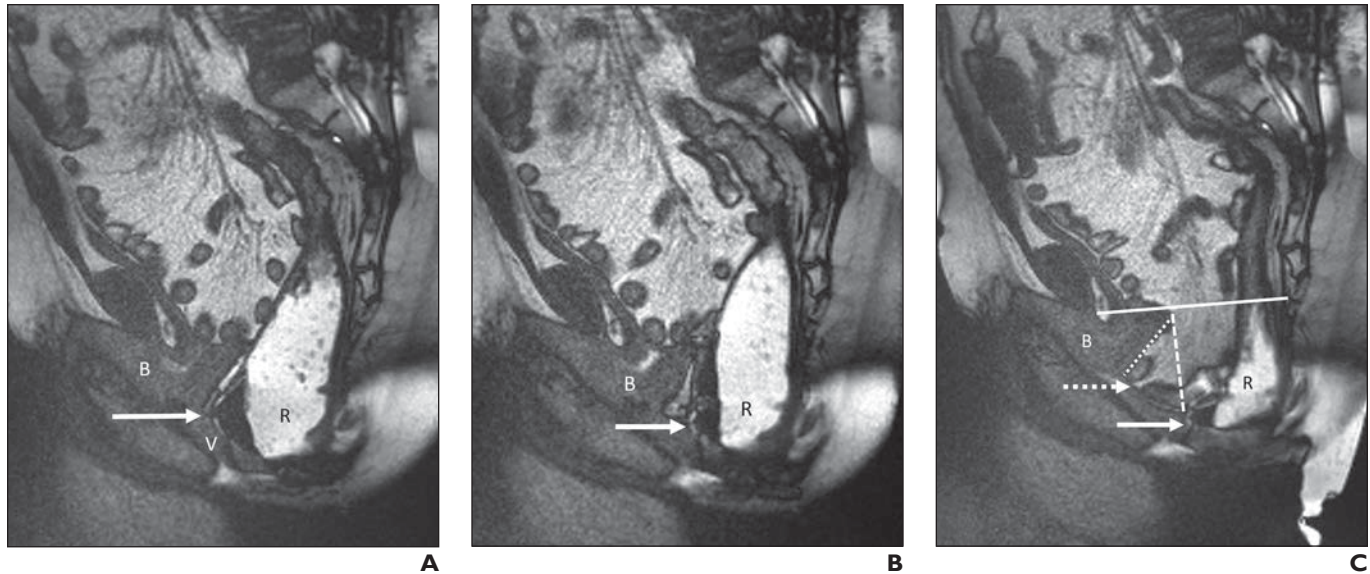


Fig. 4—52-year-old woman with suspected pelvic organ prolapse after hysterectomy, constipation, and limited clinical examination. Sagittal steady-state images were obtained during successive defecation attempts. B = bladder, R = rectum, V = vagina.

A, First defecation attempt shows rectocele (arrow).

B, Second defecation attempt shows less descent and rectocele due to poor effort (arrow).

C, Final defecation shows large enterocele (dashed arrow) with mass effect on rectum (solid arrow). Dashed line measures distance of enterocele sac descent from pubococcygeal line (solid line); dotted line measures extent of enterocele sac along posterior vaginal wall from vaginal apex.

cation acquisitions. Patients who do not evacuate during the examination may be asked to attempt to defecate in a restroom (by splinting the perineum or by digital manipulation if needed) to empty the rectum. This should be followed by acquiring an additional set of MR images during maximal Valsalva (postdefecation Valsalva maneuver) to demonstrate any prolapse that may have been masked by a full or only partially empty rectum on the earlier attempted defecation images. These images should be labeled appropriately for subsequent review.

The report should also comment on the adequacy of the defecatory effort that can be evaluated by direct patient observation during the examination and by assessing for abdominal wall motion on the sagittal images during attempts at defecation. The presence of anterior bulging of the abdominal wall with absence of rectal contrast medium evacuation may suggest true defecatory dysfunction. The absence of abdominal wall motion in this scenario may indicate poor effort [2, 3]. Once the rectum empties, the degree of rectal evacuation should be quantified by reporting the amount of evacuated contrast medium as a function of the baseline rectal contrast medium in thirds (i.e., one-third, two-thirds, or all baseline rectal contrast medium volume was evacuated). The experts also agreed that the location of retained contrast medium during defecation should be reported because it may have clinical relevance in the evaluation and treatment of defecatory dysfunction conditions (e.g., retention of contrast medium focally within a rectocele versus more proximal contrast medium retention in the upper rectum due to mass effect from a cul-de-sac hernia or above the level of rectal intussusception). This may allow differentiation between various causes of impaired rectal evacuation such as pelvic floor dyssynergia, stool entrapment secondary to a rectocele, rectal intussusception, or cul-de-sac hernia (see recommendation 7).

2. The PCL should be used as the point of reference to quantify the prolapse of organs in all compartments of the pelvic floor (degree of consensus: 89%). On MRD, the PCL should be defined as a line connecting the inferior edge of the pubic symphysis to the last coccygeal joint, not the coccygeal tip (degree of consensus: 74%).

There is an increasing appreciation that most patients with pelvic organ prolapse experience dual or even triple compartment pathology, making it important to describe the observations in all three compartments to ensure the mobilization of the appropriate team of experts to treat the patient. Thus, the consortium experts agreed that the presence of prolapse in anterior (cystocele), apical (vaginal/uterine prolapse), and posterior compartments (including perineal descent, rectocele, cul-de-sac hernia, rectal prolapse) should be described and quantified to help clinicians consider the appropriate surgical options.

Various landmarks and lines have been used as reference lines against which one can describe the movement of the pelvic floor. The PCL is the most widely used reference line and has higher interobserver agreement reported among radiologists than with other landmarks [22]. The PCL is also recommended for assessment of prolapse by the European Society of Urogenital Radiology and the European Society of Gastrointestinal and Abdominal Radiology Working Group on Pelvic Floor Imaging [3]. The PCL is drawn on sagittal images from the inferior point of the pubic symphysis to the last coccygeal joint (Fig. 5). The position of various pelvic organs (bladder, vaginal apex/cervix) and structures (cul-de-sac hernia, anorectal junction) can then be measured in centimeters using lines drawn perpendicular to the PCL. These measurements are made at rest and defecation and allow grading of prolapse according to previously published criteria [3].

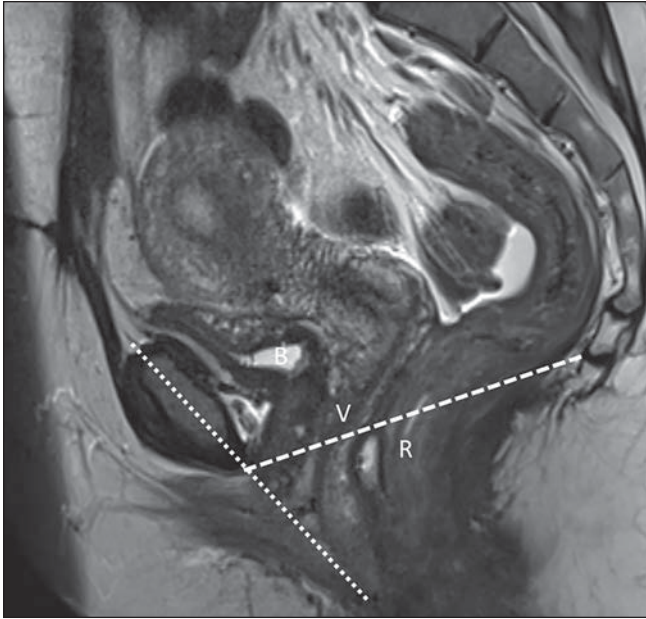


Fig. 5—43-year-old patient with stress urinary incontinence. Sagittal T2-weighted image through midline pelvis. Dashed line depicts pubococcygeal line (PCL) drawn from inferior border of pubic symphysis to last coccygeal joint. Extension of pelvic organs below PCL during defecation can be measured to grade prolapse. Dotted line represents mid pubic line drawn along axis of pubic bone to hymen. B = bladder, R = rectum, V = vagina.

In discussing the use of PCL versus other possible landmarks, experts proposed the PCL as most appropriate because it is not influenced by pelvic tilt and may thus be more reliably reproducible among centers [23]. The PCL has also shown good correlation with clinical examination for anterior and apical compartment prolapse, providing further reassurance as to its clinical significance [24]. The mid pubic line (MPL), drawn through the long axis of the pubic symphysis, was considered as a possible reference (Fig. 5) but not recommended because of higher reported inter- and intraobserver variability [22]. Although studies have shown that, in asymptomatic women, using the MPL as a reference standard results in a higher observed frequency of posterior compartment prolapse than the PCL, this finding was felt to be of uncertain significance [25].

3. A) Cul-de-sac hernias, such as enteroceles, sigmoidoceles, or peritoneoceles, should be described by measuring their extent below the PCL (in centimeters) (degree of consensus: 73%). B) Also specifying, in women, the lowest point of the hernia sac in relation to the vagina (“top of vagina,” “middle of vagina,” or “on pelvic floor”) (degree of consensus: 79%). C) Additional grading of pathology as low, moderate, or high grade may not be clinically relevant (degree of consensus: 70%).

Cul-de-sac structures such as enteroceles (containing the small bowel), sigmoidoceles (containing the sigmoid colon), or peritoneoceles (containing peritoneal fat only) can be visualized in the space between the rectum and the vagina [26]. These cul-de-sac hernias tend to be clinically relevant when they enter the rectovaginal space, causing mass effect on and potentially obstructing the vagina, the rectum, or both. This can occur regardless of their size or extent below the PCL. Imaging may help differentiate

the cul-de-sac hernia from rectocele as a cause of posterior vaginal bulge on physical examination, and, in some cases, enteroceles may be occult or confused with rectoceles on physical examination [27] (Video S1, which can be viewed in the *AJR* electronic supplement to this article, available at www.ajronline.org). After extensive discussions, the experts agreed that the best radiologic description of cul-de-sac hernias on MRD should include not only measurement of their extension below the PCL but also description of the relationship to the vaginal apex (Fig. 4). It is not always clear when surgical intervention is indicated for cul-de-sac hernias, but careful descriptions of these observations can help foster a better understanding of these phenomena and help guide future care [28]. Experts also stressed that in light of patient symptoms, given the lack of consensus on how these findings should be treated and the fact that their relevance is based on associated clinical findings, the MRD reports should not grade these as mild, moderate, or severe. In cases of incomplete or inadequate defecation, the reports should indicate a description as to whether these hernia contents appear to obstruct the rectum, thus preventing complete emptying. It is also important to note that incomplete rectal emptying or inadequate defecatory effort on MRD may decrease sensitivity for detection of cul-de-sac hernias, because these are often seen during end defecation or with an empty rectum. Finally, regardless of other dysfunction seen on the examination, it is important to always report the presence of any associated dysfunction of the levator muscles (as can be seen with dyssynergia) that would need treatment with biofeedback therapy before surgical intervention for the cul-de-sac hernia.

4. Perineal descent should be described by drawing a perpendicular line to the PCL and measuring the distance (in centimeters) of the location of the anorectal junction in relationship to the PCL at rest and during maximum defecation (degree of consensus: 100%).

In addition to pelvic organ prolapse, many patients may present with perineal descent, which is thought to increase the rates of recurrent disease and overall patient dissatisfaction with their surgical repairs. The presence or absence of perineal descent can provide clinical context to the finding of pelvic organ prolapse and should thus be reported. Landmarks such as the H-line and the M-line can be used to assess hiatal widening and perineal descent. The H-line measures the anterior-posterior dimension of the pelvic floor hiatus and is drawn from the inferior tip of the pubic symphysis to the anorectal junction. The M-line is a perpendicular line drawn from the PCL to the posterior tip of the H-line at the anorectal junction and can be used as an indirect measure of perineal descent (Fig. 6) given the lack of other established measurements. The experts agreed that these two lines should be used to quantify levator hiatus widening and perineal descent during interpretation of MRD.

5. A) Rectoceles should be quantified in centimeters by measuring the displacement of the anterior rectal wall from its position at rest to the maximally displaced position during evacuation (degree of consensus: 96%). B) Further characterization should include information regarding rectocele and rectal emptying and, in women, the degree of concomitant displacement of the posterior vaginal wall, if any (degree of consensus: 97%). C) Additional grading of pathology as low, moderate, or high grade or small, medium, or large may not be clinically relevant and should be avoided (degree of consensus: 70%).

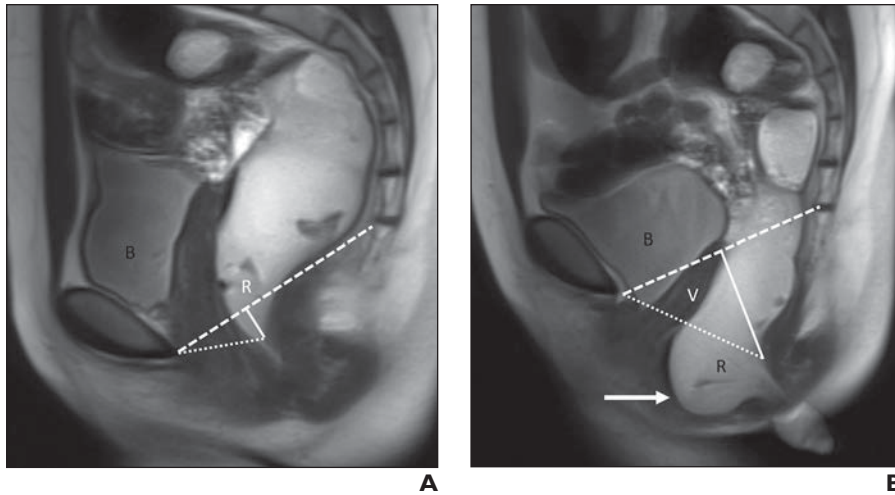


Fig. 6—63-year-old woman with constipation, vaginal bulge, and difficulty urinating. B = bladder, R = rectum, V = vagina.

A, Sagittal steady-state image at rest shows pubococcygeal line (PCL) (*dashed line*). H-line is drawn from inferior margin of pubic symphysis to anorectal junction (*dotted line*), and M-line is drawn perpendicularly down from PCL to junction of H-line and anorectal junction (*solid line*).

B, Sagittal steady-state image during early defecation shows unchanged PCL (*dashed line*); however, H-line (*dotted line*) and M-line (*solid line*) show significant lengthening compared with resting image. There is also anterior rectocele during early defecation (*arrow*).

Posterior vaginal wall prolapse is often secondary to rectocele, which is defined as anterior bulging or ballooning of the rectum into the rectovaginal septum. Clinically, rectoceles may cause weakening and lengthening of the vaginal wall and manifest as a posterior vaginal bulge and/or defecatory dysfunction. However, both rectoceles and cul-de-sac hernias can result in vaginal bulge on physical examination [27]. Furthermore, sometimes rectoceles apparent on clinical examination may not manifest on imaging with MRD. Experts discussed the relatively poor correlation between physical examination and imaging for the detection of rectocele. Decisions regarding appropriateness of surgical repair of rectoceles apparent on imaging and not on physical examination (or vice versa) are often multifactorial based on the patient- and clinician-related factors [29, 30], and discussion of appropriate indications is outside the scope of these guidelines. Nonetheless, the consortium experts agreed that rectoceles should be described when seen on MRD and should be measured in maximal anterior-posterior dimension during defecation. A vertical line drawn up from the anorectal junction during defecation extrapolates the normal location of the rectal wall at rest. A horizontal line drawn from this vertical line to the most maximally displaced portion of the anterior rectal wall should be considered the anterior-posterior dimension of the rectocele (Fig. 2C and Video S2, which can be viewed in the *AJR* electronic supplement to this article, available at www.ajronline.org). Furthermore, any resultant deformity of the vaginal wall should be described. Similar to other findings, radiologists should avoid using language that implies severity or grading terminology such as mild, moderate, or severe because the imaging finding may not always correlate with patient symptoms. Further comment should be made on whether the rectoceles empty with maximum effort or whether they retain contrast medium. It was noted that contrast medium retention within a rectocele on MRD does not always correlate with the finding of contrast medium retention on fluoroscopic defecography, presumably because of differences in consistency between the types of rectal contrast medium used for fluoroscopy and MRI. When a rectocele does not fully empty, a further comment should be made as to whether the patient can empty fully with digital splinting or manipulation. Furthermore, in patients who have a paradoxical occlusion of the anus or contraction of the pu-

borectalis with defecation, a comment about the timing of the rectocele development in relationship to the timing of the paradoxical contraction of the pelvic floor can provide further insight into the best treatment approach to these patients.

6. At minimum, rectal intussusception should be quantified as either “intraarectal,” “intraanal,” or “external” (degree of consensus: 75%).

Rectal intussusception in male or female patients refers to the infolding or telescoping of the rectum into the more distal rectum, anal canal, or through the anal sphincter muscles (external prolapse or full-thickness rectal prolapse) [31]. Surgical correction of rectal intussusception is possible, but the radiologic finding may coexist with nonsurgical conditions such as slow-transit constipation, pelvic floor dyssynergia, and irritable bowel syndrome, scenarios that may cause patients to have poorer surgical outcomes [32]. In this context, careful description and grading of the rectal intussusception is clinically significant. The literature on the proper timing and indications for surgery for this anatomical finding is evolving, although there seems to be consensus that the patients who present with, at a minimum, intraanal intussusception and symptoms of fecal incontinence may benefit from surgical correction [33]. The observation of internal intussusception in the patient with concomitant dyssynergia of the pelvic floor and/or a concern of constipation is harder to address, and the current algorithms of care are more complex.

Given the evolving clinical context, the consortium experts debated which of two scales to use for grading internal rectal intussusception: descriptive reporting or the Oxford Grading Scale [34]. After much debate, the panel agreed that a consistent description of rectal intussusception as intraarectal, intraanal, or complete external (extraanal) would provide sufficient clinical information and should be used as the minimum reporting standard (Fig. 7). Notably, the term “rectal prolapse” is used clinically, in general, for cases of external rectum intussusception in both men and women. Thus, describing the intussusception of the rectum on imaging in terms of location (intraanal, intraarectal, external) may help minimize confusion. The alternative option of using the more detailed Oxford Scale scoring to quantify the mobility of the anterior rectal wall versus the posterior rectal wall circumferentially was much debated, but ultimately experts voted against

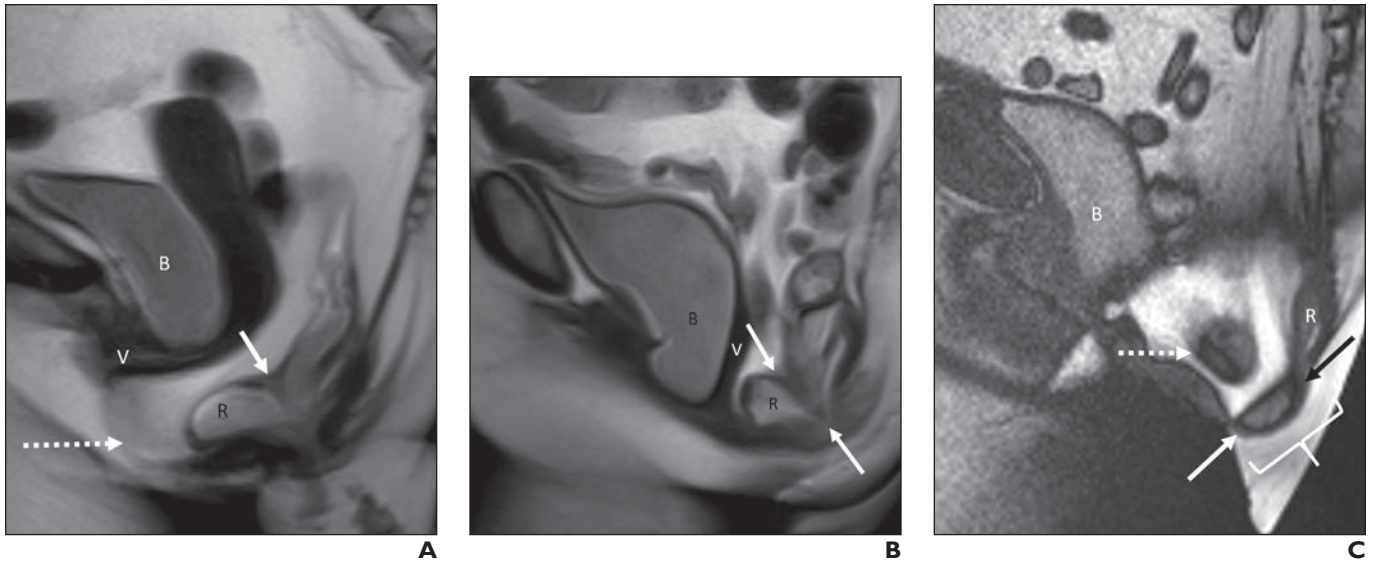


Fig. 7—Sagittal steady-state images in different patients during defecation. B = bladder, R = rectum, V = vagina.

A, Solid arrow shows invagination of anterior and posterior rectal walls into more distal rectum for short distance, consistent with intrarectal intussusception. Large fat-containing peritoneocele is seen (*dashed arrow*).

B, Arrows show invagination of anterior and posterior walls of rectum into anal canal consistent with intraanal intussusception.

C, Sagittal image during defecation in third patient shows widened anal canal (*brackets*) with complete rectal inversion and external (extraanal) prolapse (*arrows*). There is also sigmoidocele behind inverted rectum nearly extending into anal canal (*dashed arrow*).

mandating its inclusion in the minimum required reporting template (votes for the Oxford Scale: 67%, consensus not reached). These additional observations as to whether the intussusception is partial or circumferential, mucosal, or full thickness can be added when clinicians feel that these additional radiologic observations may have implications on management. When describing rectal intussusception, further useful information could also be provided as to its perceived impact on rectal emptying and as to its timing in relation to the function of the puborectalis muscle and anus to initiate the act of defecation.

7. Changes in the anorectal angle from the resting baseline to maximal defecation and during the Kegel maneuver (maximum squeeze) should be quantified on MRD (degree of consensus: 80%).

Functional defecatory dysfunction including pelvic floor dyssynergia, defined as paradoxical contraction of the levator ani muscles during defecation, is a potential cause of obstructive defecation in either male or female patients [35, 36]. The recognition of dyssynergic defecation is important because pelvic floor retraining and biofeedback is the only evidence-based treatment currently available [37]. Furthermore, untreated or unrecognized dyssynergia in the setting of other anatomic abnormalities can exacerbate symptoms, prompt premature surgery, and lead to poor long-term outcomes [38]. Nevertheless, there is no single standard test for the diagnosis of functional defecatory dysfunction and characterizing the pathology often requires a combination of clinical tests including anorectal manometry, electromyography, balloon expulsion test, and/or dynamic imaging [39].

Defecography, compared with the other physiologic anorectal tests, has the advantage of providing both functional and structural information and should be considered an initial diagnostic test in the evaluation of patients with symptoms suggestive of defecatory dysfunction [40]. MRD is particularly adept at demonstrat-

ing the posterior rectal wall and levator plate to assess the levator function during defecation. The anorectal angle is measured on MRD at rest, during the Kegel maneuver, and during defecation as the angle between a line along the posterior rectal wall and another line along the axis of the anal canal. One study reported that in healthy women the anorectal angle is approximately $100^\circ \pm 1^\circ$ (mean \pm standard error of the mean) at rest, narrows to $70^\circ \pm 2^\circ$ at the Kegel maneuver, and widens to $120^\circ \pm 2^\circ$ during evacuation [41]. Although the exact value of the angle may vary across a range, normally the anorectal angle should widen during evacuation and narrow during the Kegel maneuver compared to its value at rest (Fig. 8). The imaging hallmark of a patient with dyssynergia, however, is paradoxical narrowing of the anorectal angle during defecation and Valsalva (Fig. 9). Thus, it is imperative to report not only the value but also the direction of change of the anorectal angle from baseline on MRD. Healthy male and female patients will have a wider angle during defecation than at rest. The consortium felt that a description of both the degree of change as well as the direction would be meaningful in clinical practice.

Conclusion

Consensus was reached by the PFDC on many clinically relevant considerations for performing, interpreting, and reporting MRD. A corresponding synoptic interpretation template was suggested based on these consensus guidelines (Table 2). The described technique and template can be augmented with additional radiologic maneuvers and report elements based on specific patient indications, health care provider preferences, and local practice patterns, but the suggested verbiage and steps should be advocated as the minimum requirements when performing and interpreting MRD in patients with evacuation disorders of the pelvic floor.

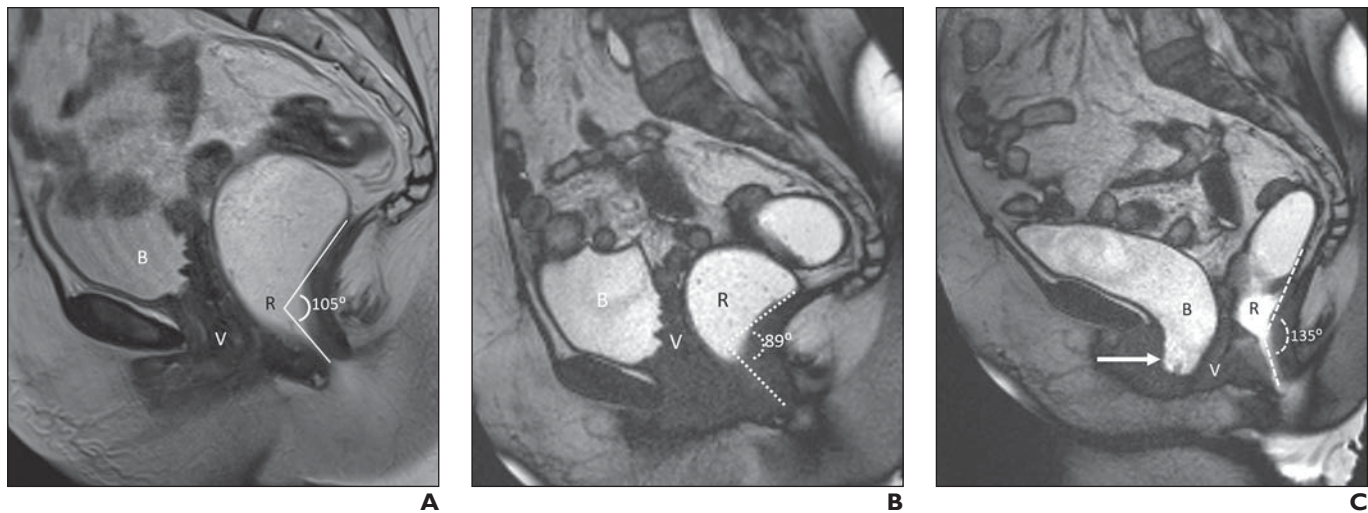


Fig. 8—73-year-old woman with recurrent cystocele, vaginal prolapse, and constipation. B = bladder, R = rectum, V = vagina. **A**, Sagittal T2-weighted midline image shows normal resting anorectal angle (solid angle) of 105°. **B**, Sagittal midline steady-state image during Kegel maneuver shows expected narrowing of anorectal angle to 89° (dotted angle). **C**, Sagittal midline steady-state image during defecation shows expected widening of anorectal angle (dashed angle) to 135°. Note cystocele on defecation image (arrow).

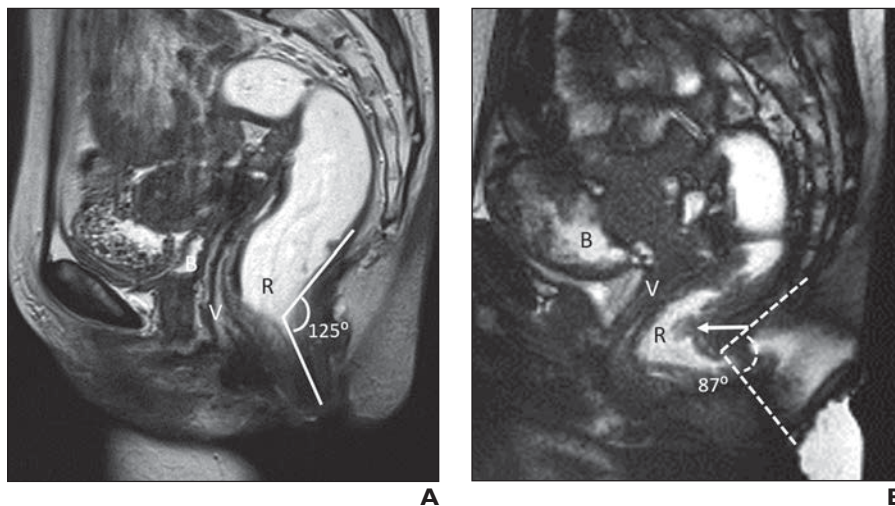


Fig. 9—64-year-old woman with constipation and pelvic organ prolapse. B = bladder, R = rectum, V = vagina. **A**, Sagittal T2-weighted midline image shows normal resting anorectal angle (solid angle) of 125°. **B**, Sagittal midline steady-state image during defecation shows incomplete rectal emptying and paradoxical narrowing of anorectal angle (dashed angle) to 87°. Note exaggerated posterior impression of puborectalis during attempted defecation (arrow).

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