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Assessment of Women With Defecatory Dysfunction and Manual Splinting Using Dynamic Pelvic Floor Magnetic Resonance Imaging

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Abstract

Objective—This study aimed to describe magnetic resonance imaging (MRI) findings in women with defecatory dysfunction who perform manual splinting.

Methods—This is a retrospective study of 29 patients from a single urogynecology center who presented with complaints of defecatory dysfunction and who reported manual splinting to assist with bowel movements. Patients were scheduled for an MRI study with a novel “splinting” protocol to evaluate the effects of their manual splinting on the pelvic floor. The protocol involved asking patients to splint during the MRI, as they normally would when trying to defecate. The goal was to evaluate any change in pelvic anatomy and compensation for an anatomic defect that could potentially lead to their defecatory dysfunction. Magnetic resonance images of the pelvis were obtained at rest, with pelvic floor contraction, with Valsalva, and during manual splinting. These images were then reviewed by radiologists who evaluated various parameters, including anorectal angle, levator ani muscle integrity, and the presence of rectocele, cystocele, apical prolapse, and enterocele. The external and internal anal sphincters were also evaluated for continuity.

Results—From September 2008 to October 2010, 29 women reported defecatory dysfunction and the need for manual splinting. Their mean (SD) age was 55.2 (10.5) years. Magnetic resonance images showed a rectocele in 86.2% of the study group, cystocele in 75.9%, enterocele in 10.3%, and a defect of the levator ani muscles in 17.2%. Twentyone (72.4%) women had more than 1 of these defects. In addition, 27.6% had an anorectal angle less than 90 degrees or greater than 105 degrees.

Patients in the study group splinted in the vagina (58.6%), on the perineum (31.0%), or on the buttock (10.3%). In all but 1 woman (96.6%), splinting improved or completely corrected the identified defect(s) as evidenced with MRI. Among those who used vaginal splinting, 52.9% of defects were corrected and 47.1% were improved. Perineal splinting corrected 55.6% and improved 33.3% of cases and was ineffective in 11.1% of cases, whereas buttock splinting corrected 33.3% and improved 66.7% of cases.

Conclusions—Most women in our study group who used manual splinting to assist in defecation are compensating for a pelvic floor defect that can be detected on MRI. Magnetic resonance imaging of the pelvis may help elucidate the etiology of the defecatory dysfunction in some women and may assist pelvic reconstructive surgeons in planning surgical correction of pelvic floor defects. Magnetic resonance imaging may also identify defects in the pelvic floor that are, at the present time, not amenable to surgical correction.

Keywords

splinting; defecatory dysfunction; MRI; pelvic organ prolapse; pelvic floor; constipation; dynamic MRI; obstructed defecation; rectocele; cystocele; enterocele; apical vaginal prolapse; vaginal vault prolapse

Pelvic floor dysfunction (PFD) requiring surgical repair affects 11% of women living in the United States. It is anticipated that the prevalence of PFD will increase with our aging population.¹ Defecatory dysfunction is characterized by a spectrum of anatomic and functional abnormalities that can lead to fecal incontinence or incomplete evacuation. This disorder affects 20% of women in the general population and 24% to 52% of those with pelvic organ prolapse.² The most common bowel symptom found in a study population with defecatory dysfunction was incomplete emptying.³ In women presenting with the complaint of incomplete evacuation, the expressed need for manual manipulation of the perineum, buttock, or vagina as a compensatory mechanism (commonly referred to as splinting) is a practice familiar to specialists in pelvic floor disorders. Splinting is defined as the placement of a finger or hand on the perineum, on the buttock, or inside or around the vagina to mechanically assist in rectal evacuation.

Dynamic magnetic resonance imaging (MRI) of the pelvis is well recognized as a useful technique in the preoperative evaluation of women with PFD because it provides the surgeon precise multicompartamental anatomic detail, as well as quantifiable functional data as to the degree of pelvic organ prolapse. It is also recognized that optimal therapy and improved surgical outcomes for patients with PFD require a full appreciation of the dynamics of the entire pelvic floor, rather than relying on a more traditional site-specific approach.⁴ It is unknown, at this time, whether MRI will enable surgeons to better target specific defects.

Furthermore, there are limited data on the relationship between patient-reported symptoms and dynamic MRI of the pelvic floor. One study reported that symptoms of PFD are poorly correlated with stage of pelvic organ prolapse as determined by physical examination and findings on dynamic MRI.⁵ This study, however, only required patients to strain during static imaging. Dynamic MRI may offer more clinically useful information regarding morphologic changes of the pelvic floor anatomy and pelvic floor dynamics during defecation. It may also provide previously unavailable information if the patient performs the splinting mechanism that she normally use to aid evacuation during the MRI. At our institution, we have used dynamic MRI of the pelvic floor to evaluate women with defecatory dysfunction for the past 2 years. We present a descriptive study of women with symptoms of defecatory dysfunction requiring splinting. These women were imaged while performing the splinting maneuvers they use to evacuate. Our primary objective was to determine whether each patient's splinting mechanism corrected her pelvic floor defect as assessed with dynamic MRI.

MATERIALS AND METHODS

Patient Sample

After institutional review board approval, we identified all patients who underwent a dynamic pelvic floor MRI examination using a novel splinting protocol at our institution from September 2008 to February 2010. The splinting protocol was developed by the division of urogynecology and department of radiology at our institution. Patients were included in the study if they had symptoms of defecatory dysfunction and reported using at least 1 method of splinting as a compensatory aid for rectal evacuation during defecation.

Clinical Assessment

At the time of initial clinical consultation, all patients were evaluated by a urogynecology fellow in conjunction with a fellowship-trained urogynecology attending. Patients were selected to undergo the splinting protocol MRI based on their report of splinting to assist in defecation.

Imaging Technique

Patients were given verbal instructions before the examination, detailing maneuvers during the interactive sequences, including Valsalva, relaxation, and contraction. Each patient was asked to empty her bladder before the examination; however, by the time of image acquisition, the bladder was usually partially full.

All patients were in the supine position using a closed-configuration 1.5-T magnet (Philips Intera, PHILIPS Healthcare, Andover, Mass) and a Synergy body phased-array coil. As with routine dynamic pelvic floor MRI examinations performed at our institution, intravenous contrast was not used. There was no bowel preparation or intraluminal contrast material administered. Static multiplanar images of the pelvis were acquired for anatomic evaluation using a 5-mm slice thickness with a 1-mm gap, for sagittal and axial T2-weighted sequences (echo time, 100 milliseconds; repetition time, 2000–2500 milliseconds) and coronal T1-weighted sequence (echo time, 10 milliseconds; repetition time, 541 milliseconds). In addition, a T2-weighted sequence (echo time, 80 milliseconds; repetition time, 2110 milliseconds) using a 3-mm slice thickness with a 0.3-mm gap was acquired in the axial oblique plane, angled to the external anal sphincter (Fig. 1).

Dynamic MRI was then performed in the midsagittal and coronal planes. This single-shot sequence (echo time, 80 milliseconds) was divided into 7 dynamics. The 7 dynamics were acquired with the patient at rest, followed by mild straining, and then during maximal strain. During the fourth dynamic, the patient was instructed to contract the pelvic floor by squeezing as if trying to prevent evacuation. The minimal and maximal straining sequences were then repeated, followed by another contraction sequence.

The final acquisition is with the Philips RealTime sequence, in which balanced fast field echo (echo time, 1.5 milliseconds; repetition time, 4 milliseconds) with a slice thickness of 7 mm was performed during simulated defecation. Before acquisition, the patient was given instructions to repeat the sequence of minimal strain, maximal strain, relaxation, and contraction for the duration of the acquisition (1 minute). A cine loop was created from this final real-time acquisition.

For the splinting component of the examination, the 7 dynamics and balanced fast-field gradient echo sequences were repeated while the patient performed her splinting maneuver during simulated defecation. Patients were asked to splint as they normally would during defecation.

Image Analysis

Initial interpretation, including measurements and grading (as detailed below), was performed independently by 1 of 3 attending radiologists. The interpreting radiologist knew the patient's presenting complaint at the time of interpretation.

Static Imaging

The multiplanar static images were used to evaluate the pelvic floor anatomy, including the iliococcygeous, pubococcygeous, and puborectalis muscles, as well as the internal and external anal sphincter and perineal body. The levator ani was evaluated for integrity, including thinning, tears, and asymmetry in the coronal plane while the puborectalis muscle was well demonstrated in the axial plane.

Dynamic Imaging

The midsagittal section was used to identify the anorectal junction (the apex of the anorectal angle, which is the angle between the posterior border of the distal rectum and the central axis of the anal canal). The anorectal junction marks the point of reference for posterior compartment descent. For this study, 90 to 105 degrees was considered a normal anorectal angle at rest and less than 90 degrees was considered normal with contraction. The pubococcygeal line (PCL) was then drawn from the inferior border of the pubic symphysis to the last coccygeal joint to serve as a reference for measuring pelvic organ prolapse (Fig. 2). The distance of the bladder neck, cervix, and anorectal junction was measured on rest and maximal strain images. In healthy subjects, there should be minimal translation of the pelvic viscera with respect to the PCL when transitioning from rest to Valsalva.⁶ The H line, which represents the anteroposterior width of the levator hiatus, is drawn from the inferior border of the pubic symphysis to the posterior wall of the rectum at the level of the anorectal junction. The M line, which represents the vertical descent of the levator hiatus, is drawn perpendicularly from the PCL to the most posterior aspect of the H line. The upper limits of normal for the H and M lines are 5 and 2 cm, respectively.³ The degree of pelvic organ prolapse is graded in severity as measured by descent beyond the PCL, with less than 3 cm representing mild; 3 to 6 cm, moderate; and more than 6 cm, severe organ prolapse.⁶ A rectocele is measured as the depth of wall protrusion beyond the extrapolated margin of the normal rectal wall and is graded as small if less than 2 cm, moderate if 2 to 4 cm, and large if more than 4 cm.⁷ Cystoceles and enteroceles are graded as small, moderate, or large if they descend less than 3 cm, 3 to 6 cm, or more than 6 cm beyond the PCL, respectively. Figure 3 lists all radiologic points referenced on dynamic pelvic floor MRI and their definitions.⁸ The internal and external anal sphincters were also evaluated.

Analysis

Analyses were conducted using Statistical Analysis System (SAS 9.2; SAS Institute, Cary, NC). Data are presented as means (SD) or proportions with the 95% confidence interval, as appropriate.

Magnetic resonance imaging data were used to characterize the specific anatomic defects of the pelvic floor. To determine whether the patient's splinting maneuver corresponded to an alteration of anatomy, pelvic floor descent, or reduction of a prolapsed organ, the interpreting radiologist used the reference landmarks detailed above on images acquired during maximal strain without and with the splinting maneuver. On the basis of these data, the efficacy of splinting was classified as no improvement, improved, or corrected. The efficacy of splinting is reported for the entire study population and stratified by the location of splinting.

RESULTS

Forty-one patients referred by our urogynecology clinic for dynamic MRI of the pelvic floor using the splinting protocol reported symptoms of defecatory dysfunction. Of those, 29 performed the splinting maneuver at the time of image acquisition and were included in this study. The 12 women who did not perform the splinting maneuver during the MRI were excluded. Although we are not certain why some patients did not splint during imaging, it is likely that patient embarrassment, modesty, or miscommunication between the clinician and patient played a role. The remaining 29 women had a mean (SD) age of 55.2 (10.5) years (range, 37–78 years).

At rest, the anorectal angle was less than 90 degrees in 2 women (6.9%) and more than 105 degrees in 6 women (20.7%). With contraction, the anorectal angle was normal in 12 women (41.4%) and abnormal in 17 women (58.6%). Table 1 includes the average measurements of the anorectal angle, the H line, and the M line obtained by MRI (Fig. 4).

Dynamic MRI revealed a rectocele in 25 women (86.2%), cystocele in 22 women (75.9%), enterocele in 3 women (10.3%), and a defect of the levator ani muscle(s) in 5 women (17.2%; Table 2). Twenty-one women (72.4%) had more than 1 of these defects, indicating a multicompartmental etiology of PFD (Fig. 5). The external anal sphincter was found to be dehiscence in 3 women (10.3%), fragmented in 13 women (44.8%), and intact in 13 women (44.8%). The internal anal sphincter was not dehiscence in any patient, fragmented in 5 women (17.2%), and intact in women 24 (82.9%).

Seventeen (58.6%) of the 29 women splinted by manually supporting the vagina with their finger(s), either at the perineal body or within the vagina during maximal strain. Nine (31.0%) women manually supported the perineum and 3 (10.3%) women exerted pressure on the buttock (Fig. 6).

In all but 1 woman (96.6%), splinting at least partially reduced the identified defect(s). Table 3 shows the extent to which splinting corrected the anatomic defects identified on dynamic MRI. Among those who used vaginal splinting, 52.9% of defects were completely morphologically corrected and 47.1% were partially reduced. Perineal splinting corrected 55.6% of cases, partially reduced 33.3% of cases, and was ineffective in 11.1% of cases. Splinting by exerting pressure on the buttock corrected 33.3% of cases and partially reduced 66.7% of cases (Fig. 7 and Fig. 8).

DISCUSSION

Our study demonstrates that dynamic MRI along with the described splinting protocol can be used to quantify how morphologic abnormalities of the pelvic floor may be overcome by patient compensatory behavior, potentially resulting in improved rectal evacuation. In this study, we found that most women were able to either partially (44.8%) or completely (51.7%) correct the pelvic support defect in an attempt to accomplish rectal emptying during defecation.

To our knowledge, image acquisition while patients perform splinting maneuvers to aid in rectal evacuation has not previously been reported. We believe that the observations reported in this study may further our understanding of anatomic pelvic floor defects with regard to defecatory dysfunction. The ability to observe this patient-specific, defect-specific mechanism and the resultant effect on pelvic floor morphology with dynamic MRI may afford surgeons the ability to better target surgical repair of specific pelvic floor defects.

The manner in which women decide how to correct their specific pelvic floor defect with manual splinting has yet to be determined. One may surmise that a trial-and-error approach leads to a behavior that is reinforced by successful rectal emptying. The ability to tailor a surgical intervention based on the efficacy of splinting as assessed with dynamic MRI may lead to improvements in surgical techniques, which have been reported to have variable outcomes.⁹

Dynamic MRI offers the well-recognized benefits of tri-compartmental evaluation of the pelvic floor, coupled with temporal resolution and soft tissue contrast, yielding both comprehensive anatomic detail and quantifiable functional data. Inclusion of this novel splinting protocol as a supplement to the currently accepted method provides a nonionizing, noninvasive technique that will continue to evolve. This tool also will likely further demonstrate its utility in the evaluation and treatment of PFD, specifically defecatory dysfunction, which is a prevalent condition that can substantially affect a woman's quality of life.

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FIGURE 1.

Sagittal T2-weighted images in a 46-year-old woman. A, The anorectal angle (dashed lines) at rest is 104 degrees (reference, 108–127 degrees). B, The angle becomes more acute with contraction of the puborectalis muscle (63 degrees), which shortens and pulls the anorectal junction toward the pubic symphysis. C, During straining, the puborectalis muscle relaxes, resulting in an obtuse anorectal angle (110 degrees).

FIGURE 2.

Sagittal T2-weighted images in a 46-year-old woman. A, The PCL extends from the inferior border of the pubic symphysis to the last coccygeal joint. The PCL (black line), which marks the level of the pelvic floor, serves as a landmark for measuring organ prolapse. B, The H line, which represents the width of the levator hiatus, extends from the inferior border of the pubic symphysis to the posterior wall of the rectum. The M line extends from the PCL to the posterior aspect of the H line and is expected to elongate during defecation as the anorectal angle opens. Note the anterior rectocele (black arrow).

FIGURE 3.
Dynamic MRI reference points.

FIGURE 4.

A 55-year-old woman with incomplete rectal evacuation during maximal strain. Sagittal T2-weighted images show a large anterior rectocele (dotted arrow) and bladder prolapse (black arrow) before splinting (A) and reduction of the rectocele (dotted arrow) and bladder prolapse (black arrow) during splinting (B), which she performs by exerting external pressure on the perineum with her fingers (broken arrow).

FIGURE 5.

A 73-year-old woman with obstructive defecatory symptoms and constipation. During maximal strain, sagittal T2-weighted images show an anterior rectocele (black arrow; A), reduced (black arrow; B) during simulated defecation as the patient inserts her fingers into the vagina (dotted arrow) and splints the rectovaginal septum manually.

FIGURE 6.

A 63-year-old woman with incomplete defecation, levator ani thinning, and cystocele. A, Coronal T2-weighted images demonstrating a thinned right levator ani muscle, which bows inferolaterally during maximal strain (black arrow). Note the caudal descent of the right side of the floor of the urinary bladder (dotted arrow). B, The patient splints by using the middle finger of her right hand to retract the right buttock and place pressure on the anus (dashed arrow). This maneuver results in decreased caudal excursion of the right levator ani (black arrow) and urinary bladder (dotted arrow).

FIGURE 7.

A 67-year-old woman with a history of hysterectomy and defecatory dysfunction. A, Sagittal T2-weighted images show an enterocele with prolapse of the mesenteric fat and small bowel (black arrow). B, The patient splints by placing her fingers in the vagina (dotted arrow) during maximal strain, which manually reduces the enterocele.

FIGURE 8.

A 46-year-old woman with obstructive defecatory symptoms, levator ani dysfunction, and a cystocele. A, Coronal T2-weighted image demonstrating a cystocele during maximal straining (black arrow). B, Sagittal T2-weighted image acquired during maximal strain showing inferolateral bowing of the right levator ani muscle (black arrow). C, Coronal T2-weighted image acquired while the patient splints by supporting the right lateral aspect of the buttock with her fingers (dotted arrow), resulting in decreased lateral and caudal excursion of the right levator ani muscle and rectum (black arrow). D, Sagittal T2-weighted image of the same patient demonstrating how her splinting maneuver (dotted arrow) supports the pelvic floor and results in reduction of the prolapsed bladder (black arrow).

TABLE 1

Anatomic Measurements as Seen on Functional MRI

Measurement	All Patients (n = 29)		
	Mean	SD	Range
Anorectal angle at rest, degrees	100.2	8.3	87.0–119.0
Anorectal angle with contraction, degrees	89.9	10.6	65.0–112.0
H line, cm	6.6	1.2	4.4–8.5
M line, cm	3.2	1.5	0.5–6.8

TABLE 2

Defect Seen on Dynamic MRI

	%	n
Rectocele	86.2	25
Cystocele	75.9	22
Enterocele	10.3	3
Levator ani defects	17.3	5
Multiple defects	72.4	21

TABLE 3

Effect of Splinting on Anatomical Defect as Seen on Functional MRI

Characteristics	All Patients (n = 29)		
	n	%	95% CI
Splinting			
No improvement	1	3.5	32.5–70.6
Improved	13	44.8	26.5–64.3
Corrected	15	51.7	0.01–17.8
Vaginal splinting			
No improvement	0	0.0	
Improved	8	47.1	23.0–72.2
Corrected	9	52.9	27.8–77.0
Perineal splinting			
No improvement	1	11.1	0.28–48.3
Improved	3	33.3	7.5–70.1
Corrected	5	55.6	21.2–86.3
Buttock splinting			
No improvement	0	0.0	
Improved	2	66.7	9.4–99.2
Corrected	1	33.3	0.84–90.6

CI indicates confidence interval.