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MRI DEFECOGRAM – USEFULNESS OF DEFECATION PHASE IN DETECTION OF RECTAL PATHOLOGIES.

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ABSTRACT

OBJECTIVE. The purpose of this study was to assess the usefulness of the defecation phase during dynamic MR defecography in detecting rectal pathologies.

MATERIALS AND METHODS. The images from 50 MR defecographic examinations (50 patients; age range, 13-73 years; mean, 49.88) were retrospectively reviewed in consensus by two observers. Images from each of four phases (rest, maximal sphincter contraction and squeezing, maximal straining, and defecation) were evaluated and scored independently with a previously published grading and scoring system. Features evaluated included the presence and degree of rectal descent and the presence and size of rectocele and intussusception. Statistical analysis was performed with a variety of tests.

RESULTS. Compared with images obtained in the other phases, defecation phase images helped in identification of additional cases of rectoceles in 23 examinations (62%), rectal descent in 10 examinations (40%) and intussusception in 2 examinations (67%). The number of additional cases of abnormalities identified on defecation phase images was significantly greater than the number identified on images obtained in the other phases. The average total scores for the rest, squeeze, strain, and defecation phases were 0.06 (SD,0.24), 0.16 (SD,0.37), 0.82 (SD, 0.66), and 1.86 (SD, 0.78). The average total defecation phase score was significantly greater than the average total score in any of the other phases ($p < 0.001$).

CONCLUSION. During dynamic MR defecography, defecation phase imaging yields important additional information on the presence and degree of pelvic floor abnormalities and is therefore an essential component of MR defecographic examinations.

KEYWORDS : defecation phase, MR defecography, pelvic floor dysfunction.

INTRODUCTION

Pelvic floor dysfunction is a major health care problem characterized by pelvic pain, prolapse of pelvic organs, urinary and fecal incontinence. The integrity of the pelvic floor can be compromised by childbirth, pelvic surgery, obesity, constipation, age, genetic factors, and heavy physical exertion. Clinical evaluation of patients with pelvic floor dysfunction is difficult. Symptoms such as constipation, incontinence, and pain are nonspecific, and physical examination is frequently inaccurate. As a consequence, imaging is becoming popular at academic medical centers as an adjunct tool for the assessment of pelvic floor abnormalities. Although endoanal sonography and endoanal MRI depict the anal sphincter complex and associated pathologic changes in exquisite anatomic detail, both modalities are limited in the assessment of pelvic floor function. Historically, fluoroscopic defecography, first described in 1952, has played an important role in the diagnosis of functional abnormalities of the pelvic floor, but the technique has inherent limitations. Primarily, depiction of pelvic soft tissues is restricted: the tissues can be enhanced only by administration of contrast material into several anatomic compartments, such as the vagina, bladder, small intestine, and peritoneum. This step inevitably increases the invasiveness of the examination. In addition, the fluoroscopic technique involves exposing the patient to ionizing radiation. As a result, interest in MR defecography has been increasing. In this technique, the high quality multiplanar soft-tissue contrast of MRI is used to visualize the pelvic viscera and supporting soft-tissue structures without the radiation burden of conventional fluoroscopic defecography.

MR defecographic technique has numerous variations. For example, no clear consensus exists on the type of rectal contrast agent instilled. Furthermore, MR defecography can be performed with a closed or an open MRI system. Although its availability is limited, open MRI has the advantage that images can be acquired with the patient in the physiologic sitting position, simulating true defecation. When a closed-configuration MRI system is used, images are acquired with the patient supine. For practical purposes, the defecation phase is often excluded from the protocol when the patient is supine. We presume that without the defecation phase, findings can be missed and the severity of disease underestimated. Although open and closed MR defecography have been compared, to the best of our knowledge, no previous study has been conducted to evaluate the importance and exact contribution of the defecation phase to the diagnostic accuracy of dynamic MR defecography. The purpose of our study was to assess the specific diagnostic yield in the defecation phase compared with the rest, squeeze, and strain phases.

Materials and Methods

Subjects

After obtaining institutional review board approval, we retrospectively reviewed the electronic radiology information databases at our institution. The requirement for informed consent was waived. The most common presenting clinical symptoms were constipation and incomplete evacuation.

Inclusion criteria

Fifty consecutive dynamic MR defecography examinations performed from 2014, through 2020, were identified. Fifty dynamic MRI examinations of 50 patients (34 women, 16 men; age range, 13-73 years; mean, 49.88 years) were included in this study.

Exclusion criteria

Patients who could not retain the rectal contrast medium and patients with rectal mass were excluded from the study.

MR Defecographic Technique

All examinations were performed with a 1.5-T superconducting closed-configuration MRI system (Aera, Siemens). Before imaging, patient preparation involved drinking 600 mL of water over 30 minutes to opacify the small bowel, better distend the small bowel, and thereby improve visualization. Finally, immediately before image acquisition, 400mL of aqueous sonographic gel was instilled into the rectum through a small rectal catheter with the patient in the right decubitus position. A sagittal localizer acquisition was performed with a fast T1-weighted spoiled gradient-recalled echo sequence (TR/TE, 63.21/4.97; flip angle, 15°; slice thickness, 5 mm; matrix size, 256 × 192; field of view, 240mm). From this series, a midsagittal slice was chosen and transcribed to a new series in which this slice was repeated 15 times at 2-second intervals for each phase with T2-weighted fully refocussed gradient echo 2d dynamic sequence (TE/TR 91/5253, slice thickness 3mm). The four dynamic phases were rest, maximal sphincter contraction (squeeze), maximal strain, and defecation. The examination was completed with an axial T2-weighted fast spin-echo sequence (TE/TR 5083/87 flip angle, 180°; slice thickness, 3 mm; matrix size, 320 × 266; field of view, 200mm) through the pelvis after evacuation.

MRI Feature Analysis

Two abdominal radiologists (6 and 4 years of experience in reading abdominal MR images) in consensus retrospectively evaluated the images at a PACS workstation. Only the midsagittal dynamic images were reviewed and they were presented in cine loop mode. Each phase was evaluated with a previously published MRI grading and scoring system (1) (Table 1). This evaluation generated a total score for each phase. Images from the four phases were reviewed in the sequence in which they were acquired and were scored independently(Figure 1).

Images were analysed with regard to the presence and degree of rectal descent in relation to the pubococcygeal line. The pubococcygeal line was defined as the line joining the inferior aspect of the symphysis pubis to the last coccygeal joint. The anorectal junction was the landmark for determining rectal descent. The anorectal junction was defined as the cross point formed by a line along the posterior border of the rectum and a line along the central axis of the anal canal

The presence and size of rectocele, rectal descent and intussusception were evaluated. The size of an anterior rectocele was expressed as the depth of wall protrusion extending beyond the expected margin of the normal rectal wall. Intussusception was defined as rectal wall invagination of varied thickness. Location was categorized as intrarectal, intraanal or extraanal, and thickness as mucosal or full thickness.

TABLE 1: Grading and Scoring of MRI Findings

Abnormality	Small		Moderate		Large	
	Size (cm) or Characteristic	Score	Size (cm) or Characteristic	Score	Size (cm) or Characteristic	Score
Rectal descent	< 3[a]	0	3-6[a]	1	> 6[a]	2
Enterocele	< 2	1	2-4	2	> 4	3
Intussusception Thickness Location	Mucosal Intrarectal	1 1	Full thickness Intraanal	2 2	N/A Extraanal	0 3

* a Below pubococcygeal line.

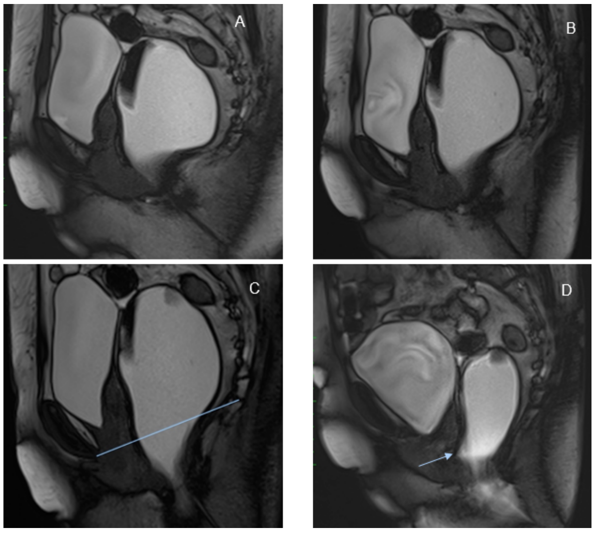


FIGURE 1: Blue line indicates pubococcygeal line.

A, Midsagittal T2-weighted fast spin-echo sequence image obtained at rest shows normal position of bladder, vaginal vault, and anorectal junction in relation to pubococcygeal line. B, Midsagittal T2-weighted fast spin-echo sequence image obtained during squeeze shows normal elevation of pelvic floor and sharpening of anorectal angle. C, Midsagittal T2-weighted fast spin-echo sequence image obtained during strain shows normal minimal descent of pelvic floor. D, Midsagittal T2-weighted fast spin-echo sequence image obtained during defecation shows small anterior rectocele (indicated by blue arrow).

STATISTICAL ANALYSIS:

The data was entered in Microsoft Excel Sheet after collection and compilation of the data. Analysis was done using Statistical software SPSS version 16. All Continuous variables were expressed as Mean and Standard Deviation. All Categorical variables were expressed as Percentages and Proportions. The test of significance used was analysis of variance and the test will be considered Significant if P<0.05, at 95% Confidence Interval.

RESULTS:

The average total scores and SD for the rest, squeeze, strain, and defecation phases were 0.06 (SD,0.24), 0.16 (SD,0.37), 0.82 (SD, 0.66), and 1.86 (SD, 0.78). The average total defecation phase score was significantly greater than the total average score in any of the other three phases ($p < 0.001$)(Figure 2).

None of the patients revealed the presence of a rectocele during rest. New rectoceles were first diagnosed during strain in 14 examinations (38%) and during defecation in 23 examinations (62%).

In our study population of the total 25 rectal descents, rectal descents were newly diagnosed during squeeze in 5 (20%), during straining in 7 (28%) and during defecation in 10 (40%).

No intussusception was seen during rest, and newly diagnosed intussusception during strain 1 (33%) and during defecation in 2 (67%). The number of additional abnormal cases identified during defecation was significantly greater than the number of cases identified in any of the other phases ($p < 0.001$) (Figure 3).

In our study population isolated pelvic descent was seen in 10 patients with a mean age of 41.71±18.29. Small degree descent was seen in 4 (40%) and moderate degree descent was seen in 6 (60%). Isolated anterior rectocele was seen in 15 with a mean age of 48.32±13.98. Small degree rectocele was seen in 8 (53%) , moderate degree rectocele was seen in 6 (42%) and large rectocele was seen in 1 (5%). Anterior rectocele and pelvic descent was seen in 19 with a mean age of 71.33±10.2(Figure 4).

FIGURE 2: SCORES AT DIFFERENT PHASES OF MR DEFECOGRAPHY.

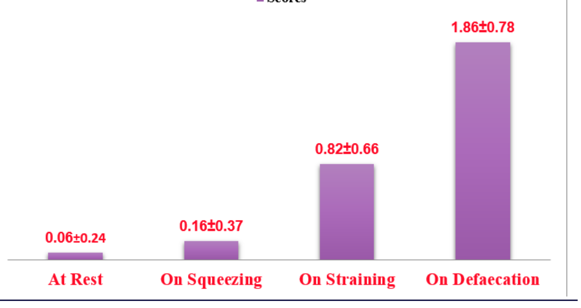
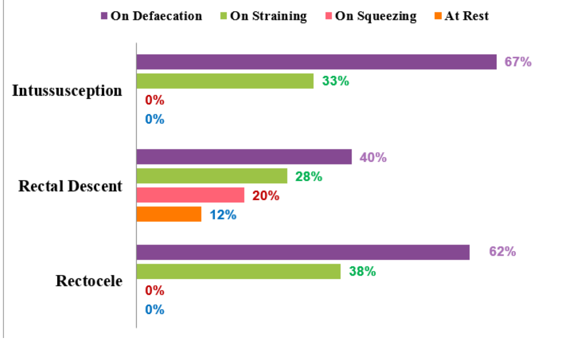


FIGURE 3: NEWLY DIAGNOSED RECTAL PATHOLOGIES IN VARIOUS PHASES OF MR DEFECOGRAPHY.



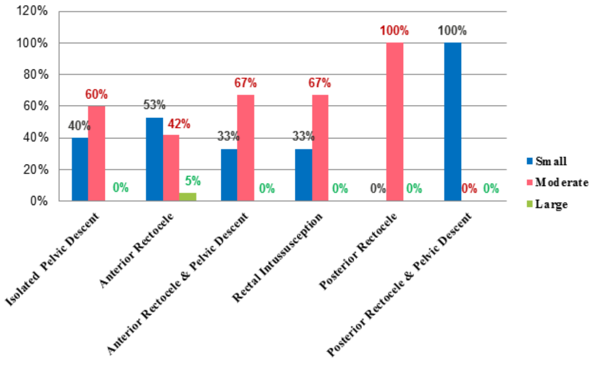


FIGURE 4: VARIOUS DEGREES OF RECTAL PATHOLOGIES.

DISCUSSION:

The evaluation and management of pelvic floor dysfunction is difficult, in part because of the complex anatomy of the pelvic floor. Typically, the pelvic floor is divided into three compartments: anterior (bladder, urethra, and prostate in men), middle (uterus, cervix, and vagina in women), and posterior (anorectum) with support structures such as bones, muscles, and ligaments that are not restricted to a single compartment. Adequate treatment, however, is contingent not only on a detailed understanding of this intricate anatomy but also on accurate pre-treatment diagnosis of the presence and degree of pelvic floor abnormalities. This is especially true when surgical treatment is planned.

Hetzer et al. [17] retrospectively reviewed the MR defecographic findings for 50 patients with fecal incontinence who were being evaluated for surgical treatment. These findings led to changes in surgical approach in the care of 22 of 33 patients (67%) who subsequently underwent surgery.

For many years, fluoroscopic defecography has been the investigation of choice for studying the pelvic floor. At many centers, it is gradually being replaced by MR defecography because of the superior soft-tissue contrast and lack of ionizing radiation of the latter. Unfortunately, because of the limited availability of open-configuration MRI systems and the physical constraints of closed configuration systems, most of these investigations are being performed with the patient in the supine position. Because this position is non physiologic and defecation in a closed system imposes practical difficulties, MR defecography is not routinely performed. Omitting defecography, however, can lead to underestimation of the presence and degree of pelvic floor abnormalities. Our aim was to evaluate the importance of the true defecation phase in MR defecography. The results of our study are compelling in that a substantial number of pathologic conditions would have been missed had defecation phase images not been obtained.

To the best of our knowledge, in no studies has the importance of the defecation phase in the same patient during the same examination been specifically investigated. Although evaluations of MR defecography have incorporated both the strain and the defecation phases, the specific diagnostic yield in each phase has not been evaluated [1, 21]. Some authors have compared MR defecography in the supine position without defecation with either fluoroscopic defecography [15, 16] or MR defecography in the sitting position with defecation [19] as the reference standard. Translation of the results of those studies to our study, however, must be viewed with caution. In all of the previous studies, there was a change in patient positioning from supine to sitting between the comparative examinations. This was an important confounding factor in the interpretation of the earlier findings. In our study, the rest, squeeze, and strain phase images obtained with the same positioning of the patient were compared with the defecation phase images from the same examination.

Healy et al. [16] compared fluoroscopic defecography and supine MR defecography without the defecation phase with respect to recognized parameters of anorectal configuration, such as change in anorectal angle and descent of the anorectal junction. With these parameters, significant correlation was found between the two imaging techniques. There was, however, poor statistical agreement, MRI showing greater mean anorectal angle change and descent than did fluoroscopic defecography. The sample size was small with only 10 patients.

Bertschinger et al. [19] compared the findings of open-configuration sitting MR defecography with those of closed-configuration supine MR defecography of 38 patients. No defecation phase was used in the supine investigation. The sitting MRI examination was used as the reference standard. The results were by no means as dramatic as ours.

Role of Pelvic Floor Imaging in Surgical Management:

The assessment and treatment of women with pelvic floor weakness require a multidisciplinary team of urologists, gynaecologists, proctologists, psychologists, physical therapists, and radiologists. The diagnosis must be based on findings at physical examination, functional testing, and imaging. When the symptoms of pelvic floor weakness are mild, the results of physical examination and imaging with conventional techniques such as urodynamics, voiding cystourethrography, evacuation proctography, or cystocolpodefecography may suffice for diagnosis. However, reliance on a routine clinical examination in patients with moderate to severe symptoms frequently leads to underestimation of the number of compartments involved and inaccurate identification of the site of prolapse (26,27). The recurrence of symptoms in 10%–30% of patients after surgery may be indicative of involvement of one or more compartments not identified at the time of the initial diagnosis of pelvic floor weakness(28). In patients in whom multicompartmental involvement is suspected, MR imaging is a highly useful method allowing the assessment of all compartments for preoperative planning.

Concordance between findings at clinical evaluation and findings at dynamic MR imaging for disease staging has been evaluated in several studies and has been shown to be good overall(29,30). Furthermore, MR defecography has been shown to demonstrate more extensive abnormalities than physical examination alone(31,32,33).

According to several reports, dynamic pelvic floor MR imaging may lead to a change in surgical therapy in as many as 67% of cases (34-39), compared with 40% with fluoroscopic studies(40).For example, an uncomplicated cystocele is treated with retropubic colposuspension, whereas fascial repair is required when the paravaginal fascia is detached. The detection of a previously undiagnosed enterocele might result in a change from a transvaginal to a transabdominal surgical approach(41). Surgical repair of an anterior rectocele, which includes repair of the rectovaginal fascia, may be performed with a transanal or transvaginal approach. It may also include posterior fixation of the rectum or rectal resection if rectal intussusception is present(42).

The incidental detection of pathologic conditions such as urethral diverticula, fibroids, and malignant lesions is also useful for treatment planning, and such conditions are better evaluated with MR imaging than with modalities such as cystoproctography and US.

LIMITATIONS:

A limitation of our study was the lack of correlation with clinical examination findings and clinical outcome. It is possible that findings apparent only in the defecation phase are clinically apparent, and therefore the radiologic diagnosis may have no implication in management. In addition, some of the findings we detected additionally during the defecation phase might have been of no clinical consequence. For example, most intussusceptions identified were intrarectal and thus transient and asymptomatic. Similarly, asymptomatic rectoceles smaller than 2 cm have been described [23, 24]. We therefore evaluated a further subcategory of rectoceles 2 cm or larger. We found it interesting that this additional division increased the number of new rectoceles identified in the defecation phase and reduced the number detected in the strain phase. Another limitation of our study was that despite coaching by the technologist before the examination, in an attempt to retain the rectal gel for the defecation phase, the patients might not have strained maximally during the strain phase. Finally, bladder distention in the subjects varied. In cases in which the bladder was markedly distended, pelvic organ prolapse might have been masked. Patients who could not retain the gel in rectum during the entire study period were excluded from the study.

CONCLUSION:

We evaluated the contribution of the true defecation phase to the diagnostic yield of MR defecography in the supine position with a 1.5 T closed-configuration MRI system. Use of such a system entails fast T2-weighted sequences, which result in better anatomic detail and image quality than T1-weighted spoiled gradient-recalled echo sequences performed with a 0.5-T upright open MRI system. To our knowledge, however, no published data have shown a statistical difference in the rates of detection of pelvic floor abnormalities with different image acquisition techniques. In addition, it would seem that even in supine MR defecography, in which lack of gravity might be predictive of an overall lower detection rate, even greater benefit may be expected from the addition of the defecation phase. Although for practical purposes the defecation phase is often excluded from supine MR defecographic examinations, it can be performed with waterproof padding for patient comfort, minimal table damage, and faster clean-up. Images obtained in the defecation phase yield important additional information on the presence and degree of pelvic floor abnormalities compared with rest, squeeze, and strain phases images alone and should be an essential part of all MR defecographic studies.

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