Utility of Static and Dynamic Magnetic Resonance Imaging in Evaluation of Female Pelvic Floor Disorders: Review

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Abstract
Background: Pelvic floor dysfunction (PFD) or weakness encompasses a spectrum of functional disorders that result from impairment of the ligaments, fasciae, and muscles supporting the pelvic organs. The underlying cause is multifactorial, with conditions such as multiparity, pudendal nerve injury, advanced age, obesity, menopause, connective tissue disorders, smoking, chronic obstructive pulmonary disease, and a chronic increase in intra-abdominal pressure contributing to the development of the pelvic floor dysfunction. The aim of this study is to evaluate the diagnostic value of the static and dynamic magnetic resonance imaging in assessment of structural and functional abnormalities in female patients with pelvic floor dysfunction.

Patients and methods: This study will be conducted in the department of Radiology, Faculty of Medicine, Minia University after being ethically approved by the institutional committee, This study will include 30 female patients with clinically suspected pelvic floor dysfunction, after informed consents and approval study.

Results: MR imaging of the pelvic floor was first introduced MRI has since gained widespread popularity, as it can non-invasively visualize organs in the pelvis and the supportive pelvic structures. It enables the concomitant assessment of all three compartments. Indeed, MRI should be used routinely in preoperative planning for pelvic floor surgery.

Keywords: Dynamic Magnetic Resonance Imaging, Static Magnetic Resonance Imaging, Resonance Imaging.

How to cite this article: Abdelghany OASA, Ebeid AFA, Abdelnaiem MA, Amin MA. Utility of Static and Dynamic Magnetic Resonance Imaging in Evaluation of Female Pelvic Floor Disorders: Review. Int J Drug Deliv Technol. 2026;16(70s): 601-605. DOI: 10.25258/ijddt.16.70s.60

Introduction:

Pelvic floor dysfunction (PFD) or weakness encompasses a spectrum of functional disorders that result from impairment of the ligaments, fasciae, and muscles supporting the pelvic organs. The underlying cause is multifactorial, with conditions such as multiparity, pudendal nerve injury, advanced age, obesity, menopause, connective tissue disorders, smoking, chronic obstructive pulmonary disease, and a chronic increase in intra-abdominal pressure contributing to the development of the pelvic floor dysfunction. There are two components to pelvic floor dysfunction: pelvic floor relaxation and pelvic organ prolapse. Although these two components are related and often coexistent, they may not be present simultaneously and should be differentiated (1).

The patients with PFD may present with urinary symptoms namely stress and urge incontinence, voiding difficulty, sexual symptoms such as dyspareunia, pelvic organ prolapse or gastrointestinal symptoms like rectal prolapse, obstructed defecation and fecal incontinence (2).

Pelvic floor disorders are extremely common and affect approximately 50% of women over the age of 50 (3).

Pelvic floor dysfunction can have a significant impact on the quality of life. Many of these patients require surgery and almost 30% of them require repeat surgery. This indicates that the current diagnostic modalities and surgical management are far from satisfactory. Hence, there is a need for a promising tool for

pretreatment evaluation for patients with pelvic floor dysfunction (4).

The female pelvis is anatomically divided into three functional compartments: the anterior (urinary bladder and urethra), the middle (vagina, cervix and uterus) and the posterior (anorectum). All three act as one unit (5).

Traditionally, urinary incontinence has been evaluated by urologists, reproductive tract problems by gynecologists, and anorectal problems by colorectal surgeons and gastroenterologists. The basic diagnostic approach for surgeons and clinicians is clinical examination, performed with the patient performing the Valsalva maneuver in the lithotomy position (6).

The clinical examination, however, is not reliable for assessing evacuation abnormalities and frequently underestimates the number of affected compartments compared to dynamic cysto-colpo-proctography (DCP) and dynamic MRI of the pelvic floor. During defecation, maximal levator ani relaxation provides the highest stress to the pelvic floor, which is needed to diagnose defecation disorders and pelvic organ prolapse (7).

Studies show that even though patients present with symptoms suggestive of isolated pelvic floor compartment dysfunction, most of these patients have concomitant defects in other compartments as well (8).

These patients are evaluated by clinical examination, physiological tests, and imaging methods. Clinical examination is mainly based on physical, neurological and digital rectal examinations. Physiological tests include urodynamic tests, anorectal manometry, and electromyography. Although highly valuable in evaluating the pathophysiology, physiological tests are not sufficient enough to determine the surgical strategy (9).

Dynamic cysto-colpo-proctography remains a useful technique for functional assessment of the pelvic organs, being easily available, and respecting a physiological sitting position. However, following the first report by Yang et al. on dynamic MR protocol for evaluation of pelvic floor prolapse, subsequent studies have proven the reliability of this technique in accessing pelvic floor disorders. Although not as widely available as fluoroscopy, MR defecography presents several advantages regarding its alternative: it is less invasive, less time consuming, radiation-free and displays a simultaneous multiplanar dynamic evaluation of the three pelvic compartments, with high spatial and temporal resolution (10).

Recently, the American College of Radiology (ACR) published the new Appropriateness Criteria for Pelvic Floor Dysfunction, stating that both the fluoroscopic cysto-colpo-proctography and MR defecography with rectal opacification are appropriate and with equal rating scales for evaluation of pelvic floor disorders of the different compartments, with preference for MR defecography in assessing defecatory dysfunctions (11).

Dynamic MRI, which provides both anatomic detail and functional assessment, is a particularly useful tool for evaluation of the pelvic floor. In clinical situations where patient symptoms and clinical exam findings do not align, prior surgical repairs have failed, or there is multicompartment involvement, dynamic MRI plays an important diagnostic role as it is the only imaging technique that provides a comprehensive functional assessment while also showing the supporting structures of the pelvic floor (12).

MR imaging of the pelvic floor was first introduced in 1991 by Yang et al and Kruyt et al. MRI has since gained widespread popularity, as it can non-invasively visualize organs in the pelvis and the supportive pelvic structures. It enables the concomitant assessment of all three compartments. Indeed, MRI should be used routinely in preoperative planning for pelvic floor surgery (13).

Patients and Methods:

This study will be conducted in the department of Radiology, Faculty of Medicine, Minia University after being ethically approved by the institutional committee.

This study will include 30 female patients with clinically suspected pelvic floor dysfunction, after informed consents and approval study.

Inclusion criteria:

- Patients with pelvic organ prolapse.

- Patients with urinary incontinence or chronic urinary symptoms.
- Patients with fecal incontinence.
- Patients with obstructed defecation.
- Patients with unexplained chronic pelvic pain.
- Patients with dyspareunia.
- Patients with sphincteric injury after episiotomy.
- Patients with pelvic floor injury after normal delivery.
- Patients with post hysterectomy pelvic complications.
- Assessment of pelvic floor after surgical repair.
- Patients with post traumatic pelvic floor injury.
- Patients with pelvic tumors involving the pelvic floor.

Exclusion criteria:

- Patients with absolute contraindication to MRI such as patient with cardiac implantable electronic device (CIED).

All the patients will be subjected to:

1- Full history taking.

2- Clinical examination.

3-Static and dynamic MRI of the pelvis.

Patient preparation:

The patients are instructed to try to empty their bladders three hours before the study to avoid discomfort during straining. A fully distended bladder may inhibit both the degree of straining and the descent of pelvic organs.

The distal rectum is filled with 120–150 mL of warm US gel that is easily introduced with a flexible tube or directly with the syringe just before the patient is moved onto the gantry. We do not fill the vagina with US gel at our hospital, but the introduction of 50 mL of gel into the vagina can improve the visibility of anatomic landmarks and the detection of prolapse in the middle compartment.

The patient is wrapped in an incontinence pad, and the table is covered with an absorbent towel to minimize discomfort from the eventual loss of urine and/or feces. The patient's knees should be slightly bent over a pillow with the legs slightly parted so as not to interfere with organ prolapse, especially during the straining and defecatory phases of the study.

MRI technique:

MRI examination was performed for all patients using a 1.5 T Ingenia (Philips Medical Systems, Netherlands), in supine position.

The MR imaging protocol begins with a T1- weighted localizer sequence with a large field of view to identify the midline sagittal section, including the pubic symphysis, bladder neck, vagina, rectum, and coccyx. This sequence is followed by T2-weighted turbo spin-echo sequences applied in the sagittal, axial, and coronal planes for thin-section anatomic evaluation.

The dynamic study, which is performed after a baseline resting study is completed, involves pelvic image acquisition while the patient alternately strains, squeezes the anal sphincter, and defecates. For the dynamic study, we apply a steady-state sequence in the midsagittal plane.

The straining phase of the study provides information about the competence of internal and external sphincters, and the squeezing phase (Kegel maneuver) provides information about pelvic floor muscle strength, particularly puborectalis muscle function. In healthy patients the anorectal junction rises 1–2 cm from its resting position and the anorectal angle closes during squeezing.

For the defecation phase, a period of 40–60 seconds usually suffices. If defecation is difficult, the sequence is repeated, and the defecation phase may be prolonged to 80–120 seconds. Once the study is completed, we ask the patient if she has the feeling of having completely evacuated the rectal gel introduced.

Coronal and axial dynamic imaging, although not routinely performed, may help improve the sensitivity of the MR imaging study,

because static MR images often do not depict all the relevant findings. When the presence of a lateral rectocele or lateral prolapse is clinically indicated, coronal and axial dynamic sequences must be added to the protocol. These sequences can be applied after the defecation sequences during maximal strain maneuvers, at the level of the pelvic hiatus in the axial plane and at the level of the anal canal in the coronal plane. The axial dynamic images can demonstrate puborectalis muscle defects and ischiorectal fossa hernias, and the coronal images may show iliococcygeus muscle defects and lateral prolapses.

Ethics approval: The study was approved by the Institutional Review Board of the Faculty of Medicine, Minia University.

Funding: No funding was received for conducting this study.

Conflicts of interest: There are no conflicts of interest.

Competing interests: The authors have no conflicts of interest to disclose.

The authors have no relevant financial or non-financial interests to disclose.

References:

1. Kobi M, Flusberg M, Paroder V, Chernyak V. Practical guide to dynamic pelvic floor MRI. Journal of Magnetic Resonance Imaging. 2018;47(5):1155-70.

2. Akkaya HE, Ünal S, Haliloğlu NÜ, Erden A. Evaluation of pelvic floor dysfunction with magnetic resonance defecography. Yüksek İhtisas Üniversitesi Sağlık Bilimleri Dergisi. 2023;4(2):24-30.

3. Fitzgerald J, Richter LA. The role of MRI in the diagnosis of pelvic floor disorders. Current urology reports. 2020;21:1-6.

4. Kepenekci I, Keskinkilic B, Akinsu F ,Cakir P, Elhan AH, Erkek AB, et al. Prevalence of pelvic floor disorders in the female population and the impact of age, mode of delivery, and parity. Diseases of the Colon & Rectum. 2011;54(1):85-94.

5. Maglinte DD, Hale DS, Sandrasegaran K. Comparison between dynamic cystocolpoproctography and dynamic pelvic floor MRI: pros and cons: which is the “functional” examination for anorectal and pelvic floor dysfunction? Abdominal imaging. 2013;38:952-73.

6. Tomšic MV, Podkrajšek M. Dynamic MR imaging of pelvic floor dysfunction. APPLIED RADIOLOGY. 2017.

7. van der Weiden RM, Rociu E, Mannaerts GH, van Hooff MH, Vierhout ME, Withagen MI. Dynamic magnetic resonance imaging before and 6 months after laparoscopic sacrocolpopexy. International urogynecology journal. 2014;25:507-15.

8. Onal S, Lai-Yuen S, Bao P, Weitzenfeld A, Hart S. Image based measurements for evaluation of pelvic organ prolapse. 2013.

9. Remes-Troche JM, Rao SS. Neurophysiological testing in anorectal disorders. Expert review of gastroenterology & hepatology. 2008;2(3):323-35.

10. Salvador JC, Coutinho MP, Venâncio JM, Viamonte B. Dynamic magnetic resonance imaging of the female pelvic floor—a pictorial review. Insights into imaging. 2019;10:1-16.

11. Pannu HK, Javitt MC, Glanc P, Bhosale PR ,Harisinghani MG, Khati NJ, et al. ACR appropriateness criteria pelvic floor dysfunction. Journal of the American College of Radiology. 2015;12(2):134-42.

12. El Sayed RF, Alt CD, Maccioni F, Meissnitzer M, Masselli G, Manganaro L, et al. Magnetic resonance imaging of pelvic floor dysfunction-joint recommendations of the ESUR and ESGAR Pelvic Floor Working

Group. European radiology. 2017;27:2067-85.

13. Schreyer AG, Paetzel C, Fürst A, Dendl LM, Hutzel E, Müller-Wille R, et al. Dynamic magnetic resonance defecography in 10 asymptomatic volunteers. World Journal of Gastroenterology: WJG. 2012;18(46):6836.