EDITORIAL
Perspectives in Dynamic Pelvic Floor Magnetic Resonance Imaging Review of Progress and New Horizons

ABSTRACT
The female pelvis is divided into three functional compartments: the anterior compartment, which contains the bladder and urethra; the middle compartment, which includes the vagina, cervix, uterus, and ovaries; and the posterior compartment, which consists of the rectum and anal canal. Pelvic floor disorders are often complex conditions involving one or more of these compartments.
Concomitant pelvic organ prolapse (POP) occurs in approximately 38% of cases and primarily affects women, significantly impacting their quality of life. Risk factors for POP include age, vaginal delivery, chronic constipation, hysterectomy, and the depth of the cul-de-sac of Douglas.
A multidisciplinary evaluation of patients with POP is recommended. The physical examination is the most crucial method for assessing POP, while dynamic pelvic floor magnetic resonance imaging (DPMRI) is the preferred adjunctive method. This imaging is most useful for patients with urogynecological or colorectal disorders, those with a history of pelvic reconstructive surgery, or patients exhibiting clinical symptoms not explained by physical examination alone. On the other hand, DPMRI is notably superior to physical examination in detecting enterocele and peritoneocele.
Clinicians must become familiar with this imaging modality to make appropriate therapeutic decisions. Underestimating POP can lead to incorrect treatment choices and increased recurrence rates.

BACKGROUND

The DPMRI has emerged as the preferred complementary study over other diagnostic methods, including fluoroscopic defecography and dynamic 360 ultrasonography.
This dynamic study was introduced by Andrew Yang in 1991. The sequence involves a T2-weighted SSFSE (Single Shot Fast Spin-Echo): fast sagittal slice capture on the pelvic midline without fat suppression. Axial images are obtained at rest and during pushing, allowing for assessment of organ position and movement. This is followed by midsagittal imaging that utilizes a cine effect: a sequence of images is captured in the mid-sagittal plane, illustrating the pelvic floor in motion. This includes the patient at rest, contracting the pelvic floor, resting, pushing, and resting again. One or several static axial images at rest, voluntary pelvic floor contraction, and pushing are selected, and lines are drawn for the measurements.
The advantages of DPMRI include avoiding radiation and allowing for a multiplanar evaluation of all pelvic compartments and soft tissues simultaneously. However, it has two disadvantages: higher costs, which may limit its availability, and the non-physiological supine position of the patient during defecation. Open resonators may improve patient comfort and compliance when sitting, although the diagnostic accuracy of open and closed systems in detecting pelvic floor and rectal pathologies remains inconclusive.
Advancements in imaging technology have made these methods valuable tools for therapeutic planning and decision-making. Specifically, DPMRI offers high-resolution images with excellent soft-tissue contrast, facilitating noninvasive and objective assessment of various potential pelvic floor disorders.
It is widely accepted that DPMRI should include both static and dynamic images. Static images visualize defects in the anatomy of the pelvic floor and supporting structures, allowing for accurate centimeter measurements. In contrast, dynamic images can demonstrate pelvic organ mobility, assess the pelvic floor, identify pelvic organ prolapse (POP), and reveal associated septal defects, such as anterior rectocele.
Additionally, DPMRI may uncover unexpected abnormalities that differ from those diagnosed based on primary symptoms, thus influencing the choice of therapeutic alternatives.
Patients should be examined in a 1.5 T or larger MRI unit. Should lie supine with their knees elevated, for instance, on a pillow. The coil must be centered over the lower pelvis to ensure complete visualization. It is advised that patients have a moderately full bladder; therefore, they should urinate two hours before the exam. A diaper should be provided to reduce patient discomfort and improve performance during the dynamic and voiding phases. No oral or intravenous contrast media are required.
A rectal cleansing enema is useful but may not be necessary if a spontaneous bowel movement occurred before the examination. Endorectal ultrasound gel facilitates the clear identification of the posterior compartment. The amount ranges from 120 to 250 cc and is administered before the commencement of the study. Our group does not routinely use intravaginal gel. There is no consensus regarding its application, and its use may be limited by the social and/or religious context.
In 2017, the *European Society of Genitourinary Radiology* and the *European Society of Gastrointestinal and Abdominal Radiology* published a set of joint recommendations on DPMRI. The document is intended to standardize the technique and reporting by guiding indications, preparation, imaging protocols, image analysis, measurement, classification, and reporting.
In 2021, the *Pelvic Floor Disorders* Consortium (*PFDC*), a multidisciplinary organization composed of colorectal surgeons, urogynecologists, gastroenterologists, radiologists, and physical therapists, developed a consensus statement on DPMRI. The consensus statement aims to guide all practitioners caring for patients with pelvic floor pathology. These recommendations further delineate techniques and templates that can be adapted to the patient's indications and the physician's preferences and experiences.

STATIC EVALUATION OF IMAGES

The following lines are drawn in the static medio-sagittal sections (Fig. 1):

- Pubococcygeal line (PCL): From the inferior border of the pubis to the last coccygeal joint. It serves as the standard for evaluating the POP. The anatomic location of the anorectal angle (ARA) is typically not more than 2.5 centimeters below the PCL.
- H line (hiatus): From the lower border of the pubis to the posterior rectal aspect at the ARA. The normal value is < 6 cm.
- M line, also known as the pelvic descent (PD) line: Line perpendicular to the PCL, from the posterior point of the H line. It represents the vertical descent of the levator hiatus and allows for an evaluation of the pelvic floor descent during pushing. In healthy individuals, this measurement should not exceed 2 cm.

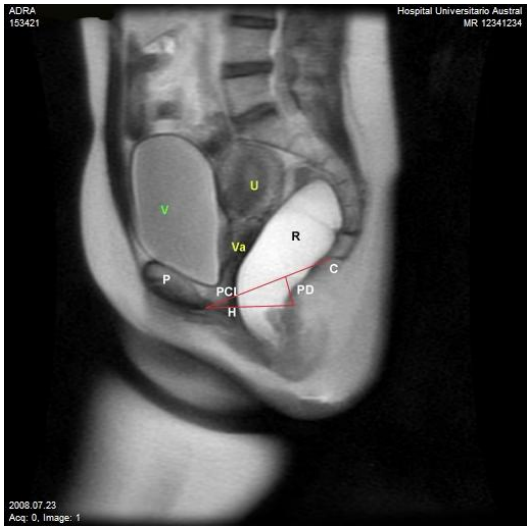

Figure 1. *Dynamic MRI of the pelvic floor. P: Pubis. V: Bladder. U: Uterus. Va: Vagina. R: Rectum. C: Coccyx. PCL: Pubococcygeal line. PD: Pelvic floor descent line, also referred to as M line. H: Puborectal hiatus line.*

The ARA is measured by drawing a line along the posterior border of the rectum and another line along the long axis of the anal canal in the sagittal plane (Fig. 2).
During rest, the typical configuration of the pelvic floor reveals the upper segment of the urethra, bladder, upper portion of the vagina, uterus (if present), rectum, sigmoid colon, and small bowel. The mesenteric fat should be observed above the H line.
These measurements will be taken from each sagittal static image during rest, voluntary contraction of the sphincter muscles, and the evacuation or pushing phase.
Static images in the axial plane during rest and moderate straining allow visualization of the hiatus opening and evaluation of puborectalis muscle integrity.

EMERGING TRENDS AND FUTURE POSSIBILITIES

Medical practice is confronted with the challenge of processing large volumes of data to facilitate the optimization of patient diagnosis and treatment outcomes.
The term "artificial intelligence" (AI) was coined in 1956 by John McCarthy (1927–2011), an American computer and cognitive scientist. AI systems potentially improve the interpretation of medical images, including ultrasound, MRI, and CT scans, representing one of the challenges in POP management. Specifically, deep learning systems are utilized in dynamic MRI for diagnosing and classifying POP, enabling semi-automated pelvic floor measurements and providing consistent results. Complex algorithms are integral to this process, as they facilitate the navigation of available options and the prediction of treatment responses for various pelvic floor-related disorders. Furthermore, the objective is to enhance the precision of predictive models to optimize therapeutic benefits.

CONCLUSIONS

Pelvic examination and staging using the Pelvic Organ Prolapse Quantification (POP-Q) system is the primary means of diagnosing and quantifying POP.
DPMRI may detect unexpected abnormalities that do not always coincide with the main symptoms, and may influence the choice of different treatments.
Due to the additional cost, DPMRI should be reserved for cases where a physical examination yields insufficient information.
Undoubtedly, AI will play a substantial role in the standardized management of processes and reporting.

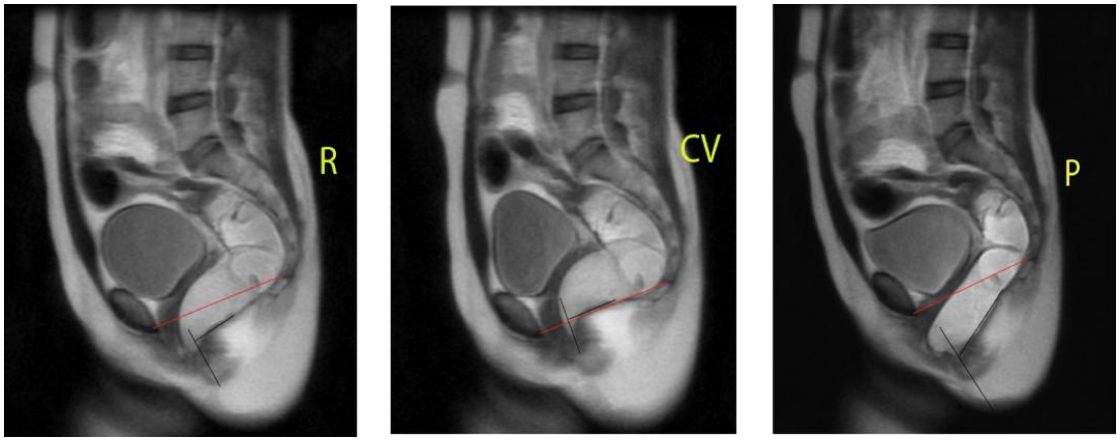

Figure 2. *Modification of the anorectal angle during rest (R), voluntary contraction (CV), and pushing (P).*

XPERIENCE OF THE COLOPROCTOLOGY SECTOR OF THE SURGERY SERVICE AT THE HOSPITAL UNIVERSITARIO AUSTRAL

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From April 2005 to April 2025, we performed 588 DPMRIs on patients with a mean age of 54.2 years (range 18–94 years); 94.6% were female. Of these studies, 86.7% (n = 507) were requested for obstructed defecation syndrome (ODS).

A statistically significant difference was observed between the number of pelvic floor disorders detected during physical examination and those detected by DPMRI (mean: 1.5 vs. 2.8, respectively; $p < 0.001$).

DPMRI confirmed the physical examination findings in 118 patients, revealed pathologies not previously detected in 358 patients, and modified the initial clinical diagnosis in 101 patients.

Anterior rectocele (AR) was the most frequent finding in 421 patients. However, an isolated AR was found in only 40 cases (9.5%). Sixty-three percent of patients with AR also had a concomitant cystocele, either as the sole additional finding or accompanied by other pelvic floor in conjunction with other pelvic floor abnormalities. The second most prevalent finding was the association of AR with pelvic floor descent, which was observed in 39% of cases with AR.

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RECOMMENDED READINGS

1. El Sayed RF, Alt CD, Maccioni F, Meissnitzer M, Masselli G, Manganaro L. Magnetic resonance imaging of pelvic floor dysfunction - joint recommendations of the ESUR and ESGAR Pelvic Floor Working Group. *Eur Radiol.* 2017;27(5):2067-85.
2. Feng F, Ashton-Miller JA, DeLancey JOL, Luo J. Feasibility of a Deep Learning-Based Method for Automated Localization of Pelvic Floor Landmarks Using Stress MR Images. *Int Urogynecol J.* 2021;32(11):3069-75.
3. García-Mejido JA, Solis-Martín D, Martín-Morán M, Fernández-Conde C, Fernández-Palacín F, Sainz-Bueno JA. Applicability of Deep Learning to Dynamically Identify the Different Organs of the Pelvic Floor in the Midsagittal Plane. *Int Urogynecol J.* 2024;35(12):2285-93.
4. Gurland BH, Khatri G, Ram R, Hull TL, Kocjancic E, Quiroz LH. Consensus Definitions Aad 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. *Int Urogynecol J.* 2021;32(10):2561-74.
5. Huang X, Wang D, Li S, Yang L, Zhao J, Guo D. Advancements in Artificial Intelligence for Pelvic Floor Ultrasound Analysis. *Am J Transl Res.* 2024;16(4):1037-43.
6. Maccioni F, Busato L, Valenti A, Cardaccio S, Longhi A, Catalano C. Magnetic Resonance Imaging of the Gastrointestinal Tract: Current Role, Recent Advancements and Future Prospects. *Diagnostics (Basel).* 2023;13(14):2410.
7. Omouri A, Rapacchi S, Duclos J, Niddam R, Bellemare M-E, Pirró N. 3D Observation of Pelvic Organs with Dynamic MRI Segmentation: A Bridge Toward Patient-Specific Models. *Int Urogynecol J.* 2024;35:1389-97.
8. Rosato GO, Chwat C, Lemme G , Alexandre F, Valli D, Terres M, et al. Added Value of Dynamic Magnetic Resonance Images in Pelvic floor Dysfunction. *J Coloproctol.* 2020;40(2):163-67.
9. Shimron E, Perlman O. AI in MRI: Computational Frameworks for a Faster, Optimized, and Automated Imaging Workflow. *Bioengineering (Basel).* 2023;10(4):492.
10. Vivoda Tomšič M, Podkrajšek M. Dynamic MR imaging of Pelvic Floor Dysfunction. *App Radiology.* 2017, August, pp. 8 21-7.