Article published online: 2023-09-19

Magnetic Resonance Defecography in Obstructive Defecation Syndrome: A Pictorial Review Imaging Findings and Impact on Surgical Management

Seema Sud[1] Rishabh Khurana[2] Brij B. Agarwal[3] Tarvinder B.S. Buxi[1] Samarjit S. Ghuman[1]

[1] Department of CT & MRI, Sir Ganga Ram Hospital
[2] Post DM Senior Resident, VMMC and Safdarjung Hospital, New Delhi
[3] Department of Laparoscopic and General Surgery, Sir Gangaram Hospital & GRIPMER, New Delhi

Address for correspondence Seema Sud, MBBS, DNB, Department of CT & MRI, Sir Ganga Ram Hospital, Rajender Nagar, New Delhi 110060 (e-mail: sudseema@gmail.com).

Indographics 2022;1:16–26.

Abstract

Pelvic floor, a funnel-shaped muscular structure plays a significant role in bowel and bladder activities. Defecatory disorders result from the structural changes and functional disorders. Pelvic floor dysfunction affects 15% of multiparous women. It is being expected that after 30 years, there would be 45% rise in demand of pelvic floor imaging. After ruling out primary and secondary causes of constipation, diagnosis of obstructed defecation syndrome (ODS) is made. ODS is emerging as one of the important causes of constipation. As the symptoms are nonspecific and examination findings are frequently inaccurate, the clinical evaluation becomes a difficult task. Hence, various imaging modalities are becoming popular as an adjunct tool for the assessment of these disorders. Clinical management of ODS is based on the Constipation and Bowel Activity Score (CABA) and delineation of the pelvic floor anatomy. After defining the pelvic floor anatomy–based structural abnormality, day care ambulatory surgical procedure, that is, stapled transanal resection rectopexy (STARR), is offered to the patients of ODS. It provides significant relief to patients suffering from constipation and reduction in postoperative CABA score. This review discusses the role of magnetic resonance defecography imaging in ODS its impact on subsequent management.

Keywords

- ► magnetic resonance defecography
- ► obstructed defecation syndrome
- ► constipation and bowel activity score

Introduction

The pelvic floor supports anterior, middle, and posterior compartments. Any disorder in any compartment leads to pelvic floor dysfunction (PFD). Posterior compartment is clinically considered an index compartment of pelvic floor. Constipation is an index symptom of posterior pelvic floor compartment and thus has become an important clinical parameter for evaluation of PFD.[1] After ruling out primary and secondary causes of constipation, diagnosis of obstructed defecation syndrome (ODS) is made. ODS is emerging as one of the important causes of constipation.[2,3]

According to the National Institute for health and Clinical Excellence (NICE) guidelines 2010, ODS is characterized by the urge to defecate but an impaired ability to expel the focal bolus.[4]

ODS can be graded by various scoring systems, that is, the Longo Score, Wexner, and Constipation and Bowel Activity Score (CABA; ►**Table 1**).[3] Clinical management of ODS is based on CABA score and delineation of the pelvic floor anatomy (PFA). The rectal intussusception is detected on pelvic imaging after its suspicion on clinical examination in patients of CABA score being more than 10. After definition of

DOI https://doi.org/10.1055/s-0042-1742576.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

Table 1 The Constipation and Bowel Activity Score (CABA) questionnaires[3]

CABA score questionnaires					
Frequency					
Symptoms	**Never**	**Rarely**	**Sometimes**	**Usually**	**Always**
Excessive straining	0	1	2	3	4
Incomplete evacuation	0	1	2	3	4
Use of laxatives	0	1	2	3	4
Digital pressure	0	1	2	3	4
Constipation	0	1	2	3	4
Score________					
never, 0; rarely <1/month; sometimes <1/week, ≥1/month, usually <1/day, ≥1/week; always ≥1/day					
Score: >5, suspicious; >10, indicative; >15, diagnostic of ODS					

PFA-based structural abnormality, surgical correction is offered to the patients of ODS. The surgical procedure, that is, stapled transanal resection rectopexy (STARR) is done after confirmation of rectal intussusceptions during examination under anesthesia.[5] It is a day-care ambulatory surgery that provides significant relief to patients suffering from constipation and reduction in postoperative CABA score.[6]

Magnetic Resonance Defecography Procedure and Imaging Technique

Bowel preparation is recommended 2 to 8 hours before the examination. Before imaging, patients are instructed regarding the maneuvers they will be asked to perform as a part of the procedure (squeezing, straining, and defecation), using easy to understand language/patient's vernacular language.

Finally, 150 to 200 mL of warm ultrasound jelly is instilled in the patient's rectum using rectal tube in left lateral decubitus position and patients are made to wear an adult diaper and lie down in supine position with hips and knees bent at 45 degrees.

The entire scan acquisition phase is divided into two phases which include static images of pelvic floor (high-resolution T2-weighted [W] coronal and transverse images) and dynamic phase imaging with the True Fast Imaging with Steady State Precession (FISP) in sagittal plane over 55 seconds at a frequency of one shot per 1.1 seconds (TR: 5.8 ms and TE: 2.8 ms), slice thickness: 7 mm (field of view: 270 mm

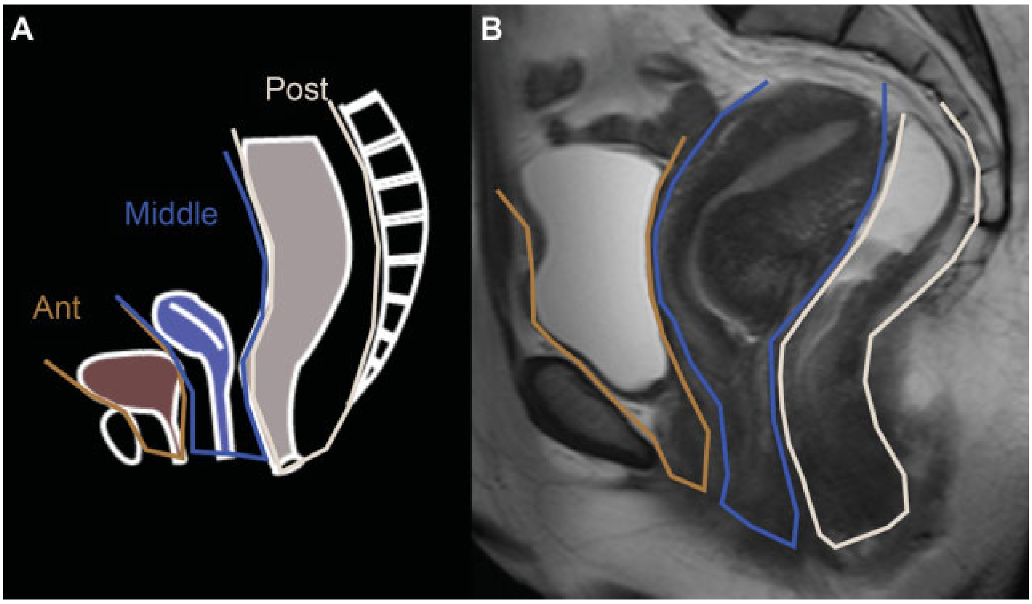

Fig. 1 Normal pelvic floor anatomy: schematic representation of anterior, middle and posterior compartments of the pelvis (**A**) and T2-weighted sagittal MR image of female pelvis showing urinary bladder, uterus and rectum in the anterior, middle, and posterior compartment (**B**), respectively. MR, magnetic resonance.

× 270 mm and matrix 256 × 256) at rest, squeezing and defecating, followed by postvoiding.

Normal Anatomy of the Pelvic Floor and Imaging Findings

The pelvic floor is divided into three compartments: anterior compartment (urinary bladder and urethra), middle compartment (uterus, cervix, and vagina), and posterior compartment (includes rectum and anal canal) as shown in ►**Fig. 1**.

The endopelvic fascia is a layer of connective tissue which attaches the pelvic organs to the pelvic side walls. A tear in its anterior portion results in bladder descent (cystocele) while a tear in its posterior aspect results into anterior rectocele/enterocele. Perineal body is another passive structure into which many structures insert. These include: external anal sphincter, endopelvic fascia, muscles of urogenital diaphragm (superficial and deep transverse perinei), levator ani, and puborectalis muscles.

Levator ani muscle consists of three different muscle groups: iliococcygeus, pubococcygeus, and ischiococcygeus. The pubococcygeus and ileococcygeus are horizontal sheet like structures which fan out to insert at the pelvic side wall. These are assessed well on coronal images. The puborectalis arises from the pubic bone and forms a sling around the rectum. It is easily imaged in the axial plane (►**Figs. 2** and **3**).

The anorectal junction is the point of taper of the distal part of the rectum as it meets the anal canal (►**Fig. 4**). It is the point of reference for posterior compartment descent. The anorectal angle is the angle between the posterior border of the distal part of the rectum and the central axis of the anal canal. At rest, it usually measures between 108 to 127 degrees. It changes depending on contraction or relaxation of puborectalis muscle. Normally, the angle becomes more acute during squeezing and becomes more obtuse on defecation (►**Fig. 5**).

Subsequently, few lines are drawn on the sagittal magnetic resonance (MR) resting and defecation phase images.

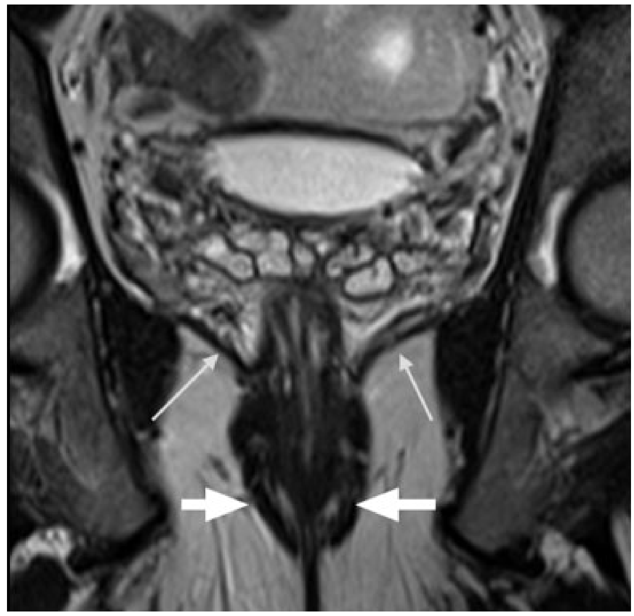

Fig. 3 Normal pelvic floor anatomy: T2-weighted coronal image of the pelvis showing the levator ani muscle (long arrows), as well as puborectalis muscle (solid arrows).

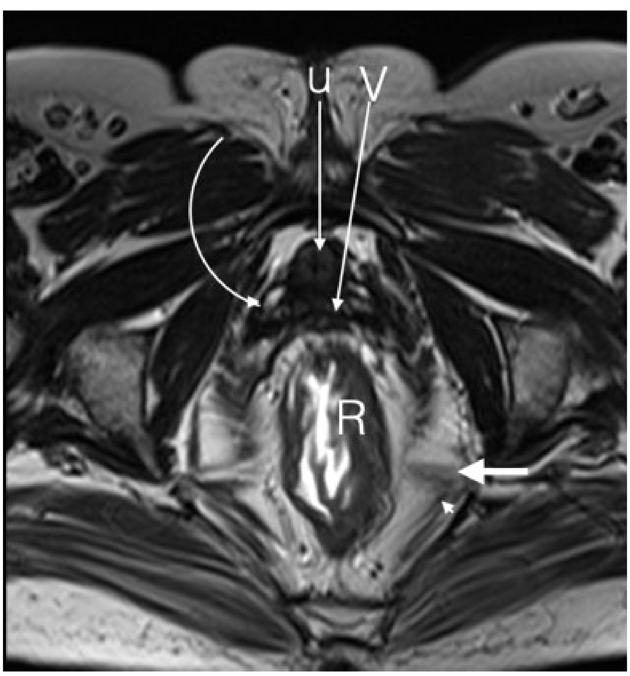

Fig. 2 Normal pelvic floor anatomy. T2-W axial image of the pelvic floor, showing the urethra (U),vagina (V), rectum (R) iliococcygeus (long arrow), ischiococcygeus (short solid arrow) and the pubococcygeus muscle (curved arrow).

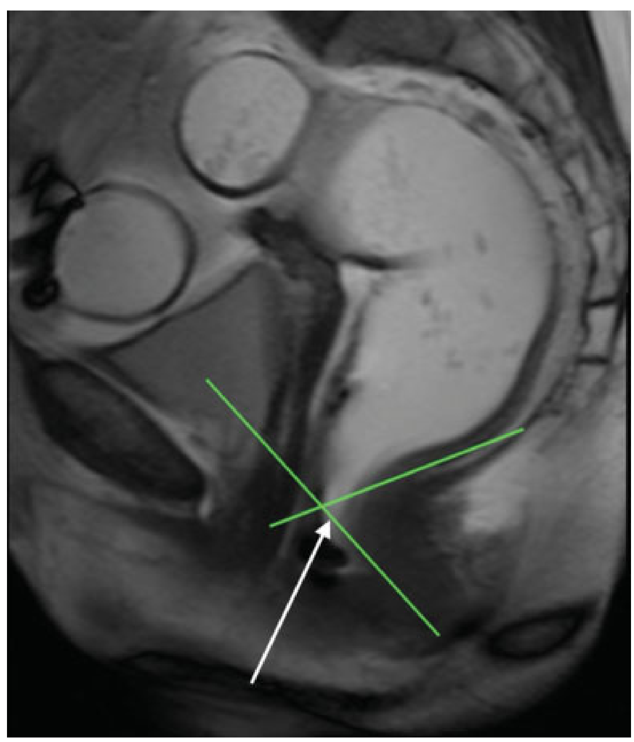

Fig. 4 Anorectal junction: seen as point of taper of the distal part of the rectum as it meets the anal canal (white arrow). It represents the point of reference for posterior compartment descent. Anorectal angle: angle between the posterior border of the distal part of the rectum and the central axis of the anal canal (angle between the green lines).

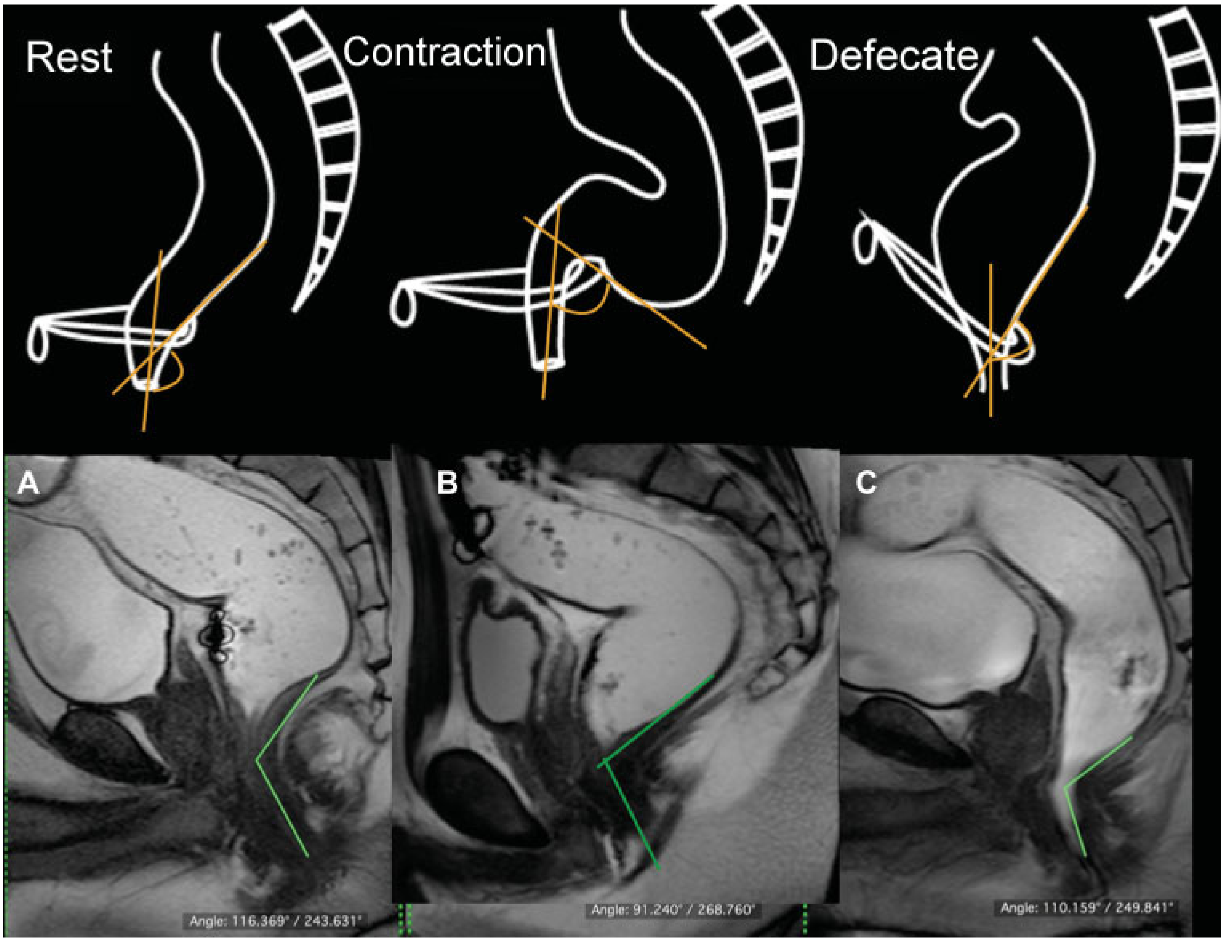

Fig. 5 Normal MR defecogram—anorectal angle: schematic and T2-weighted sagittal dynamic MR images (true FISP) showing the change of anorectal angle during various maneuvers: at rest the angle is acute due to indentation of the puborectalis sling on the posterior rectal wall (**A**); during squeezing the angle becomes more acute due to contraction of the puborectalis muscle (**B**); during defecation the angle becomes more obtuse due to relaxation of the puborectalis muscle and mild pelvic floor descent (**C**). FISP, fast imaging with steady state precession; MR, magnetic resonance imaging.

The pubococcygeal (PC) line is drawn from the inferior border of the pubic symphysis to the last coccygeal articulation (►**Fig. 6**). It represents the level of pelvic floor and is the landmark for measuring pelvic organ prolapse. PC line is reproducible and is independent of pelvic tilt. The perpendicular distances of the bladder neck, uterocervical junction, and the anorectal junction from the PC line are measured during the rest and defecation phases.

Following these measurements, the puborectal hiatus line and M lines are measured. The H line is drawn from the inferior margin of symphysis pubis up to the posterior wall of rectum at the level of anorectal junction. It represents the anteroposterior width of the levator hiatus.

M line is a perpendicular line drawn from PC line to the most posterior aspect of the H line (►**Fig. 6**). It represents the vertical descent of the levator hiatus. Normally, the H and M lines should not exceed 5 and 2 cm, respectively. Pelvic floor weakening will result in widening of the levator hiatus and descent of the levator plate resulting into elongation of the H and M lines on pelvic floor relaxation respectively (►**Fig. 7**; ►**Table 2**).

Pathological Conditions

Pelvic floor abnormalities have been classified topographically which involve anterior, middle or posterior compartments or their combinations. Prolapse is graded according to the rule of three: prolapse of a pelvic organ below the PC line by 3 cm is mild, between 3 to 6 cm is moderate, and more than 6 cm is severe (►**Table 3**).[7]

Anterior Compartment Abnormalities

Cystocoele: it is defined as descent of the bladder base below the PC line (►**Fig. 8**). The perpendicular distance of bladder base from the PC line is measured. Normally, it should lie above the PC line. Cystocoeles are graded as mild, moderate, or severe. The repair is done by retropubic urethropexy.

Urethral hypermobility: it indicates a loss of urethral sphincter integrity when there has been loss of urethral sphincter and fascial support. Increase of abdominal pressure leads to rotation of the urethral axis into the horizontal plane. Dynamic MR imaging can depict urethral hypermobility. It requires a pubovaginal sling procedure for repair (►**Fig. 9**).

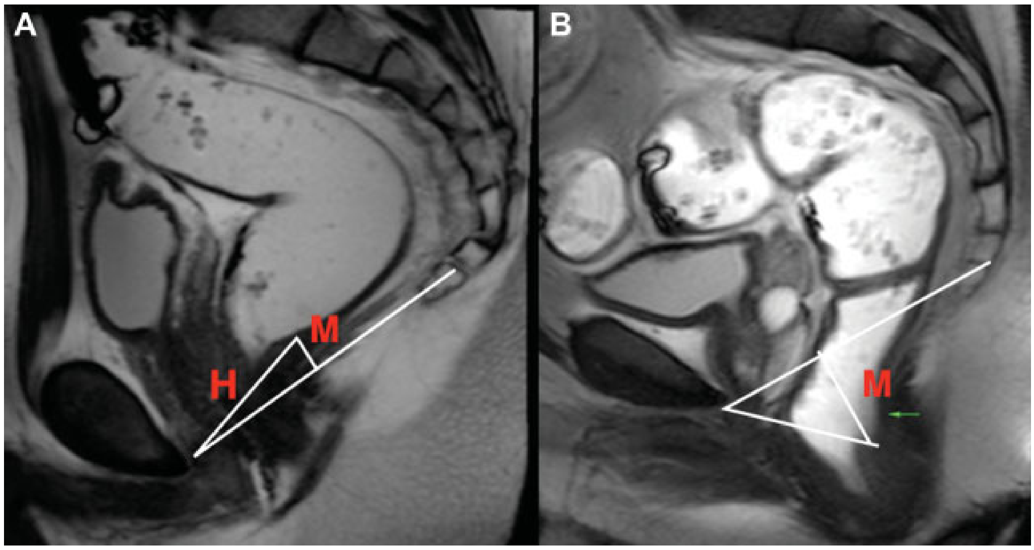

Fig. 6 The lines: schematic image (A) and T2-weighted sagittal MR image at rest (B) showing the pubococcygeal (PC, blue) line, H line (white dotted) and the M line (red). MR, magnetic resonance.

Middle Compartment Abnormalities

Vaginal vault or cervical prolapse is defined as descent of the vaginal vault or cervix below the PC line (►**Fig. 10**). The degree of prolapse is graded as mild, moderate, or severe. In cases of uterine prolapse, the cervix is located abnormally low through the vagina which may thus appear shortened. If isolated organ prolapse is present, pelvic organ prolapse (POP) surgery is performed (►**Fig. 11**). In case it is associated with intussusception, pelvic organ prolapse and stapled transanal resection of rectum (POPSTARR) procedure is performed which is a combination of POP surgery along with STARR procedure (►**Fig. 12**).

Table 2 Grading pelvic floor descent by H line and M line

Grade	H line (cm)	M line (cm)
Normal	<6	0–2
Mild	6–8	2–4
Moderate	8–10	4–6
Severe	>10	6–8

Posterior Compartment Abnormalities

Rectocele: they can arise from anterior, posterior, or lateral walls and are measured as the depth of wall protrusion

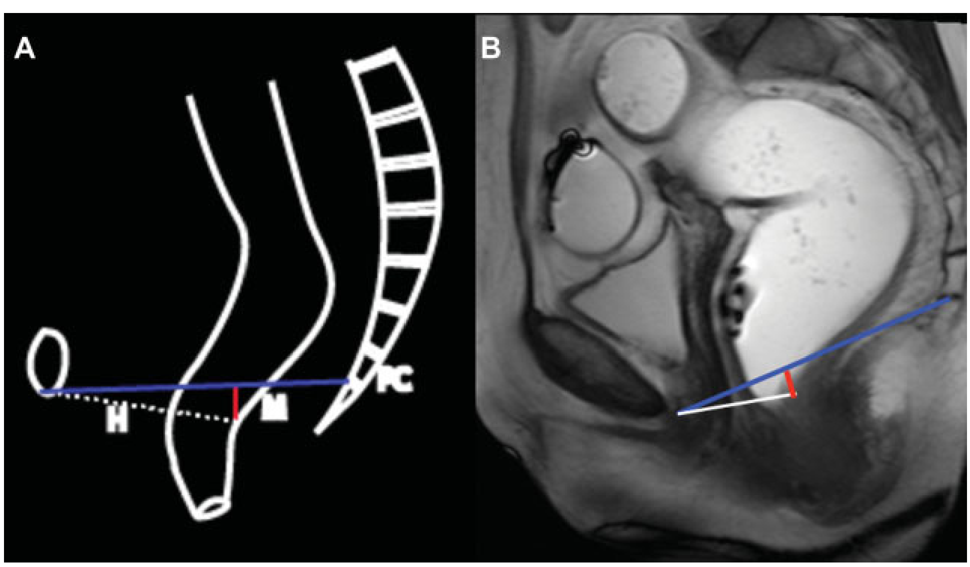

Fig. 7 Normal M line at rest (A) and increase in the M line during defaecation (B) suggesting descent of the levator plate.

Table 3 Grading of prolapse severity: rule of 3[7]

Abnormality	Mild (cm)	Moderate (cm)	Severe (cm)
Cystocoele: bladder neck below pubococcygeal (PC) line	0–3	3–6	>6
Vaginal vault descent: posterior margin of vault below PC line	0–3	3–6	>6
Rectal descent: anorectal junction below PC line	0–3	3–6	>6
Peritoneocele	0–3	3–6	>6

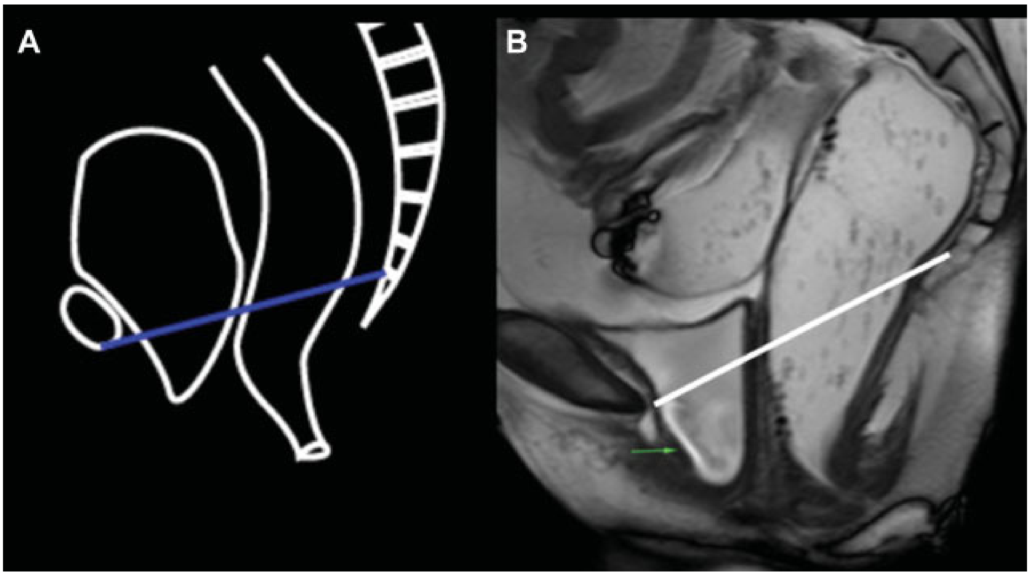

Fig. 8 Anterior compartment abnormalities: cystocoele: schematic and T2W dynamic sagittal MR image showing descent of the bladder neck below the PC line during defecation phase (green arrow). MR, magnetic resonance; PC, pubococcygeal.

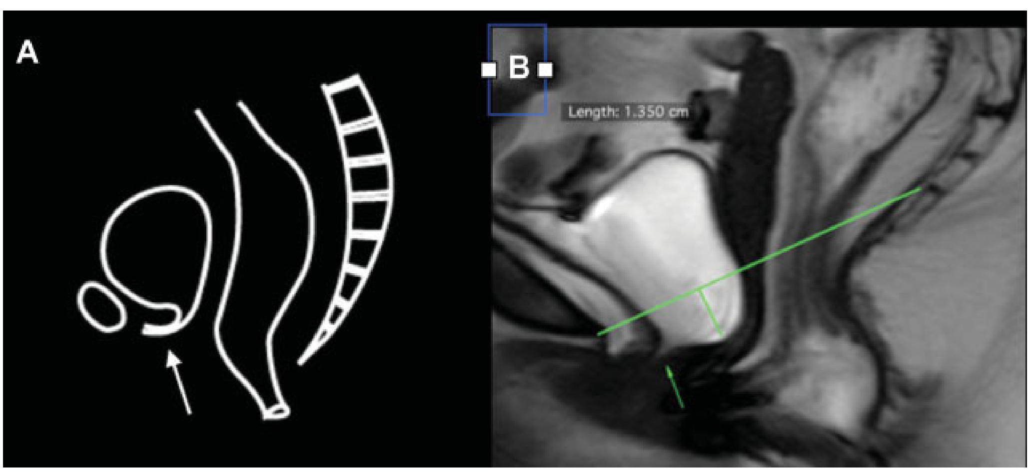

Fig. 9 Urethral hypermobility: schematic and T2-weighted dynamic sagittal MR images showing horizontal orientation of urethra, along with cystocoele, during defecation phase (**A, B**). MR, magnetic resonance.

beyond the expected margin of the normal anorectal wall (►**Fig. 13**).[8] They are clinically significant when the bulge exceeds 2 cm during evacuation. Rectoceles are graded as small, moderate, and large if they measure less than 2, 2 to 4, and 4 cm or more, respectively. The advantage of MR defecography is that it provides information about the size, as well as dynamics, of rectocele emptying, as well as any residual contrast retention, within the rectocele postevacuation, along with any coexistent abnormalities.[8]

Rectal invagination and prolapse: it includes prolapse of the mucosa alone (►**Fig. 14**), or a full-thickness rectal wall prolapse involving both the mucosa and muscular layer which is referred to as intussusception (►**Fig. 15**). When evaluating intussusception, the distance of parietal

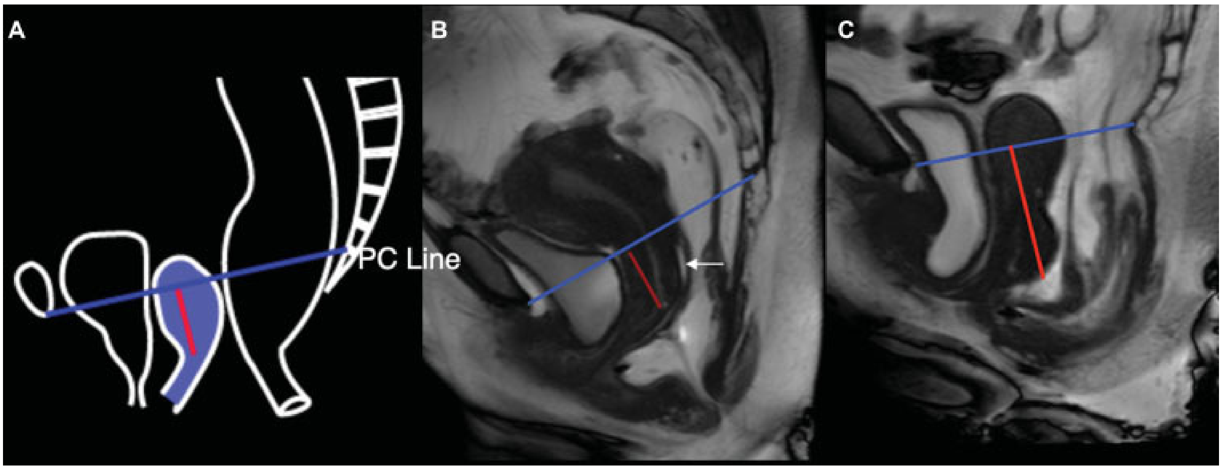

Fig. 10 Middle compartment: (**A**) Schematic diagram showing tricompartmental pelvic floor descent. (**B**) T2-weighted sagittal dynamic MR images during rest (B) showing tri-compartment descent at rest with cervix below the PC line (white arrow) and further descent during defecation. (**C**) T2-weighted sagittal dynamic MR images during evacuation phase showing tri-compartmental pelvic floor descent-cystocoele, uterine prolapse (arrow), and rectal descent with associated rectal prolapse. MR, magnetic resonance.

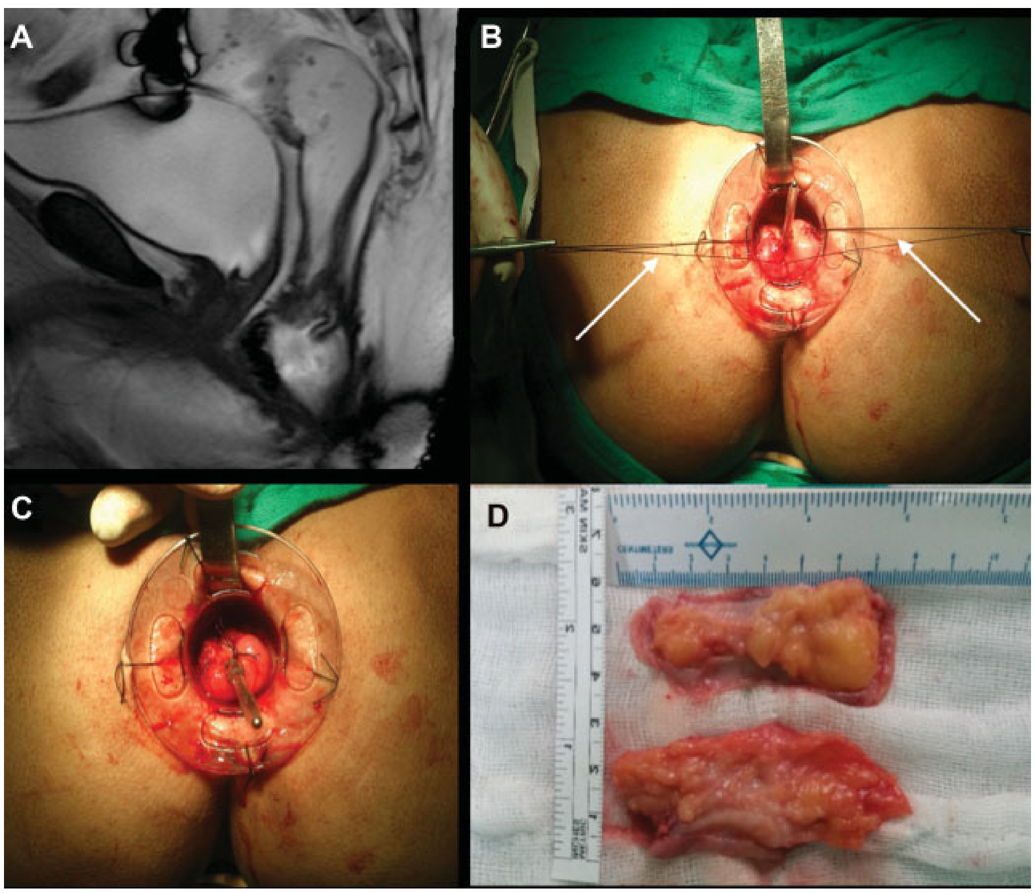

Fig. 11 STARR procedure: (**A**) T2-weighted sag image showing rectoanal intussusception with rectal prolapse (**B**) Parachute sutures placed through full thickness of rectum (white arrow) (**C**) simultaneous cutting and stapling of the rectum from 9 to 3 o'clock and 3 to 9 o'clock axis (**D**) resected donut specimen.

inversion from the anal verge is assessed. Further, it is classified into intrarectal, intra-anal, or extra-anal. Extension beyond the anal verge is referred as rectal prolapse (►**Fig. 16**).[9] Intussusception is classified as low-grade (rectal mucosa infolding but not entering the anal canal) and high-grade intussusceptions (full-thickness prolapse that penetrates the anal canal).[8] Simple mucosal prolapse is treated with transanal excision of the prolapsed mucosa. Rectopexy might be required for full-thickness rectal intussusception.

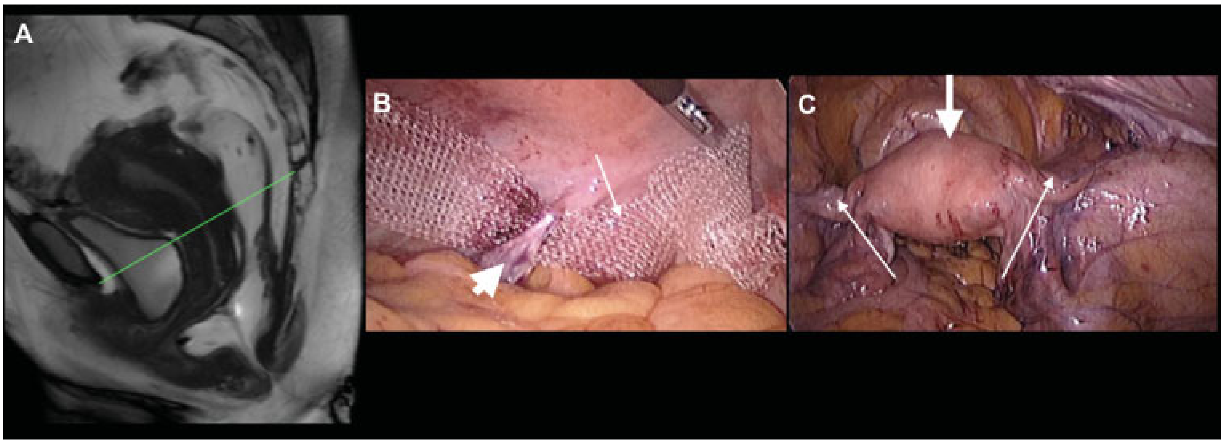

Fig. 12 Pelvic organ prolapse and stapled transanal resection of the rectum (POPSTARR): mesh is placed through the utero-sacral ligaments (arrow in **B**) to suspend the uterus along with STARR (**A–C**).

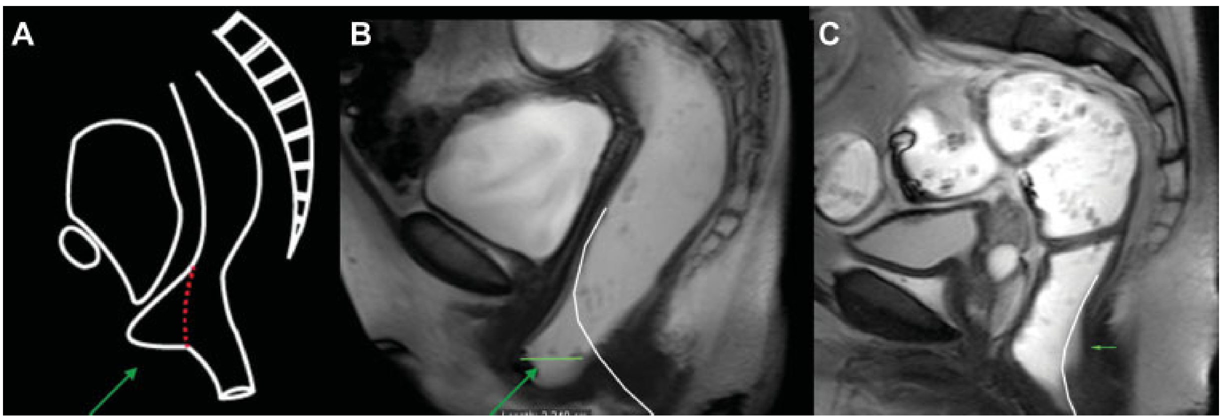

Fig. 13 (**A–C**) Schematic image and T2-weighted sagittal dynamic MR images during evacuation phase showing moderate anterior rectocele (arrow in A–C). MR, magnetic resonance.

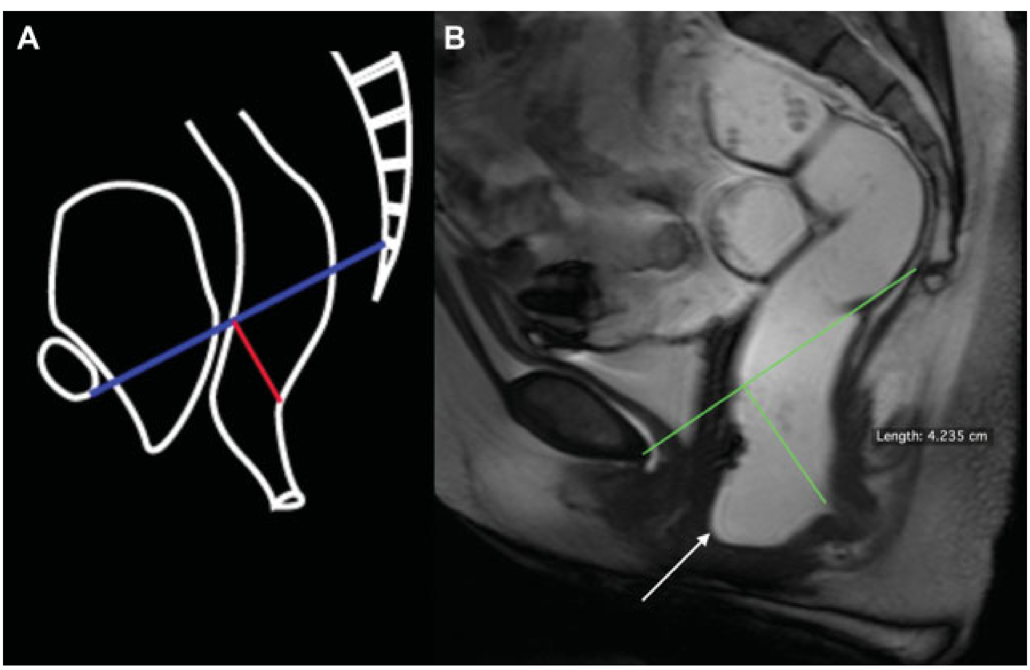

Fig. 14 (**A, B**) T2-weighted sagittal dynamic MR images during evacuation phase showing moderate posterior compartment descent with anterior rectocele (arrow) with no intussusceptions. MR, magnetic resonance.

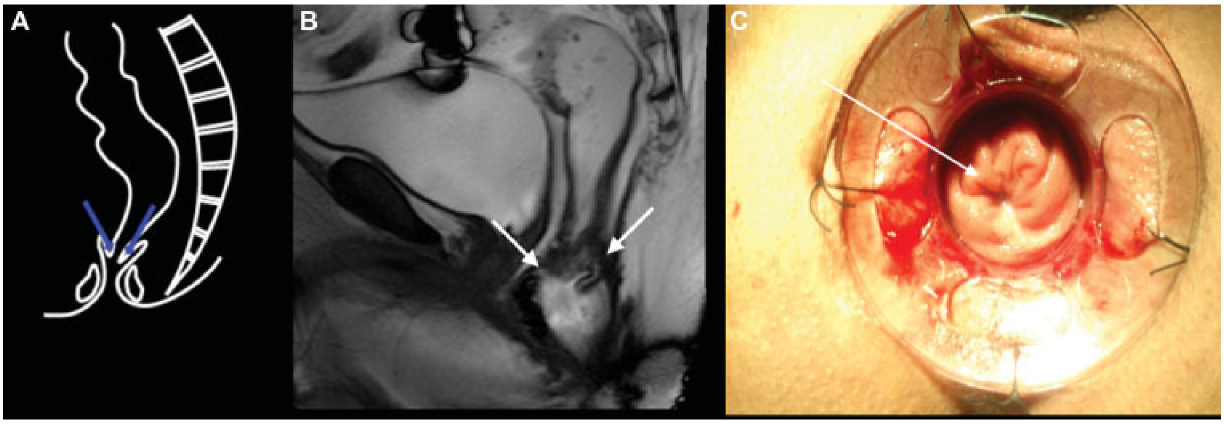

Fig. 15 Schematic image (**A**) and T2-weighted sagittal dynamic MR images during evacuation phase (**B**) showing prolapse of rectal mucosa (arrows) suggestive of rectorectal intussusception. Intussusception as seen on the operating table (**C**). MR, magnetic resonance.

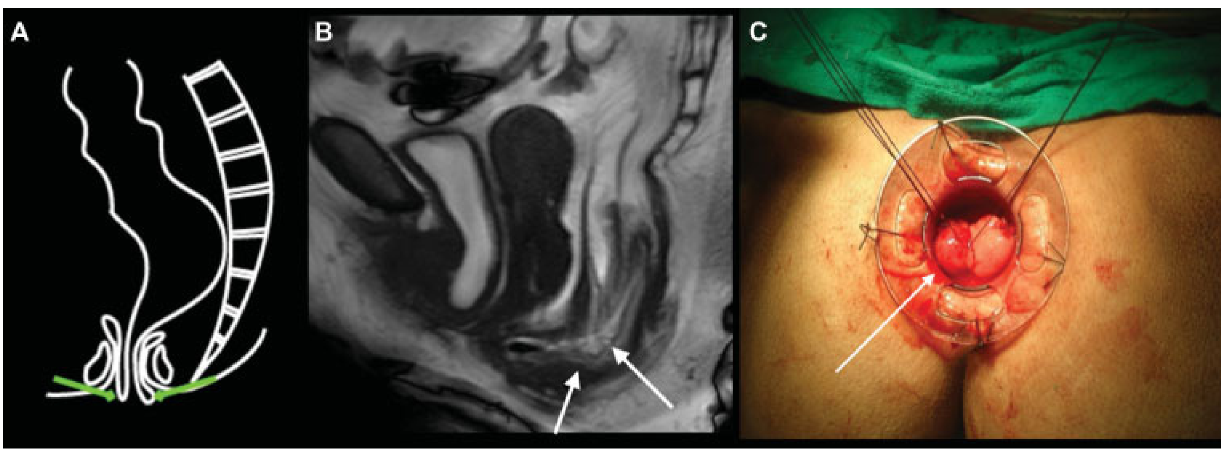

Fig. 16 Schematic image (**A**) and T2-weighted sagittal dynamic MR images during evacuation phase (**B**) showing full thickness recto-anal intussusception (arrows). (**C**) Per operative image showing rectoanal intussusception (white arrow). MR, magnetic resonance.

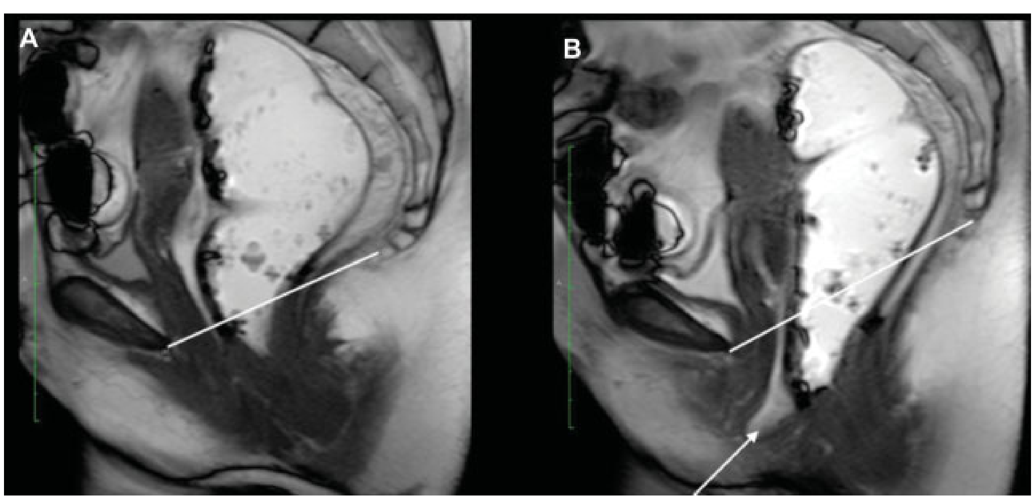

Fig. 17 T2-weighted dynamic MR images at rest (A) and defecation (B).

Peritoneocele/enterocele: defined as herniation of the pelvic peritoneal sac into the rectogenital space, the rectovaginal septum in women, passing below the proximal one-third of the vagina. It may contain fat (referred to as peritoneocele as shown in ►Fig. 17), small bowel, or sigmoid colon (enterocele). MR imaging criteria for enterocele diagnosis include: bowel loops seen between the vagina and rectum, bowel below the PCL, rectovaginal space widening, and abnormal deepening of the cul-de-sac. Enteroceles are usually not visualized at rest phase, as a filled rectum does not provide a sufficient space for small bowel loop to descend into the pelvis.[8] These are usually seen at the end of defecation as a consequence of increased intra-abdominal pressure. Descent of small-bowel loops more than 2 cm into the rectovaginal space indicates a torn rectovaginal fascia that should be treated with culdoplasty.

Descending perineal syndrome: it refers to a condition in which the pelvic muscles lose tone which results into excessive descent of the entire pelvic floor at rest or during evacuation. On dynamic images, perineal descent is quantified by measuring the descent of the anorectal junction from the PCL (►Fig. 18). It is considered abnormal if the descent exceeds 2.5 cm. The H and M lines will be longer as the width of the pelvic hiatus is greater in descending perineal syndrome. This syndrome can involve not only the posterior but, frequently, the anterior and middle compartments thereby classified as uni-, bi-, or tri-compartmental.

Spastic pelvic floor syndrome (also referred as pelvic floor uncoordination or anismus) is a functional abnormality that affects some constipated patients who experience evacuation failure associated with involuntary, inappropriate, and paradoxical contraction of striated pelvic floor musculature (►Fig. 19). Its etiology is unclear and can include both abnormal muscle activity and psychologic or cognitive factors.

The impact of MR imaging findings on the management has been depicted in a flow chart in ►Fig. 20.

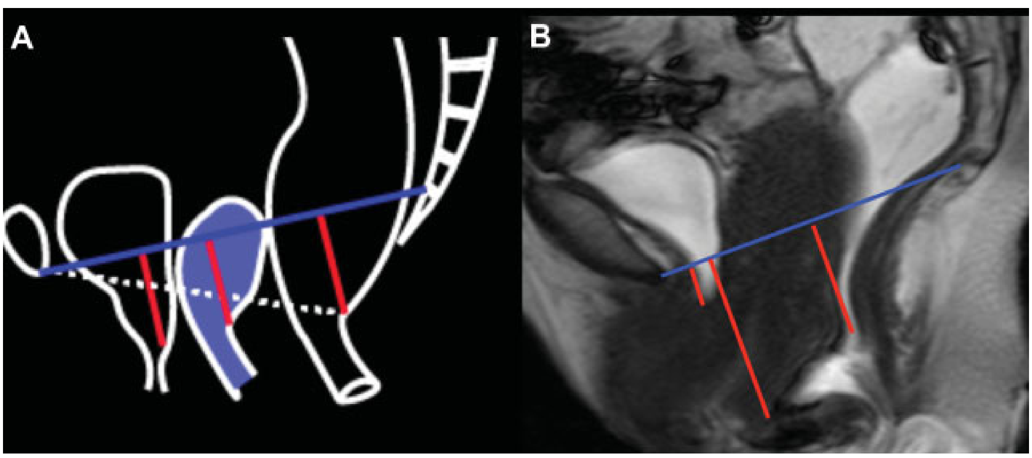

Fig. 18 Schematic (A) and T2-weighted sag MR image (B).

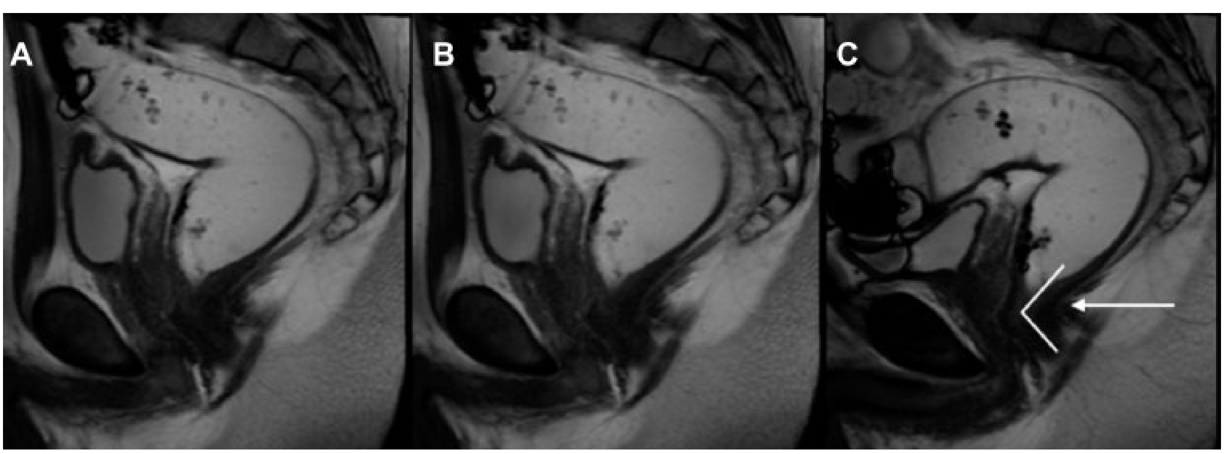

Fig. 19 Spastic perineum syndrome. T2-weighted sagittal dynamic images at rest (A), squeezing (B) and defecation phase (C).

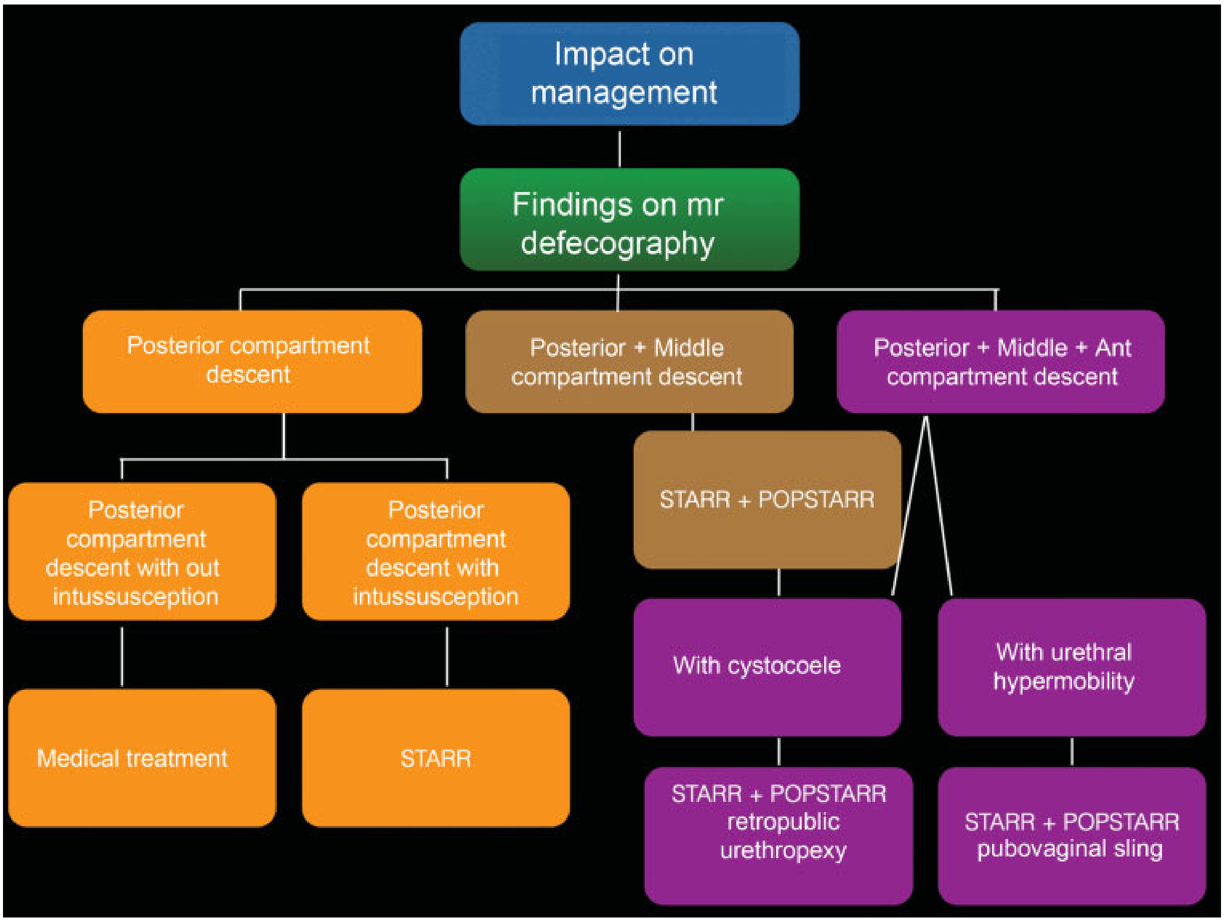

Fig. 20 Flow chart showing the impact on management depending upon the imaging findings on MR defecography. MR, magnetic resonance.

Conflict of Interest
None declared.

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