Reporting dynamic MRI of the pelvis in obstructed defecation syndrome: what the surgeon needs to know

Poster No.: C-2394
Congress: ECR 2012
Type: Educational Exhibit
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Keywords: Colonography MR, MR, Abdomen, Pelvic floor dysfunction
DOI: 10.1594/ecr2012/C-2394

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Learning objectives

- To briefly describe the dynamic-MR imaging technique
- To outline the indications and limits of the technique
- To highlight the radiological findings with surgical relevance

Background

Pelvic floor dysfunction is a general term including a heterogeneous group of disorders including obstructed defecation syndrome, anal or urinary incontinence and pelvic organ prolapse, among others. Patients affected can suffer a wide variety of symptoms: pressure, pelvic pain, dyspareunia, organ protrusion, incomplete emptying, incontinence, obstructed defecation, flatulence or constipation. The etiology has not been completely understood yet but some possible causes include denervation of pelvic musculature, fascial defects or collagen abnormalities. [1,2] Nevertheless there are several known risk factors such as age, multiparity, complicated deliveries, obesity, menopause, collagen-related disorders and hysterectomy [1,3]

Obstructed defecation syndrome (ODS) is a complex clinical condition. It includes a series of symptoms due to anomalies, difficulty or impossibility in expelling the feces. ODS is usually related with pelvic floor weakness. Failure to relax, or paradoxical contraction of the puborectalis muscles and the anal sphincters are acknowledged to be the main functional causes of ODS. The syndrome may be caused by functional and/or anatomic alterations, such as recto-anal intussusception and rectocele. The patient complains of incomplete evacuation with painful effort, fragmented defecation, use of perineal support, digital evacuation, laxative and/or enema abuse, and rectal bleeding. It can seriously compromise the quality of life of patients, who often present with associated psychological problems.

The diagnostic work-up includes taking a focus on the history of patient's complaints. This can be objectified using a standardized scoring system, (ODS Longo score), Gynaecological examinations must be performed on all female patients. Intraluminal abnormalities are best excluded by colonoscopy and rectoscopy. An abnormal score in combination with negative findings on endoscopy and gynecologic examinations warrant a radiological assessment with Dynamic magnetic resonance.
In selected cases, surgery may offer a solution to these patients, either by rectopexy, either by transanal rectal resection (STARR). The type and moment of surgery is still controversial. The most frequent techniques used are Stapled Trans-Anal Rectal Resection (STARR) or abdominal approach (laparoscopic rectopexy). Dynamic magnetic resonance of the pelvic floor helps to choose the adequate surgical technique. In our experience, all symptomatic patients (ODS>10) undergo for MR. The presence of multicompartent defect (cystocele, colpocele, enterocoele, eltrocele) or the presence of rectal intussusceptions associated with rectocele (rectocele IIIº) without a sphincter's lack of coordination at anal manometry is a indication of rectopexia. The STARR technique is a safe and effective procedure in the surgical treatment of ODS. The amelioration of symptoms related to the correction of rectal prolapse rectocele was very satisfactory but in literature the incidence of reoperation for a constipation's recrudescence is high [4]. For this reason and according with a recent French multicenter study, we suggests that the STARR approach is feasible and safe for the treatment of rectocele as a single anatomic disorder [5].

**Imaging findings OR Procedure details**

Dynamic MRI is a very interesting tool in the preoperative planning as it provides high resolution and illustrative images of the pelvic organs anatomy and their supporting structures, not only at rest but also on straining and during defecation maneuvers. It allows quantifying the position of any pelvic structure and its variation. This information can help select those patients who may benefit from surgery and provide the clues needed to decide the most appropriate surgical option. Lets learn how to get the images, how to read them and how to transmit this information to our clinician.

**1. PREPARATION FOR DYNAMIC-MR IMAGING**

The first thing to do is to spend the time needed to explain the patients the aim of procedure, to instruct them adequately on the strain and relaxation maneuvers and to solve any doubts that they may present. This greatly improves patient cooperation, facilitates the acquisition of images and reduces notably the level of stress that these patients often present. Technicians must be trained in place the patients at easy.

No intravenous contrast or premedication are needed. Patients can drink 4-5 cups of water 30 min prior to imaging to opacify the small bowel. In most institutions patients are asked to void 1-2 hours before the examination, bladder should be half full. The opacification of the vagina and rectum with 10mL and 100-240mL warmed ultrasonographic gel respectively can help to the interpretation of small abnormalities.
Administration of a rectal enema with warm water the night before could also be requested. [6,7]

In closed-configuration magnets, patients are placed in the supine position with slightly flexed legs. Vertically open-configuration magnets allow imaging the patient in a more physiologic way in the sitting position but normally they are less available. In some cases, intussusceptions and perineal descent can be missed in supine position. [6,8] As leakages are very frequent, patients should wear hospital cloths and no undergarments. A swab is placed under the pelvic area in order to protect the scanner from soiling.

2. DYNAMIC-MR IMAGING TECHNIQUE

Dynamic pelvic MRI is feasible at 1.5T or at 3T (using adapted sequences) with no significant differences in final diagnoses [7]. Pelvic or body phased-array coils are used.

MR imaging sequences at 1.5T:

- **Static images**: T2-weighted turbo spin-echo or fast spin-echo sequences in the axial, sagittal and coronal planes.
- **Dynamic images**: Consecutive images are acquired in the midsagittal plane using a T2-weighted rapid half-Fourier sequence (T2-weighted single shot fast spin echo SSFSE or balance steady-state free precession bSSFP). One image is acquired every 2s for a total of 10-15 images per scan. Patients are asked to strain progressively, to relax, and to strain again to the maximal effort and to evacuate. If an adequate straining is not achieved, a new acquisition should be performed.

3. IMAGE ANALYSIS: FINDINGS WITH SURGICAL RELEVANCE

READING STATIC IMAGES

Static images give us information about anatomical and pathological conditions of the pelvic support system.

Pelvic is usually divided in 3 artificial compartments for practical reasons: the anterior compartment (containing the bladder, the urethra and the prostate in males), the middle or genital compartment (uterus, cervix, vagina and adnexa), and the posterior or digestive compartment (anorectum) [1,6].
We can differentiate 2 components of the support system:

- **Passive support system**: pelvic bones, ligaments, tendons, aponeuroses and connective tissues. Difficult to see in RM images. Some structures can be imaged with high resolution techniques and using endoluminal coils. The inferior space between the introitus of the vagina and the anal canal represents the *perineal body* and is the site of attachment of the perineal membrane, the levator ani muscles, the external anal sphincter and the Denonvillers fascia. The latter extends superiorly with the cardinal and uterosacral ligaments forming the *cardinal ligament complex* suspending the cervix and posterior wall of the vagina towards the sacrum. The perineal body attaches also laterally to the ischiopubic rami. The pubocervical fascia attaches anteriorly to the pubis and laterally to the obturator internus and superiorly to the uterus, thus supporting the bladder and the urethra [1,6].

- **Active support system**, essentially the levator ani muscle with its ilio-coccygeal and pubo-rectal portions (Fig. 1 on page 7) When reading the static images we should look for atrophy, stretching, loose of normal shape, rupture and exceptionally thickness of the muscular components (Fig. 2 on page 8).

**READING DYNAMIC IMAGES**

We call "dynamic" those images showing the movement of pelvic structures. Movement is defined as any change in the position of one point to another point which is taken as reference. So we have to define several **mobile landmarks** to refer pelvic organs position and movements, and clearly specify in our report the **static landmarks** that are been used in each case (Fig. 4 on page and Fig. 5 on page 9 ). This will avoid many misunderstandings. [3].

Dynamic images provide information about:

- **Pelvic floor relaxation**: It is secondary to the development of weakness in the supporting structures (endopelvic fascia, muscular pelvic diaphragm and urogenital diaphragm). It is represented by the variation of standardized measurements of supporting structures above the normal limits (See Table 1 on page 10 and images Fig. 6 on page 11 , Fig. 7 on page 12 and Fig. 8 on page 13 ) [1,9].

- **Pelvic organ descent**: In healthy conditions pelvic organs descent with the pelvic floor during dynamic examination without prolapsing or bulging into other organ. **PROLAPSE** is the pathologic protrusion of a pelvic organ through the puborectal hiatus (when using the H line as a reference) or beyond the PCL line (when using the PCL line as the reference). Any of the above mentioned mobile landmarks descending below the reference lines is considered a pathologic feature.
The most relevant pathologic findings in this sense are: cervico-cystoptosis, cystocele (Fig. 9 on page 14), hysteroptosis or colpocele (Fig. 10 on page 15), elyrocele or peritoneocele, enterocele, sigmoidocele (Fig. 11 on page 16) and rectal descent. [1,3]

Attending the grade of descent we can differentiate several stages for prolapses (Table 2).

<table>
<thead>
<tr>
<th>Grading of POP</th>
<th>Modified classification</th>
<th>Yang's classification</th>
<th>HMO system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>&lt;3cm below the PCL</td>
<td>0-1 cm below the H line</td>
<td></td>
</tr>
<tr>
<td>(mild or small)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 2</td>
<td>3-6cm below the PCL</td>
<td>2-4cm below the H line</td>
<td></td>
</tr>
<tr>
<td>(moderate)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 3</td>
<td>&gt;6cm below the PC</td>
<td>&gt;4cm below the H line</td>
<td></td>
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<tr>
<td>(severe or large)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Stage 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(procidentia)</td>
<td></td>
<td></td>
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</tbody>
</table>

- Other important anorectal disorders are: rectocele (Fig. 12 on page 17), intussusceptions, rectal prolapse (Fig. 13 on page 18) and anismus.

Anismus or spastic pelvic floor syndrome is a cause of obstructed defecation. It is characterized by the paradoxal contraction of the puborectal muscle during straining without the normal descent of the pelvic floor and it is usually associated with puborectal hypertrophy [6].

All these anorectal disorders are formal contraindications for STARR reparation technique. Rectopexy is the most suitable surgical approach in these cases and those others with associated pathology in the anterior or middle compartments.

4. INDICATIONS AND LIMITS OF THE TECHNIQUE

Indications and advantages:

- Diagnosis of herniation defects could be challenging at physical examination, especially in posterior compartment affection other than
rectocele or multicompartiment coexisting disorders. Dynamic MRI easily demonstrates these entities helping surgical planning.

- MR is the best tool for pelvic floor muscles and fascial planes evaluation.
- MR allows the characterization of incidental pathologic findings that can change surgical approach.
- When surgery is planned for posterior compartment disorders, MR provides additional information about anterior and middle compartment that can be also affected in the 30% of patients. Moreover, follow-up MR after surgery demonstrates that if one compartment of pelvic floor is repaired, another compartment develops dysfunction in more than 73% of patients [10].
- Postsurgical dynamic MRI might be helpful to demonstrate residual or recurrent organ prolapse, even before the onset of clinical symptoms.
- It allow differentiation between mucosal and mural intussusception.

Limits:

- Evacuation proctography better depicts: rectal mucosal prolapsed, solitary rectal ulcers and incompletely emptying anterior rectoceles.

Images for this section:

A, B Axial T2-WI of female and male pelvis. **Pubo-rectal portion** of the levator ani muscle with the normal U shape sling around the genital hiatus and rectum

C Coronal T2-WI. **Ilio-coccygeal portion** of the levator ani muscle. Red line showing the typical dome shape.
**Fig. 1**

A, B Axial T2-WI: Atrophy and ballooning of the pubo-rectal muscles with opening of the urogenital hiatus. C, D Axial and coronal T2-WI. Spastic pelvic floor syndrome, thickened pubo-rectal muscle bilateraly.

**Fig. 2**
Pubococygeal line (PCL)
Extends from the inferior part of the pubic bone to the last coccygeal articulation. Most commonly static reference used.

Anal canal line
Passes through the anterior wall of the anal canal. Employed for the rectocele classification

Midpubic line
Passes through the midaxis of pubic bone. Usually employed for the assessment of the genitourinary prolapses.

Midsagittal T2-WI

B. Pellicer de Gracia

Fig. 3
**Pelvic compartments:**
A: Anterior
M: Middle or genital
P: Posterior or digestive

**Mobile reference landmarks:**
1. Bladder neck
2. Uterine cervix
3. Anterior wall of the rectum
4. Pouch of Douglass

Midsagittal T2-WI

Fig. 5
<table>
<thead>
<tr>
<th>Supporting structures</th>
<th>Definition</th>
<th>Meaning</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puborectal hiatus line or H line (midsagittal images)</td>
<td>Extends from the inferior part of the pubic bone to the convex posterior margin of the puborectalis muscle sling</td>
<td>Hiatal enlargement</td>
<td>Normal &lt;6cm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mild 6-8cm</td>
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<td></td>
<td></td>
<td></td>
<td>Moderate 8-10 cm</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Severe &gt;10cm</td>
</tr>
<tr>
<td>M line (sagittal images)</td>
<td>Extends perpendicularly from the PCL to the convex posterior margin of the puborectalis muscle sling</td>
<td>Descent of pelvic floor</td>
<td>Normal &lt;2cm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mild 2-4cm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderate 4-6 cm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Severe &gt;6cm</td>
</tr>
<tr>
<td>Levator plate angle (sagittal images)</td>
<td>Angle formed between the PCL and the levator plate</td>
<td>Posterior compartment floor support</td>
<td>Normal &lt; 15°</td>
</tr>
<tr>
<td>Ileococygeus angle* (coronal images)</td>
<td>Angle formed by the ileococygeus muscle with the horizontal plane of the pelvis</td>
<td>Weekness of levator ani</td>
<td>Decreases progressively from anterior to posterior</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Normal &lt; 25° at rest</td>
</tr>
<tr>
<td>Levator hiatus width* (axial images)</td>
<td>At the level of the superior margin of the symphysis pubis, the transverse line between the widest points of the levator hiatus, defined as the medial aspects of the levator muscles</td>
<td>Hiatal enlargement</td>
<td>Normal &lt; 45mm Pathologic &gt;45mm</td>
</tr>
</tbody>
</table>

(*) The ileococcygeal angle and the levator hiatus width can change with the Valsalva maneuver but normally, as they are visualized in coronal and axial planes respectively and the dynamic images are acquired in midsagittal plane only, they are just measured in static images.

Table 1
A, B Midsagittal T2-WI at rest and during straining: Normal length of the H and M lines at rest with moderate hiatal enlargement (H line 82mm) and moderate descent of pelvic floor (M line 53mm) during the effort.

Fig. 6
A, B Midsagittal T2-WI at rest and during straining: Pathologic levator plate angle measured at 53° during the effort (pathologic >15°) meaning loose of posterior compartment floor support
Coronal T2-WI from the same patient showing the ileoccygeus angle decreasing progressively from anterior A to posterior C.

Axial T2-WI: D Normal condition, E mild and F moderate enlargement of the Levator hiatus.

Fig. 8
**DYNAMIC IMAGES: Anterior floor PROLAPSES**

**Cervico-cystopectosis:**
Lowering of the bladder neck and bladder base below the PCL

**Cystocele:**
Lowering of only bladder’s base below the PCL. Bladder neck in normal position

Midsagittal T2-WI during straing

B. Pellicer de Gracia

**Fig. 9**
Hysteroptosis or colpocele:
Descet of the cervix or the vaginal vault (in case of hysterectomy) below the PCL

Midsagittal T2-WI during straing. Hysteroptosis with associated rectocele and cervico-cystoptosis.

B. Pellicer de Gracia

Fig. 10
**DYNAMIC IMAGES: Posterior floor PROPALSES**

**Elytrocele or peritoneocele:** Descent of pouch of Douglas below the PCL.

**Enterocele:** Descent of a bowel loop through the rectovaginal space. We call complex enteroceles those ones associated with vaginal vault prolapse.

**Sigmoidocele:** Descent of the sigmoid through the rectovaginal space.

Midsagittal T2-WI. **Elytrocele** with associated cervico-cystoptosis and rectocele

Midsagittal T2-WI. **Enterocele**

B. Pellicer de Gracia

Fig. 11
**Rectocele:** Bulge of the anterior wall of the rectum >5mm relative to the anal canal line

Figures. Midsagittal T2-WI during straining. Different grades of anterior rectoceles
A grade I
B grade II
C grade III
D procidentia

<table>
<thead>
<tr>
<th>Grading rectocele</th>
<th>Anterior wall relative to the anal canal line</th>
</tr>
</thead>
<tbody>
<tr>
<td>grade I</td>
<td>0.5-2cm</td>
</tr>
<tr>
<td>grade II</td>
<td>2-4cm</td>
</tr>
<tr>
<td>grade III</td>
<td>&gt;4cm</td>
</tr>
<tr>
<td>Stage 4</td>
<td>(procidentia)</td>
</tr>
</tbody>
</table>
**Intussusception:** Invagination of the full thickness of the rectal wall or only the mucosa. Depending on the extension they are intrarectal, intraanal or extraanal.

**Rectal prolapse:** Is another term for extraanal intussusception.

Midsagittal T2-WI during straining: mucosal intrarectal intussusception

Fig. 13
Conclusion

MRI can help select those patients who may benefit from surgery and provide information needed to decide the most appropriate surgical option. Radiologist's ability to reflect this information in the report greatly facilitate surgical decision making progress.

Personal Information

References