Role of the MR Imaging in the evaluation of pelvic floor dysfunction

Poster No.: C-0189
Congress: ECR 2013
Type: Educational Exhibit
Authors: C. García de Iturraspe Elices, I. Aguirre Urcelay; Bilbao/ES
Keywords: Defecography, MR, Pelvis
DOI: 10.1594/ecr2013/C-0189

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

Our learning objectives are:

- Review the role of the MR Imaging in the evaluation of pelvic floor dysfunction.

- Describe the technique of the study, static and dynamic (dephecography).

- We also suggest a systematic reading of these studies as shown in our model of MR imaging report.

Background

Pelvic floor dysfunction is a broad term for a heterogeneous group of disorders affecting a high percentage of middle and old aged women presenting, more frequently, with chronic pelvic pain, urinary and fecal incontinence, incomplete emptying and pelvic organ prolapse and represents an important public health concern.

The factors that contribute to the development of a pelvic floor dysfunction are multiple and complex and although the combination of the clinical history of the patient and a complete and rigorous physical examination often allows a reasonably knowledge of the underlying problem, each time is getting more and more evident that additional examinations such as MRI can help in the understanding of these complex problems.

Imaging findings OR Procedure details

MRI STRONG POINTS

- Excellent spatial and temporal resolution:

- High spatial resolution sequences allow an excellent evaluation of the anatomy of the structures that provide support to the pelvic organs.

- High temporal sequences are ultrafast sequences that give functional information which complements the anatomic one.
- Simultaneous evaluation of the three pelvic compartments. **Fig. 1 on page 17**

- **Multiplanar ability.** **Fig. 2 on page 18**

- **No use of ionizing radiation.**

**MRI WEAK POINTS**

- **Minimally invasive:** It is considered minimally invasive because you have to fill the rectum, and frequently the vagina, with some filling media such as sonographic gel. However, this procedure is really very well tolerated by the patients.

- **It is not performed in the physiologic position:** Although the examination is not performed in the sitting position, it has been published that in the detection of clinically relevant pelvic floor abnormalities, there is no substantial difference between imaging patients in a sitting or in a supine position and that even more important than the effect of gravity is the contribution of the true defecation phase in the supine position usually performed in higher field strength (1.5 or 3.0-T) closed magnets which result in better anatomic details and image quality compared to 0.5-T upright open MRI systems. Finally, we have to keep in mind that physical examination is usually performed in the lithotomy position.

**PREPARATION AND TECHNIQUE**

**Preparation:**

- Fasting for 4 hours, to minimize the risk of artifacts due to peristaltism.

- Bowel preparation, to help technicians and mostly patients to better psychologically face the examination. With the same purpose, we make the patients wear a nappy.

- Rectal filling with sonographic gel (200 ml) **Fig. 3 on page 19.** Since pelvic floor dynamic imaging is a dynamic form of imaging, aiming to evaluate the evacuation phase, rectal filling is mandatory. Moreover, many rectoceles, enteroceles and invaginations are diagnosed during or at the end of the evacuation phase and the highest grades of prolapse are usually diagnosed during this phase, especially in the anterior and middle compartments.
- Filling the vagina with gel (50 ml) is optional, although in our experience, it helps to identify the cervix and the vaginal cuff.

- Distended bladder, because the high signal of urine in T2-weighted sequences works as a physiologic contrast media.

**Technique:**

- **1.5-T closed magnet.**

- **Supine position**, with a wedge under the legs to make it easier the squeezing, straining and especially the defecation.

- **Phased array coil** wrapped around the inferior part of the pelvis.

- **High spatial resolution TSE-T2 weighted sequences** (23 cm FOV, 4 mm slice thickness, 320 x 68 matrix, TR / TE 5480 / 99) are performed axial and coronal to the axis of the anal canal. These sequences are the basis of the static or anatomic study because they serve to evaluate the active and passive pelvic organ supporting structures (endopelvic fascia, ligaments and muscles) and the anal sphincter complex.

- **High temporal resolution gradient echo real time T2 weighted sequence** (26 cm FOV, 8 mm slice thickness, 320 x 100 matrix, 250 phases, 73 sc imaging time) is performed by acquiring only one section (sometimes two or three) in the midsagittal plane at rest, during maximal sphincter contraction, straining and defecation. The first three or four images are obtained with the patient at absolute rest and the last three or four images are obtained at the end of defecation to reassess the position of the pelvic organs after evacuation. Enough repetitions should be acquired to ensure that complete evacuation is covered. This sequence is the basis of the dynamic or functional study because it allows evaluate the movement of the pelvic floor while it is deformed under the progressive increase of the abdominal pressure. It is mandatory to repeat the dynamic study because, very frequently, after some repetitions, patients perform better the manoeuvres and higher degrees of organ prolapse can be diagnosed. There is not an objective way to measure the effort during the dynamic study. We use the repetition of the dynamic study until the degree of prolapse remains stable. **Fig. 4** on page 19, **Fig. 5** on page 20, **Fig. 6** on page 21.

- **HASTE sequences during defecation manoeuvre** adquired in the coronal, sagittal and axial planes. They make it easier, in our experience, to identify pelvic organs
Whenever they are out of the midline, because of anatomical reasons or because of patient relocation, and to show some rectal invaginations. It has been also described their value in the diagnosis of perineal hernias. Fig. 7 on page 22, Fig. 8 on page 23.

- No use of oral or intravenous contrast agent.

**STATIC ANALYSIS: ANATOMIC EVALUATION**

In the static images you have to look for lesions of the urethral and vaginal supporting system and the anal sphincter complex.

Before going on to review these supporting structures and their possible lesions, it can be useful to remember some important anatomic aspects.

**Normal anatomy:**

The pelvic floor is a multilayered anatomic and functional unit composed, from cranial to caudal, of the endopelvic fascia and ligaments, the pelvic diaphragm and the perineal membrane.

*Endopelvic fascia and ligaments*

The endopelvic fascia is the connective tissue sheet that surrounds the pelvic viscera and attaches them to the pelvic sidewall. The portion of the fascia between the bladder and vagina is known as the pubocervical fascia. Superiorly, the fascia forms the uterosacral and cardinal ligaments. Posteriorly, the fascia between the vagina and rectum is known as the rectovaginal fascia. This way, the vagina is completely surrounded by the endopelvic fascia.

The vagina is functionally divided in three thirds Fig. 9 on page 24:

The 2 to 3 upper cm forms the De Lancey level I, which is horizontally suspended over the Douglas pouch by the cardinal ligaments (lateral fixation) and the uterosacral ligaments (posterior fixation). The defects of the endopelvic fascia in this level are correlated with uterine and vaginal cuff prolapse.

In the second third or the De Lancey level II, the vaginal walls are fixed anteriorly to the pubocervical fascia and posteriorly to the rectovaginal fascia. The pubocervical fascia
inserts laterally to the tendineus arcus and the rectovaginal distally to the perineal body and proximally to the uterosacral - cardinal complex. The pubocervical and rectovaginal fascias prevent the protrusion of the vaginal walls through the vaginal canal. The defects of the pubocervical fascia are correlated with bladder prolapse and those of the puborectal fascia with the rectocele and peritoneocele.

The distal third or the De Lancey level III extends from the introitus to 2 or 3 cm up from the plane of the hymen. In this level, the paracolpos disappears and the vagina fuses with the perineal body, the levator ani and the urethra. The defects of the endopelvic fascia in this level are correlated with the urethrocele.

The endopelvic fascia is not directly imaged at MR imaging. Its failures can be inferred by indirect signs.

The urethral ligaments are thin structures that along with the endopelvic fascia and the anterior vaginal wall and pelvic floor muscles support the urethra. Its precise anatomy has not been fully elucidated and there is currently no uniform opinion concerning these structures. Unfortunately, they are not consistently or easily visualized on MR images Fig. 10 on page 25. The most important of them are the pubourethral ligaments and correspond to the pubic insertion of the pubocervical fascia Fig. 11 on page 26.

*Pelvic diaphragm*

It separates the pelvis cavity from the perineus and it is suspended as a hammock between the pubis, anteriorly, and the coccyx, posteriorly. It constitutes a true diaphragm with a hole that allows the passage of the urethra, the vagina and the rectum.

The pelvic diaphragm is tonically contracted at rest and helps maintain continence, especially during increased intraabdominal pressure by closing the hiatus and compressing the urethra, the vagina and the anorectal junction in the direction of the pubic bone.

It is composed of the following muscles:

- Ischiococcygeal muscle Fig. 12 on page 27.

- Levator ani muscle:
- Pubococcygeal muscle Fig. 13 on page 28.

- Puborectalis muscle Fig. 14 on page 29.

- Iliococcygeal muscle Fig. 15 on page 30.

The components that provide more support are the puborectalis and the iliococcygeal muscles. The levator plate is a midline raphe formed by the fusion of the iliococcygeal fibers anterior to the coccyx Fig. 16 on page 32.

*Perineal membrane*

It was previously known as the urogenital diaphragm. It is penetrated by the urethra and the vagina.

It is composed of:

- Connective tissue.

- Deep transverse perineus muscle.

- Urethrovaginal sphincter.

It is a diamond-shaped combination of two triangles, the urogenital (anterior) and the anal (posterior), whose common base is the transverse perineus muscle. The central point between these two triangles is the perineal body.

The perineal body Fig. 17 on page 32 is directly anterior to the anal sphincter and anchors critical surrounding structures:

- Deep transverse perineus muscle.

- Superficial transverse perineus muscle Fig. 18 on page 33.

- External urethral sphincter.
- External anal sphincter.

- Ani levator muscle.

Its function is anchor the anus and the vagina and prevent the expansion of the pelvic hiatus.

*Anal sphincter Fig. 19 on page 34*

Excellent detail of the anatomy of the anal complex is possible with MR imaging:

- Internal sphincter (anal smooth muscle).

- External sphincter (formed by four separated muscular bundles):
  - Puborectalis muscle.
  - Deep sphincter.
  - Superficial sphincter.
  - Subcutaneous sphincter.

- Intersphincteric spaces, external and internal (separated by a thin muscular bundle, the vertical portion of the levator ani).

**Lesions:**

Lesions of the urethral supporting structures

Great controversy exists about which are the true urethral supporting structures although it is generally accepted that these are the urethral ligaments, the endopelvic fascia (level III) and the puborectalis muscle.
- Urethral ligaments: Despite their great variable appearance in MR imaging, one should look for any asymmetry, distortion or discontinuity Fig. 20 on page 35.

- Level III of the endopelvic fascia: A defect at this level is recognized by the "dropping mustache sign" which is formed by fat in the prevesical space against the bilateral sagging of the detached lower third of the anterior vaginal wall from the arcus tendineus fascia.

- Puborectalis muscle: Look for any asymmetry Fig. 21 on page 36 or disruption of the attachment of the muscle to the pubic bone.

Lesions of the vaginal supporting structures

The level II of the endopelvic fascia and the iliococcygoeus muscle takes part in the support of the uterus and the vagina.

- Levels I and II of the endopelvic fascia: The endopelvic fascia cannot be seen by MR imaging. Its defects are assumed by the indirect sign that consist of a sagging of the posterior wall of the bladder, the "saddlebags sign" Fig. 22 on page 37.

- Iliococcygeus muscle: Look for any asymmetry or detachment Fig. 23 on page 38.

Lesions of the anal sphincter

It is mandatory to pay attention not only to the internal sphincter but also and specially to the external one, which is worse evaluated with endoanal sonography, and look for any defect, atrophy or scarring.

It has been published that external phased-array MR imaging is comparable to endoanal MR imaging in the depiction of clinically relevant anal sphincter defects and that MR imaging is preferred to select patients as candidates for surgery and endoanal sonography for the postsurgical evaluation.

**DYNAMIC ANALYSIS: FUNCTIONAL EVALUATION**

Two fundamental aspects have to be considered, pelvic floor relaxation and pelvic organ prolapse.
**Pelvic floor relaxation**

The pubococygeal line (PCL) is used as the reference line to evaluate pelvic floor relaxation. This line extends from the inferior border of the symphysis pubis anteriorly to the last coccygeal joint posteriorly. It is assumed that reflects the position of the pelvic floor.

Pelvic floor relaxation has two components, hiatal enlargement and pelvic floor descent that are measured with the H and M line respectively. Measurement is performed on mid sagittal MR images obtained at maximal strain (defecation phase).

The H line (puborectal hiatus line) represents the most caudal part of the levator ani group (the puborectal muscle) and is drawn between the inferior border of the symphysis pubis and the convex posterior margin of the puborectalis sling.

The M line extends perpendicularly from the PCL to the posterior end of the H line.

Pelvic floor relaxation can be graded using a table that takes into account these two components of relaxation Fig. 24 on page 40, Table 1 on page 40.

Another measurements of pelvic floor relaxation are:

- Iliococcygeus angle: Normal< 40º Fig. 25 on page 41.

- Width of the levator plate: Normal< 5 cm Fig. 26 on page 42.

- Levator plate angle: Normal< 20º Fig. 27 on page 42.

- Anorectal angle: Normal between 108º and 127º Fig. 28 on page 43. It closes between rest and squeezing and opens between rest and defecation by about 15º - 20º.

**Pelvic organ prolapse**

Several reference lines have been proposed to evaluate pelvic organ prolapse:

- Pubococygeal line (PCL).
- Mediopubic line (MPL).

- H Line.

Organ prolapse grade is measured in centimetres by lines drawn perpendicular to the chosen reference line from the reference point in each compartment at maximal strain. The reference point in the anterior compartment is the most posterior and inferior aspect of the bladder base, in the middle compartment the anterior cervical lip (or the posterior superior vaginal apex if the patient has been hysterectomized) and in the posterior compartment the anterior margin of the anorectal junction Fig. 29 on page 44.

The most commonly used is the pubococcygeal line, probably because it is easily reproduced as it is based on fixed bony points, fixed points that, on the other part, are also used in the conventional fluoroscopy. Moreover, it is believed to provide an estimate of the pelvic floor as it lies along the plane of the pubococcygeal and puborectalis muscles. So, it is placed in the "normal or ideal" position of the pelvic floor.

Prolapse severity is graded according to the "rule of three" Table 2 on page 46, Fig. 31 on page 47.

Mediopubic line measurements are performed by drawing a midsagittal line caudally through the long axis of the symphysis pubis. This line has been shown to approximate the level of the vaginal hymen on cadaveric dissection.

The clinical POP Q staging system is applied directly to MPL measurements since both are based on the level of the vaginal hymen Table 3 on page 48, Fig. 32 on page 49.

The H line is the least commonly used and the least reproducible of the three lines probably because in many patients with pelvic floor muscle atrophy it can be difficult to exactly locate the puborectal muscle. However, it is located closer to the hymen than the PCL and pinpoints the "real" position of the pelvic floor Fig. 33 on page 50.

As pelvic organ prolapse is any protrusion of a given organ through the puborectal hiatus, or the H line, grading of prolapse is made by using a table that measures the shortest distance between the most caudal aspect of a given organ relative to the H line Table 4 on page 51, Fig. 34 on page 52.

There is not a commonly accepted reference line. There are many discrepancies among the results published in different articles. Some authors conclude that there are not
significant differences between using one or another line, although, on the other part, they
don't find good correlation between MR staging and patient's symptoms. Other authors
find that the mediopubic line has "enough" correlation in the three compartments while the
pubococygeal one has "enough" correlation in the anterior compartment but "poor" in the
middle and posterior and that the mediopubic line is superior to the pubococygeal one
in the anterior compartment. So that, more studies are needed to prove which of these
lines is the most useful. Nowadays, the election among them is upon the experience of
the radiologist and the preference of the clinicians.

**DYNAMIC ANALYSIS OF ORGAN PROLAPSE IN THE DIFFERENT COMPARTMENTS**

**Anterior compartment:**

Lesion of the urethral supporting structures and or weakness of the levator ani muscle
(puborectal) allow the caudal displacement of the bladder (cystocele) which associates to
a higher or lesser degree of enlargement and descent of the pelvic floor and to a bulging
in the anterior wall of the vagina with eversion of its mucosa in severe cases.

Sometimes, there is also a rotation of the urethral axis into the horizontal plane, the so
called urethral hypermobility, which diagnoses is important because it requires a specific
surgical treatment.

In other cases, prolapse of the bladder base may be responsible for kinking of the
urethrovesical junction, which is a potential cause of urinary retention. This condition can
be associated with or mask symptoms of incontinence and may lead to urinary stasis and
infections. [Fig. 35](#) on page 53, [Fig. 36](#) on page 54

**Middle compartment:**

Lesions of the vaginal supporting structures and or weakness of the levator ani muscle
allow the caudal displacement of the uterus, or the vaginal cuff in hysterectomized
women, which associates to a higher or lesser degree of enlargement and descent of
the pelvic floor and to a more horizontal axis of the vagina. [Fig. 37](#) on page 55, [Fig.
38](#) on page 56

In hysterectomized women, the caudal displacement of the vaginal cuff may cause a
traction effect on the peritoneal cul de sac or create a wider potential space for it to
descend through, resulting in a peritoneocele (if it only contains peritoneal fat), enterocele
(if it contains small bowel loops) or sigmoidocele (if it contains the sigma). Fig. 39 on page 57, Fig. 40 on page 58

MR identifies more easily than conventional defecography the contents of a cul de sac bulge.

Cul de sac defects are particularly challenging to diagnose and characterize on physical examination because a posterior vaginal wall bulge can be due to a peritoneocele, enterocele, sigmoidocele or a rectocele.

**Posterior compartment:**

Not forgetting that the levator ani and the ischiococcygeal contraction is fundamental to prevent the prolapse, a defect of the rectovaginal fascia can help the development of a rectocele or a rectal intussusception.

A rectocele is the protrusion of the anterior wall of the rectum in the posterior wall of the vagina. Its size is measured in centimetres drawing a line perpendicular between the supposed normal position of the anorectal wall and the deepest zone of the rectocele Fig. 41 on page 59. Less frequently, rectoceles can occur posteriorly or laterally.

Rectoceles smaller than two centimetres are common findings in women without defecatory dysfunction. They become clinically relevant when there is retention of contrast medium in the rectocele during rectal voiding. This correlates with the feeling of incomplete evacuation some women describe.

A rectocele is considered mild if it is smaller than 2 cm, moderate if it is between 2 and 4 cm and severe if it is larger than 4 cm.

Although rectal mucosa alone may prolapse Fig. 42 on page 60, rectal invagination or intussusception is defined as a full thickness rectal wall prolapse involving both the mucosa and the muscular layer Fig. 43 on page 61. It is classified as intrarectal, intraanal or extraanal (rectal prolapse) depending on the distance of parietal inversion to the anal verge Fig. 44 on page 62.

It has been published that physical examination has difficulties in the diagnosis of prolapse in the posterior compartment and that some defecographic examination is necessary especially if surgical treatment is an option.
For the diagnosis of intussusception, the sensitivity of MR defecography has been reported to be 70% relative to evacuation proctography. The clinical relevance of missed findings at MR imaging has been reported to be of little importance. In fact, the frequency of low grade intussusception (not obstructing the passage of stool) is high even in the asymptomatic population. However, MR defecography has the potential advantage of clearly distinguishing between rectal mucosa intussusception and rectal full thickness intussusception, a difference that can only be inferred at conventional defecography and which is relevant in that the treatment for the two conditions is different.

**CONCLUSIONS:**

To reach conclusions, it is necessary to put together all the information obtained by the static and the dynamic examination. They can be organized in a syndrome-like form.

**DESCENDING PERINEAL SYNDROME**  [Fig. 45 on page 63]

It is characterized by:

- A decreased elevation of the pelvic floor at maximal contraction.
- Pelvic floor relaxation signs (the H and M lines tend to be longer).
- Abnormally low position of the anorectal junction.
- Caudal angulation of the levator plate.
- There can be a greater or lower grade of pelvic organ prolapse.

**SPASTIC PELVIC FLOOR SYNDROME**  [Fig. 46 on page 64, Fig. 47 on page 65]

It is also known as pelvic floor uncoordination or anismus.

It is characterized by:

- Long interval between opening of the anal canal and start of defecation.
- Lack of descent of the pelvic floor during defecation and paradoxical contraction of the puborectalis muscle with failure of the anorectal angle to open that results in a prolonged or incomplete defecation.
- An anterior rectocele can be associated.

**OBSTRUCTED DEFECATION SYNDROME** Fig. 48 on page 65

It is characterized by an excessive effort during defecation and a feeling of incomplete rectal evacuation, sometimes requiring vaginal or perineal digitations to empty the rectum.

It can be due to or associated to:

- Rectocele.
- Rectal invagination and prolapse.
- Peritoneocele, enterocele, sigmoidocele.

**ANAL INCONTINENCE** Fig. 49 on page 65

It can be related to:

- Lesions of the sphincter anal complex.
- Weakness of the levator ani muscle: It is characterized by pelvic floor relaxation signs and low variability of the anorectal angle. It can also be associated to a rectocele or an enterocele that may contribute to mask the incontinence. It has been published that MR defecography findings lead to changes in surgical approach in many patients who are candidates to some form of surgery especially if a rectocele or an enterocele is diagnosed.

**MR IMAGING REPORT**

Our MR imaging report tries to include in an organized way all the aspects previously presented and if it is possible ending with a personal opinion about which is(are) the predominant defect(s) as suggested by Rania F. El Sayed, MD in her paper "Pelvic Floor Dysfunction: Assessment with Combined Analysis of static and Dynamic MR Imaging Findings" published in Radiology 2008.

This is our MR imaging report:
ANATOMIC EVALUATION

- Pelvic floor muscles (atrophy, focal defect, detachment…).
- Endopelvic fascia (indirect signs of lesion) and ligaments (distortion, discontinuity…).
- Anal sphincter (atrophy, hypertrophy, defect, scar, open at rest…).

DYNAMIC EVALUATION

A- Pelvic floor relaxation: grade (0, 1, 2, 3) (normal, mild, moderate, severe).

- H line:
- M line:
- Iliococcygeus angle:
- Levator plate angle:
- Anorectal angle, anorectal elevation: normal or paradoxical.

B- Organ prolapse (specify the reference line chosen):

1) Anterior compartment:

- Cystocele: Nor / yes (mild, moderate, severe).
- Urethral hypermobility: Nor / yes.
- Kinking of the urethrovessical junction: Nor / yes.

2) Middle (apical) compartment:

- Vaginal or cervical prolapse: Nor / yes (mild, moderate, severe).
- Peritoneocele / enterocele / sigmoidocele: Nor / yes, whether can be reduced or not, whether it obstructs or not normal passage of stools.

3) Posterior compartment:
- Anterior rectocele: Nor / yes (mild, moderate, severe), whether or not is voided after defecation.

- Rectal invagination: Nor / yes; mucosa or full thickness; intrarectal, intraanal or extraanal.

CONCLUSIONS

- Descending perineal syndrome…
- Spastic pelvic floor syndrome…
- Obstructed defecation syndrome…
- Anal incontinence…

PERSONAL OPINION

The predominant defect(s) is(are):
- Ligaments.
- Fascia.
- Muscle injury and/or weakness.

Images for this section:
Fig. 1: Anterior (anterior). Medio (middle). Posterior (posterior).
Fig. 3: Orina (Urine).
Fig. 4: Patient with cystourethrocele, rectocele and rectal prolapse. During the first dynamic sequence there is only a mild movement of the abdominal wall due to breathing.
Fig. 5: During the second dynamic sequence performed on the same patient as in Fig. 4, a mild contraction of the pelvic floor muscles can be appreciated and after that some degree of increase in the abdominal pressure that does not succeed in opening the anal sphincter.
Fig. 6: During the third dynamic sequence, the same patient as in Fig. 4 and 5 performs properly not only the Kager manoeuver but also the progresive Valsalva manoeuver until succeeding in defecating the sonographic gel. A cystocele and urethral hypermobility is also shown.
Fig. 7: Patient who complains about incomplete defecation. During the dynamic sequence there is no sign of rectal invagination.
**Fig. 8:** HASTE sequence acquired in the sagittal plane during defecation. Same patient as in Fig. 7. It can be seen a full thickness distal intrarectal invagination.
Fig. 9: Nivel I (Level I). Nivel II (Level II). Nivel III (Level III).
**Fig. 10:** Lig periuretrales (Periurethral ligaments). Lig parauretrales (Paraurethral ligaments).
Fig. 11: Lig pubouretrales (Pubourethral ligaments).
Fig. 14
Fig. 19: Esp. interesfintérico int. (Inner intersphincteric space). Esp. interesfintérico ext. (Outer intersphincteric space). Porción vertical del elevador (Vertical portion of the levator ani). Nivel Puborrectal (Puborectal plane). Nivel P. Profunda (Deep sphincter plane). Nivel P. Superficial (Superficial sphincter plane). Nivel P. Subcutánea (Subcutaneous sphincter plane).
**Fig. 20:** Posterior displacement of the right periurethral ligament (yellow arrow). Detachment of the puborectalis muscle from the pubic bone on the right side and atrophy (black arrows). The vagina loses its characteristic "H" shape.
Fig. 21: Atrophy of the right side of the puborectalis muscle with normal attachment to the pubic bone.
Fig. 22: Nivel I fascia normal (Normal level I endopelvic fascia). Defecto paravaginal derecho (Right paravaginal defect). Defecto central y paravaginal (Central and paravaginal defect).
**Fig. 23:** Normal left side of the iliococcygeal muscle. Atrophy of the right side.

**Fig. 24:** Static image of the dynamic sequence during defecation. The black arrow is the Pubococcygeal line. The green line is the H line. Its measure in centimetres is the anteroposterior measure of the pelvic hiatus. The blue line is the M line. Its the measure in centimetres of muscular pelvic floor descent.
Table 1
Grading of Pelvic Floor Relaxation

<table>
<thead>
<tr>
<th>Grade</th>
<th>Hiatal Enlargement (cm)</th>
<th>Pelvic Floor Descent (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (normal)</td>
<td>&lt;6</td>
<td>0–2</td>
</tr>
<tr>
<td>1 (mild)</td>
<td>6–8</td>
<td>2–4</td>
</tr>
<tr>
<td>2 (moderate)</td>
<td>8–10</td>
<td>4–6</td>
</tr>
<tr>
<td>3 (severe)</td>
<td>≥10</td>
<td>≥6</td>
</tr>
</tbody>
</table>

Note.—Pelvic floor relaxation has two components: hiatal enlargement and pelvic floor descent. Measurement is performed on midsagittal MR images obtained at maximal strain.

Table 1
Fig. 25: Angle between the iliococcygeal muscle and the horizontal plane.

Fig. 26
Fig. 27: Angle between pubococcygeal line and the levator plate.
Fig. 29: Bladder base (star). Vaginal apex (short arrow). Anterior margin of the anorectal junction (long arrow).
**Fig. 30:** If the pelvic floor is normally placed, the puborectal plane and the pubococcygeal line coincides.
<table>
<thead>
<tr>
<th>Grade</th>
<th>Organ Location Relative to the PCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (no prolapse)</td>
<td>Above</td>
</tr>
<tr>
<td>1 (mild or small)</td>
<td>0–3 cm below</td>
</tr>
<tr>
<td>2 (moderate)</td>
<td>3–6 cm below</td>
</tr>
<tr>
<td>3 (severe or large)</td>
<td>≥6 cm below</td>
</tr>
</tbody>
</table>

Table 2
**Fig. 31:** The measure in centimetres of the yellow lines, drawn perpendicular to the pubococcygeal line in this case, determines the grade of prolapse of the bladder, the vaginal apex and the peritoneal cul the sac in this patient.
<table>
<thead>
<tr>
<th>Stage</th>
<th>Criteria⁹</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>&gt; 3 cm to (TVL⁵ – 2 cm) above MPL</td>
</tr>
<tr>
<td>1</td>
<td>Does not meet stage 0, but &gt; 1 cm above MPL</td>
</tr>
<tr>
<td>2</td>
<td>≤ 1 cm above or below MPL</td>
</tr>
<tr>
<td>3</td>
<td>&gt; 1 cm below MPL</td>
</tr>
<tr>
<td>4</td>
<td>Complete organ eversion</td>
</tr>
</tbody>
</table>

Note—Stages 2–4 are usually symptomatic. The MPL reference line and clinical pelvic organ prolapse quantification examination use the same staging system [61].

⁹Distance of inferior bladder base, anterior cervical lip, and anterior anorectal junction from MPL.

⁵On physical examination and sagittal MR images, total vaginal length (TVL) is the greatest vertical vaginal measurement in centimeters from the posterior vaginal fornix to the level of the introitus in patients with a cervix. In patients without a cervix, the measurement is made from the most superior aspect of the vaginal cuff to the level of the introitus [74].
Fig. 32: The measure in centimetres of the yellow lines, drawn perpendicular to the mediopubic line in this case, determines the grade of prolapse of the bladder, the vaginal apex and the peritoneal cul the sac in the same patient as in Fig. 32.
Fig. 33: Modified image. The green line corresponds to the H line that lies in the puborectal plane. In cases of a normally placed pelvic floor, this line practically overlaps with the pubococcygeal line (red line). However, in cases of pelvic floor weakness, the H line is caudal to the pubococcygeal line.
Table 2
Grading of Pelvic Organ Prolapse

<table>
<thead>
<tr>
<th>Grade</th>
<th>Organ Location Relative to the H Line*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (no prolapse)</td>
<td>Above</td>
</tr>
<tr>
<td>1 (mild or small)</td>
<td>0–2 cm below</td>
</tr>
<tr>
<td>2 (moderate)</td>
<td>2–4 cm below</td>
</tr>
<tr>
<td>3 (severe or large)</td>
<td>≥4 cm below</td>
</tr>
</tbody>
</table>

*Measurement is performed on midsagittal MR images obtained at maximal strain. Severe cystourethroceles are classified as grade 4 or procidentia.

Table 4
**Fig. 34:** The measure in centimetres of the yellow lines, drawn perpendicular to the H line in this case, determines the grade of prolapse of the bladder, the vaginal apex and the peritoneal cul the sac in the same patient as in Fig. 32 and 33.
Fig. 35: Patient submitted because of pelvic organ prolapse. Hysterectomized 28y before. Dynamic sequence.
Fig. 36: Static image of the same dynamic sequence as in Fig. 36, during defecation. A severe cystocele, a moderate vaginal vault prolapse (blue star) and a mild descent of the anorectal junction (M line, blue line) can be seen. There is also a mild hiatal enlargement (H line, green line) and descent (M line). The dotted yellow line signals the kinking of the vesicourethral junction and the rotation of the urethral axis.
Fig. 37: Patient submitted because of fecal leakage and rectocele.
**Fig. 38:** Static image of the same dynamic sequence as in Fig. 38, during defecation. Uterine procidentia with eversion of the vaginal wall (yellow arrows). Hiatal enlargement and descent. Moderate cystocele, rotation of the urethral axis and mucosal rectal intussusception (pink arrow).
Fig. 39: Patient submitted because of pelvic organ prolapse.
**Fig. 40:** On the left, static image of the same dynamic sequence as in Fig. 40, during defecation. On the right, coronal and axial HASTE at maximum strain. A severe enterocele is seen after the evacuation of the sonographic gel.
**Fig. 44:** The arrow pinpoints the invagination of the posterior cervical lip in the perirectal fat that accompanies the rectal prolapse.
**Fig. 45:** Reposo (at rest), contracc. (strain), defec. (defecation). Lack of elevation of the anorectal junction during contraction of the pelvic floor (blue star) and abnormal descent during defecation. There is also an abnormally increased levator plate angle (dotted blue lines), a cystocele and an enterocoele (yellow arrows).

**Fig. 46:** Patient submitted because of chronic constipation and anal fissure.
**Fig. 47:** Reposo (At rest). Defecación (Defecation). Static images of the same dynamic study as in Fig. 47. It can be observed that the anorectal angle closes abnormally between rest and contraction.

**Fig. 48:** Arrows signal the progressive descent of the cul de sac which compresses the anterior rectal wall making the evacuation of the sonographic gel difficult.
Fig. 49: Patient submitted because of fecal leakage and pelvic organ prolapse. Anal sphincter open at rest (pink arrow). Detachment of the puborectalis muscle from the pubic bone on the right side and atrophy (orange arrow). Scarring of the external and internal anal sphincter (yellow circle). Dynamic examination demonstrates severe pelvic floor relaxation, cystocele and uterine prolapse.
Conclusion

Physical examination is mandatory in women with symptoms of pelvic floor weakness in order to diagnose pelvic organ prolapse. Most women presenting with mild symptoms of pelvic floor weakness, such as mild stress urinary incontinence, may require only a physical and an urodynamic examination. However, in patients with moderate and severe symptoms that suggest there is a complex disorder, physical examination alone may be not enough.

It has been published that clinical examination either underestimates or results in misdiagnosis of the site of prolapse in a high percentage of patients and that it is not reliable for assessing evacuation abnormalities.

Nowadays, MR Imaging gives all the information, anatomical and functional, needed for optimal patient management, especially before surgical correction is attempted, minimizing the risk of recurrence and repeated surgical procedures.

MR Imaging is especially indicated in cases of multicompartimental pathology, mostly whenever posterior compartment pathology is suspected, in patients who have been surgically treated many times and in cases with discrepancy between clinical and classical examinations results.

It plays an important role in selecting the most appropriate surgical candidates and in choosing the appropriate surgical approach:

- Identifying a pelvic floor weakness as the predominant defect, which may be treated with physiotherapy, or a structural defect (ligamentous, fascial or muscular), which usually need surgical repair.

- Demonstrating whether a cystocele coexist or not with urethral hypermobility and or kinking of the vesicourethral junction because it requires a different surgical approach.

- Showing the size of a rectocele and specifying whether it voids after defecation or retains the contrast medium.

- Diagnosing a peritoneocele, what it contains (peritoneal fat, small bowel, the sigma), if it reduces or not at the end of defecation (perineal hernia) and differentiating it from a high rectocele.
- Demonstrating or excluding an anal sphincter defect in patients with fecal leakage and in those cases with a structural defect whether other problems of the posterior compartment such as a rectocele or a peritoneocele coexist.

However,

- It has to be kept in mind that imaging findings must be interpreted in conjunction with physical examination findings, the results of other diagnostic tools usually used in these patients and patient’s symptoms.

- MR Imaging must not only be used to grade the pelvic organ prolapse but also as a research tool in trying to understand the pathophysiology of these complex disorders in order to reach the most efficient treatment.

References

- Dynamic MR Imaging of the Pelvic Floor: a Pictorial Review. Radiographics May-June 2009 29:3 e35; Published online March 6, 2009, doi:10.1148/rg.e35. Colaiacomo et al.


- Role of Static and Dynamic MR Imaging in Surgical Pelvic Floor Dysfunction. RadioGraphics 2008; 28:949-967; Published online 10.1148/rg.284075139. Boyadzhyan et al.


**Personal Information**

Cristina G. de Iturraspe Elices.

Osatek, S.A. Las Arenas Health center and Galdakao Hospital departments. Bilbao (Spain).

cgarcia@satek.net

www.osatek.net